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2018

SECONDARY 4

Express Exam Paper

Pure Chemistry

1	CHIJ Katong Convent	SA1
2	Gan Eng Seng	SA1
3	Hua Yi Secondary	SA1
4	Mayflower Secondary	SA1
5	Temasek Secondary	SA1
6	Bendemeer Secondary	SA2
7	Bukit Batok Secondary	SA2
8	Geylang Methodist	SA2
9	Jurong West Secondary	SA2
10	Seng Kang Secondary	SA2

Name: _____( ) Class:_____

CHIJ KATONG CONVENT
MID-YEAR EXAMINATIONS 2018
Secondary Four Express

CHEMISTRY 6092/01

Duration: 1 hour

Classes: 406

Additional Materials: Optical Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.
Write your name, class and index number in the spaces provided at the top of this page and on the Optical Answer Sheet.

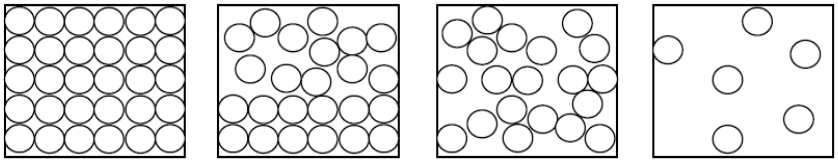
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Data Sheet is printed on page 14.
A copy of the Periodic Table is printed on page 15.

At the end of the examination, hand in:
1. Optical Answer Sheet; and
2. Question paper **separately**.

1 The diagram represents different arrangement of atoms.



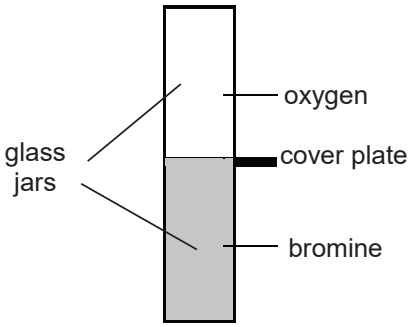
1 2 3 4

Bromine melts at -7°C and boils at 59°C. A tank filled with bromine at 30°C (room temperature) is cooled to -7°C.

Which row best represents the arrangement of bromine particles at -7°C and at 30°C?

	-7°C	30°C
A	1	4
B	2	3
C	1	2
D	2	4

2 The diagram shows the cover plate removed from the gas jars containing oxygen and bromine respectively. After several days, the colour of the gas is the same in both jars.



Which statement explains this change?

A Equal volumes of oxygen and bromine contain equal numbers of molecules.
B Oxygen and bromine gases have equal densities.
C Oxygen and bromine molecules are in random motion.
D Oxygen and bromine molecules diffuse at the same rate.

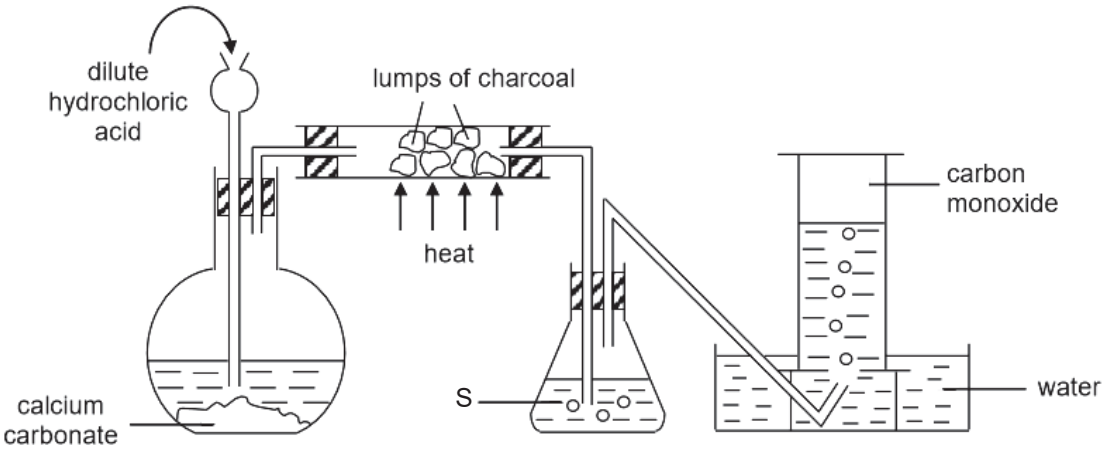
3 The properties of two substances are shown in the table.

substance	melting point/ °C	boiling point/ °C	solubility in water
1	□8	67	insoluble
2	- 95	210	soluble

Which is the best method to separate these two substances at room temperature and pressure?

A filtration
B paper chromatography
C separating funnel
D simple distillation

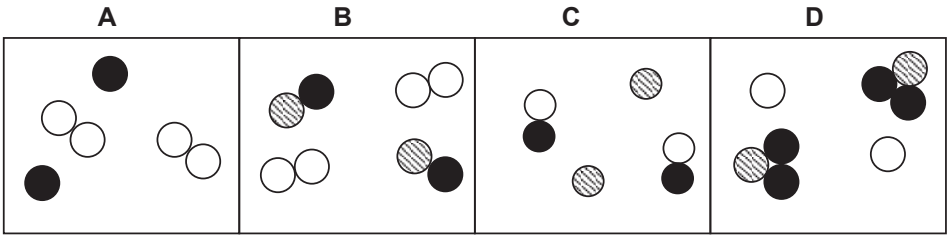
4 The diagram shows a set-up used to obtain carbon monoxide gas.



What is the purpose of solution S?

A to remove the presence of carbon dioxide gas
B to remove the presence of hydrogen chloride gas
C to remove the presence of water vapour
D to prevent water from being drawn into the hot charcoal

5 Which diagram best represents a mixture of neon and hydrogen bromide?



6 Potassium has 2 major isotopes. They are ^{39}K and ^{41}K.

If the relative atomic mass of naturally occurring potassium is 39.14, what are the relative abundance of ^{39}K and ^{41}K?

	^{39}K	^{41}K
A	7%	93%
B	25%	75%
C	75%	25%
D	93%	7%

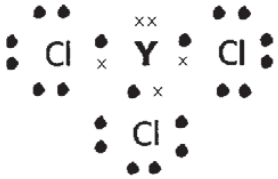
7 The table shows the number of neutrons and electrons in the following four particles.

particle	number of neutrons	number of electrons
P	18	8
Q^+	12	10
R^{2-}	16	10
S	13	11

Which particle is an isotope of P?

A Q^+
B R^{2-}
C S
D none of the above

8 The electronic structure of a compound formed between an element Y and chlorine is shown in the diagram. Only valence electrons are shown.



What is the chemical formula when sodium combines with element Y?

A Na_2Y
B NaY_2
C Na_3Y
D Na_5Y

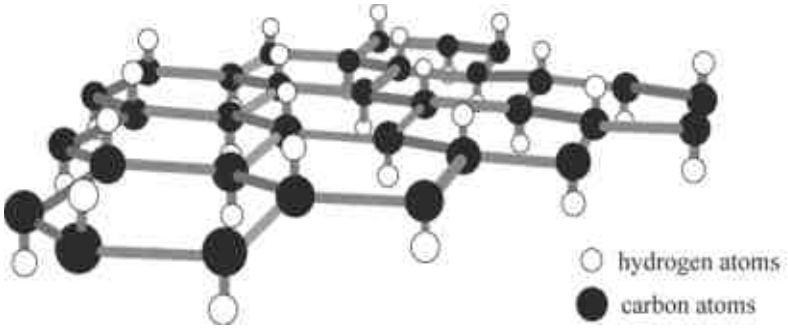
9 The following table shows four elements P, Q, R and S with their proton numbers.

elements	P	Q	R	S
proton number	6	8	17	19

Which are the likely formulae of the ionic compound and covalent compound formed from the four elements?

	ionic compound	covalent compound
A	PR_4	SR
B	S_2Q	PQ_2
C	SP	PR_4
D	SR	RQ

10 Graphane, an allotrope of carbon, has a structure similar to graphite. Graphane, however, has one hydrogen atom attached to each carbon as shown in the diagram.



Which set of properties will graphane have?

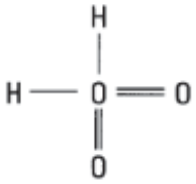
1 It is soluble in water.
2 It has a high melting point.
3 It has a giant molecular structure.
4 It conducts electricity in the solid state.

A 1 and 2 only
B 2 and 3 only
C 1, 2 and 3 only
D 1, 2, 3 and 4

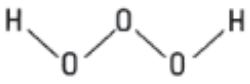
11 Trioxidane has the formula H_2O_3.

Which is the most likely structure of trioxidane?

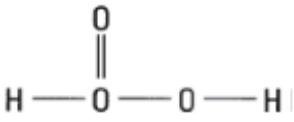
A



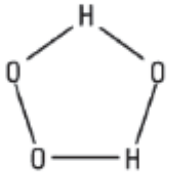
B



C



D



12 An element Q has x neutrons and y protons.

Which symbol can be used to represent the ion of Q if it belongs to Group VI?

A $^{x+y}_{y}Q^{2+}$

B $^{x}_{y}Q^{2+}$

C $^{x+y}_{y}Q^{2-}$

D $^{x}_{y}Q^{2-}$

13 The elements in a group of the Periodic Table show the following trends.

1 The element with the lowest proton number has the lowest reactivity.
2 All the elements in the group form basic oxides.
3 The density of the elements increases down the group.
4 The melting point of the elements decreases down the group.

In which group are the elements found?

A I
B IV
C VI
D VII

14 Elements X and Y are in the same period.

Which statement is correct?

A Atoms of X and Y have the same electronic structure.
B Atoms of X and Y have the same number of electrons.
C If X is a metal, Y must be a non-metal.
D The number of shells containing electrons is the same in atoms X and Y.

15 Two unlabelled bottles contain colourless solutions. One of which was sodium carbonate solution and the other was sodium chloride solution.

Which solution when added to a sample from each bottle would most readily identify the bottles?

A ammonia
B hydrochloric acid
C lead(II) nitrate
D sodium hydroxide

16 Four statements about hydroxide, OH^- ions are made.

- It reacts with hydrogen ions to form water.
- It reacts with aqueous iron(III) sulfate to form a green precipitate.
- It migrates to the cathode in electrolysis of an aqueous solution.
- Its solution gives an alkaline gas when warmed with aqueous ammonium chloride.

How many statement(s) is/ are correct?

A 1 only
B 2 only
C 3 only
D 4 only

17 In an experiment, 10.0 cm^3 of 0.01 mol/dm^3 copper(II) sulfate solution was mixed with 5.0 cm^3 of 0.01 mol/dm^3 sodium carbonate solution in a flask according to the equation:

$$CuSO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + CuCO_3$$

What was observed in the flask at the end of the reaction?

A a colourless solution only
B a green precipitate and a blue solution
C a green precipitate and a colourless solution
D a white precipitate and a colourless solution

18 A student would like to prepare a high yield of lead(ll) sulfate salt.

Which is the best method?

A Adding excess dilute sulfuric acid to lead(ll) hydroxide.
B Adding excess lead(ll) carbonate to dilute sulfuric acid.
C Adding excess lead metal to dilute sulfuric acid, filter and collect the residue.
D Adding excess lead metal to dilute nitric acid, filter, and followed by adding dilute sulfuric acid to filtrate.

19 The statements give some information about metals R, S, T and U.

- Carbonate of U does not decompose on heating.
- Only oxides of R and T can be reduced by heating with carbon.
- R and S react with dilute hydrochloric acid but not with cold water.
- T reacts with neither dilute hydrochloric acid nor water.

Which is the correct order of increasing reactivity of the four metals?

A T < R < S < U
B T < S < R < U
C U < S < R < T
D U < T < R < S

20 Chrysotile is a type of asbestos which is used in buildings for its flame-retarding and insulating properties. It has the formula $Mg_3Si_2O_5(OH)_4$.

What is the oxidation state of silicon in this compound?

A +2
B -2
C +4
D -4

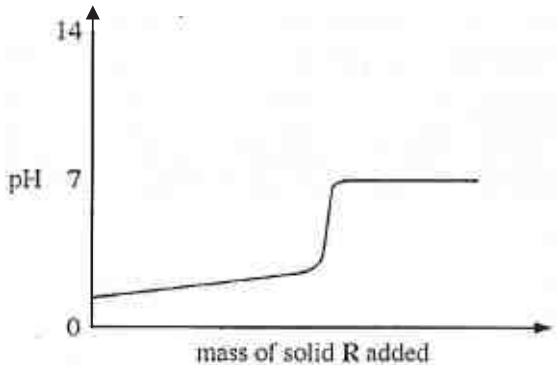
21 A sample of flue gas from the power station is bubbled into different solutions and the results are shown in the table.

solution	observation
acidified potassium manganate (VII)	purple solution turns colourless
acidified potassium iodide	colourless solution turns brown
red litmus solution	turns blue
blue litmus solution	turns red

Which are the possible gases present in the sample?

A sulfur dioxide gas and chlorine gas
B chlorine gas, hydrogen gas and carbon monoxide gas
C ammonia gas, sulfur dioxide and oxygen gas
D ammonia gas, nitrogen monoxide gas and oxygen gas

22 Solid R is gradually added to aqueous solution S. The changes in pH are shown in the graph below.



What are R and S?

	R	S
A	insoluble metal oxide	hydrochloric acid
B	insoluble non-metal oxide	sodium hydroxide
C	soluble metal oxide	hydrochloric acid
D	soluble non-metal oxide	sodium hydroxide

23 Which volume of 1.0 mol/dm^3 hydrochloric acid is required to react completely with 1.25 g of zinc carbonate?

A 10 cm^3
B 20 cm^3
C 100 cm^3
D 200 cm^3

24 An 8 g sample of oxygen atoms contains the same number of atoms as 16 g of element X.

What is X?

A helium
B sodium
C sulfur
D xenon

25 When hydrogen peroxide is used as a bleaching agent, it decomposes to form water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

When 68 g of hydrogen peroxide decomposes, the volume of oxygen gas collected under room temperature and pressure is 1200 cm^3.

What is the percentage purity of hydrogen peroxide?

A 2.5 %
B 5.0 %
C 10.0 %
D 15.0 %

26 The compound S_2O_7 reacts with water to produce sulfuric acid and oxygen only.

What volume of oxygen, measured at room temperature and pressure, is produced when 0.704 g of S_2O_7 is reacted?

A 48 cm^3
B 96 cm^3
C 192 cm^3
D 384 cm^3

27 Which equation does not represent a redox reaction?

A $3Cl_2(g) + 2Fe(s) \rightarrow 2FeCl_3(s)$
B $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
C $Fe^{2+}(aq) + Mg(s) \rightarrow Fe(s) + Mg^{2+}(aq)$
D $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

28 The table shows some bond energies.

bond	kJ/ mol
C – C	346
C – H	413
Si – Si	176
Si – H	318

Which statement is correct?

A Si – Si chains are more stable than C – C chains.
B Si – Si bonds are the least readily broken of those listed.
C Methane, CH_4, is chemically more stable than silane, SiH_4.
D 346 kJ is the energy evolved when 1 mole of graphite sublimes.

29 Which is an endothermic process?

A $C(s) + O_2(g) \rightarrow CO_2(g)$
B $HCl(aq) + NaOH\ (aq) \rightarrow NaCl(aq) + H_2O(l)$
C $6CO_2(g) + 6H_2O(g) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$
D $H_2O(g) \rightarrow H_2O(l)$

30 Which requires the largest number of electrons for complete discharge during electrolysis?

A 4 mol of aluminium ions
B 5 mol of hydroxide ions
C 6 mol of copper(II) ions
D 7 mol of oxide ions

31 The combustion of methane is an exothermic process.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g) \qquad \Delta H = -890\ kJ/mol$$

How much methane should be used to produce 2670 kJ of heat?

A 48 g
B 64 g
C 96 g
D 120 g

32 Which statement correctly describes how the ammonia that is produced in the Haber Process is separated from the reaction mixture?

A By cooling the mixture.
B By dissolving the other two gases.
C By filtering out the other two gases by passing through cotton wool.
D By passing the gaseous mixture through fused calcium chloride.

33 Which statement about the three processes – respiration, combustion and rusting, is correct?

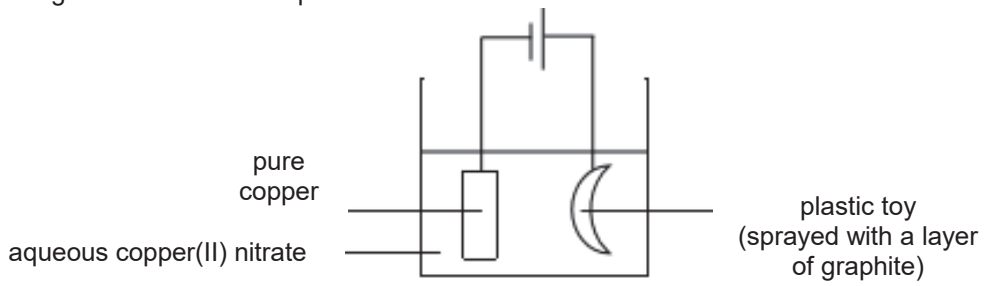
A Nitrogen must be present for the processes to occur.
B The mass of reactants is greater than that of the products.
C The processes cause a decrease in the oxygen content of the atmosphere.
D The processes cause an increase in the carbon dioxide content of the atmosphere.

34 Ammonia is manufactured by the Haber Process.

Which statement is correct?

A At the optimum conditions, the yield of ammonia is 100 %.
B Hydrogen is the reducing agent.
C Increasing the temperature lowers the activation energy.
D Nitrogen is oxidised by hydrogen.

35 A student decides to coat his plastic toy with a layer of copper metal using electrolysis. The diagram shows his set-up.

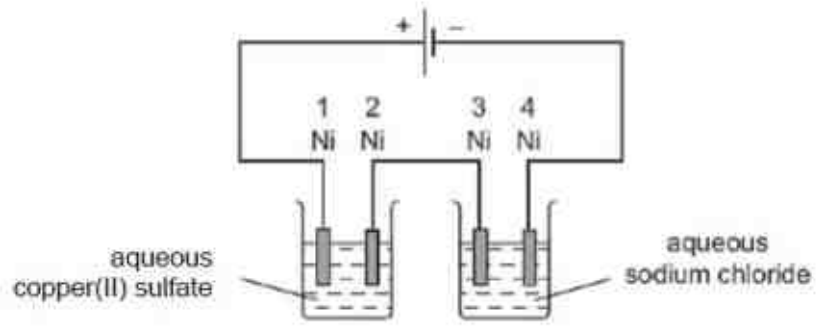


The experiment failed and no copper was deposited on the plastic toy.

Which statement best explains why the experiment failed?

A The electrolyte used should be aqueous silver nitrate.
B The plastic toy should not be submerged in the electrolyte.
C The plastic toy should not be sprayed with a layer of graphite.
D The pure copper strip should be attached to the positive electrode.

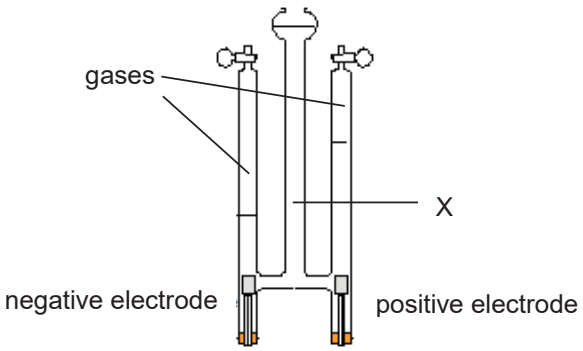
36 The diagram shows an electrolysis experiment to electroplate nickel with a different metal.



Which nickel electrode(s) is/ are plated with a metal?

A 1 only
B 1 and 3 only
C 2 only
D 2 and 4 only

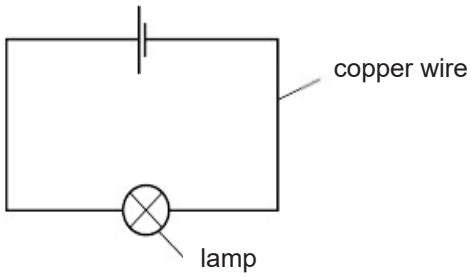
37 The diagram shows the electrolysis of a substance X after a few hours.



What substance could X be?

A copper(II) sulfate solution
B concentrated hydrochloric acid
C silver nitrate solution
D sodium chloride solution

38 Copper wire is used to complete an electrical circuit.

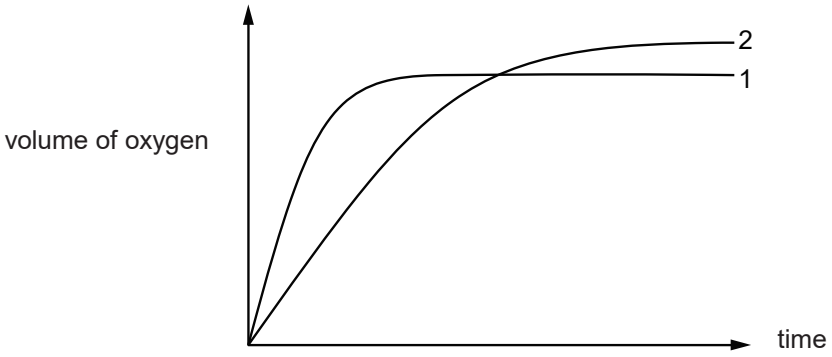


Which statement correctly describes what happens in the copper wire?

A Electrons move along the wire to the negative terminal and positive ions stay in position.
B Electrons move along the wire to the positive terminal and positive ions move to the negative terminal.
C Electrons move along the wire to the positive terminal and positive ions stay in position.
D Negative ions move along the wire to the positive terminal while positive ions move to the negative terminal.

39 In the graph, curve 1 was obtained by observing the decomposition of 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide solution, catalysed by manganese(IV) oxide.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$



Which alteration to the original experimental conditions would produce curve 2?

A adding some 0.1 mol/dm^3 hydrogen peroxide solution
B lowering the temperature
C using a different catalyst
D using less manganese(IV) oxide

40 In which reaction is the pressure least likely to affect the speed of reaction?

A $C(s) + CO_2(g) \rightarrow 2CO(g)$
B $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
C $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
D $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

Colours of Some Common Metal Hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group

I	II											III	IV	V	VI	VII	0
				Key			1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9			proton (atomic) number atomic symbol name relative atomic mass								5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____( ) Class: _____

CHIJ KATONG CONVENT

MID-YEAR EXAMINATIONS 2018

Secondary Four Express

CHEMISTRY 6092/02

Duration: 1 hour 45 minutes

Class: 406

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, registration number and class on all the work you hand in.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.
The use of an approved scientific calculator is expected, where appropriate.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** three questions, the last question is in the format of either/ or.
Write your answers in the spaces provided on the Question Paper.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
At the end of the examination fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Data Sheet is printed on page 21.
A copy of the Periodic Table is printed on page 22.

FOR EXAMINER'S USE	
Paper 1	**/ 40**
Section A	**/ 50**
Section B	**/ 30**
TOTAL	**/ 120**

This question paper consists of **22** printed pages.

Section A [50 marks]
Answer **all** the questions in this section.
Write your answers in the spaces provided.

1 Fig 1.1 shows the set-up of an experiment. After some time, a ring of yellow powder is seen in the tube. A, B or C are possible positions at which this ring may be formed.

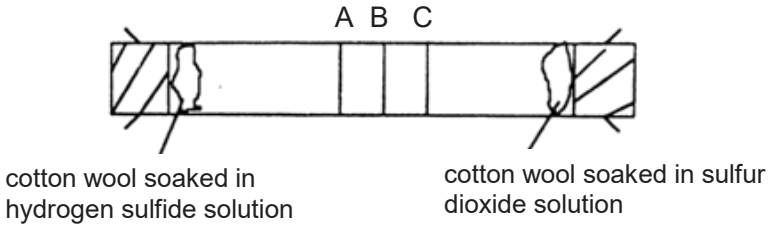


Fig 1.1

It is known that hydrogen sulfide gas reacts with sulfur dioxide gas as follows:

$$2H_2S(g) + SO_2(g) \rightarrow 3S(s) + 2H_2O(g)$$

(a) Name the yellow powder formed in the tube.

…… [1]

(b) **(i)** At which position, A, B or C is the ring of yellow powder most likely to be formed?

…… [1]

(ii) Explain your answer to **(b)(i)**.

……...

……...

…… [2]

[Total: 4]

2 Fig. 2.1 shows the structures of various compounds, **A**, **B**, **C**, **D**, **E** and **F**.

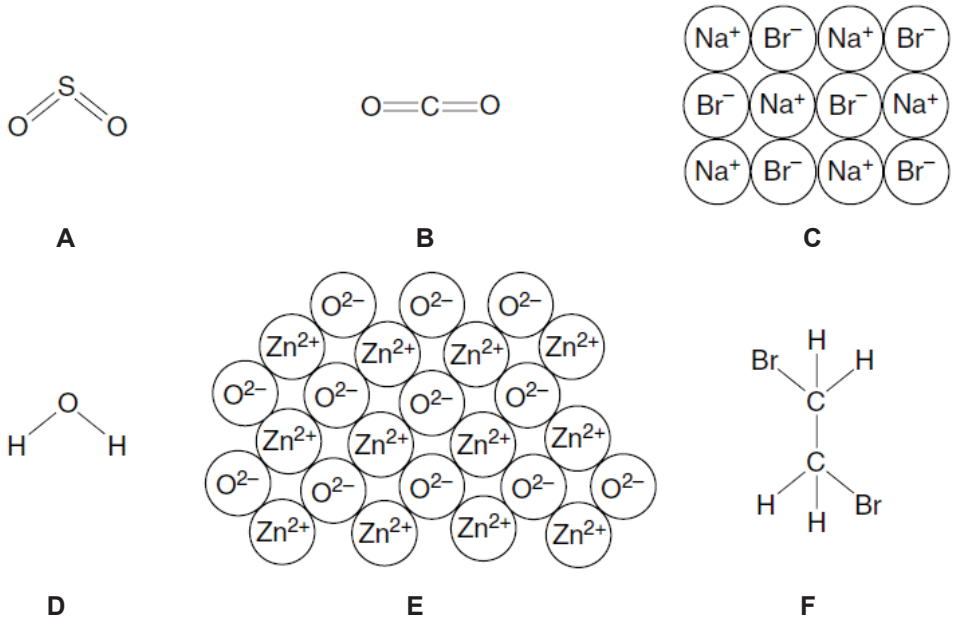


Fig. 2.1

(a) Use the letters **A** to **F** to answer the following.
Each compound may be used once, more than once or not at all.

(i) Which compound is most likely to contribute to acid rain?

……..... [1]

(ii) Which compound is an amphoteric oxide?

……..... [1]

(iii) Which two of these compounds have giant structures?

……..... [1]

(iv) Which compound when molten, releases a reddish brown gas at the anode during electrolysis?

……..... [1]

(b) State the empirical formula of compound **F**.

……..... [1]

[Total: 5]

3 Two experiments were carried out to find out the positions of the metals cobalt (Co), gallium (Ga) and bismuth (Bi) in the reactivity series.

In experiment I, hydrogen gas was passed separately over the heated oxides of the three metals in the combustion tube. The results are given in Table 3.1.

Table 3.1

metal oxide	formula	appearance before heating	appearance after heating
cobalt oxide	CoO	green powder	grey powder and a colourless liquid on the side of the glass tube
gallium oxide	Ga_2O_3	white powder	white powder; no liquid on glass tube
bismuth oxide	Bi_2O_3	yellow powder	grey powder and a colourless liquid on the side of the glass tube

In experiment II, pieces of Bi, Ga and Co were added separately to a solution of $Pb(NO_3)_2$. The results are given in Table 3.2.

Table 3.2

cobalt	gallium	bismuth
Grey solid formed on cobalt. The solution slowly turned pink.	Grey solid formed on gallium. The solution remained colourless.	No change in bismuth metal or in solution.

(a) From the results of both experiments, place Bi, Ga, Co and Pb in the correct order in the reactivity series.

most reactive ……

……

……

least reactive ……

[2]

(b) Name the colourless liquid observed when Bi_2O_3 and CoO are heated in hydrogen.

…… [1]

(c) State the property hydrogen shows when it reacts with bismuth oxide.

…… [1]

(d) Write an ionic equation for the reaction between Ga and $Pb(NO_3)_2$ solution.

…… [2]

3 **(e)** Describe what you would observe if a piece of cobalt is placed in aqueous bismuth nitrate.

……

…… [2]

[Total: 8]

4 Fig. 4.1 shows some reactions of copper(II) nitrate, $Cu(NO_3)_2$.

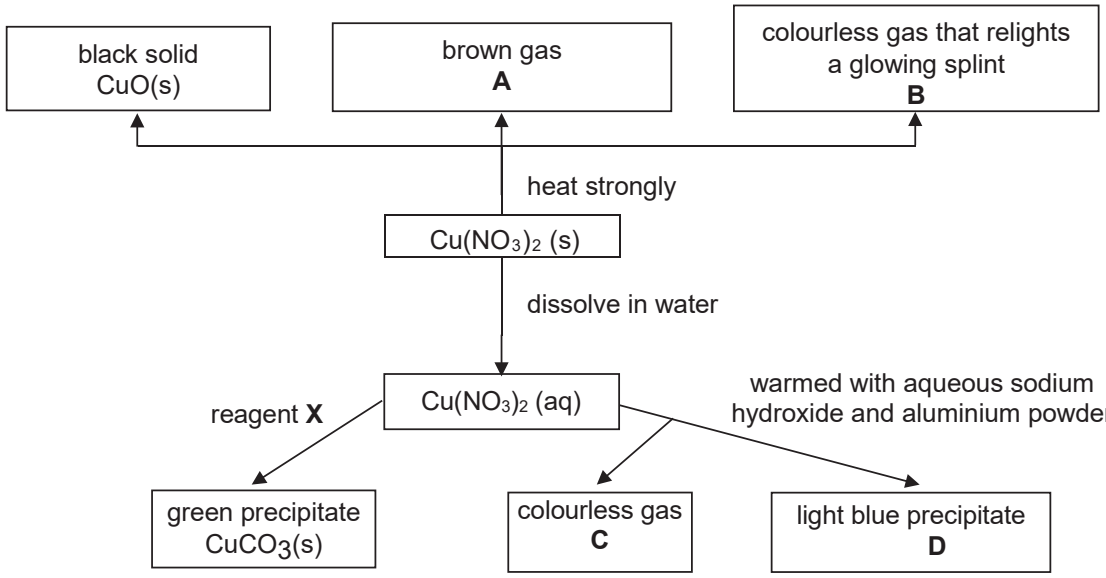


Fig. 4.1

(a) When two moles of $Cu(NO_3)_2$ is heated strongly, two moles of CuO, four moles of **A** and one mole of **B** are made.

(i) Identify **B**.

…… [1]

(ii) Write the balanced chemical equation for the reaction when $Cu(NO_3)_2$ is heated.

…… [2]

(b) Identify

C …… [1]

D …… [1]

X …… [1]

(c) Write the ionic equation for the formation of the light blue precipitate **D**.

…… [1]

[Total: 7]

5 5 g of hydrogen reacts with 142 g of chlorine to form hydrogen chloride. The reaction is exothermic and can be represented by the equation shown.

$$H_2 + Cl_2 \rightarrow 2HCl \qquad \triangle H = -184 \text{ kJ/mol}$$

(a) Explain with supporting calculations which reactant is in excess.

……

……

……

…… [3]

(b) Calculate the energy released when 4 g of hydrogen reacts completely with 71 g of chlorine.

You may assume that no other side reaction occurs.

…… [1]

(c) Explain why the reaction is exothermic, in terms of the energy changes that take place during bond breaking and bond making.

……

……

……

…… [3]

[Total: 7]

6 In an experiment, 20.0 cm^3 of 0.550 mol/dm^3 of barium nitrate was added to excess aqueous sodium sulfate to produce barium sulfate and sodium nitrate.

(a) Calculate the maximum mass of barium sulfate produced.

mass = …….. g

[2]

(b) A mass of 1.92 g of dry barium sulfate was obtained.

Calculate the percentage yield of barium sulfate.

percentage yield = ……. %

[2]

[Total: 4]

7 Fig. 7.1 shows part of the electrolytic cell for an electroplating process.

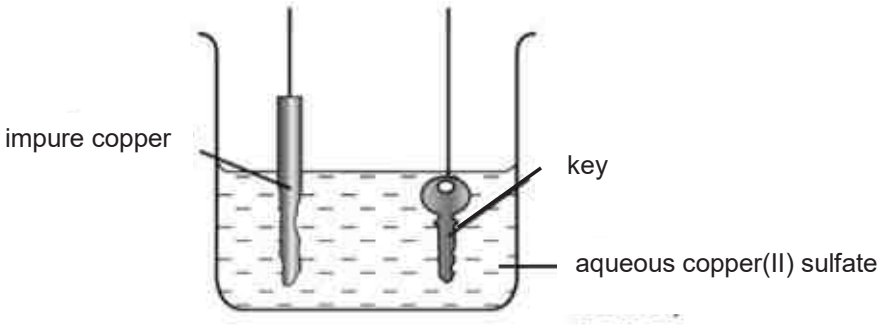


Fig. 7.1

(a) A student wants to electroplate her key with copper.

Complete Fig. 7.1 by drawing in a battery and connecting wires. [1]

(b) Write the half equations for the reactions occurring at the electrodes.

anode : ……

cathode : …… [2]

(c) State one use of electroplating.

…… [1]

(d) Table 7.1 shows information about the electroplating process.

Table 7.1

	before electroplating	after electroplating
mass of impure copper electrode/ g	150	136.5
mass of key/ g	62	74.6

Calculate the percentage of impurities in the impure copper electrode

percentage yield = …… %

[2]

[Total: 6]

[Turn over

8 **(a)** Fig. 8.1 shows the set-up of a simple cell which can be used to determine the relative positions of metals in the reactivity series. The voltage of the cell is measured by a voltmeter.

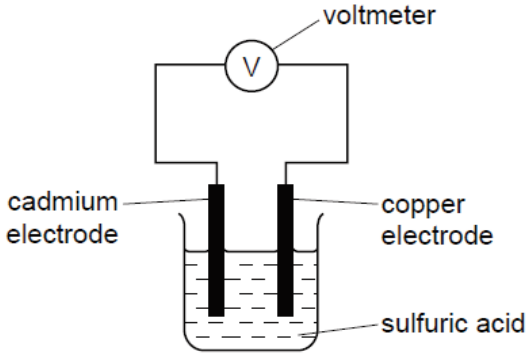


Fig. 8.1

Results from cells using the metals cadmium, tin, zinc and copper are given in Table 8.1.

Table 8.1

cell	electrode 1 (–)	electrode 2 (+)	voltage / volts
1	cadmium	copper	0.74
2	tin	copper	0.48
3	zinc	copper	1.10

(i) Explain what is meant by a *simple cell*?

……

…… [2]

(a) **(ii)** Place the four metals in order of increasing reactivity and explain how you used the data in Table 8.1 to arrive at this order.

least reactive ……

……

……

most reactive ……

……

……

……

…… [3]

8 **(b)** Cadmium is in the same group of the Periodic Table as zinc. Cadmium carbonate is insoluble in water and reacts in the same way as zinc carbonate with dilute acids. Cadmium sulfate is soluble in water.

Describe how you would prepare a pure, dry sample of cadmium carbonate, starting from cadmium sulfate.

……

……

……

……

……

……

…… [4]

[Total: 9]

Section B [30 marks]

Answer **three** questions.

Question **11** is in the form of an **Either/ Or** question. Only one part should be answered.

Write your answers in the spaces provided.

9 Aspirin is a medicine that is used as a painkiller. It is made from salicylic acid.

(a) A student makes a sample of aspirin. She thinks it contains some impurities.

(i) The student tests the melting point of the sample of aspirin.

Explain how she can use the result of the test to find out whether the sample contains impurities.

……

……

…… [2]

(ii) The student uses chromatography to compare the sample of aspirin in **(a)** with pure samples of aspirin and salicylic acid.

Fig. 9.1 shows the results of the chromatogram.

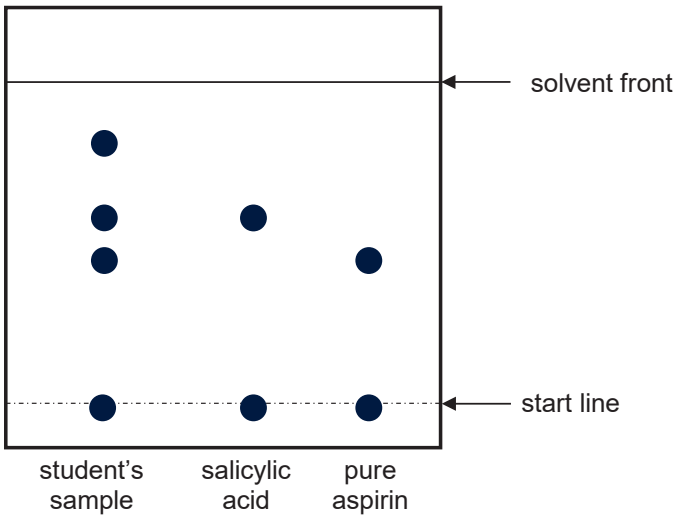


Fig. 9.1

Is the student's sample of aspirin pure? Explain your answer.

……

…… [2]

9 (a) (iii) In another chromatography using pure samples of aspirin and salicylic acid, the solvent was allowed to travel 9 cm from the start line.

Table 9.1 shows the Rf values of pure aspirin and salicylic acid.

Table 9.1

substance	aspirin	salicylic acid
R_f values	0.56	0.654

Using the information provided in Table 9.1, calculate the distance travelled by aspirin.

distance = …… cm
[1]

(b) The student buys a few packets of aspirin tablets from a store and performs a titration using a crushed tablet and aqueous sodium hydroxide.

The formula for aspirin can be represented as  .

The equation for the reaction between aspirin and aqueous sodium hydroxide is shown below.

Table 9.2 shows the results of the student's titration.

Table 9.2

concentration of aqueous NaOH used	0.10 mol/dm^3
volume of aqueous NaOH needed for neutralisation	15.90 cm^3
relative molecular mass of aspirin	180

(i) Calculate the mass of aspirin, in mg, in one tablet. Leave your answer in 3 significant figures. (1 g = 1000 mg)

mass = …… g

[3]

9 (b) (ii) It is known that some aspirin tablets also contain citric acid. The student repeats the titration using one of these tablets.

Explain why the mass of aspirin calculated in the second titration is different from that in **(b)(i)**.

……

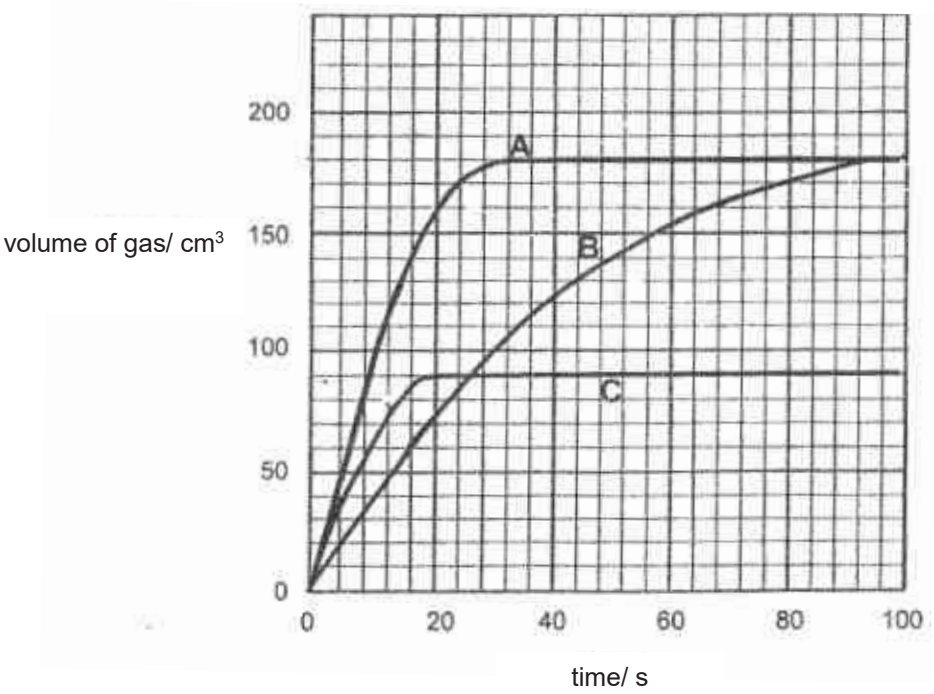
……

…… [2]

[Total: 10]

10 An experiment was carried out involving two separate reactions between 0.18 g of magnesium and two acids, hydrochloric acid and sulfuric acid. The volume and concentration of both acids used were 20.0 cm^3 and 2.00 mol/dm^3. The results of reactions A and B are shown on Fig. 10.1.

A third reaction C was carried out using 20.0 cm^3 and 2.00 mol/dm^3 of an acid and a unknown amount of magnesium ribbon.



(a) With relevant equations and calculations, explain why the same volume of gas was produced for reactions A and B.

……

……

……

……

……

…… [3]

10 **(b)** Determine which reaction, A or B, used sulfuric acid.

Explain your choice.

……

……

……

……

……

…… [3]

(c) In reaction C, identify the acid and calculate the mass of magnesium ribbon that was used.

……

……

……

…… [2]

(d) When calcium was used in place of magnesium to react with the 2.00 mol/dm^3 sulfuric acid, the reaction stopped very quickly and also produced less gas.

Give reasons for this observation.

……

……

……

…… [2]

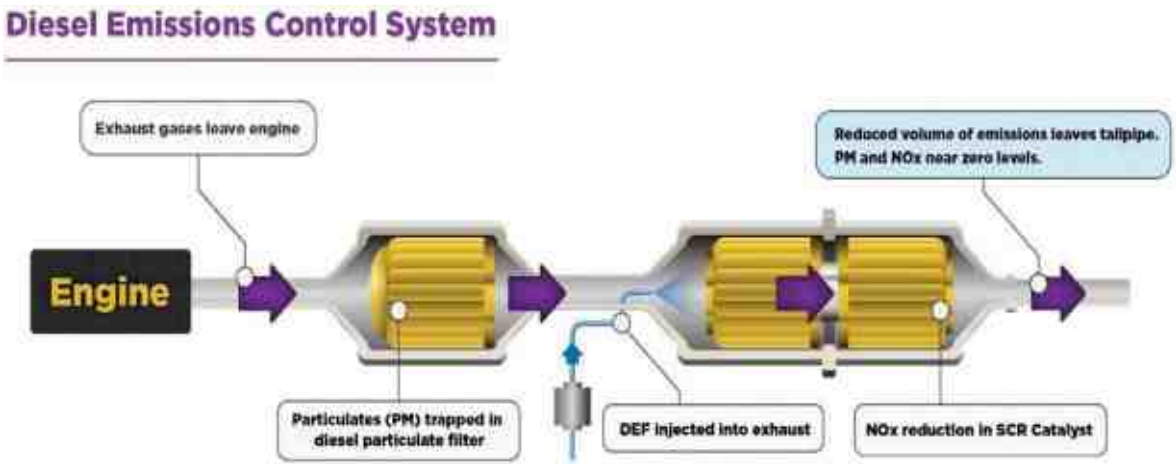
[Total: 10]

11 Either

Diesel engines can be run with a lean burn air-to-fuel ratio which is larger than that in petrol engine, This is to ensure the full combustion of soot and to prevent them from giving out unburnt fuel. This then leads to generation of oxides of nitrogen (NO_x), which are harmful pollutants, from the nitrogen and oxygen in the air.

Introduction to Diesel Exhaust Fluid (DEF)
Diesel exhaust fluid (DEF) is an aqueous urea solution made with 32.5% by mass of urea, $(NH_2)_2CO$, and 67.5% by mass of deionised water. It is called AUS 32 (aqueous urea solution).

DEF is used in selective catalytic reduction (SCR) in order to lower the concentration of NO_x in the diesel exhaust emissions from diesel engines. Within the SCR catalyst, the NO_x are catalytically reduced by ammonia into water and nitrogen, which are both harmless. These are then released through the exhaust.



Source: http://www.dieselforum.org/about-clean-diesel/what-is-scr

Selective Catalytic Reduction (SCR) systems
SCR catalysts are made from various ceramic materials used as a carrier, such as titanium oxide, and active catalytic components are usually oxides of base metals such as vanadium, molybdenum and tungsten.

The two most common designs of SCR catalyst geometry used today are honeycomb and plate. Each design has different advantages and disadvantages.

	plate-type	honeycomb-type
pressure drop	lower	larger
plugging and fouling	less susceptible	more susceptible
size	large and bulky	smaller
price	expensive	relatively cheaper

**'Plugging and fouling' causes the catalyst to be coated with a layer of unwanted material.*

Reduction of oxides of nitrogen (NO_x)
DEF from a separate tank is injected into the exhaust pipeline. When it is injected into the hot exhaust gas stream, the water evaporates and the urea thermally decomposes to form ammonia and isocyanic acid:

$$(NH_2)_2CO(g) \rightarrow NH_3(g) + HNCO(g)$$

The isocyanic acid hydrolyses to carbon dioxide and ammonia:

$$HNCO(g) + H_2O(g) \rightarrow CO_2(g) + NH_3(g)$$

Overall reaction:

$$(NH_2)_2CO(g) + H_2O(g) \rightarrow 2NH_3(g) + CO_2(g)$$

From this point, ammonia, in the presence of oxygen and a catalyst, will reduce oxides of nitrogen:

$$2NO(g) + 2NH_3(g) + \frac{1}{2}O_2(g) \rightarrow 2N_2(g) + 3H_2O(g) \text{ and}$$

$$3NO_2(g) + 4NH_3(g) \rightarrow \frac{7}{2}N_2(g) + 6H_2O(g)$$

The overall reduction of nitrogen monoxide by urea is:

$$2(NH_2)_2CO(g) + 4NO(g) + O_2(g) \rightarrow 4N_2(g) + 4H_2O(g) + 2CO_2(g)$$

DEF is injected into the exhaust gas at 2–6% of diesel consumption volume.

Storage
It is recommended that DEF be stored in a cool, dry, and well-ventilated area that is out of direct sunlight.

Adapted from: https://en.wikipedia.org/wiki/Diesel_exhaust_fluid
https://en.wikipedia.org/wiki/Selective_catalytic_reduction

(a) Suggest why the running of diesel engines with a lean burn air-to-fuel ratio leads to the production of more oxides of nitrogen.

……

…… [1]

(b) Suggest why, unlike diesel engines, petrol engines do not require the use of DEF.

……

…… [1]

(c) Which type of SCR design, honeycomb or plate, is more suitable to be fitted in cars?

Give a reason for your answer.

……

…… [1]

11 **(d)** State the overall equation for the reduction of nitrogen dioxide (NO_2) by urea.

…… [1]

(e) **(i)** What is the maximum volume of DEF vapour that needs to be added to 100 dm^3 of diesel vapour?

…… [1]

(ii) What is the maximum volume of nitrogen gas that can be formed from the combustion of 100 dm^3 of diesel vapour if the DEF injected only contains urea?

…… [1]

(f) State why active catalytic components are usually oxides of metals such as vanadium, molybdenum and tungsten instead of Group I metals.

……

…… [1]

(g) Suggest why DEF should be stored in a cool area that is out of direct sunlight.

……

…… [1]

(h) Explain why the use of DEF is not completely environmentally friendly.

……

……

…… [2]

[Total: 10]

11 OR

The reaction between nitrogen and hydrogen to form ammonia is a reversible reaction. This means that when nitrogen and hydrogen react to form ammonia, some ammonia is decomposed back to its reactants at the same time. The two reactions are shown below:

Forward reaction: $N_2 + 3H_2 \rightarrow 2NH_3$ $\triangle H = -92.4$ kJ/mol
Backward reaction: $2NH_3 \rightarrow N_2 + 3H_2$

The forward reaction is exothermic.
During the development of Haber process, Fritz Haber conducted a series of experiments to determine the most cost-effective way to produce ammonia. Table 11.1 shows some of the results. In each case, the experiment began with the molar ratio of nitrogen to hydrogen 1:3.

Table 1.1

temperature (°C)	pressure (atm)		
	300	400	500
400	48% NH_3	55% NH_3	61% NH_3
500	26% NH_3	32% NH_3	38% NH_3
600	13% NH_3	17% NH_3	21% NH_3

He applied **Le Chatelier's principle** to the reaction. This principle, in simple terms, states that when a change is applied to a reaction system, the system will tend to move in a direction that reduces the change.

For example, when a change such as increased pressure is applied to a mixture of nitrogen and hydrogen, more ammonia will be formed as there will be fewer number of moles of ammonia than nitrogen and hydrogen. As a result, the change is reduced. Hence, in this reaction, an increase in pressure tends to favour the forward reaction as it reduces the pressure on the system. Consequently, more ammonia is produced.

(a) By referring to the data in Table 11.1, state the physical conditions required to produce the highest amount of ammonia.

……

…… [1]

(b) With reference to the kinetic particle theory and relevant number of moles of gases, explain why the forward reaction of Haber Process reduces pressure.

……

……

……

…… [2]

11 **(c)** Ideally, as ammonia is being formed, it should be removed as quickly as possible.
With reference to Le Chatelier's principle and/ or other suitable explanation, suggest why this is done.

……

……

……

…… [2]

(d) With reference to Le Chatelier's principle and enthalpy change, explain the effect of raising the temperature on the amount of ammonia produced in the Haber process.

……

……

……

…… [2]

(e) One way to increase the rate of reaction between nitrogen and hydrogen to produce ammonia is to raise the temperature. Unfortunately, this method increases the rate of decomposition of ammonia as well.

Suggest another way to increase the rate of reaction between nitrogen and hydrogen in the Haber process without altering the temperature.

…… [1]

(f) Draw and label the energy profile diagram of the forward reaction of the Haber process.

[2]

[Total: 10]

Colours of Some Common Metal Hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

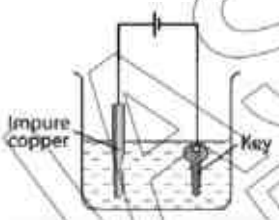
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

4E Chemistry MYE 2018 answer scheme

1	B	**2**	C	**3**	C	**4**	A	**5**	C
6	D	**7**	B	**8**	C	**9**	B	**10**	B
11	B	**12**	C	**13**	A	**14**	D	**15**	B
16	B	**17**	B	**18**	C	**19**	A	**20**	C
21	C	**22**	A	**23**	B	**24**	C	**25**	B
26	A	**27**	B	**28**	C	**29**	C	**30**	B
31	A	**32**	A	**33**	C	**34**	B	**35**	D
36	C	**37**	D	**38**	C	**39**	A	**40**	D

Section A (50 marks)

Qn no	Answer	Marks/ Remarks
1(a)	sulfur	[1]
1(b)(i)	Position **C**	[1]
1(b(ii)	Hydrogen sulfide (Mr = 34) has a smaller molecular mass compared to sulfur dioxide (Mr = 64). Hence, hydrogen sulfide diffuses faster than sulfur dioxide and travel further to react with sulfur dioxide at point **C**.	[1] [1]
2(a)(i)	A	[1]
2(a)(ii)	E	[1]
2(a)(iii)	C and E	[1]
2(a)(iv)	C	[1]
2(b)	CH_2Br	[1]
3(a)	Gallium/ Ga Cobalt/ Co Lead/ Pb Bismuth/ Bi	All correct – [2], 2-3 correct – [1]
3(b)	water	[1]
3(c)	Hydrogen is a reducing agent. (Accept Hydrogen is more reactive than Bismuth)	[1]
3(d)	$2Ga\ (s) + 3Pb^{2+}\ (aq) \rightarrow 2Ga^{3+}\ (aq) + 3Pb\ (s)$ ½ mark – correct formula ½ mark – correct state symbols 1 mark – correct balancing	[2]
3(e)	Grey solid formed on cobalt. The solution turned pink.	[1] [1]
4(a)(i)	B is O_2	[1]
4(a)(ii)	$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$ Identification of NO_2 as a product (1) Balanced equation	[2]
4(b)	C is ammonia D is copper(II) hydroxide X is Any soluble carbonate e.g. sodium carbonate/potassium carbonate/ammonium carbonate	[1] [1] [1]
4(c)	$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$	[1]

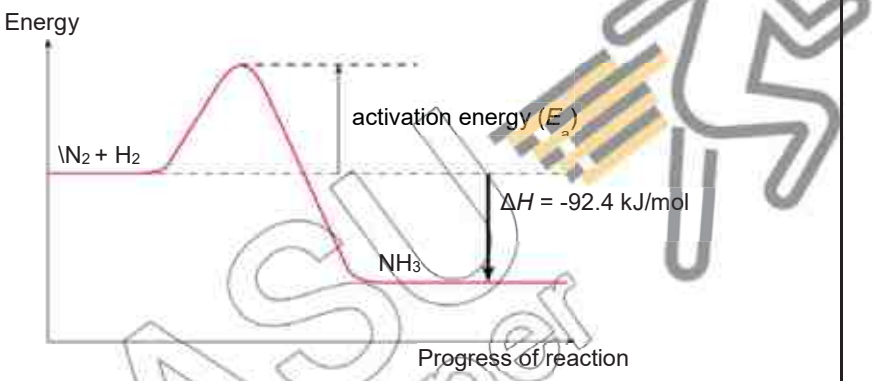
5(a)	Hydrogen; Number of moles of H_2 = 5/2 = 2.5 mol Number of moles of Cl_2 =142/71 = 2 mol; Mole ratio is 1: 1, hence hydrogen is in excess	[1] [1] [1]
5(b)	Energy released = 184 x 2 = 368 kJ;	[1]
5(c)	Energy taken in to break bonds in hydrogen and chlorine; is less than; energy given out to form bonds in hydrogen chloride;	[1] [1] [1]
6(a)	Number of moles = 0.020 X 0.550 = 0.011 mol Mass = 0.011 x (137 + 32 +16x4) = 2.563 g	[1] [1]
6(b)	Percentage yield = (1.92 ÷ 2.563) x 100 % = 74.9% ECF for (a)	[1]
7(a)	 Must show correct polarity of cell	[1]
7(b)	Anode: $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$ Cathode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ *1 mark for each correctly balanced equation with state symbols.*	[1] [1]
7(c)	To prevent corrosion/ to improve the appearance of an object	[1]
7(d)	Mass of copper + impurities lost from electrode = 150 - 136.5 =13.5 g Mass of copper deposited on key = 74.6 - 62 =12.6 g Mass of impurity = 13.5 - 12.6 =0.9 g Percentage of impurities in copper electrode = $\frac{0.9}{13.5} \times 100\% = 6.67\%$ *Award 1 mark if students found percentage purity instead of percentage impurity.*	0.5 0.5 0.5 0.5
8(a)(i)	device which changes chemical energy [1] into electrical energy; [1] OR produces a voltage / potential difference / electricity [1] due to difference in reactivity of two metals; [1] OR produces a voltage / potential difference / electricity [1] by redox reactions [1]	

8(a)(ii)	Cu Sn Cd Zn (i.e. all 4 in correct order) The further apart the metals in the reactivity series, the greater the voltage produced. Tin-copper pair has the smallest voltage hence tin is just slightly more reactive than copper. Zinc-copper pair has the largest voltage hence zinc is the most reactive amongst the 4 metals.	[1] [1] [1]
8(b)	1. Add aqueous cadmium sulfate to aqueous sodium carbonate (or any soluble carbonate). 2. Filter the mixture to obtain the precipitate (cadmium carbonate). 3. Wash the residue. 4. Dry the residue (using sheets of filter paper).	[1] [1] [1] [1]

Section B (30 marks)

Qn no	Answer	Marks/ Remarks
9(a)(i)	If his sample is pure, the melting point should be a fixed temperature. If his sample is not pure, the aspirin should melt over a range of temperatures.	[1] [1]
9(a)(ii)	Sample is not pure. Sample contains **two** impurities. The impurities are salicylic acid and an unidentified/unknown substance.	 [1] [1]
9(a)(iii)	$0.56 \times 9 = 5.04$ cm	[1]
9(b)(i)	mole ratio of aspirin : NaOH = 1:1 (from equation) Mass of aspirin = $\left(\frac{15.90}{1000} \times 0.10\right) \times \frac{1}{1} \times 180 = 0.286$ g = **286 mg** *Award 1m for calculating number of moles of aspirin using 'M = C × V'.* *Award 1m for calculating mass of aspirin using 'mass = molar mass × moles'.* *Award 1m for giving final answer in mg and 3 s.f.*	[3]
9(b)(ii)	Citric acid (in the tablets) will also **react with** / **be neutralised** by sodium hydroxide during the titration. Hence **more** sodium hydroxide would be used / the calculated mass of aspirin will be **greater** than actual.	[1] [1]
10(a)	No. of moles of Mg = 0.18 / 24 = **0.0075** No. of moles of hydrochloric acid = No. of moles of sulfuric acid = 0.02 x 2.00 = **0.04** **$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$** 1 mole of Mg reacts with 2 moles of HCl, hence, magnesium is the limiting reactant and hydrochloric acid is in excess. **$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$** 1 mole of Mg reacts with 1 mole of H_2SO_4 hence, magnesium is the limiting reactant and sulfuric acid is in excess. Since magnesium is the **limiting reactant for both reactions**, the same volume of hydrogen is produced.	 [1] [1] [1]
10(b)	Curve A. This is because curve A has a **steeper gradient** showing that its reaction is faster. Reaction between magnesium and sulfuric acid is faster than its reaction with hydrochloric acid because there are **more hydrogen ions per unit volume / higher concentration of hydrogen ions in sulfuric acid.**	[1] [1] [1]

10(c)	The acid used is **sulfuric acid** because it has the same initial rate of reaction. Volume of hydrogen = 90 cm^3. No. of moles of hydrogen = 0.09 / 24 = 0.003750 No. of moles of magnesium = 0.003750 Therefore, mass of magnesium = 0.003750 x 24 = **0.09 g** OR Volume of hydrogen is half that of curve A and magnesium is the limiting reactant. Hence mass of magnesium = 0.18 / 2 = **0.09 g**	[1] [1]
10(d)	The reaction stopped very quickly because when calcium reacts with sulfuric acid, **a layer of insoluble calcium sulfate coats over the calcium**. Hence, **some calcium remains unreacted**, resulting in less hydrogen produced.	 [1] [1]
11 Either		
11(a)	Lean burn engines uses more air so more nitrogen gas can burn in oxygen;	[1]
11(b)	Petrol engines produce less soot; petrol is easier to burn completely; petrol engines produce less oxides of nitrogen;	[1]
11(c)	Honeycomb type as it is smaller;	[1]
11(d)	$2(NH_2)_2CO + 3NO_2 \rightarrow \frac{7}{2}N_2 + 4H_2O + 2CO_2$;	[1]
11(e)(i)	6 dm^3	[1]
11(e)(ii)	12 dm^3	[1]
11(f)	They are transition metals;	[1]
11(g)	To prevent the decomposition of DEF;	[1]
11(h)	It produces carbon dioxide which is a greenhouse gas; excessive amount leads to global warming which results in melting of polar ice caps;	[1] [1]
11 OR		
11(a)	400 °C, 500 atm	[1]
11(b)	When more ammonia is formed, the total number of moles of gases reduces since 4 moles of reactants (nitrogen) produce 2 moles of products (ammonia). Since there are fewer particles per unit volume, pressure is reduced.	[1] [1]
11(c)	The change is 'ammonia removal'. To reduce this change, there is a tendency to produce more ammonia. Hence, removing ammonia will cause more ammonia to be formed. Or The reaction between nitrogen and ammonia is a reversible process. Thus some of the ammonia produced will be converted back into nitrogen and hydrogen.	[1] [1] [1] [1]
11(d)	The reaction is exothermic so heat is produced. When heat is applied to the system, to reduce this change, the reverse reaction which is endothermic (cold) will tend to occur to reduce the amount of heat that is applied.	[1] [1]
11(e)	use a catalyst (of iron)	[1]

11(f)		[1] shape [1] label

O

GAN ENG SENG SCHOOL
Mid-Year Examination 2018

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

CHEMISTRY

6092/01
7 May 2018
1 hour

Secondary 4 Express

Paper 1 Multiple Choice

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the OTAS.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is on page 14.

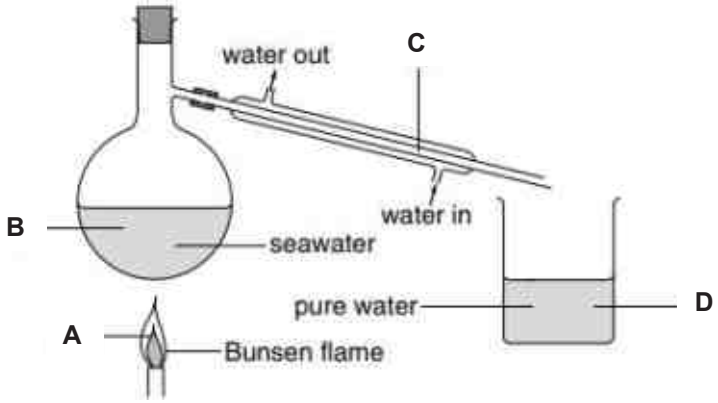
The use of an approved scientific calculator is expected, where appropriate.

Total Marks
40

This paper consists ing the cover page.

1 The diagram shows how to obtain pure water from seawater.

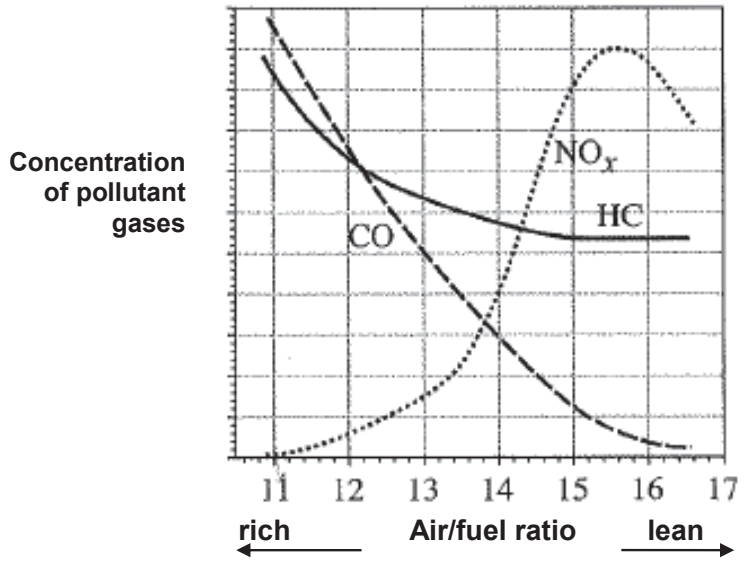
Where do water molecules lose energy?



Refer to the following to answer questions **2** and **3**.

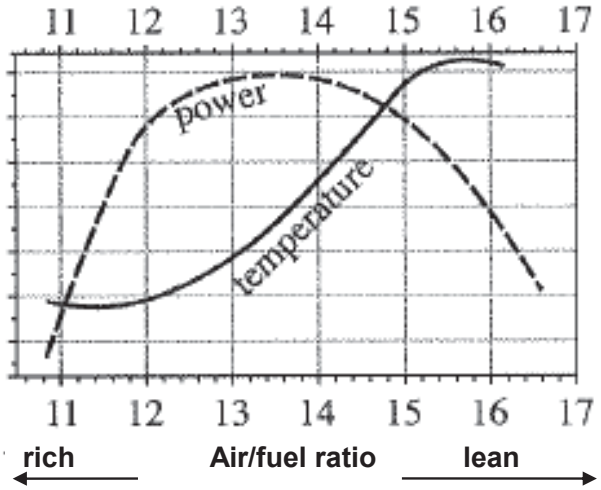
2 In a car engine, petrol vapour is mixed with air and undergoes combustion. When different amounts of petrol are mixed with air, different amounts of pollutant gases will be formed.

Graph I shows how the production of carbon monoxide (CO), nitrogen oxides (NO*x*) and hydrocarbons (HC) is dependent on the ratio of air to petrol.



Graph I

Graph II shows how the engine power and temperature vary with the different ratios of air to fuel of the fuel mixture.



Graph II

Which of the following is not true?

A The amount of carbon monoxide decreases as the air to fuel ratio increases.
B The emission of nitrogen oxides increases as temperature of engine increases.
C Increasing the proportion of air in the mixture will increase the amount of hydrocarbons emitted.
D Increasing the proportion of air in the mixture will increase the level of nitrogen oxides produced.

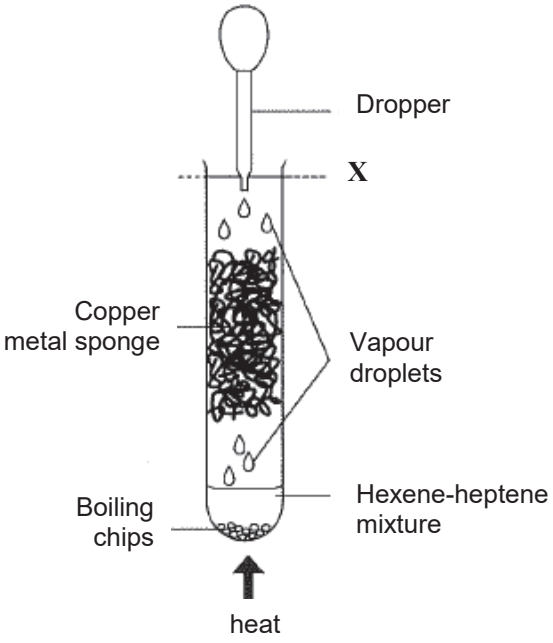
3 Which of the following conclusions **cannot** be drawn based on the information from the graphs?

A A fuel-rich mixture and low combustion temperature will reduce nitrogen oxide formation.
B The overall levels of the three pollutants are best reduced by increasing the air-to-fuel ratio.
C A fuel-lean mixture reduces the carbon monoxide and hydrocarbons but reduces the engine output.
D A fuel-rich mixture reduces the level of nitrogen oxides emitted but reduces the engine power output.

Refer to the following to answer questions **4** and **5**.

1-hexene and 1-heptene are two members of the alkene class of hydrocarbons.

A small amount of mixture of 1-hexene and 1-heptene was placed in a boiling tube and gently heated to boiling in a sand bath using the following setup:



Droplets were formed and could be seen condensing on the sides of the tube. When the vapour condensation line reached the level marked **X**, the hot vapours were very slowly withdrawn and condensed by using a small dropper.

4 What is the purpose of the copper metal sponge?

A Minimises contact of the mixture with air.
B Prevents the two compounds from escaping.
C Acts as a catalyst to speed up the reaction of the two compounds.
D Provides a large surface area for repeated vapourisation and condensation.

5 What process is demonstrated in this experiment?

A Cracking
B Combustion
C Addition reaction
D Fractional distillation

6 Which of the following does not affect the rate at which a gas spreads throughout a room?

A Boiling point of gas
B Temperature of gas
C Molecular mass of gas
D Density

7 Three elements, **X**, **Y** and **Z** have consecutive increasing atomic numbers.

If element **Y** is a noble gas, what will be the symbol for the ions formed by elements **X** and **Z** in their compounds?

A X^- and Z^+
B X^{2-} and Z^{2+}
C X^+ and Z^-
D X^{2+} and Z^{2-}

8 Potassium ferrate, K_2FeO_4, has been described as a 'green oxidising agent' because the by-products generated are environmentally-friendly.

What are the ions in this compound?

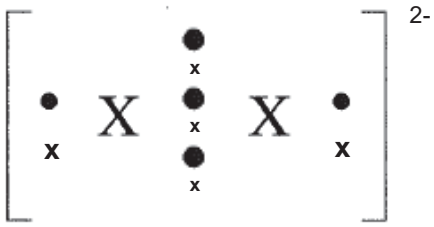
A K^+, FeO_4^{2-}
B K_2^+, FeO_4^-
C K^+, Fe^{6+}, O^{2-}
D K_2^+, Fe^{2+}, O^{2-}

9 Peeling onions often causes tearing of the eyes due to the release of a sulfide compound. Peeling them under running water reduces the problem. Which of the following statements are true of the sulfide compound?

I. It is soluble in water
II. It has low boiling point.
III. It has small and light ions with weak bonding.
IV. It is a covalent compound with weak covalent bonds.

A I and II only
B I and IV only
C I, II and III only
D I, II and IV only

10 Element **X** forms the ion X_2^{2-} with the following structure:



What is the formula of the covalent compound **X** forms with chlorine?

A XCl
B XCl_2
C XCl_3
D XCl_4

11 What is the maximum concentration of H^+ ions in 0.250 mol/dm^3 of phosphoric(V) acid, H_3PO_4?

A 0.125 mol/dm^3 **B** 0.250 mol/dm^3
C 0.500 mol/dm^3 **D** 0.750 mol/dm^3

12 Heating iron in dry chlorine gas results in the formation of an iron(II) chloride. Experimental determination gives a reading of 34.5% by mass of iron in the Iron(II) chloride formed. What is the charge of the iron in the chloride?

A 2- **B** 2+
C 3- **D** 3+

13 Which of the following results is obtained when 100 cm^3 of 0.500 mol/dm^3 dilute sulfuric acid is added to 60.0 g of granular solid lead(II) carbonate?

A No visible reaction.
B Colourless solution with effervescence is produced.
C Colourless solution with white precipitate
D A colourless solution with white precipitate, effervescence and granular remains.

14 Which of the following pairs of aqueous reagents is **not** suitable for preparing insoluble salts?

A Sulfuric acid and calcium chloride
B Aluminium chloride and silver nitrate
C Barium hydroxide and copper(II) sulfate
D Lithium carbonate and iron(II) sulfate

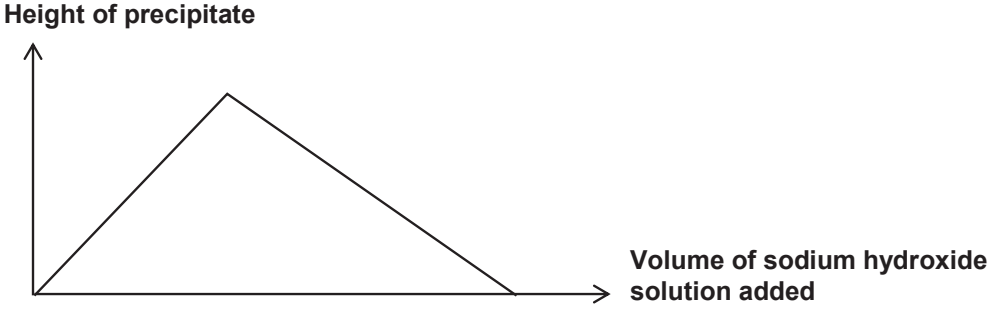
15 A salt has the formula $NH_4Fe(SO_4)_2.12H_2O$. Excess aqueous sodium hydroxide was added to an aqueous solution of the salt in a test tube and the mixture was then warmed gently. Which of the following would **not** be observed?

A A pungent gas was detected.
B A green precipitate was formed.
C A reddish brown precipitate was obtained.
D A piece of moist litmus paper placed at the mouth of the test tube turned blue.

16 A compound **Q** formed white precipitate when acidified aqueous silver nitrate is added. Aqueous ammonia was used to identify the presence of the other ion and there is no visible change. Identify compound **Q**.

A Calcium chloride
B Ammonium nitrate
C Calcium nitrate
D Zinc chloride

17 An aqueous solution of a salt **X** is placed in a test tube and sodium hydroxide solution is gradually added. The height of the precipitate in a test tube is plotted against the volume of sodium hydroxide solution added.



What could be **X**?

A Aluminium sulfate
B Calcium nitrate
C Iron(II) sulfate
D Ammonium nitrate

18 The formula for hydrated copper(II) nitrate is $Cu(NO_3)_2.xH_2O$. It contains 36.5% water of crystallisation by mass.

What is the value of x?

A 4 **B** 5
C 6 **D** 7

19 Element **X** is found in Group IV of the Periodic table. Which of the following could not be a formula for a compound of **X**?

A **X**O
B **X**O_2
C **X**O_3^{2-}
D **X**O_4

20 Which of the following statements best explains why 99.99% copper is used in manufacturing high quality electrical wires for audio equipment?

A Copper is a good conductor of electricity.
B Copper is a very reactive metal.
C 99.99% copper is less ductile and cannot be stretched easily.
D Copper is of high purity and is able to conduct electric current.

21 Which of the following statements about Group VII is **false**?

A Colours of elements become darker down the Group.
B Densities of elements increase down the Group.
C Melting points of elements increase down the Group.
D Number of valence electrons of elements increases down the Group.

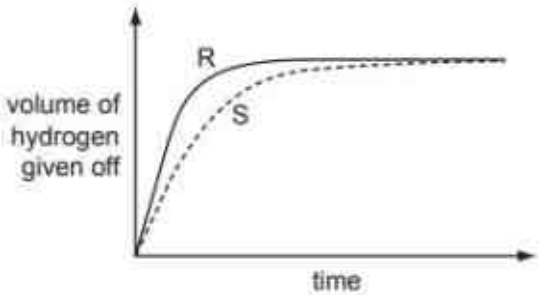
22 Methane gas reacts extremely slowly with air at room temperature. If a piece of warm platinum is held in a methane-air mixture, methane ignites. Which of the following statements correctly describes the reaction with platinum?

I The activation energy is low.
II The energy change is greater.
III The energy of the reactants is lower than expected.
IV The rate of reaction is faster.

A **I** and **II**
B **I** and **IV**
C **I**, **II** and **IV**
D **I**, **II**, **III** and **IV**

23 A student investigates the rate of reaction between magnesium and excess sulfuric acid. The volume of hydrogen given off in the reaction is measured over time.

The graph shows the results of two experiments, **R** and **S**.



Which change in conditions would cause the difference between **R** and **S**?

A Catalyst is added into **S**.
B The acid is more concentrated in **R** than in **S**.
C The magnesium is less finely powdered in **R** than in **S**.
D The temperature in **R** is lower than in **S**.

24 Which statement is correct for the element of proton number 19?

A It is a gas that dissolves in water.
B It is a hard metal that is not very reactive with water.
C It is a non-metal that burns quickly in air.
D It is a soft metal that is highly reactive with water.

25 Statement 1: Alloying iron with other materials to form stainless steel prevents iron from rusting by excluding oxygen.

Statement 2: Painting, oiling and electroplating are all methods of preventing iron from rusting.

Which is correct?

A Both statements are correct and statement 2 explains statement 1.
B Both statements are correct but statement 2 does not explain statement 1.
C Statement 1 is correct but statement 2 is incorrect.
D Statement 2 is correct but statement 1 is incorrect.

26 The reactions shown may occur in the air during a thunder-storm.

$$N_2 + O_2 \rightarrow 2NO$$

$$2NO + O_2 \rightarrow 2NO_2$$

$$NO + O_3 \rightarrow NO_2 + O_2$$

Which row shows what happens to the reactant molecules in each of these reactions?

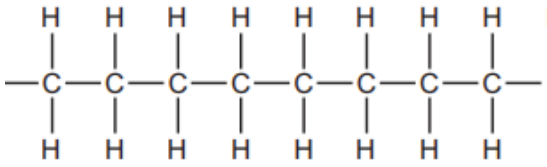
	N_2	**NO**	**O_3**
A	oxidised	oxidised	oxidised
B	oxidised	oxidised	reduced
C	reduced	reduced	oxidised
D	reduced	reduced	reduced

27 Iron is extracted from hematite in a blast furnace.

Which reaction contributes most of the heat in the blast furnace as it increases the temperature to over 1500°C?

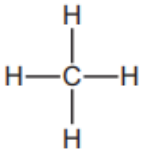
A calcium carbonate → calcium oxide + carbon dioxide
B calcium oxide + silicon dioxide → calcium silicate
C carbon + oxygen → carbon dioxide
D carbon dioxide + carbon → carbon monoxide

28 The diagram shows part of the molecule of a polymer.

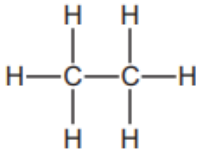


Which diagram shows the monomer from which this polymer could be manufactured?

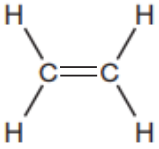
A



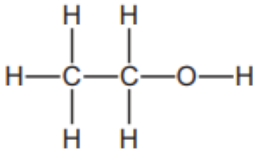
B



C



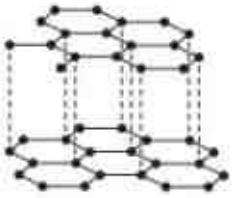
D



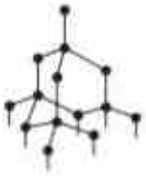
29 Slate has a layered structure and is slippery.

Which diagram shows a structure that closely resembles slate?

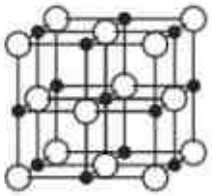
A



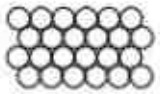
B



C



D



30 In separate experiments conducted, a gaseous halogen was bubbled into an aqueous solution of a halide salt.

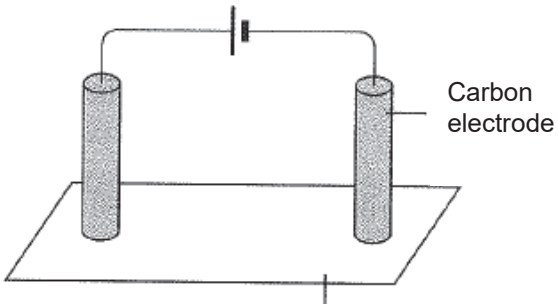
The following results were observed.

	Halides	
Halogen	**Y^-**	**Z^-**
X_2	No observable reaction	Displaced as Z_2
Y_2	No observable reaction	Displaced as Z_2
Z_2	No observable reaction	No observable reaction

What is the arrangement of halogens **X**, **Y** and **Z** in Group VII in order of decreasing reactivity?

A X, Y, Z
B Y, X, Z
C Z, X, Y
D Y, Z, X

31 Two carbon electrodes are placed on a piece of red litmus paper soaked in concentrated sodium chloride solution as shown:

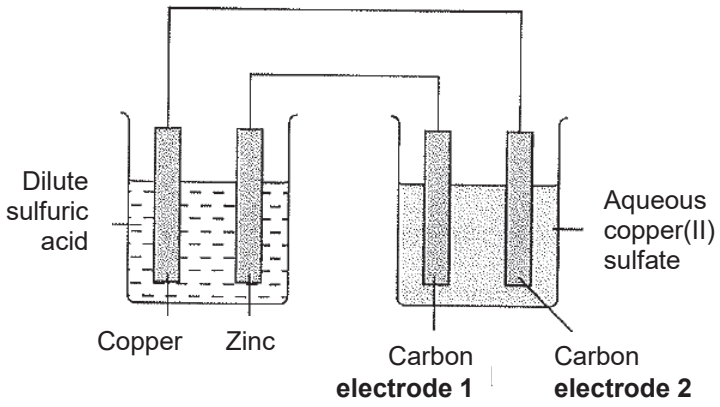


Litmus paper soaked in concentrated sodium chloride solution

What are the observations of the litmus paper at the respective electrodes?

	Cathode	Anode
A	Litmus paper is bleached.	Litmus paper turns blue.
B	Litmus paper turns blue.	Litmus paper is bleached.
C	Litmus paper turns blue.	Litmus paper remains red.
D	Litmus paper remains red.	Litmus paper remains red.

32 Two simple cells were set up as shown:

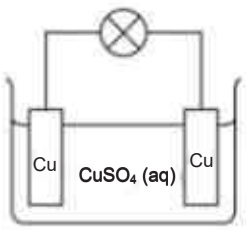


Two substances were discharged at the carbon electrodes. What were these two substances?

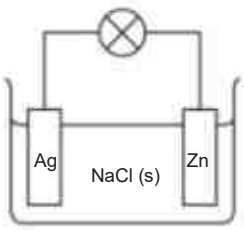
	Electrode 1	Electrode 2
A	Copper metal	Hydrogen gas
B	Hydrogen gas	Copper metal
C	Copper metal	Oxygen gas
D	Oxygen gas	Copper metal

33 In which circuit does the bulb light?

A



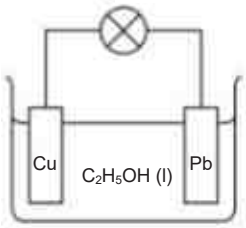
B



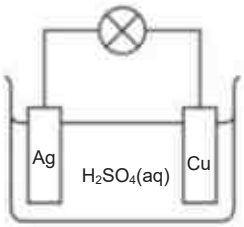
Key

= **bulb**

C



D



34 What are the main gases that escape from the top of the blast furnace in the manufacture of iron by the blast furnace?

A Nitrogen, steam and oxygen
B Oxygen, carbon dioxide and steam
C Nitrogen, carbon monoxide and carbon dioxide
D Carbon monoxide, carbon dioxide and nitrogen monoxide

35 A molten compound is electrolysed. Two atoms of X are deposited at the negative electrode at the same time as three atoms of Y are deposited at the positive electrode.

These results show that:

X is a …**1**…;
Y is a …**2**…;

the formula of the compound is …**3**… .

How are gaps **1**, **2** and **3** correctly completed?

	1	**2**	**3**
A	Metal	Non-metal	X_3Y_2
B	Metal	Non-metal	X_2Y_3
C	Non-metal	Metal	X_3Y_2
D	Non-metal	metal	X_2Y_3

36 Zinc reacts with acids to form salts. Which of the following solutions would give the slowest rate of reaction when reacted with zinc?

A 0.0500 mol sulfuric acid in 500 cm^3 of water.
B 0.0250 mol sulfuric acid in 100 cm^3 of water.
C 0.0500 mol hydrochloric acid in 200 cm^3 of water.
D 0.0250 mol hydrochloric acid in 75 cm^3 of water.

37 Which compound will react with steam, in the presence of catalyst, to produce the alcohol $CH_3CH_2CH_2OH$?

A CH_3CHCH_2 **B** $CH_3CHCHCH_3$
C $CH_3CH_2CH_2CH_3$ **D** CH_3CH_2COOH

38 Which type of reaction does this equation show?

$$C_3H_8 + F_2 \rightarrow C_3H_7F + HF$$

A Hydration
B Neutralisation
C Addition
D Substitution

39 An unsaturated hydrocarbon with six carbon atoms contains only three C=C double bonds. This hydrocarbon is reacted with excess bromine at a room temperature.

What is the formula of the resulting hydrocarbon?

A $C_6H_8Br_3$ **B** $C_6H_{10}Br_3$
C $C_6H_8Br_6$ **D** C_6H_{14}

40 A hydrocarbon is found to contain about 80% of carbon by mass. What is the hydrocarbon?

A Methane **B** Ethene
C Propane **D** Hexene

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
						1 H hydrogen 1											2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

O

GAN ENG SENG SCHOOL
Mid-Year Examination 2018

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

CHEMISTRY

6092/02
3 May 2018
1 hour 45 minutes

Paper 2

Secondary 4 Express

Candidates answer on the Question Paper.
Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid / tape.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is on page 20.

The use of an approved scientific calculator is expected, where appropriate.

	For Examiner's Use
Section A	.....
Section B	
B7	.....
B8	.....
B9 *Either / OR	
**Circle where appropriate*	.....
Total	**80**

This paper consists of **20** printed pages including the cover page.

[Turn over

Section A (50 marks)

Answer **all** the questions in the spaces provided.

A1 The table below shows some information about elements **A**-**F**. The letters are **not** the chemical symbols of the elements.

Element	Colour	Melting point / °C	Boiling point / °C	Conducts electricity	Density / g/cm^3
A	Dull grey	1415	2898	Yes	2.0300
B	Pale yellow	-219	-188	No	0.0017
C	Orange brown	-7	59	No	3.1000
D	Shiny brown	1074	2927	Yes	8.9200
E	Shiny grey	1540	2861	Yes	7.8700
F	Colourless	-157	-153	No	0.0033

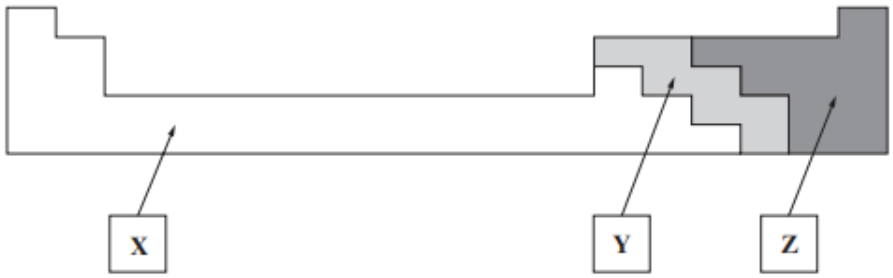
(a) **(i)** State which of the elements **A**-**F** are gases at room temperature. [1]

……..

(ii) Give the letter of the element **A**-**F** that has the biggest difference between melting point and boiling point. [1]

……..

(iii) The diagram shows an outline of the Periodic Table.



Element **A** is found in area **Y** of the Periodic Table shown above. Explain how the information in the table above supports this statement. [2]

……..

……..

……..

(b) Methane reacts violently with fluroine according to the following equation.

$$CH_4\ (g) + 4F_2\ (g) \rightarrow CF_4\ (g) + 4HF\ (g) \qquad \Delta H = -1904\ kJ/mol$$

Mean bond energies are given in the table shown below.

Bond	C-H	C-F	H-F
Mean bond energy / kJ/mol	412	484	562

A student suggested that one reason for the high reactivity of fluorine is a weak F-F bond.

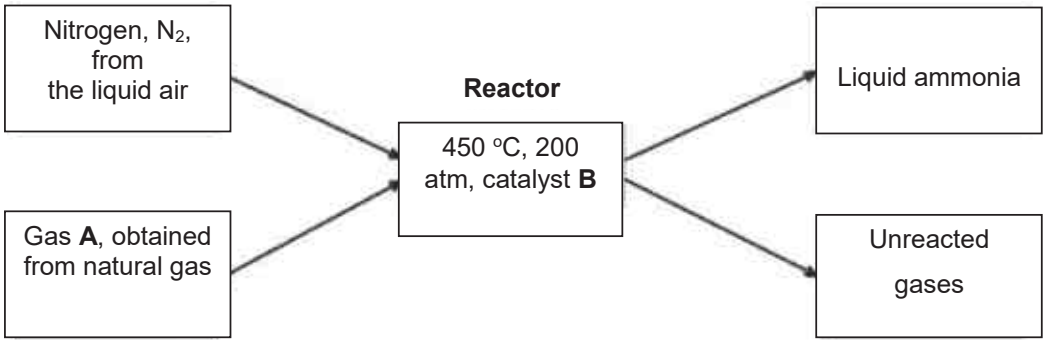
Is the student correct? Justify your answer with calculations using the above data. [4]

(c) Write an ionic equation for the reaction between potassium and cold water. [1]

……

[Total: 9]

A2 Ammonia is produced during the Haber process. The reaction is summarised in the diagram below.



(a) Give the name of gas **A**. …….. [1]

(b) Name the catalyst **B** and explain why it is used. [2]

……..

……..

(c) The yield of ammonia is only 28% therefore 72% of the gases remain unreacted. [2]

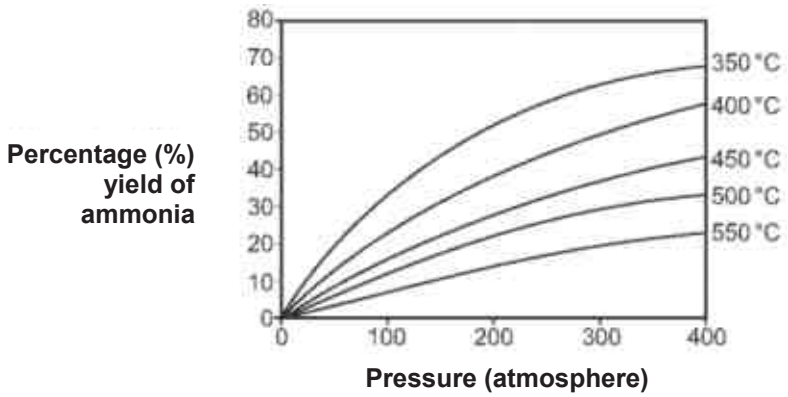
Describe what happens to these unreacted gases and explain why this is important.

……..

……..

……..

(d) The following graph below shows the effect of temperature and pressure on the yield of ammonia during the Haber process.



Describe how the yield of ammonia varies with temperature and pressure. [2]

……..

……..

(e) **(i)** Construct an equation for the production of ammonia in a Haber process. State symbols are required. [1]

……

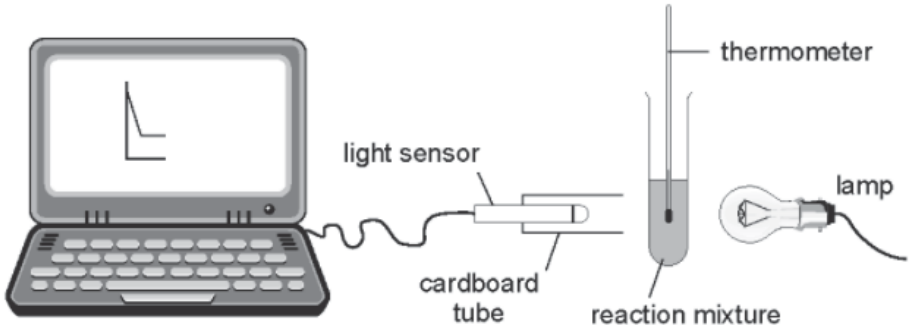
(ii) Explain if the above process is a redox reaction. Use oxidation number in your explanation. [2]

……

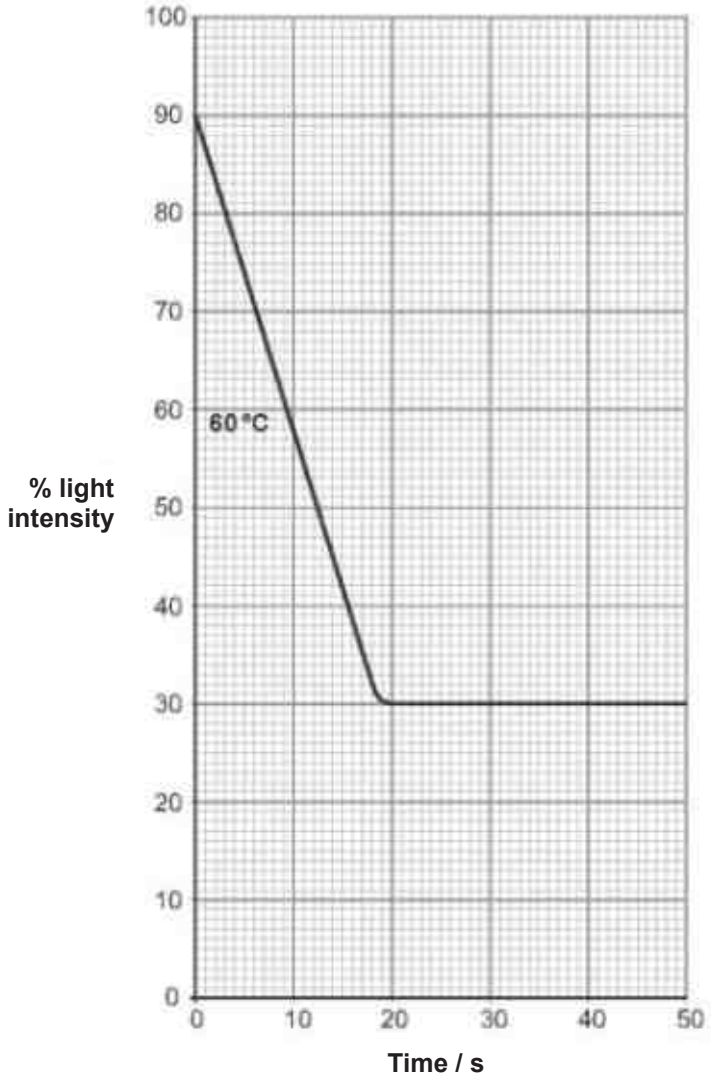
……

[Total: 10]

A3 Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction was investigated using the equipment below.



5 cm^3 of dilute hydrochloric acid was added to 10 cm^3 of sodium thiosulfate solution at 60 °C and the light intensity was measured over time. The results are shown on the grid below.



(a) Explain why the light intensity decreases as the reaction takes place. [2]

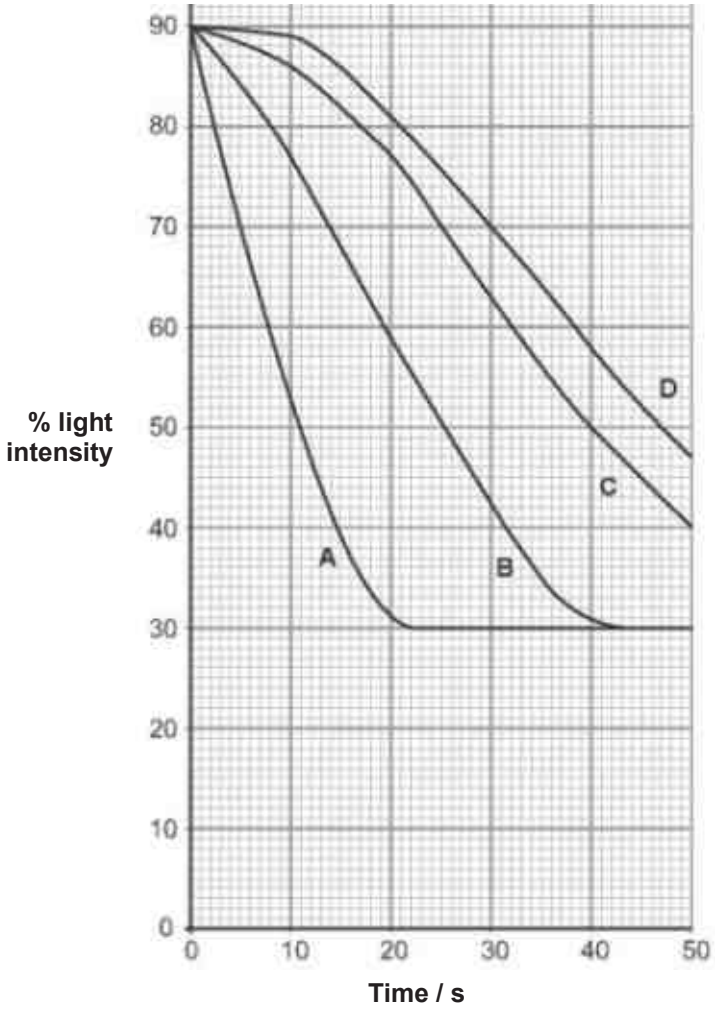
……

……

(b) Suggest one possible reason why the light intensity does not fall to 0%. [1]

……

(c) In a separate experiment, 5 cm^3 of dilute hydrochloric acid was added separately to 10 cm^3 of sodium thiosulfate solution at four different temperatures. All other factors were kept the same. The results are shown on the grid below.



(i) Provide the letter **A**, **B**, **C** or **D** from the graph shown that represents the reaction carried out at the highest temperature. Explain your choice. [1]

……

……

(ii) The rate of reaction can be calculated using the formula: [1]

Rate = 1 / time

The reaction is considered to be complete when the percentage light intensity reaches 30%. Calculate the mean rate for experiment **B**.

(iii) Using collision theory, provide a conclusion you can draw from the above investigation. [3]

……

……

……

(d) A chemist carried out an experiment to find out the reactivity of the metals. Below shows the time taken for limewater to form white precipitate for each metal carbonate.

Metal carbonate	**Time taken to form white precipitate / s**
Copper carbonate	10
Magnesium carbonate	40
Zinc carbonate	24

Explain these results in terms of reactivity of the metals. [2]

……

……

……

[Total: 10]

A4 An alcohol **G** was known to be one of the following.

HOHOCHCH=CHCHOHOH Alcohol **1**

$CH_3CH_2CH_2CH_2OH$ Alcohol **2**

A sample of 1.20 g of alcohol **G** was burned in excess oxygen. 1.79 g of carbon dioxide was formed.

(a) Calculate the mass of carbon present in the sample of alcohol **G**. [1]

(b) The mass of hydrogen in the sample is 0.0812 g. Assuming that the rest of the sample is oxygen, calculate the mass of oxygen in the sample. [1]

(c) Use your answers above to find the empirical formula of alcohol **G**. [2]

(d) State the identity of alcohol **G**. Explain clearly how you reached this conclusion. [1]

……..

……..

……..

……..

(e) Describe a chemical test to distinguish between alcohol **1** and alcohol **2**. Include expected results in your answer. [1]

……..

……..

……..

……..

(f) Propene can be converted into an alcohol.

Show the **structural equation** for the above reaction. [2]

[Total: 8]

A5 **(a)** Aspirin tablets have important medical uses.

Aspirin ($C_9H_8O_4$) is made when salicylic acid ($C_7H_6O_3$) reacts with ethanoic anhydride.

The equation for this reaction is

$$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + CH_3COOH$$

Calculate the **maximum** mass of aspirin that could be made from 100 g of salicylic acid. [2]

(b) **(i)** In an experiment, a chemist calculated the maximum yield of aspirin is 400 g. The chemist did the experiment but only made 250 g of aspirin. Calculate the percentage yield of aspirin for this experiment.

Show clearly how you work out your answer and suggest one possible reason why the chemist did not have a percentage yield of 100%. [2]

……

……

(ii) Suggest how the use of catalyst might reduce costs in the industrial production of aspirin. [1]

……

……

(c) Instant cold packs are used to treat sports injuries.

One type of cold pack has a plastic bag containing water. Inside the bag is a smaller bag containing solid ammonium nitrate. The outer bag is squeezed so that the inner bag bursts.

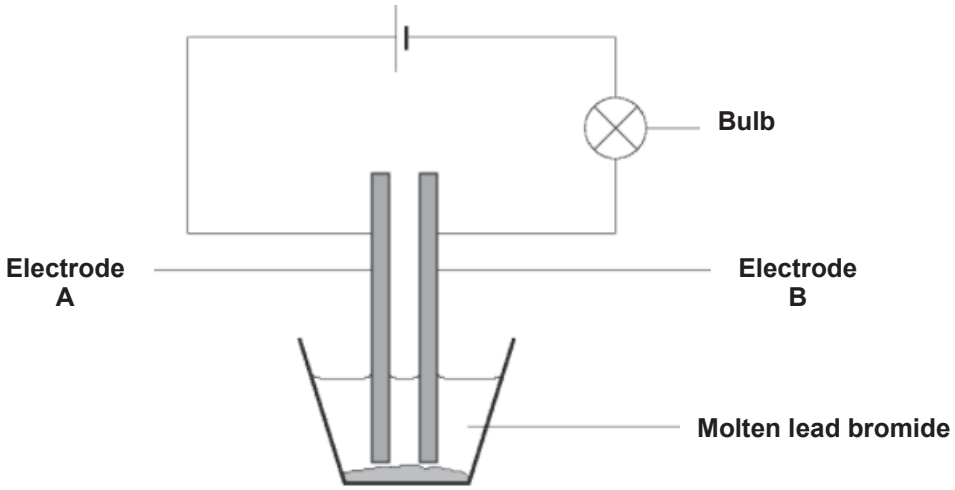
Explain why the bag becomes cold. [2]

……

……

[Total: 7]

A6 The diagram below shows the apparatus used during electrolysis of molten lead (II) bromide.



(a) Suggest a reason why lead (II) bromide must be molten in order for electricity to flow. [1]

……...

……...

(b) Write the half equation for the reaction taking place at the electrode **A**. [1]

……...

(c) **(i)** State, in terms of electrons, what happens to the ions at the electrode **B.** [1]

……

……

(ii) Describe an observation you would expect at the electrode **B**. [2]

……

……

(iii) Electrolysis is allowed to continue for some time before the apparatus is cooled to room temperature. The bulb remains lit. [1]

Explain this observation.

……

……

……

[Total: 6]

Section B (30 marks)

Answer all **three** questions. The last question is in the form **either/or**.

Write your answers in the spaces provided.

B7 The investigation of hydrocarbons

Information 1

From its modest beginning in 1980, the U.S. ethanol industry has grown tremendously in response to surging domestic use and worldwide demand.

The table below shows two different identified processes to produce ethanol.

Process 1	Process 2
Fermentation of a sugar solution by yeast in a reaction vessel. The reaction vessel has to be emptied, cleaned and refilled every few days. The process produces a 15% ethanol solution in water daily.	Reaction of ethene (from crude oil) with steam in a reactor. The reaction is only stopped if there is a fault in the reactor. The process produces 100% pure ethanol.

Information 2

An advertisement for crisps claimed that they are healthier because they are cooked in certain oils. A student found the following information about four oils that are used to make crisps.

	Rapeseed oil	Sunflower oil	Olive oil	Corn oil
Saturated fat / %	6.6	12.0	14.2	14.4
Poly-unsaturated fat / %	29.3	63.3	8.1	51.3
Melting point / °C	+5	-18	-12	-15

One hypothesis is that oils are thought to be healthier if they are:

- Low in saturated fat.
- High in poly-unsaturated fat.

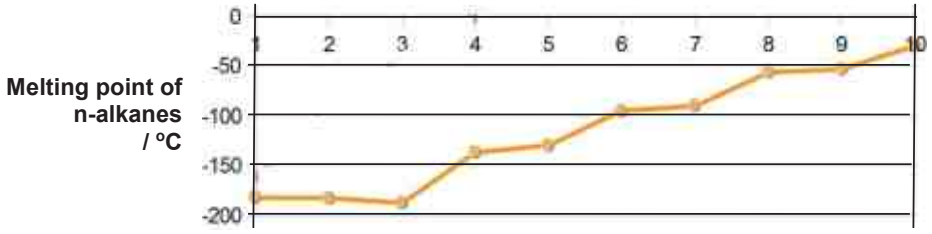
For certain oils and fats such as olive oil, soybean oil, or nut oils, when compared with others, such as margarine, butter, chicken fat and beef fat (the white stuff found in and around slabs of meat), the most prominent difference that was discovered was that different oils and fats have different states of matter at room temperature.

Some oils and fats are liquid at room temperature, and even when kept in the fridge, like olive oil and soybean oil. By contrast, other fats have higher melting temperatures.

The melting point of fats is the temperature at which they become liquid. **Graph 1** shows the change in melting point for saturated hydrocarbon.

Graph 1

Melting point of n-alkanes



The melting temperature is the same as freezing temperature; it is the temperature where the fat changes from a liquid to a solid.

In addition, the effect of the percentage of saturated fats within certain oils on the energy released from combustion was investigated. It was found out that as the saturation of the carbon chain increases, the energy released from combustion decreases.

Table 1: Experimental results on the four different oil used

		Rapeseed oil	Sunflower oil	Olive oil	Corn oil
Energy released from combustion (kJ/g)	Trial 1	5.05	3.48	6.55	3.95
	Trial 2	4.98	3.20	5.98	2.01
	Trial 3	4.46	2.98	6.24	3.88

Table 2: Hydrocarbon table

Name	Chemical formula	Heat of combustion (kJ/g)
Methane	CH_4	55.6
Ethane	C_2H_6	52.0
Propane	C_3H_8	50.0
Butane	C_4H_{10}	49.2

Note: Heat of combustion is also known as enthalpy change. It refers to the heat energy released when a compound undergoes complete combustion with oxygen under a given condition.

(a) Using **Information 1**,

(i) Give one advantage that Process 1 has over Process 2. [1]

……

……

(ii) State one advantage Process 2 has over Process 1 as a manufacturer of ethanol. [2]

……

……

……

(b) Using **Information 2**,

(i) Determine which oil should be healthier. [2]

Explain your answer.

……

……

……

(ii) These unsaturated oils can be hardened by an addition reaction with hydrogen at 200 °C with nickel catalyst. [2]

A student said that this hardening process would make sunflower oil healthier.

Is this student's hypothesis correct? Explain your answer.

……

……

……

(iii) Using **Table 2**, describe and explain the data patterns for series of heat of combustion on the different alkanes. [2]

……

……

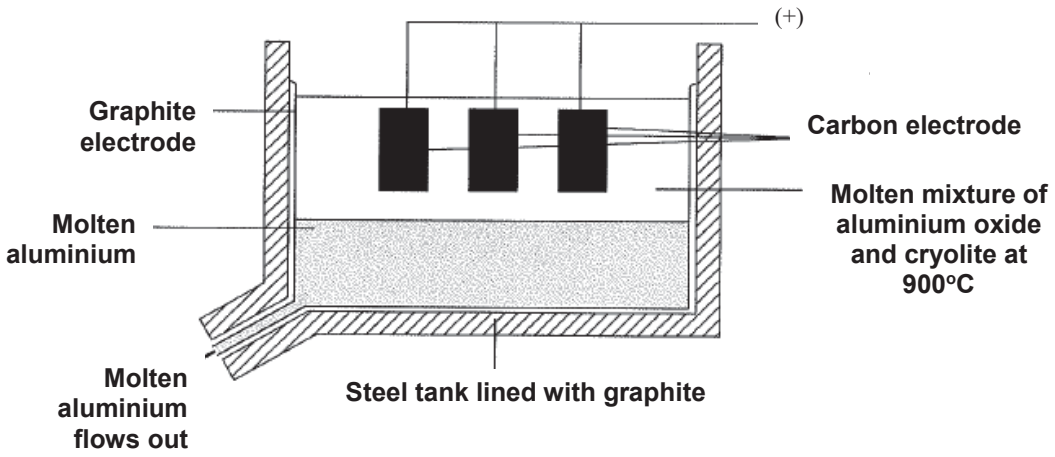
……

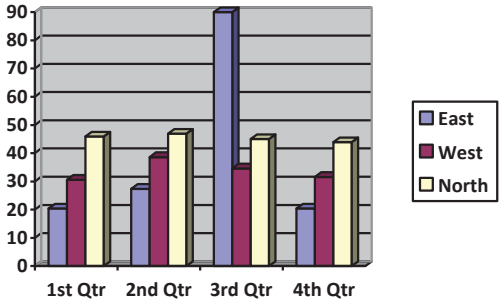
(iv) Based on the information given, describe the trend of the melting point of alkanes. [1]

……

[Total: 10]

B8 The diagram shows an electrolysis tank used to extract aluminium from aluminium oxide. Pure aluminium oxide melts at 2055 °C.





(a) Cryolite is mixed, as an impurity, with aluminium oxide. State the effect it has on the melting point of the mixture and explain why mixing cryolite is necessary. [2]

……...

……...

(b) Write half equations for the reactions that take place at the anode and cathode. [2]

Anode: ……

Cathode: ……

(c) Draw **two** arrows on the diagram to indicate the flow of electrons. Clearly label on the two electrodes. [1]

(d) What is the volume of oxygen produced, under room temperature and pressure when 540 g of aluminium is produced? [2]

(e) The carbon electrodes are replaced at regular intervals. Explain the need for this. [1]

……...

……...

(f) Draw a clearly labelled diagram to show how a metal object could be electroplated with copper. [2]

[Total: 10]

EITHER

B9 Zinc is extracted from an ore called zinc blende, which consists mainly of zinc sulfide, ZnS. The zinc blende is first crushed to powder and then treated by froth flotation *(mineral processing, where it is used in the extraction of several metals)*.

Zinc blende reacts with oxygen in the air to produce zinc oxide and a gas which escapes as waste gas.

(a) **(i)** Explain why zinc blende is crushed to powder before treatment? [1]

……

……

(ii) Write a chemical equation for the reaction in **(a)(i)**. [1]

……

(b) Zinc oxide is converted into zinc. Zinc oxide and coke are fed into a furnace. Hot air is blown into the bottom of the furnace. Zinc has a melting point of 420 °C and a boiling point of 907 °C. The temperature inside the furnace is over 1000 °C.

(i) Explain how zinc oxide is converted into zinc. Your answer should include details of how the heat is produced and equations for all the reactions you describe. [3]

……

……

……

(ii) Give **two** reasons why the zinc produced inside the furnace is in gaseous state. [2]

……

……

(iii) State the name of the physical change for conversion of gaseous zinc into molten zinc. [1]

……

(c) Rusting of steel can be prevented by coating the steel with a layer of zinc. [2]

Explain, in terms of electron transfer, why steel does not rust even if the layer of zinc is scratched and the steel is exposed to air and water.

……

……

……

[Total: 10]

OR

B9 Petroleum is a source of many important chemicals.

(a) Name **two** industrial processes which must take place to produce alkenes from petroleum. [2]

……..

(b) Ethene and propene can both be converted into polymers.

(i) State the type of polymerisation that takes place when ethene forms a polymer. [1]

……..

(ii) Identify the empirical formula of the polymer formed from ethene. [1]

……..

(iii) Draw **two** repeat units of the polymer made from propene. [2]

(c) Most of the hydrocarbons obtained from petroleum are alkanes. The alkanes are homologous series of saturated hydrocarbons with the general formula C_nH_{2n+2}. [2]

Give two characteristics, other than having the same general formula, of members in the same homologous series.

……

……

(d) When one mole of chlorine, Cl_2, reacts with one mole of propane, a mixture of **two** structural isomers is formed in the **first step** of substitution. [2]

Draw **all** the structural formulas of the isomers formed when one mole of chlorine reacts with one mole of propane.

[Total: 10]

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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GAN ENG SENG SCHOOL
Mid-Year Examination 2018

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

CHEMISTRY

6092/01
7 May 2018
1 hour

Secondary 4 Express

Paper 1 Multiple Choice

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the OTAS.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is on page 14.

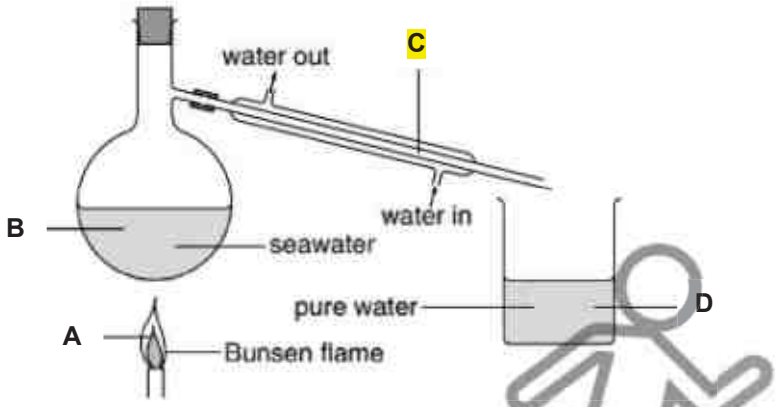
The use of an approved scientific calculator is expected, where appropriate.

Total Marks
40

This paper consists ng the cover page.

1 The diagram shows how to obtain pure water from seawater.

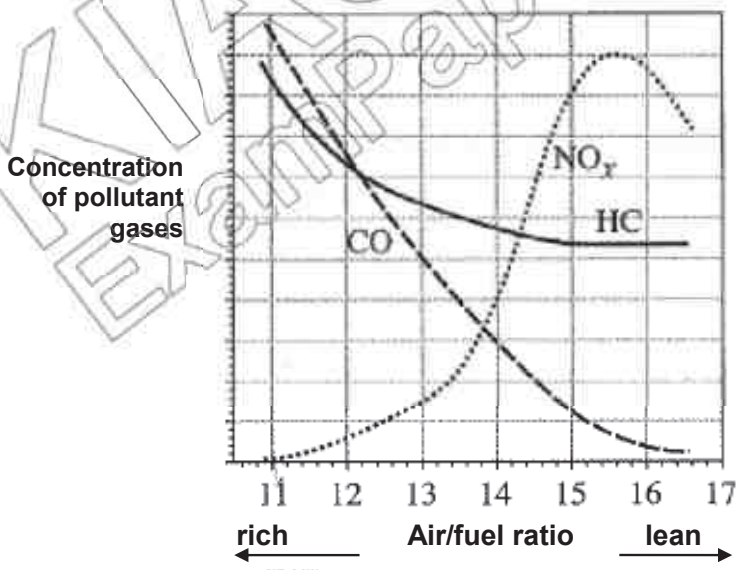
Where do water molecules lose energy?



Refer to the following to answer questions **2** and **3**.

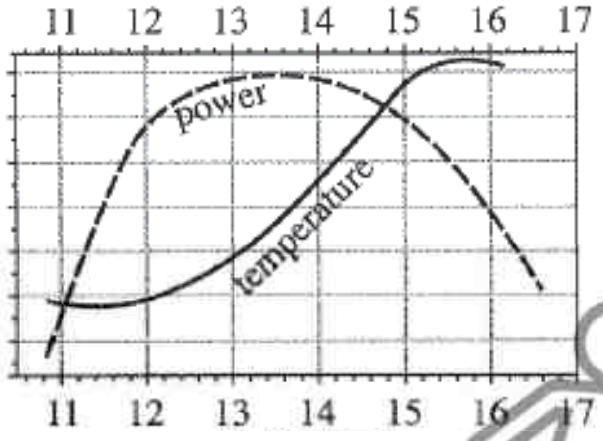
2 In a car engine, petrol vapour is mixed with air and undergoes combustion. When different amounts of petrol are mixed with air, different amounts of pollutant gases will be formed.

Graph I shows how the production of carbon monoxide (CO), nitrogen oxides (NO*x*) and hydrocarbons (HC) is dependent on the ratio of air to petrol.



Graph I

Graph II shows how the engine power and temperature vary with the different ratios of air to fuel of the fuel mixture.



Graph II

Which of the following is not true?

A The amount of carbon monoxide decreases as the air/ratio fuel ratio increases.
B The emission of nitrogen oxides increases as temperature of engine increases.
C Increasing the proportion of air in the mixture will increase the amount of hydrocarbons emitted.
D Increasing the proportion of air in the mixture will increase the level of nitrogen oxides produced.

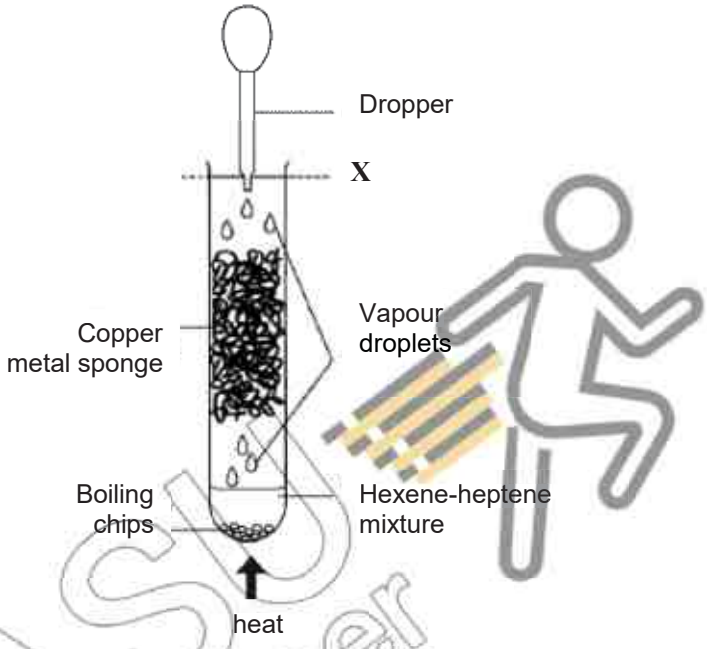
3 Which of the following conclusions **cannot** be drawn based on the information from the graphs?

A A fuel-rich mixture and low combustion temperature will reduce nitrogen oxide formation.
B The overall levels of the three pollutants are best reduced by increasing the air-to-fuel ratio.
C A fuel-lean mixture reduces the carbon monoxide and hydrocarbons but reduces the engine output.
D A fuel-rich mixture reduces the level of nitrogen oxides emitted but reduces the engine power output.

Refer to the following to answer questions **4** and **5**.

1-hexene and 1-heptene are two members of the alkene class of hydrocarbons.

A small amount of mixture of 1-hexene and 1-heptene was placed in a boiling tube and gently heated to boiling in a sand bath using the following setup:



Droplets were formed and could be seen condensing on the sides of the tube. When the vapour condensation line reached the level marked **X**, the hot vapours were very slowly withdrawn and condensed by using a small dropper.

4 What is the purpose of the copper metal sponge?

A Minimises contact of the mixture with air.
B Prevents the two compounds from escaping.
C Acts as a catalyst to speed up the reaction of the two compounds.
D Provides a large surface area for repeated vapourisation and condensation.

5 What process is demonstrated in this experiment?

A Cracking
B Combustion
C Addition reaction
D Fractional distillation

6 Which of the following does not affect the rate at which a gas spreads throughout a room?

A Boiling point of gas
B Temperature of gas
C Molecular mass of gas
D Density

7 Three elements, **X**, **Y** and **Z** have consecutive increasing atomic numbers.

If element **Y** is a noble gas, what will be the symbol for the ions formed by elements **X** and **Z** in their compounds?

A X^- and Z^+
B X^{2-} and Z^{2+}
C X^+ and Z^-
D X^{2+} and Z^{2-}

8 Potassium ferrate, K_2FeO_4, has been described as a 'green oxidising agent' because the by-products generated are environmentally-friendly.

What are the ions in this compound?

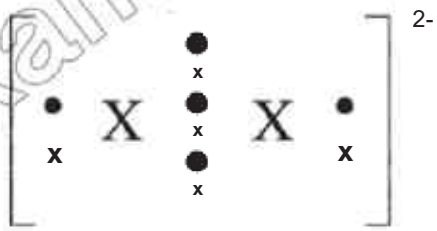
A K^+, FeO_4^{2-}
B K_2^+, FeO_4^-
C K^+, Fe^{6+}, O^{2-}
D K_2^+, Fe^{2+}, O^{2-}

9 Peeling onions often causes tearing of the eyes due to the release of a sulfide compound. Peeling them under running water reduces the problem. Which of the following statements are true of the sulfide compound?

I. It is soluble in water
II. It has low boiling point.
III. It has small and light ions with weak bonding.
IV. It is a covalent compound with weak covalent bonds.

A I and II only
B I and IV only
C I, II and III only
D I, II and IV only

10 Element **X** forms the ion X_2^{2-} with the following structure:



What is the formula of the covalent compound **X** forms with chlorine?

A XCl
B XCl_2
C XCl_3
D XCl_4

11 What is the maximum concentration of H^+ ions in 0.25 mol/dm^3 of phosphoric(V) acid, H_3PO_4? 0.25 x 3 = 0.750

A 0.125 mol/dm^3
B 0.250 mol/dm^3
C 0.500 mol/dm^3
D 0.750 mol/dm^3

12 Heating iron in dry chlorine gas results in the formation of an iron(II) chloride. Experimental determination gives a reading of 34.5% by mass of iron in the Iron(II) chloride formed. What is the charge of the iron ion in the chloride? 34.5% = 56 / (56+106.5)

A -2
B +2
C -3
D +3

13 Which of the following results is obtained when 100 cm^3 of 0.500 mol/dm^3 dilute sulfuric acid is added to 60 g of granular solid lead(II) carbonate?

A No visible reaction.
B Colourless solution with effervescence is produced.
C Colourless solution with white precipitate
D A colourless solution with white precipitate, effervescence and granular remains.

14 Which of the following pairs of aqueous reagents is not suitable for preparing insoluble salts? Salts containing group I metals are soluble

A Sulfuric acid and calcium chloride
B Aluminium chloride and silver nitrate
C Barium hydroxide and copper(II) sulfate → barium sulfate and copper(II) hydroxide
D Lithium carbonate and iron(II) sulfate → Lithium sulfate and iron(II) carbonate

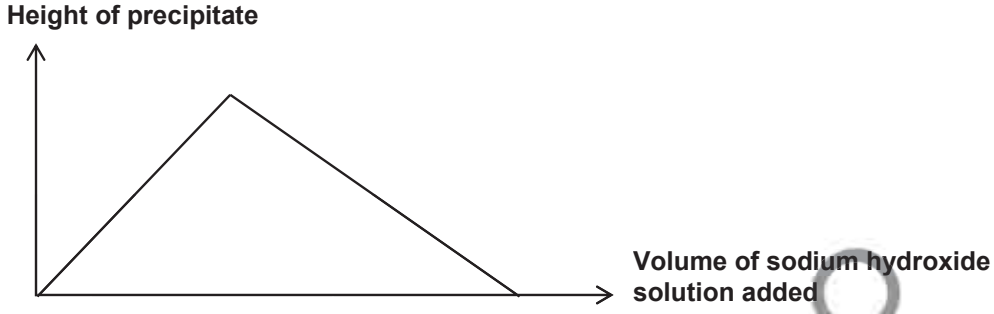
15 A salt has the formula $NH_4Fe(SO_4)_2.12H_2O$. Excess aqueous sodium hydroxide was added to an aqueous solution of the salt in a test tube and the mixture was then warmed gently. Which of the following would **not** be observed? Fe = +3 (reddish brown iron ion)

A A pungent gas was detected.
B A green precipitate was formed.
C A reddish brown precipitate was obtained.
D A piece of moist litmus paper placed at the mouth of the test tube turned blue.

16 A compound **Q** formed white precipitate when acidified aqueous silver nitrate is added. Aqueous ammonia was used to identify the presence of the other ion and there is no visible change. Identify compound **Q**.

A Calcium chloride
B Ammonium nitrate
C Calcium nitrate
D Zinc chloride

17 An aqueous solution of a salt **X** is placed in a test tube and sodium hydroxide solution is gradually added. The height of the precipitate in a test tube is plotted against the volume of sodium hydroxide solution added.



What could be **X**?

A Aluminium sulfate (soluble salt, Al is soluble in excess sodium hydroxide)
B Calcium nitrate
C Iron(II) sulfate
D Ammonium nitrate

18 The formula for hydrated copper(II) nitrate is $Cu(NO_3)_2.xH_2O$. It contains 36.5% water of crystallisation by mass.

What is the value of x?

A 4 **B** 5
C 6 **D** 7

19 Element **X** is found in Group IV of the Periodic table. Which of the following could not be a formula for a compound of **X**?

A **X**O
B XO_2
C XO_3^{2-}
D XO_4

20 Which of the following statements best explains why 99.99% copper is used in manufacturing high quality electrical wires for audio equipment?

A Copper is a good conductor of electricity.
B Copper is a very reactive metal.
C 99.99% copper is less ductile and cannot be stretched easily.
D Copper is of high purity and is able to conduct electric current.

21 Which of the following statements about Group VII is **false**?

A	Colours of elements become darker down the Group.	**B**	Densities of elements increase down the Group.
C	Melting points of elements increase down the Group.	**D**	Number of valence electrons of elements increases down the Group.

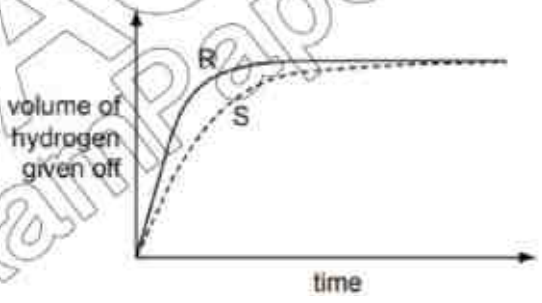
22 Methane gas reacts extremely slowly with air at room temperature. If a piece of warm platinum is held in a methane-air mixture, methane ignites. Which of the following statements correctly describes the reaction with platinum?

I The activation energy is low.
II The energy change is greater.
III The energy of the reactants is lower than expected.
IV The rate of reaction is faster.

A **I** and **II**
B **I** and **IV**
C **I**, **II** and **IV**
D **I**, **II**, **III** and **IV**

23 A student investigates the rate of reaction between magnesium and excess sulfuric acid. The volume of hydrogen given off in the reaction is measured over time.

The graph shows the results of two experiments, **R** and **S**.



Which change in conditions would cause the difference between **R** and **S**?

A Catalyst is added into **S**.
B The acid is more concentrated in **R** than in **S**.
C The magnesium is less finely powdered in **R** than in **S**.
D The temperature in **R** is lower than in **S**.

24 Which statement is correct for the element of proton number 19?

A It is a gas that dissolves in water.
B It is a hard metal that is not very reactive with water.
C It is a non-metal that burns quickly in air.
D It is a soft metal that is highly reactive with water.

25 Statement 1: Alloying iron with other materials to form stainless steel prevents iron from rusting by excluding oxygen.

Statement 2: Painting, oiling and electroplating are all methods of preventing iron from rusting.

Which is correct?

A Both statements are correct and statement 2 explains statement 1.
B Both statements are correct but statement 2 does not explain statement 1.
C Statement 1 is correct but statement 2 is incorrect.
D Statement 2 is correct but statement 1 is incorrect.

26 The reactions shown may occur in the air during a thunder-storm.

$$N_2 + O_2 \rightarrow 2NO$$

$$2NO + O_2 \rightarrow 2NO_2$$

$$NO + O_3 \rightarrow NO_2 + O_2$$

Which row shows what happens to the reactant molecules in each of these reactions?

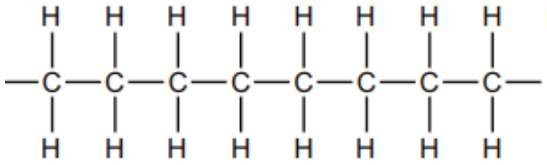
	N_2	NO	O_3
A	oxidised	oxidised	oxidised
B	oxidised	oxidised	reduced
C	reduced	reduced	oxidised
D	reduced	reduced	reduced

27 Iron is extracted from hematite in a blast furnace.

Which reaction contributes most of the heat in the blast furnace as it increases the temperature to over 1500°C?

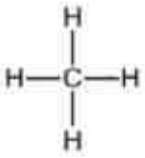
A calcium carbonate → calcium oxide + carbon dioxide
B calcium oxide + silicon dioxide → calcium silicate
C carbon + oxygen → carbon dioxide
D carbon dioxide + carbon → carbon monoxide

28 The diagram shows part of the molecule of a polymer.



Which diagram shows the monomer from which this polymer could be manufactured?

A



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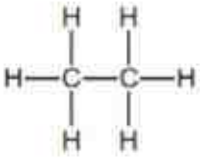
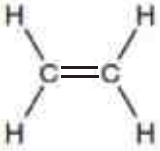


C



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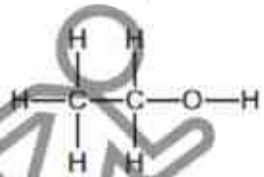
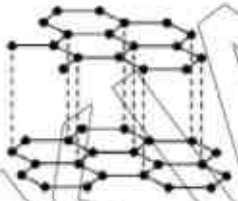


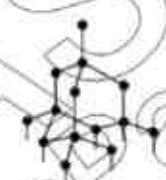
29 Slate has a layered structure and is slippery.

Which diagram shows a structure that closely resembles slate?

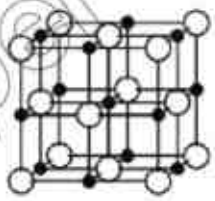
A



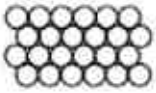
B



C



D



30 In separate experiments conducted, a gaseous halogen was bubbled into an aqueous solution of a halide salt.

The following results were observed.

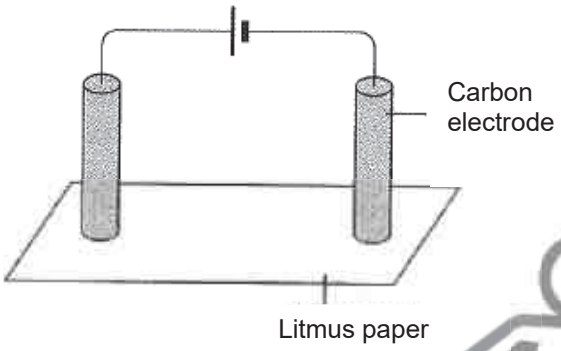
	Halides	
Halogen	**Y^-**	**Z^-**
X_2	No observable reaction	Displaced as Z_2
Y_2	No observable reaction	Displaced as Z_2
Z_2	No observable reaction	No observable reaction

What is the arrangement of halogens **X**, **Y** and **Z** in Group VII in order of decreasing reactivity?

A X, Y, Z
B Y, X, Z
C Z, X, Y

D Y, Z, X

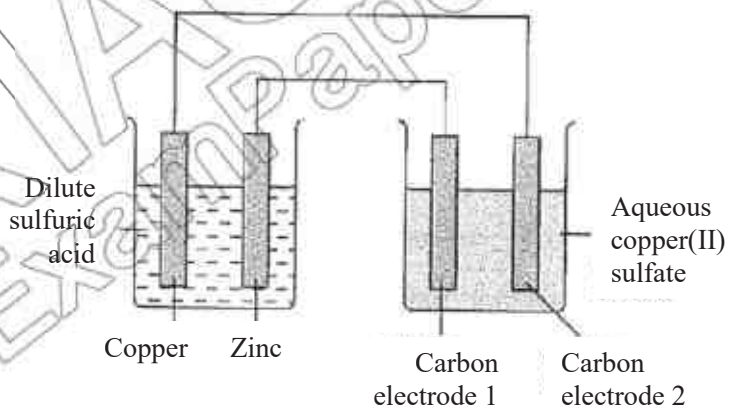
31 Two carbon electrodes are placed on a piece of red litmus paper soaked in concentrated sodium chloride solution as shown:



What are the observations of the litmus paper at the respective electrodes?

	Cathode	Anode
A	Litmus paper is bleached.	Litmus paper turns blue.
B	Litmus paper turns blue.	Litmus paper is bleached.
C	Litmus paper turns blue.	Litmus paper remains red.
D	Litmus paper remains red.	Litmus paper remains red.

32 Two simple cells were set up as shown:

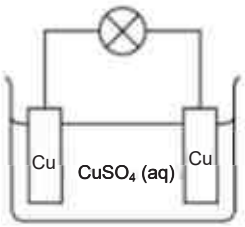


Two substances were discharged at the carbon electrodes. What were these two substances?

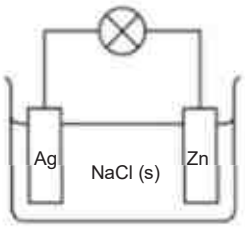
	Electrode 1	Electrode 2
A	Copper metal	Hydrogen gas
B	Hydrogen gas	Copper metal
C	Copper metal	Oxygen gas
D	Oxygen gas	Copper metal

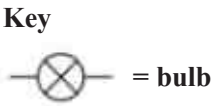
33 In which circuit does the bulb light?

A



B





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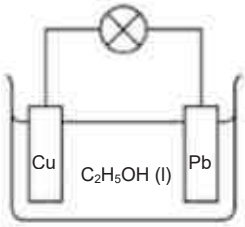
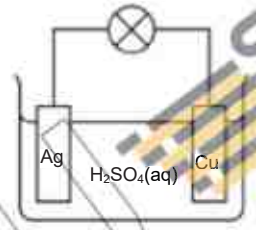


D



34 What are the main gases that escape from the top of the blast furnace in the manufacture of iron by the blast furnace?

A Nitrogen, steam and oxygen
B Oxygen, carbon dioxide and steam
C Nitrogen, carbon monoxide and carbon dioxide
D Carbon monoxide, carbon dioxide and nitrogen monoxide

35 A molten compound is electrolysed. Two atoms of X are deposited at the negative electrode at the same time as three atoms of Y are deposited at the positive electrode.

These results show that:

X is a …**1**…;
Y is a …**2**…;

the formula of the compound is …**3**… .

How are gaps **1**, **2** and **3** correctly completed?

	1	2	3
A	Metal	Non-metal	X_3Y_2
B	Metal	Non-metal	X_2Y_3
C	Non-metal	Metal	X_3Y_2
D	Non-metal	metal	X_2Y_3

36 Zinc reacts with acids to form salts. Which of the following solutions would give the slowest rate of reaction when reacted with zinc?

A 0.0500 mol sulfuric acid in 500 cm^3 of water.
B 0.0250 mol sulfuric acid in 100 cm^3 of water.
C 0.0500 mol hydrochloric acid in 200 cm^3 of water.
D 0.0250 mol hydrochloric acid in 75 cm^3 of water.

37 Which compound will react with steam, in the presence of catalyst, to produce the alcohol $CH_3CH_2CH_2OH$?

A CH_3CHCH_2 **B** $CH_3CHCHCH_3$
C $CH_3CH_2CH_2CH_3$ **D** CH_3CH_2COOH

38 Which type of reaction does this equation show?

$$C_3H_8 + F_2 \rightarrow C_3H_7F + HF$$

A Hydration
B Neutralisation
C Addition
D Substitution

39 An unsaturated hydrocarbon with six carbon atoms contains only three C=C double bonds. This hydrocarbon is reacted with excess bromine at a room temperature.

What is the formula of the resulting hydrocarbon?

A $C_6H_8Br_3$ **B** $C_6H_{10}Br_3$
C $C_6H_8Br_6$ **D** C_6H_{14}

40 A hydrocarbon is found to contain about 80% of carbon by mass. What is the hydrocarbon?

A Methane **B** Ethene
C Propane **D** Hexene

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
						1 H hydrogen 1											2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

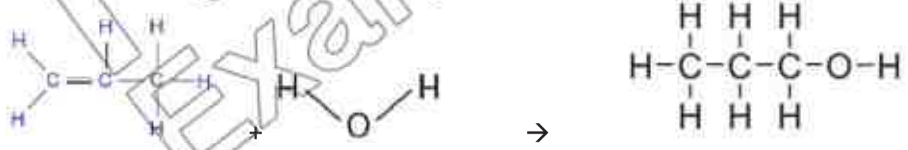
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Marking Scheme for Paper 2

Qn	Possible answers	Mark
A1 (a)	**(i)** B and F [1] **(ii)** D [1] **(iii)** It is a metalloid/shows properties of both metal and non metal. [1] (Provide one property of a metal and one of a non metal e.g. conducts electricity but low density, dull colour accepted) – [1]	**[4]**
A1 (b)	**Bonds broken** 4(C–H) + 4(F–F) = 4 × 412 + 4 × F–F - [1] **Bonds formed** 4(C–F) + 4(H–F) = 4 × 484 + 4 × 562 – [1] [Enthapy change = bond break – bond make] **–1904** = [4 × 412 + 4(F–F)] – [4 × 484 + 4 × 562] [1] 4(F–F) = –1904 – 4 × 412 + [4 × 484 + 4 × 562] = 632 F–F = 632 / 4 = **158 kJ/mol** , **The student is correct**. [1] because the F–F bond energy is much less than the C–H or other covalent bonds, therefore the F–F bond is weak / easily broken.	**[4]**

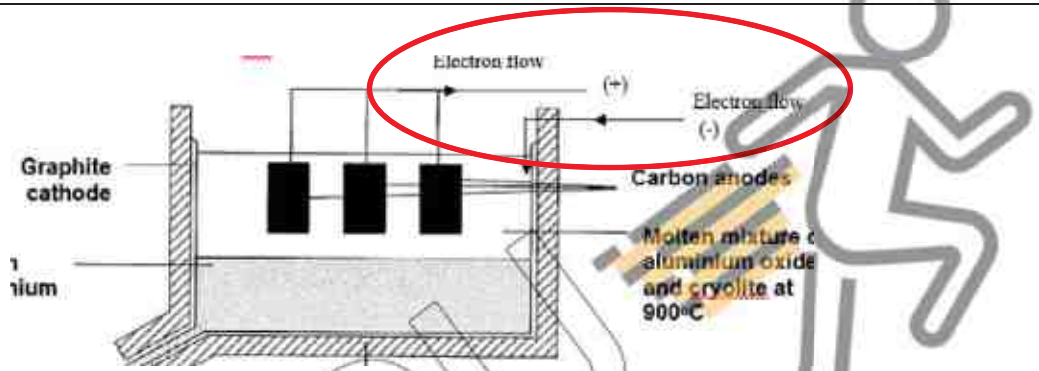
A1 (c)	**Chemical eqn** $2K (s) + 2H_2O (l) \rightarrow 2KOH (aq) + H_2 (g)$ **Ionic eqn** $2K (s) + 2H_2O (l) \rightarrow 2K^+ (aq) + 2OH^- (aq) + H_2 (g)$ [1]	**[1]**
A2 (a)	Hydrogen	**[1]**
(b)	Finely divided Iron. [1] It speeds up the reaction / increase the rate of reaction. [1]	**[2]**
(c)	It will be fed back into the reactor / recycled / returned to the reaction. [1] It helps to reduce the cost of the process / less waste of raw materials used. [1]	**[2]**
(d)	A higher temperature will give a lower yield [1] A higher pressure will give a higher yield [1]	**[2]**
(e)	**(i)** $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ Reversible arrow and state symbols are required.	**[1]**
	(ii) It is a redox reaction. The oxidation number of N decreases from 0 in N_2 to -3 in NH_3. Hence nitrogen gas has been reduced. [1] The oxidation number of H increases from 0 in H_2 to +1 in NH_3. Hence hydrogen gas has been oxidised. [1]	**[2]**
A3 (a)	Insoluble substance / precipitate formed [1] Hence, light cannot travel through / stops light / block light [1]	**[2]**
(b)	Precipitate formed is not dense enough / thick enough / does not block all light / settled to the bottom of the tube.	**[1]**

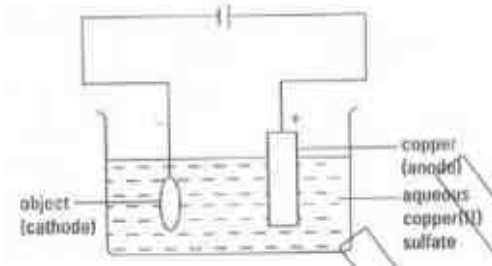
(c) (i)	A. It is the steepest graph, indicating fastest rate of reaction / finishes in the shortest time	**[1]**
(c) (ii)	Time = 42s Rate = 1/42 = 0.024 s^{-1} [1, with units] **NO FRACTIONS ALLOWED IN CALCULATION !**	**[1]**
(c) (iii)	As temperature increases, particles gain heat with more kinetic energy and will move faster at a higher temperature and collide more frequently. [1] More particles possess energy greater or equal than the activation energy. [1] Therefore, there is a higher frequency of effective collision, increasing the rate of reaction [1]	**[3]**
(d)	A more reactive metal will form a more stable metal carbonate [1] which takes a longer time to decompose to produce carbon dioxide gas [1] where white precipitate is formed in the limewater. **Note: Metal carbonate → Metal oxide + carbon dioxide gas**	**[2]**
A4 (a)	Mole of CO_2 = 1.79 / (12+16+16) = 0.04068 mol (leave to at least 4 sf in working) Mass of C = 0.04068 mol x 12 = **0.488 g (3sf)**	**[1]**
(b)	1.20 – 0.488 – 0.0812 = 0.631 g **[Ecf allow from part (a)]**	**[1]**

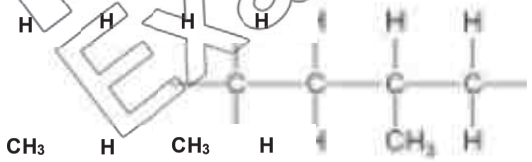
(c)	C : H : O 0.488/ 12 : 0.0812/1 : 0.6 31/16 - [1] 0.0407 : 0.0812 : 0.0394 1 : 2 : 1 Empirical formula is: **CH_2O** - [1] **[Ecf allowed from part (b) and part (a)]**	**[2]**
(d)	Since Empirical formula is: **CH_2O** **[Ecf allowed]** Mr of empirical formula is 30. For alcohol 1, 120 / 30 = 4 Hence, molecular formula will be $C_4H_8O_4$ [1] **Therefore, alcohol G is alcohol 1. – above proven.** For alcohol 2, not possible. OR Alcohol 1 has the simplest ratio that is the same as the empirical formula. [1]	**[1]**
(e)	Add aqueous bromine to alcohol 1, it decolouries OR turned from reddish brown to colourless. From alcohol 2, aq bromine remains reddish brown.	**[1]**
(f)		**[2]**

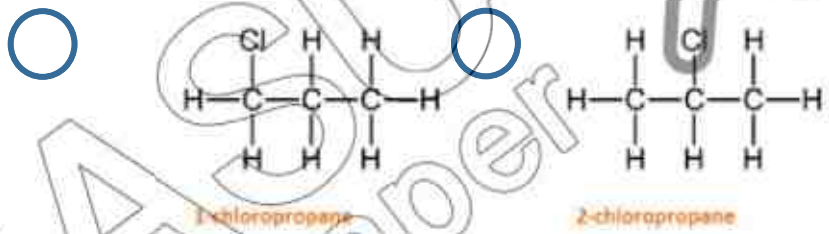
	1m – correct structure for propene and water 1m – correct structure for propanol **[accept –O-H group to be at second carbon atom]**	
A5 (a)	Moles of salicylic acid = 100 g/ 138 = 0.7246 mol [1] (working round off to 4sf) mass of aspirin = 0.7246 mol x 180 = 130.4 g = 130 g (3sf) [1]	**[2]**
A5 (b)(i)	250 / 400 * 100 = 62.5 % [1] - Reversible reaction / Some products are lost through other reactions / reactants are contaminated / contains impurities. [1]	**[2]**
A5 (b)(ii)	Catalyst provides an alternative pathway of lesser energy, hence less energy / temperature is required, reducing the cost of production.	**[1]**
A5 (c)	It is an endothermic reaction [1] It absorbs heat energy from the surroundings / temperature mixture as the ammonium nitrate dissolves. [1]	**[2]**
A6 (a)	It allows the **ions** to be mobile / move / act as mobile charge carriers.	**[1]**
(b)	$2Br^-$ (l) → $2e^-$ + Br_2 (g) (Happens at anode, hence oxidation happens)	**[1]**
(c)(i)	Lead (II) ions / Ions would gain electrons	**[1]**
(ii)	Increase [1] in mass / size / layer formed [1]	**[2]**

	OR Silvery [1] substance [1] R: Solid. Because it is molten state.	
(iii)	Lead <u>metal conducts electricity</u> [1]	**[1]**
B7 (a) (i)	Raw materials are renewable / Does not use crude oil	**[1]**
(a) (ii)	Alcohol <u>does not need to be distilled [1]</u> as <u>alcohol produced is pure</u> [1]	**[2]**
(b) (i)	The healthier oil is sunflower oil. [1] It has <u>less saturated fat</u> than olive oil and corn oil [1] / it has the <u>highest value of polyunsaturated fat</u> compared with all the other oils. [1] OR Rapeseed oil is healthiest [1] because it has the <u>lowest value of saturated</u> fat compared with the other oils. [1] / it has more polyunsaturated fat than both olive and corn oil [1]	**[2]**
(b) (ii)	No, hydrogen adds to the unsaturated fat and <u>reduces the number of carbon carbon</u> <u>double</u> bonds. [1] Hence there will be less polyunsaturated fat [1]	**[2]**
(b) (iii)	Heat of combustion decreases as the number of carbon atom increases. [1] More <u>bonds are broken</u> during the combustion of longer chain alkanes<u>, hence less energy is released</u>. [1]	**[2]**
(b) (iv)	Melting point increases as the number of carbon atoms increase.	**[1]**
B8 (a)	The mixture would have a lower melting point. [1] this allow the oxide to melt at a lower temperature and make the process more economical. [1] / Save money from electrical energy that is reduced. [1]	**[2]**
(b)	Anode: $2O^{2-}$ (l) → O_2 (g) + $4e^-$	**[2]**

	Cathode: Al^{3+} (l) + 3e- → Al (l)	
(c)		**[1]**
(d)	The overall equation is $2Al_2O_3$ → $4Al + 3O_2$ No. of moles of Al = 540 / 27 = 20 mol No. of moles of oxygen produced = 20 / 4 x 3 = **15 mol [1]** Volume of oxygen produced = 15 x 24 dm^3 = **360 dm^3 [1]**	**[2]**
(e)	The presence of oxygen gas reacts with the carbon anode to form oxides of carbon [1]. Or Oxidises the carbon electrode and reduce the mass. [1]	**[1]**

(f)	 **1m – correct terminals and label of anode and cathode** **1m – correct label of materials** **(Copper and copper sulfate solution)**	**[2]**
Either **B9 (a) (i)**	Larger surface area [1] for collision to occur, hence higher rate of reaction [1].	**[2]**
(a) (ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$	**[1]**
(b) (i)	[1] heat produced by carbon/ coke (burning in) oxygen/ air; [1] $C + O_2 \rightarrow CO_2$ produces heat/ exothermic; OR $2C + O_2 \rightarrow 2CO$ produces heat/ exothermic [1] $ZnO + CO \rightarrow Zn + CO_2$; OR	**[3]**

	$ZnO + C \rightarrow Zn + CO$; OR $2ZnO + C \rightarrow 2Zn + CO_2$	
(b) (ii)	Temperature (inside the furnace) is above 907 °C OR Temperature (inside the furnace) is above the boiling point (of zinc) OR 1000°C is above the boiling point (of zinc)	**[1]**
(b) (iii)	Condensation	**[1]**
(c)	Zinc is more reactive than iron / Zinc is higher in the reactivity series than iron / Zinc reacts more readily with oxygen than iron. [1] Zinc loses electrons more easily and it is able to react with the air and water [1]	**[2]**
OR **B9 (a)**	Fractional distillation [1] and cracking [1]	**[2]**
(b) (i)	Addition polymerization **[R: Additional polymerization]**	**[1]**
(ii)	CH_2	**[1]**
(iii)		**[2]**

	[1] chain of 4 carbon atoms with single bonds and continuation bonds; [1] correctly positioned CH_3 side chains;	
(c)	**any 2 from** - similiar chemical properties - same functional group - trend each consecutive member differ by CH_2	**[2]**
(d)	 Cl either at first or second carbon atom.	**[2]**

Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

Mid Year Examination 2018

4E **4E**

CHEMISTRY **6092/1**

Paper 1 9 May 2018

1 hour

Candidates answer on the Multiple Choice Answer Sheet provided.
Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you have done.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

For Examiner's Use	
Paper 1	

This document consists of **15** printed pages including the cover page.

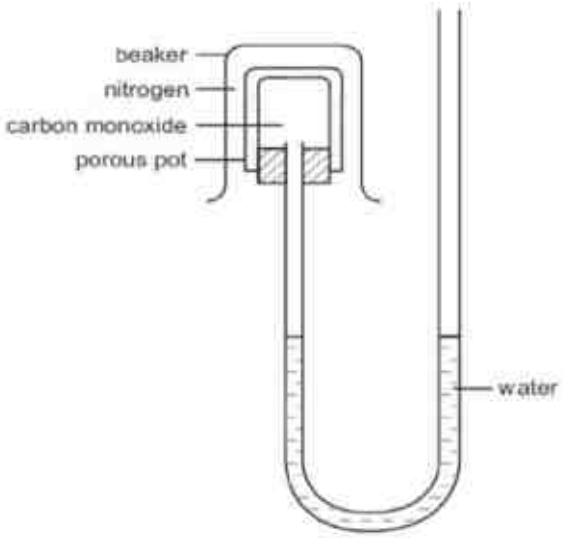
[Turn Over

Setter: Ms Tok Peilin

1 When iodine crystals were heated in a test tube, the iodine sublimed. How did the movement of the iodine particles change?

A particles slide over one another → particles move freely
B particles slide over one another → particles vibrate about fixed positions
C particles vibrate about fixed positions → particles move freely
D particles vibrate about fixed positions → particles slide over one another

2 A beaker of nitrogen is inverted over a porous pot containing carbon monoxide as shown.



The water level does **not** change.

Which statement is correct?

A Both gases are diatomic.
B Nitrogen is an unreactive gas.
C The gas particles are too large to pass through the porous pot.
D The two gases have the same relative molecular mass.

3 In which of the following do both gases change the colour of damp red litmus paper?

A ammonia and chlorine
B ammonia and sulfur dioxide
C carbon dioxide and chlorine
D carbon dioxide and sulfur dioxide

4 A solid can be purified by crystallisation from its aqueous solution.

Which of the following properties does the solid have?

A It dissolves in cold water, but not in hot water.
B It is equally soluble in hot and cold water.
C It is more soluble in hot water than in cold water.
D It is very soluble in cold water.

5 The table shows some information about the solubilities of three solids.

solid	solubility in water	solubility in propanol
P	insoluble	soluble
Q	soluble	insoluble
R	insoluble	insoluble

The following operations could be carried out to obtain pure P from a mixture of P, Q and R.

1 evaporate filtrate to dryness
2 add propanol
3 filter
4 add water
5 collect residue

In what order should the operations be carried out?

A 2, 3, 4, 5, 1
B 2, 3, 5 only
C 4, 1, 2, 3 only
D 2, 3, 1 only

6 An element E forms a negative ion, E^{2-}, with the electronic structure 2,8,8.
What is the proton number of E?

A 16
B 17
C 18
D 20

7 Which statements correctly describes the properties of mixtures of iron and sulfur, and the compound iron(II) sulfide, FeS?

	mixtures of iron and sulfur	compound iron(II) sulfide
1	iron and sulfur mix without chemically reacting	iron and sulfur combine in a chemical reaction to form iron(II) sulfide
2	the ratio of iron to sulfur in mixture can vary	the ratio of iron to sulfur in iron(II) sulfide is always the same
3	the mixtures do not have the properties of iron or sulfur	iron(II) sulfide has the properties of iron and sulfur

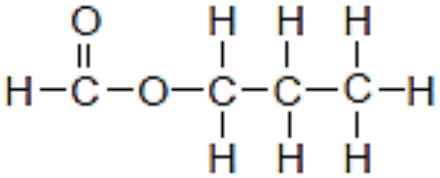
A 1 only
B 1 and 2
C 2 and 3
D 3 only

8 Deuterium (chemical symbol D) is an isotope of hydrogen. An atom of deuterium contains one neutron.

Which of the following statements is **not** true?

A An atom of deuterium is heavier than an atom of hydrogen.
B An atom of deuterium has a relative atomic mass of 1.
C An atom of deuterium has one valence electron.
D The formula of the compound formed between deuterium and oxygen is D_2O.

9 The diagram shows the structural formula of propyl methanoate.



What is the total number of electrons that are **not** involved in chemical bonding in the molecule?

A 8
B 14
C 20
D 28

10 The table shows four elements W, X, Y and Z with their atomic numbers.

element	W	X	Y	Z
atomic number	6	8	11	17

What are the likely formulae of ionic compound and covalent compound formed from the four elements?

	formula of ionic compound	formula of covalent compound
A	W X	YZ
B	Y_2X	WX_2
C	YW	WZ_4
D	YZ	ZX

11 Which particles are responsible for the conduction of electricity through metals?

A electrons only
B electrons and positive ions
C negative ions only
D negative ions and positive ions

12 The table shows some of the physical properties of P, Q, R and S.

substance	melting point / °C	boiling point / °C	electrical conductivity		solubility in water
			solid	liquid	
P	122	550	poor	poor	insoluble
Q	690	1790	poor	good	soluble
R	1510	2489	poor	poor	insoluble
S	1453	2730	good	good	insoluble

Which of the following statements about the four substances is correct?

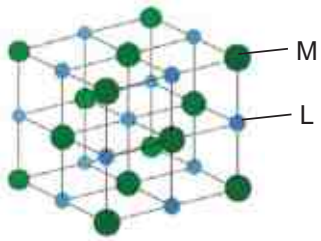
A P is a simple molecular compound held by weak covalent bonds.
B Q is an ionic compound with mobile electrons in the liquid state.
C R is a macromolecule held by strong electrostatic forces of attraction between ions.
D S has a giant lattice structure with mobile electrons.

13 The melting points of magnesium oxide and calcium oxide are given below.

metal oxide	melting point/ °C
magnesium oxide	2852
calcium oxide	2572

A The charge of the calcium ion is higher than that of the magnesium ion.
B The charge of the magnesium ion is higher than that of the calcium ion.
C The radius of the calcium ion is smaller than that of the magnesium ion.
D The radius of the magnesium ion is smaller than that of the calcium ion.

14 Element L and M form a compound which has a structure shown below.



Based on the structure shown above, deduce the chemical formula of the compound formed between element L and M.

A LM
B L_2M
C LM_2
D $L_{14}M_{13}$

15 When sugar, $C_{12}H_{22}O_{11}$, (M_r = 342) is fermented using yeast, the following reaction takes place.

$$C_{12}H_{22}O_{11}(s) + H_2O(l) \rightarrow 4C_2H_5OH(aq) + 4CO_2(g)$$

1kg of sugar is completely fermented.

Which expression shows the volume of carbon dioxide produced?

A $\frac{342 \times 4 \times 24}{1000}$ dm^3

B $\frac{1000 \times 24}{342 \times 4}$ dm^3

C $\frac{342 \times 24}{1000 \times 4}$ dm^3

D $\frac{1000 \times 4 \times 24}{342}$ dm^3

16 A sample of nitrogen gas contains the same number of atoms as found in 4.00 g of methane gas.

What is the mass of the sample of nitrogen gas?

A 7.00 g
B 14.0 g
C 17.5 g
D 35.0 g

17 In an experiment carried out at room conditions, 1.0 dm^3 of carbon dioxide was collected when an excess of dilute hydrochloric acid was added to 5.0 g of calcium carbonate.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

What is the percentage yield of carbon dioxide gas?

A 4.16%
B 12.0%
C 41.6%
D 83.3%

18 What is the total volume of gas, measured at room temperature and pressure, that remains if 20 cm^3 of sulfur dioxide reacts with 20 cm^3 of oxygen to form sulfur trioxide?

$$2SO_2\ (g)\ +\ O_2\ (g)\ \rightarrow\ 2SO_3\ (g)$$

A 10 cm^3
B 20 cm^3
C 30 cm^3
D 60 cm^3

19 An excess sample of an alloy, containing two metals, was dissolved in dilute sulfuric acid. Aqueous sodium hydroxide was then added to the solution. A precipitate was formed. An excess of the alkali caused the mass of the precipitate to decrease leaving a dirty green solid and a colourless solution.

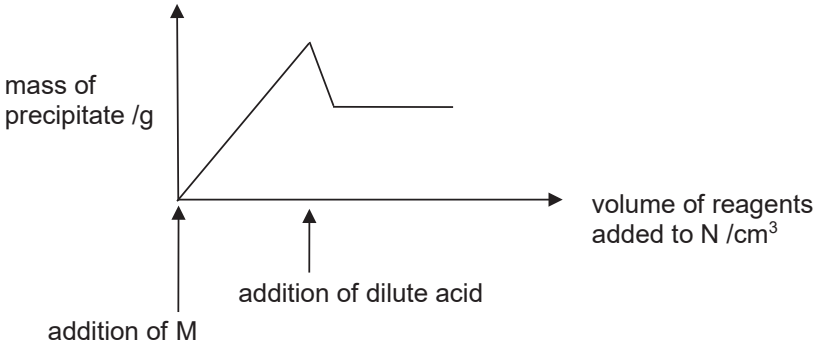
What were the two metals present in the alloy?

A calcium and zinc
B copper and iron
C copper and lead
D iron and zinc

20 Which equation shows the most suitable reaction for the production of lead(II) sulfate in the school laboratory with good yield?

A $Pb + H_2SO_4 \rightarrow PbSO_4$
B $Pb(OH)_2 + H_2SO_4 \rightarrow PbSO_4 + 2H_2O$
C $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$
D $PbCO_3 + H_2SO_4 \rightarrow PbSO_4 + CO_2 + H_2O$

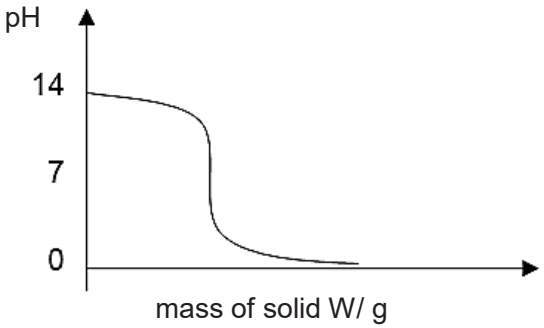
21 In a qualitative analysis, reagent M is gradually added to a salt solution N followed by the addition of a dilute acid. The graph below shows how the mass of the precipitate formed changes with the reagents added.



Which of the following set of anions would produce the given results?

	reagents (M and acid) added	anion(s) in N
A	add silver nitrate, followed by dilute nitric acid	Cl^-, CO_3^{2-}
B	add silver nitrate, followed by dilute nitric acid	I^-
C	add aqueous barium nitrate, followed by dilute hydrochloric acid	Cl^-, CO_3^{2-}
D	add aqueous barium nitrate, followed by dilute hydrochloric acid	CO_3^{2-}

22 Solid W is gradually added to solution X. The changes in pH are shown on the graph.



What are W and X?

	solution X	solid W
A	nitric acid	insoluble metal oxide
B	hydrochloric acid	soluble metal oxide
C	aqueous ammonia	soluble non-metal oxide
D	sodium hydroxide	soluble non-metal oxide

23 In which of the reactions is the underlined substance acting as a reducing agent?

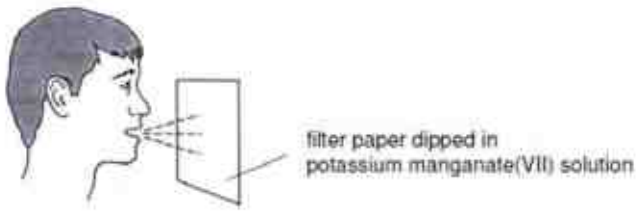
A $\underline{Cl_2} + 2FeCl_2 \rightarrow 2FeCl_3$
B $2HCl + \underline{MgO} \rightarrow MgCl_2 + H_2O$
C $H_2 + \underline{CuO} \rightarrow Cu + H_2O$
D $ZnO + \underline{CO} \rightarrow Zn + CO_2$

24 Disproportionation is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

A $Cl_2 + H_2O \rightarrow HClO + HCl$
B $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
C $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$
D $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

25 Acidified potassium manganate(VII) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.



A colour change of the filter paper is observed.

Which of the following conclusion about ethanol is observed?

A It is a reducing agent because it reduces the oxidation state of the manganese.
B It is an alkali because the final colour is purple.
C It is an oxidising agent because the manganese atoms gain oxygen atoms.
D It is neutralised by acidified potassium manganate(VII) solution.

26 Which of the following substances could be used to reduce atmospheric pollution caused by flue gases?

A ammonium carbonate and ammonium sulfate
B ammonium sulfate and calcium carbonate
C calcium carbonate and calcium oxide
D calcium oxide and ammonium sulfate

27 The equation for a particular reaction is shown below.

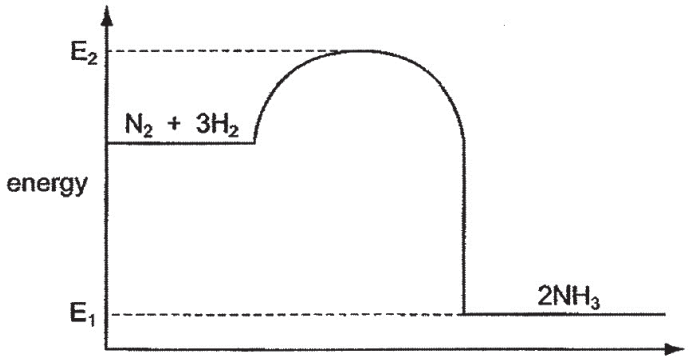
$$2AgI + light \rightarrow 2Ag + I_2$$

Why is this an endothermic reaction?

A Energy is required to vaporise iodine.
B It involves the formation of covalent I – I bonds.
C It involves the transfer of electrons from iodide ions to silver ions.
D Light energy is absorbed when the reaction takes place.

28 The energy profile diagram is that for the Haber process.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H = -92\,kJ$



What does the energy change $E_2 - E_1$ represent?

A activation energy of the forward reaction
B activation energy of the reverse reaction
C enthalpy change of the forward reaction
D enthalpy change of the reverse reaction

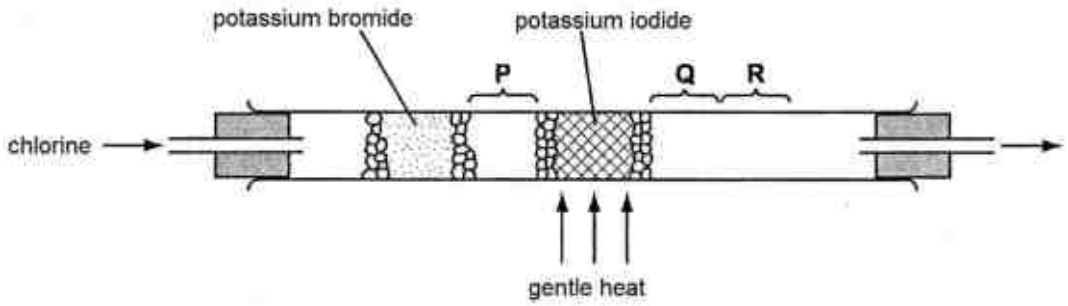
29 Caesium is an element in the same group of the Periodic Table as lithium, sodium and potassium.

Which statements about caesium are likely to be **false**?

I It reacts explosively with cold water.
II It forms a soluble carbonate salt.
III It forms a carbonate with a formula of $CsCO_3$.
IV It can be extracted via electrolysis of concentrated aqueous CsCl.

A I and II
B I and III
C II and III
D III and IV

30 Using the apparatus shown, chlorine is passed through the tube. After a short time, coloured substances are seen at **P**, **Q** and **R**.



What are these coloured substances?

	P	Q	R
A	reddish-brown vapour	violet vapour	black solid
B	reddish-brown vapour	reddish-brown vapour	reddish-brown vapour
C	green gas	violet vapour	black solid
D	green gas	reddish-brown vapour	reddish-brown liquid

31 The table below gives some information about element Y.

density / g/cm^3	6.2
melting point / °C	1280
formulae of oxides	YO (white) Y_2O_3 (brown)
chemical properties	reacts readily with O_2 or Cl_2

Which of the following statements about element Y is likely to be correct?

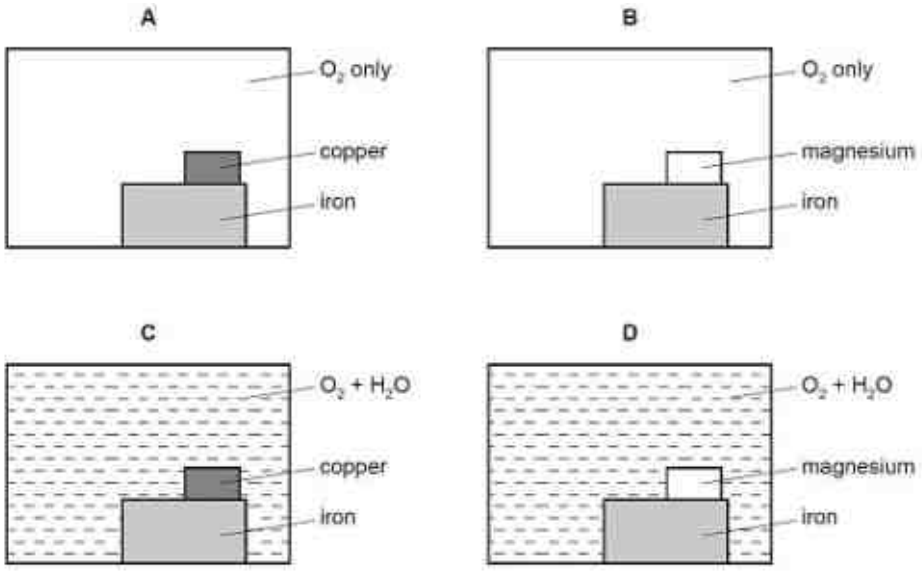
A It is a metal in Group III.
B It is a transition metal.
C It is an alkali metal.
D It forms oxides that are amphoteric in nature.

32 A new element, Hb, placed in Group VII of the Periodic Table, has a higher relative atomic mass than astatine.

Which statement about element Hb is **not** correct?

A Hb atom gains electrons less readily than a chlorine atom.
B Hb displaces astatine out from aqueous potassium astatide.
C Hb has a higher boiling point than bromine.
D Hb is a less powerful oxidizing agent than iodine.

33 Which diagram correctly shows the conditions necessary for rusting of iron and also the metal that can be used to prevent rusting by sacrificial protection?

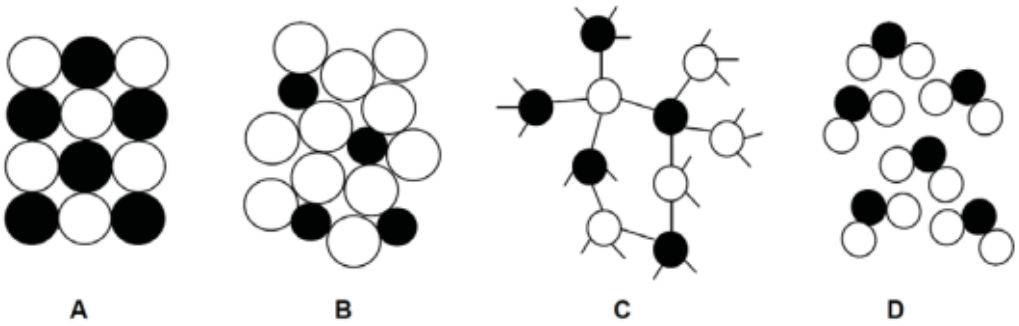


34 Scrap iron is often recycled.

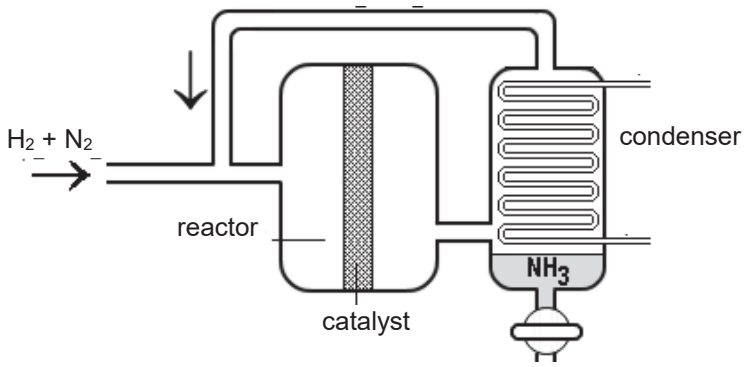
Which reason for recycling is **not** correct?

A It reduces the amount of pollution at the site of the ore extraction.
B It reduces the amount of waste taken to landfill sites.
C It reduces the need to collect the scrap iron.
D It saves natural resources.

35 Which diagram below shows the structure of an alloy?



36 Ammonia is produced by Haber process as shown in the diagram.



Which one of the following processes separates ammonia from the reaction mixture?

A cooling the gaseous mixture
B distillation of the gaseous mixture
C filtering out the other two gases
D passing the gaseous mixture through fused calcium oxide

37 Which solution(s) would produce hydrogen gas at the cathode upon electrolysis?

1 dilute nitric acid
2 aqueous potassium hydroxide
3 aqueous sodium chloride

A 1 only
B 1 and 2
C 2 and 3
D all of the above

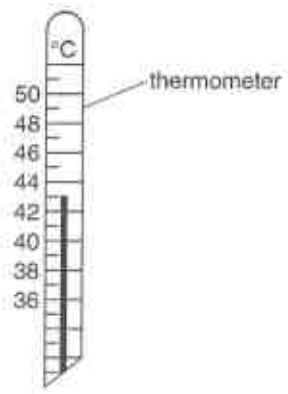
38 The table shows the energy released by complete combustion of some compounds used as fuels.

compound	M_r	ΔH (kJ/mol)
methane	16	-880
ethanol	46	-1380
propane	44	-2200
heptane	100	-4800

Which fuel produces the least energy when 1 g of the compound is completely burned?

A methane
B ethanol
C propane
D heptane

39 A thermometer is placed in warm water and the temperature is measured as shown.



When a solid is dissolved in the water, an exothermic change takes place. The temperature changes by 5°C.

What is the final temperature?

A 38.0 °C
B 38.5 °C
C 48.0 °C
D 48.5 °C

40 In which reaction is the pressure **not** likely to affect the rate of reaction?

A $3H_2$ (g) + N_2 (g) → $2NH_3$ (g)
B CuO (s) + H_2 (g) → Cu (s) + H_2O (l)
C Fe_2O_3 (s) + 3CO (g) → 2Fe (s) + $3CO_2$ (g)
D H_2SO_4 (aq) + 2NaOH (aq) → Na_2SO_4 (aq) + $2H_2O$ (l)

End of Paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number / atomic symbol / name / relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lantharum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

Name	Index Number	Class

HUA YI SECONDARY SCHOOL

Mid Year Examination 2018

4E **4E**

CHEMISTRY **6092/2**

Paper 2 7 May 2018

1 hr 45 min

Candidates answer on the Question Paper.
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 21.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **21** printed pages including the cover page.

[Turn Over

Setter: Ms Tok Peilin

Section A

Answer **all** the questions in this section in the spaces provided.
The total mark for this section is **50**.

A1 The following compounds are used in manufacturing chemicals for agriculture.

A	K_3PO_4
B	H_2SO_4
C	NH_3
D	$Ca(OH)_2$
E	NH_4NO_3

Use the letters **A**, **B**, **C**, **D** and **E** to answer the following questions.

(a) Which solid compound is added to increase the pH of soil?

…….. [1]

(b) Two raw materials are used to make a compound.

- One of the raw materials is made by cracking petroleum.
- The other raw material is obtained by fractional distillation of air.

Which compound is manufactured from these two raw materials?

…….. [1]

(c) Which **two** compounds can be reacted together to form an ammonium salt?

……and……..…….. [1]

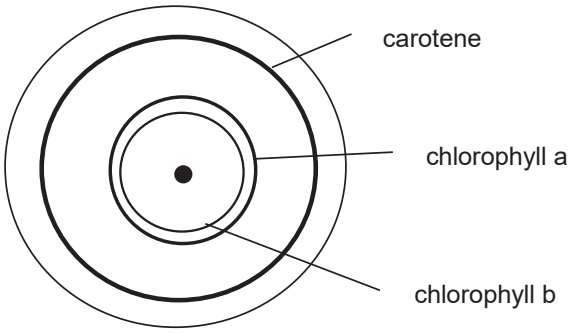
(d) NPK fertilisers are solid fertilisers that contain compounds of nitrogen, phosphorus and potassium.

Which **two** compounds could be mixed to produce an NPK fertiliser?

……and……..…….. [1]

[Total: 4]

A2 Spinach is an edible plant that has a deep green colour. The following chromatogram is obtained when water-acetone mixture is added to a drop of spinach extract in the centre of a piece of filter paper.

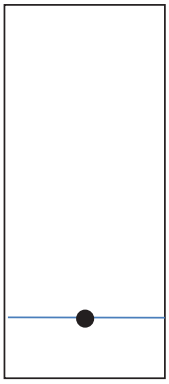


(a) State the property which allows the components of the spinach extract to be separated using chromatography.

……..

…….. [1]

(b) The experiment was repeated using a typical chromatography paper as shown below.



Draw and label the expected positions of the components of spinach extract on the chromatogram. [2]

(c) State one experimental procedure that should be followed to obtain a good **separation** of the components.

……..

…….. [1]

(d) Suggest why a water-acetone mixture is used as the solvent, instead of just a pure water or pure acetone solvent.

……..

…….. [1]

[Total: 5]

A3 One of the ways to reduce air pollution is to curb the number of vehicles on the road.

(a) Name **two** air pollutants produced by motor vehicles.

……... [2]

(b) Catalytic converters are fitted in cars to reduce the amount of air pollutants emitted by motor vehicles. In the catalytic converter, nitrogen monoxide and carbon monoxide react together to form harmless products.

(i) Write a chemical equation to show how air pollutants are removed by catalytic converters.

…… [1]

(ii) Explain why catalytic converters do **not** solve all the environmental problems caused by motor vehicles.

……

……...

…… [2]

[Total: 5]

A4 The reaction below is an example of a redox reaction.

…….I^-(aq) + …….H^+(aq) + …….H_2O_2(aq) → …….I_2(aq) + ……H_2O(l)

(a) Balance the equation by inserting numbers (if necessary) on the dotted lines provided. [1]

(b) Identify the oxidising agent in this reaction. Explain your answer using oxidation states.

……..

……..

……... [2]

(c) What colour change will be seen when this reaction is carried out?

……..…..

……..….. [1]

[Total: 4]

A5 The table shows some data about the different components of air.

components	melting point / °C	boiling point / °C
argon	– 189	– 186
carbon dioxide	– 78	– 78
krypton	– 157	– 153
neon	– 249	– 246
nitrogen	– 210	– 196
oxygen	– 219	– 183
water vapour	0	100

(a) State the percentage by volume of nitrogen and oxygen in air.

nitrogen…… oxygen…… [2]

(b) Air is a source of nitrogen, oxygen and the noble gases. These are obtained by the fractional distillation of liquid air. Before air is liquefied, carbon dioxide and water are removed.

(i) Suggest why air is dried before it is liquefied.

……

……..….. [1]

(ii) At – 200 °C, liquid air is fractionally distilled by allowing it to warm up gradually. List the order of the fractions (elements) obtained, starting from the first fraction

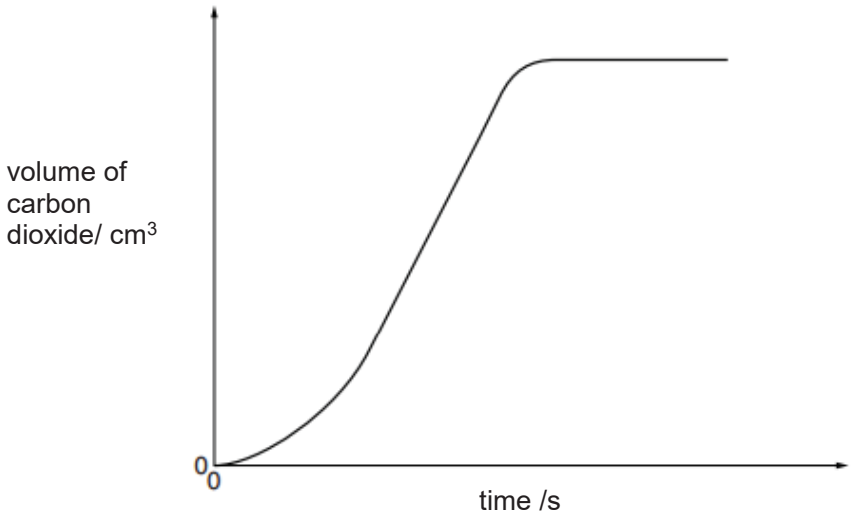
……

……..….. [1]

[Total: 4]

A6 In **Experiment I**, a sample of magnesium carbonate is heated in a test-tube using a hot plate at 300 °C. The total volume of carbon dioxide formed is measured every 10 seconds.

The graph shows his results.



(a) Suggest why there is **no significant** increase in the volume of carbon dioxide when magnesium carbonate is first heated.

……

…… [1]

(b) In **Experiment II**, the same mass of magnesium carbonate is heated in a test-tube using a hot plate at a **higher temperature** of 500 °C.

Sketch a curve on the graph above to show the results for this experiment.

Explain your answer.

……

……

……

…… [3]

(c) Ron wishes to investigate how the thermal stability of metal carbonates is related to the position of their metal in the reactivity series.

To ensure a fair experiment, he repeated **Experiment I** using different metal carbonates, while keeping all other variables constant.

The table below shows the results of the experiment after the first 60 seconds.

metal carbonate	total volume of gas collected/ cm^3
$\mathbf{X}_2CO_3$	0
$\mathbf{Y}CO_3$	0
$CaCO_3$	2
$FeCO_3$	7
$ZnCO_3$	5

(i) Write a balanced equation, with state symbols, for the thermal decomposition of $FeCO_3$.

……..…. [2]

(ii) Explain why $\mathbf{X}_2CO_3$ and $\mathbf{Y}CO_3$ do **not** decompose.

……..….

……..….

……..…. [2]

(iii) A solution containing 0.002 mol of sulfuric acid is titrated with a solution containing 9.2 g/dm^3 of $\mathbf{X}_2CO_3$. The volume of $\mathbf{X}_2CO_3$ solution needed to exactly neutralise the acid is 23.2 cm^3.

1 mole of sulfuric acid reacts with 1 mole of $\mathbf{X}_2CO_3$.

Calculate the relative atomic mass, *A*r, of **X** and suggest its identity.

A_r of **X** = ...
identity of **X** ..... [3]

[Total:11]

A7 The reaction between magnesium and steam is an exothermic reaction.

(a) Write a balanced equation, with state symbols, to represent the reaction between magnesium and steam.

…… [2]

(b) The energy output of the reaction between magnesium and steam can be shown using an energy profile diagram.

Draw an energy profile diagram for the reaction.

Your diagram should include names of the reactants and products, labels for the reaction enthalpy change and activation energy.

[3]

(c) Explain, using ideas about bond breaking and bond making, why the overall reaction is exothermic.

……

……

…… [2]

[Total: 7]

A8 Molten lead(II) bromide was electrolysed using carbon electrodes.

(a) **(i)** Write the ionic equation for the reaction at the cathode.

……..... [1]

(ii) Write the ionic equation for the reaction at the anode.

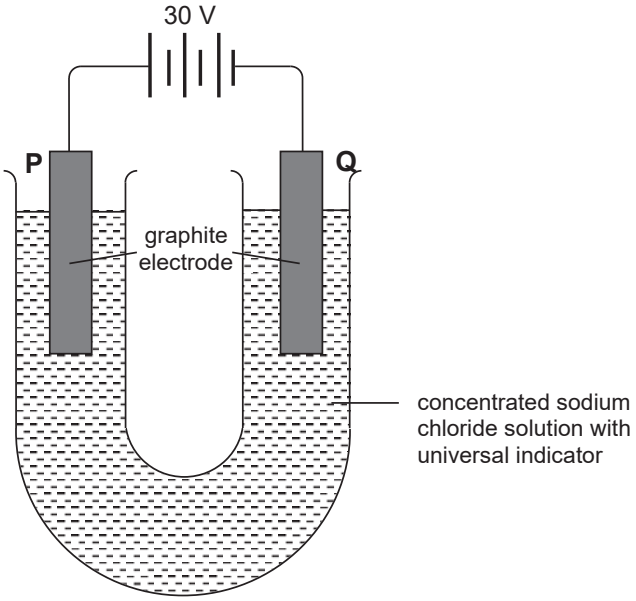
……..... [1]

(iii) State the observation at the cathode during the electrolysis.

……..…

……..... [1]

(b) The setup shows the electrolysis of concentrated sodium chloride solution.



(i) Describe the observations at the electrodes of **P** and **Q**.

Electrode **P**: ……..

……..…

……..…

Electrode **Q**: ……..

……..…

……..... [4]

(ii) How does the pH of the electrolyte change as the electrolysis proceeds? Explain your answer.

……

……

…… [2]

(iii) Suggest why iron is **not** suitable to be used as an electrode for this experiment.

……

…… [1]

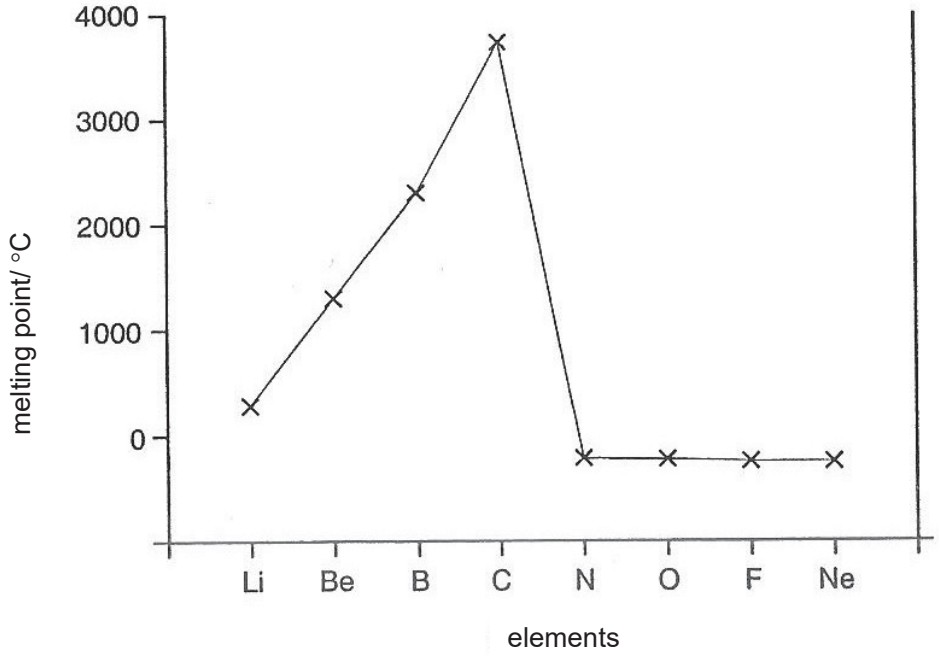
[Total:10]

Section B

Answer all **three** questions in this section.

The last question is in the form of an either/or and only one of the alternatives should be attempted.

B9 This information is about the elements in **Period 2** of the Periodic Table.



element	electrical conductivity (at room temperature and pressure)
Li	good
Be	good
B	poor
C	good
N	does not conduct
O	does not conduct
F	does not conduct
Ne	does not conduct

12

(a) **(i)** Use the information to describe the trends in melting point and electrical conductivity across Period 2.

……

……

…… [2]

(ii) How does the data show that the first four elements in Period 2 are solids at room temperature and pressure?

……

…… [1]

(b) **(i)** Does the electrical conductivity of carbon fit the general pattern across the period? Justify your answer.

……

……

……

…… [2]

(ii) There are two forms of carbon: diamond and graphite.

Which form of carbon does the data refer to?
Explain your answer with reference to the structure of the substance you have chosen.

……

……

……

…… [2]

(c) Draw a sketch graph to show how atomic number changes across the period.

[1]

(d) An element in **Period 3** has the following properties.

melting point/ °C	98
conductivity	good

Use the information given in the question to suggest the element that this data is most likely to refer to.

Explain your answer.

……

……

…… [2]

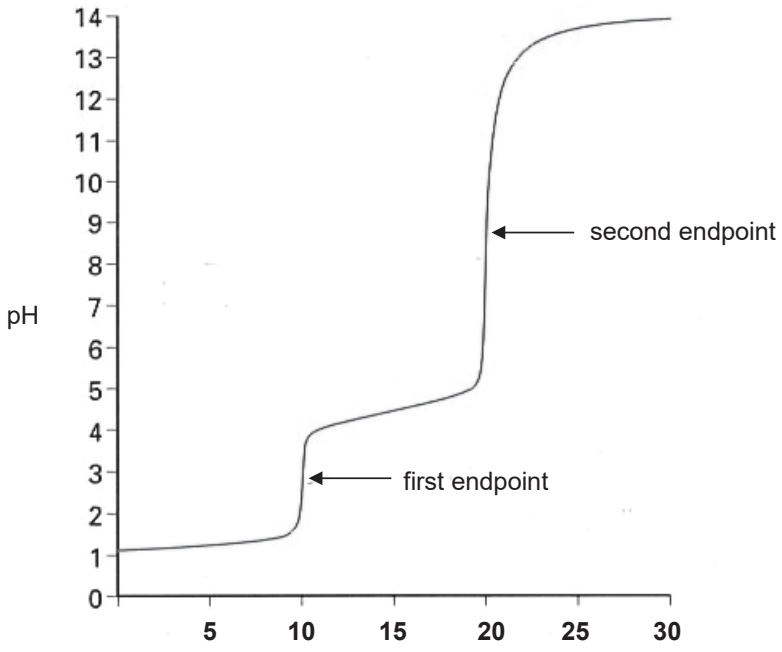
[Total: 10]

B10 Different experiments were set up to investigate the reactions of sulfuric acid.

25.0 cm^3 of 0.10 mol/dm^3 sulfuric acid was transferred to a conical flask and sodium hydroxide was added from a burette.

After each addition of sodium hydroxide, the pH of the solution was recorded using a pH probe attached to a data logger.

The display from the data logger shows the results below. The pH curve has two endpoints, which resulted because H_2SO_4 undergoes two stages of ionisation in water to produce hydrogen sulfate ions, and sulfate ions respectively.



(a) (i) Sulfuric acid ionises in water in two stages. In stage I, it ionises to produce HSO_4^- ions.

$$H_2SO_4\,(aq) \rightarrow HSO_4^-\,(aq) + H^+\,(aq)$$

Write an equation to show the second stage of ionisation of HSO_4^- in water.

…… [1]

(ii) State the chemical formula and name of the salt formed at the first endpoint.

chemical formula ……

chemical name ……..... [2]

(iii) H_2SO_4 is completely neutralised when the second endpoint is reached.

Use the information from the pH curve to calculate the concentration of sodium hydroxide used in the experiment.

[3]

(b) Describe how you would show that iron(II) sulfate rather than iron(III) sulfate is formed when iron is dissolved in dilute sulfuric acid.

……

……

…… [2]

(c) In an experiment, hydrated iron(II) sulfate was gently heated to constant mass, leaving behind anhydrous iron(II) sulfate.

The following table shows the results obtained.

mass of hydrated salt at the start	27.8 g
mass of anhydrous salt at the end	15.2 g

Use the results to work out the empirical formula of the hydrated iron(II) sulfate used in this experiment.

[2]

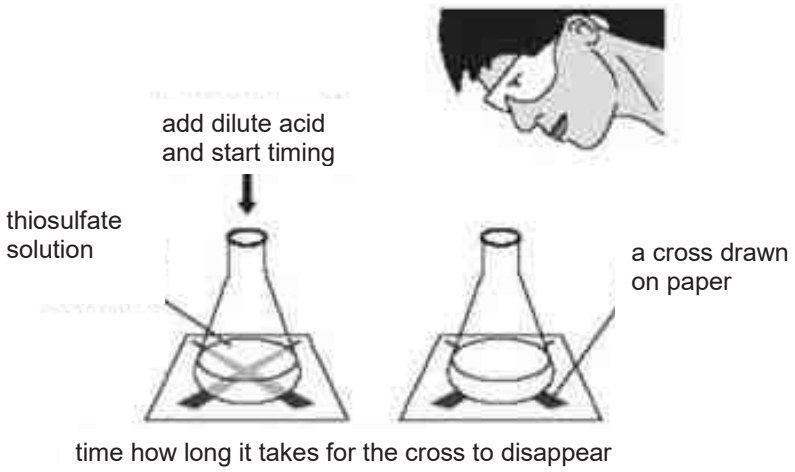
[Total: 10]

Either

B11 Aqueous sodium thiosulfate, $Na_2S_2O_3$, reacts with dilute hydrochloric acid. The reaction was used in an experiment to determine the effects of varying concentration and temperature on the speed of the reaction.

The equation for the reaction is:

$$Na_2S_2O_3\,(aq) + 2HCl\,(aq) \rightarrow 2NaCl\,(aq) + S\,(s) + SO_2\,(g) + H_2O\,(l)$$



A cloudy suspension of sulfur forms and covers the cross (X) slowly. When the cross completely disappears from top view, the time taken is recorded.

The table below shows the results obtained in different experiments using 10 cm^3 of acid and 10 cm^3 of 1 mol/dm^3 aqueous sodium thiosulfate.

experiment	concentration of acid / mol/dm^3	temperature / °C	time taken / s	1/time / s^{-1}
A	0.15	20	65	
B	0.10	30	45	
C	0.10	20	85	
D	0.05	30	55	
E	0.05	20	105	

(a) **(i)** Complete the table by calculating the values of 1/time for each experiment. Leave your answers to 3 significant figures. [1]

(ii) Explain the significance of 1/ time.

……

……

…… [2]

(b) Which of the experiments (**A** to **E**) are suitable to be used to show the effect of concentration on the speed of the reaction? Explain your answer.

……

……

…… [2]

(c) Explain, using the collision theory, the effect of concentration on the speed of the reaction.

……

……

……

…… [2]

(d) In trying to explain the effect of temperature on the speed of the reaction, a student said, "The higher the temperature, the faster is the speed of the reaction. This is because at a higher temperature, the activation energy of the reaction is lowered. Thus, more effective collisions can occur."

Is the student correct? Justify your answer.

……

……

……

……

…… [3]

[Total: 10]

OR

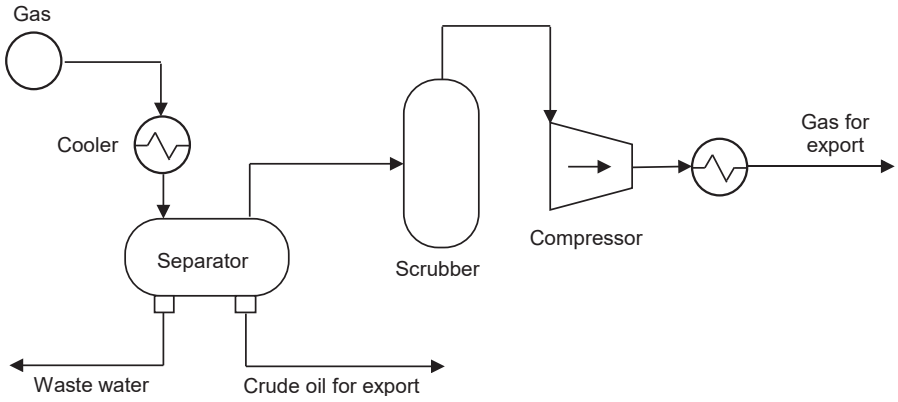
B11 Natural gas is a mixture of hydrocarbon compounds formed from the remains of dead plants and animals over a long period of time. It is often found together with other fossil fuels such as crude oil.

An example of components of natural gas is shown in the table.

name	**formula**	**percentage composition / %**	**boiling point / °C**	**liquid density / g/cm^3**
methane	CH_4	70	- 162	0.423
ethane	C_2H_6	10	- 89	0.546
propane	C_3H_8	10	- 42	0.493
others (carbon dioxide, hydrogen sulfide, etc.)	-	10	-	-

Adapted from: www.naturalgas.org

Natural gas that is extracted from the ground must be purified before it can be used. A simplified diagram showing the process of purification is given in the diagram below. The first step is to cool the mixture and remove water and other dense components like crude oil. The raw gas is then sent to a series of scrubbers, compressors and coolers. Finally, the gas is either compressed or liquefied, and then exported.



Compressed natural gas (CNG) is compressed to 200 to 250 times atmospheric pressure, such that it occupies about 1% of the volume it would otherwise have occupied, and stored in high-pressure tanks. Liquefied natural gas (LNG) is cooled to about -170°C, where it occupies about 1/600th of the volume it would otherwise have occupied, and stored in special insulated tanks.

(a) **(i)** What is the main component of natural gas?

…… [1]

(ii) Draw a dot and cross diagram to show the bonding of one molecule of the main component of natural gas stated in **(a) (i).**
You only need to show the outer shell electrons.

[2]

(iii) Explain, using ideas about bonding and structure, why natural gas is volatile.

……

……

……

……

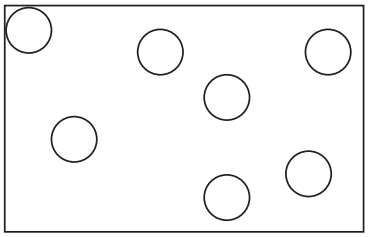
……

…… [2]

(b) Name a piece of apparatus found in the school laboratory which functions on the similar principle as the separator shown in the diagram.

…… [1]

(c) **(i)** The diagram shows the arrangement of particles in natural gas at room temperature and pressure. Draw similar diagrams to show the arrangement of the same number of particles in liquefied natural gas (LNG) and compressed natural gas (CNG).



LNG **CNG**

[2]

(ii) Using the information given, suggest **one** advantage of using liquefied natural gas (LNG) over compressed natural gas (CNG).

……

……

……

……

……

…… [2]

[Total: 10]

End of Paper

The Periodic Table of Elements

Group

I	II											III	IV	V	VI	VII	0
			Key proton (atomic) number atomic symbol name relative atomic mass				1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
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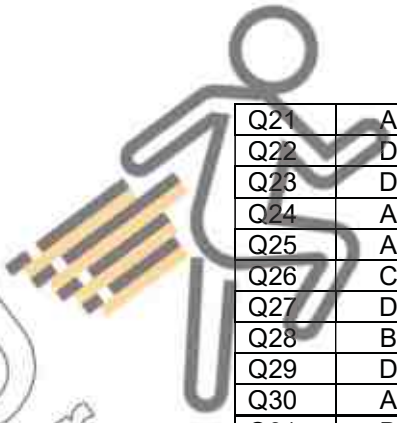
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

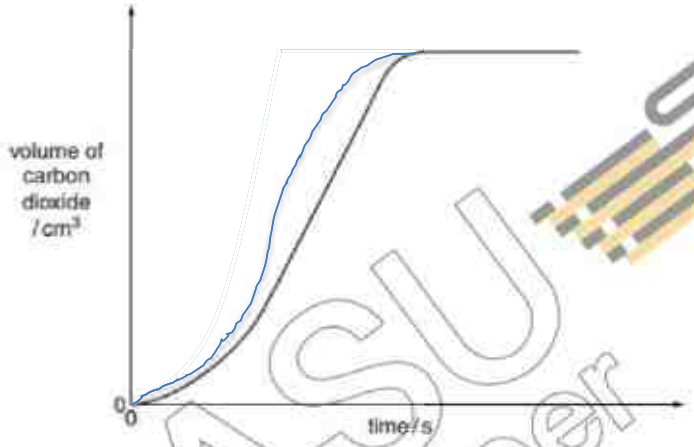
4E Pure Chem MYE P1 MS 2018

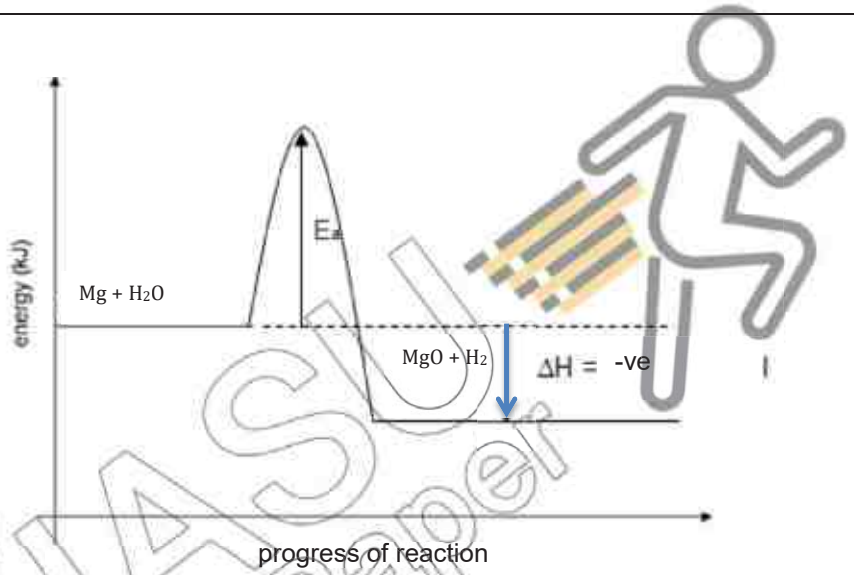
Q1	C
Q2	D
Q3	A
Q4	C
Q5	D
Q6	A
Q7	B
Q8	B
Q9	C
Q10	B
Q11	A
Q12	D
Q13	D
Q14	A
Q15	D
Q16	C
Q17	D
Q18	C
Q19	D
Q20	C

Q21	A
Q22	D
Q23	D
Q24	A
Q25	A
Q26	C
Q27	D
Q28	B
Q29	D
Q30	A
Q31	B
Q32	B
Q33	D
Q34	C
Q35	B
Q36	A
Q37	D
Q38	B
Q39	C
Q40	D



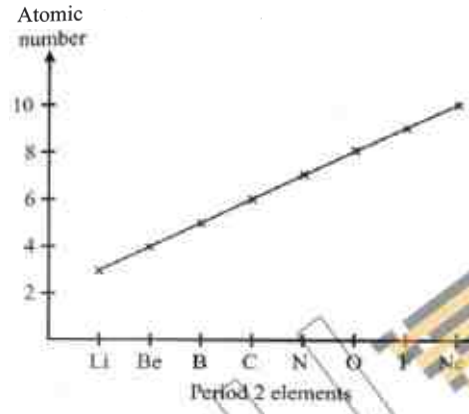
A1			
(a)	D		[1]
(b)	C		[1]
(c)	B and C		[1]
(d)	A and E		[1]
			Total: 4
A2			
(a)	The components have <u>different solubilities</u> in the solvent.		[1]
(b)	3 components [1] correct distance (relative height): • chlorophyll b – 0.8 to 1 cm • chlorophyll a – 1.0 to 1.2 cm • carotene – 1.8 to 2.1 cm [1]		[2]
(c)	• The chromatography should be allowed to run until the solvent front almost reaches the top of the filter paper/ • The drop of extract spotted on the filter paper should be as small as possible. • Cover with a lid to ensure consistent acetone/water compostition. • Use a longer chromatography paper. NB: Do not award: solvent level should be below starting line/ startling line should be drawn in pencil		[1]
(d)	Spinach extract consists of substances that are soluble only in acetone-water mixture.		[1]
			Total: 5
A3			
(a)	carbon monoxide, nitrogen oxides, sulfur dioxide, unburnt hydrocarbons (No chemical formula) Any two answers. [1] each.		[2]
(b)	(i)	$2CO + 2NO \rightarrow 2CO_2 + N_2$	[1]
	(ii)	<u>Carbon dioxide</u> [1 mk pt] is produced by the reactions in the catalytic converters and it is a <u>greenhouse gas</u> [1 mk pt] that causes <u>global warming</u>. [1 mk pt] 3 mk pts – [2] 1-2 mk pts – [1]	[2]
			Total:5
A4			
(a)	2 2 (1) → (1) 2		[1]
(b)	**<u>H_2O_2</u>** is the oxidizing agent. It oxidizes **<u>I^- to I_2</u>** which increases in oxidation number from **<u>-1 (I^-) to 0 (I_2).</u>**		[1] [1]
(c)	**<u>Colourless</u>** solution turns **<u>yellow/ brown.</u>**		[1]
			Total:4
A5			
(a)	Nitrogen – 78% [1] Oxygen – 21% [1]		[2]
(b)	(i)	At low temperature (for fractional distillation of liquefied air), <u>water is a solid</u> **[1]**. {Hence, it would block the flow of liquid air through the pumps and pipes.}	[1]
	(ii)	(distilled first) Nitrogen , Argon, Oxygen, Krypton.	[1]

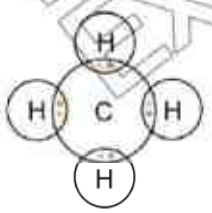
		NB: 0 M if students include Ne or compounds.	
			Total:4
A6			
(a)	Not much magnesium carbonate has achieved activation energy required. [1] Accept: The flame is not hot enough to decompose much magnesium carbonate. *Note: Many students' responses reflect a poor understanding of the question The question involves decomposition and hence responses that revolve around rate of effective collision is invalid as there's no collision of reactants involve here. Other responses which are inaccurate include 'There wasn't enough energy to overcome the activation energy'.*		[1]
(b)	 Correct graph [1] At higher temperature, rate of reaction increases because more zinc carbonate particles have sufficient energy to overcome the activation energy. [1] Volume of carbon dioxide stays constant as it is dependent on the number of moles/ mass of zinc carbonate which did not change. [1]		[3]
(c)	(i)	$FeCO_3$ (s) → FeO (s) + CO_2(g) Correct state symbols – 1M Correct formula – 1M	[2]
	(ii)	X and Y are highly reactive metals [1], thus forming highly stable metal carbonates [1] that do not decompose on heating	[2]
	(iii)	Mass of X_2CO_3 used = 9.2 x 0.0232 = 0.2134 g [1] M_r of X_2CO_3 = 0.2134/0.002 = 106.72 A_r of X = (106.72 – 12 – 16 x 3)/2 = 23.4 [1] (3 s.f.) A_r of X = 23.4 identity of X sodium [1]	[3]
			Total: 11
A7			
(a)	Mg (s) + H_2O (g) → MgO (s) + H_2 (g)		[2]

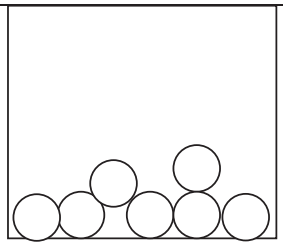
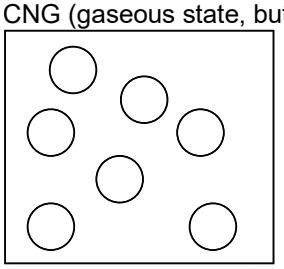
	1M for all accurate formula 1M for all accurate state symbols		
(b)	 • Correct shape [1] • Labels (Ea, ΔH); directions must be both correct [1] • Reactants and products (correct indicators of reactants and products) [1]		[3]
(c)	Heat energy **released** for **bond forming** in <u>1 mole of magnesium oxide and 1 mole of hydrogen</u> is **greater** than heat **absorbed** for **bond breaking** in <u>1 mole of water and 1 mole of magnesium.</u> [1] – underlined phrases i.e. where the bonds are broken and formed; [1] – bold words i.e. connecting energy released/gained to bond forming/breaking *Note: This question involves the overcoming of ionic bonds and the phrasing proves to be difficult for students. Students who gave responses such as Mg-O will be marked down as this is a denotation for covalent bond.*		[2]
			Total: 7
A8			
(a)	(i)	$Pb^{2+}(l) + 2e^- \rightarrow Pb(l)$	[1]
	(ii)	$2Br^-(l) \rightarrow Br_2(g) + 2e^-$	[1]
	(iii)	Shiny, silvery globule was found at the bottom of the beaker.	[1]
(b)	(i)	**P**: Green Universal indicator turned blue/violet. [1] /**bubbling / effervescence** of pale green gas [1] [max 2] **Q**: Green Universal indicator turned red. [1] / **bubbling / effervescence** of colourless gas [1]	[4]
	(ii)	pH will increase. [1] Hydrogen ions preferentially discharged at cathode results in decreasing concentration of hydrogen ions / concentration of hydroxide ions	[2]

		higher than that of hydrogen ions. [1] NB: reject if students write gas instead of ions are discharged.	
	(iii)	**Chlorine** gas formed at anode will oxidise iron anode away/ hydrogen ions at cathode will react iron cathode away Reject: chloride ions will react with iron. [Reaction of chloride ions with iron is slow] NB: reject if students write gas instead of ions are discharged.	[1]
			Total: 10

B9			
(a)	(i)	The melting points increase across Period 2 from Li to C, then decrease sharply from C to N. The melting points decreases gradually from N to Ne. [1] The electrical conductivity is high for the first elements in the period and is low for the last four elements. Boron is the exception as it is one of the first few elements in the period, yet it has poor electrical conductivity. [1] NB: X Wrong: merely restating the table information in sentence form, *for example, "lithium, beryllium and carbon are good conductors, boron is poor and the other elements do not conduct.* √ Right: answers that identified a general trend, "the conductivity is high for the first elements in the period and is low for the last four elements' and then highlighted the exception 'except for boron' or 'except for carbon'.	[2]
	(ii)	They have high melting points that are above room temperature.	[1]
(b)	(i)	No. Electrical conductivity generally decreases across Period 2. [1] (specific mention of a trend) However, carbon is a good electrical conductor despite the preceding element, boron, being a poor conductor, and the following element, nitrogen, being a non-conductor. [1] NB: Only ans that presents the idea of a <u>general pattern</u> will be accepted.	[2]
	(ii)	Graphite. [no marks] Graphite has a giant molecular structure consisting of layers of carbon atoms. <u>Each carbon atom</u> is covalently bonded to <u>three other carbon</u> atoms. This leaves each carbon atom with <u>one valence electron not involved in bonding</u>. [1] This electron becomes <u>delocalised</u> and can <u>move freely</u> along the layers of carbon atoms, [1] thus conducting electricity. NB: Reject if students write each atom is bonded to 3 other electrons. Concept must be entirely correct.	[2]

	(c)	 NB: reject if axes are unlabeled.	[1]
(d)	Sodium. [no mark] A relatively low melting point (compared to other metals) [1] and good electrical conductivity are properties of Group I/alkali metals.[1]		[2]
			Total: 10
B10			
(a)	(i)	HSO_4^- (aq) → H^+ (aq)+ SO_4^{2-} (aq)	[1]
	(ii)	$NaHSO_4$ [1] sodium hydrogensulfate [1]	[2]
	(iii)	No. of mol H_2SO_4 = (25.0/1000) x 0.10 = 0.0025 mol [1] H_2SO_4 + 2NaOH→ Na_2SO_4 + $2H_2O$ From equation, 1 mol H_2SO_4 : 2 mol NaOH 0.0025 mol H_2SO_4:0.005 mol NaOH [1] Concentration of NaOH = 0.005 / (20.0/1000) = 0.250 mol/dm^3 [1]	[3]
(b)	Add 2 to 3 drops, and then, excess of NaOH solution [1]. If a <u>dirty green precipitate</u> that is <u>insoluble in excess NaOH</u> is formed, iron (II) sulfate is formed. [1]		[1] [1]
(c)	<table><tr><td>compound</td><td>$FeSO_4$</td><td>H_2O</td></tr><tr><td>mass/g</td><td>15.2</td><td>27.8 – 15.2 = 12.6</td></tr><tr><td>no. of moles</td><td>15.2 / 152 = 0.1 mol</td><td>12.6 / 18 = 0.7 mol</td></tr><tr><td>simplest ratio</td><td>0.1 / 0.1 = 1</td><td>0.7 / 0.1= 7</td></tr></table> Empirical formula is **$FeSO_4.7H_2O$**. 1m for simplest ratio 1m empirical formula		[2]
			Total:10

B11	EITHER		
(a)	(i)	<table><tr><th>1/time/ (1/s)</th></tr><tr><td>0.0154</td></tr><tr><td>0.0222</td></tr><tr><td>0.0118</td></tr><tr><td>0.0182</td></tr><tr><td>0.00952</td></tr></table>	[1]
	(ii)	1/ time provides information about the speed of reaction. [1] The longer the time taken, the slower is the speed of the reaction. / The shorter the time taken, the faster is the speed of the reaction. [1]	[2]
(b)	The results of experiments A, C and E can be used. / The results of experiments B and D can be used. [1] These experiments were conducted using <u>different concentrations of acid</u> but the <u>temperature was kept constant</u>. [1]		[2]
(c)	The higher the concentration, the faster is the speed of the reaction. No marks awarded. With a higher concentration, there are <u>more reactant particles in a unit volume</u>. [1] Thus, there are <u>more collisions</u> between reactant particles. This results in a <u>higher frequency of effective collisions</u> occurring. [1]		[2]
(d)	The student is not correct. The activation energy of the reaction is not lowered with higher temperature. [1] Must mention what is wrong with the student's explanation. At higher temperatures, reactant particles possess <u>greater amount of kinetic energy</u>. Thus, they are able <u>move more quickly</u> [1] and <u>collide into one another more frequently</u>. This results in a <u>higher frequency of effective collisions</u> occurring. [1]		[3]
			Total:10
B11	OR		
(a)	(i)	Methane	[1]
	(ii)		[2]
	(iii)	• Natural gas is a mixture of <u>covalent c</u>ompounds which have a <u>simple molecular structure</u>. • There are <u>weak intermolecular/ van der Waals forces of attraction between the molecules</u>, [1] • hence <u>little energy</u> must be supplied to <u>overcome these forces of attraction</u>, and natural gas has a <u>low boiling point</u>, which makes it volatile. [1]	[2]
(b)	Separating funnel		[1]
(c)	(i)	LNG (liquid state) [1]	[2]

		 CNG (gaseous state, but closer together than original diagram) [1] 	
	(ii)	Data quoted: • Compared to the original volume of natural gas, LNG occupies **1/600th /0.167%** of the original volume, which is **100 times/ significantly less** than CNG, which occupies **1%** of the original volume. [1] *Student must quote the data of both CNG and LNG Implication: • Hence, ○ LNG is likely to be **easier to transport** than CNG, [1] **OR** ○ for the same volume, LNG **contains more natural gas** than CNG [1] **OR** ○ LNG is **safer** to use than CNG because CNG is compressed but LNG is not, hence if a pressurised CNG cylinder is damaged, the danger of an explosion is much greater [1] 1m for comparison of volume/ evidence 1m for stating implication Accept any reasonable implication of the difference in volume	[2]
			[Total:10]

Name | Reg. No | Class

4EX

CHEMISTRY **6092/01**

Paper 1 Multiple Choice [40 Marks]

SEMESTRAL ASSESSMENT ONE
May 2018

Additional Materials
Approved Calculator
OTAS answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

1 hour

INSTRUCTIONS TO CANDIDATES:

Do not start reading the questions until you are told to do so.
Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class, and index number on the OTAS provided.

INFORMATION FOR CANDIDATES

There are **forty** questions on this paper. Answer **all** questions.

For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the **OTAS**.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table can be found on **page 22**.

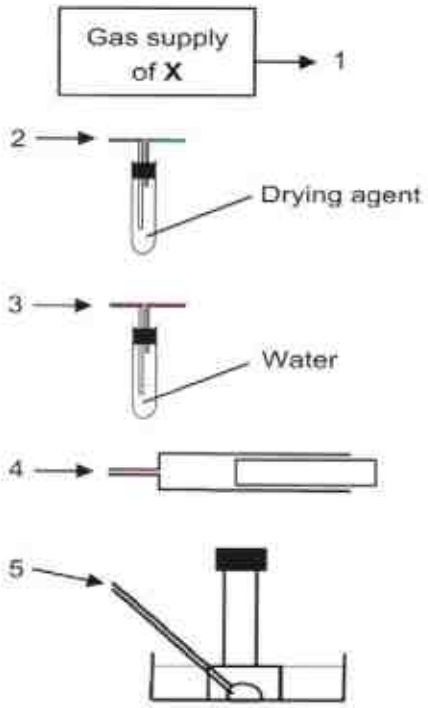
This question paper consists of **22** printed pages.

Setter: Mr Mohamad Gaddafi Annuar Vetter: Mdm Jarina

Paper 1 (40 marks)

Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the **OTAS**

1 A gas **X** is insoluble in water and less dense than air. An impure supply of **X** contains water vapour and a water-soluble impurity.



Which of the following order can be used to collect a pure dry sample of gas **X**?

A 1, 2, 3, 4
B 1, 3, 2, 4
C 1, 2, 3, 5
D 1, 3, 2, 5

2 The reaction between aqueous iron(II) sulfate and aqueous sodium hydroxide is shown below.

$FeSO_4$ (aq) + 2NaOH (aq) $\rightarrow$ $Fe(OH)_2$ (s) + Na_2SO_4 (aq)
pale green colourless dirty green colourless

Which method could be used to separate the products?

A crystallization
B distillation
C filtration
D separatory funnel

3 The diagram shows three balloons filled with different gases held by students.

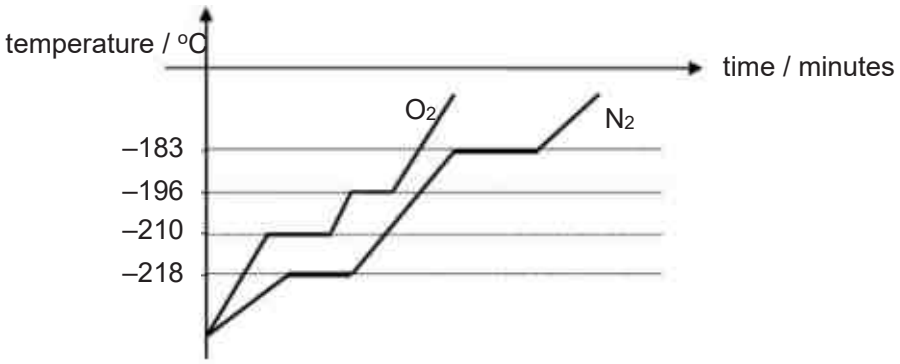
Which statements are correct?

1 The number of moles of gases in the 3 balloons is the same.
2 The number of molecules in the 3 balloons is different.
3 The mass of gases in the 3 balloons is different.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

[Turn Over

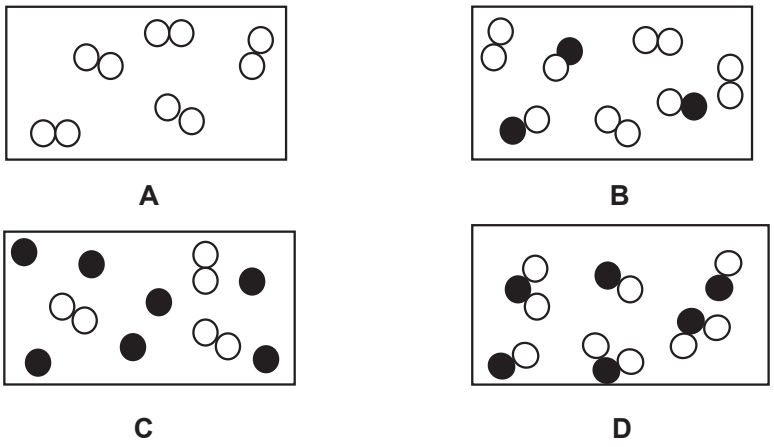
4 The graphs (not drawn to scale) show the heating curves of oxygen and nitrogen over a period of time.



At what temperature will there be two different phases (states) of matter co-existing at the same time, in a mixture of oxygen and nitrogen under room conditions?

A -180 °C
B -195 °C
C -200 °C
D -210 °C

5 Which of the following diagrams shows a pure hydrogen gas?



6 An element **X** has two isotopes of 16 and 18. Its relative atomic mass is 16.4. Which statement correctly states the proportion of isotope-16 in the sample?

A 20 %
B 40 %
C 60 %
D 80 %

7 Elements **X**, **Y** and **Z** have consecutive, increasing proton numbers.

If element **X** is a noble gas, what is the symbol for the ion of element **Z** in its compounds?

A Z^{+}
B Z^{2+}
C Z^{2-}
D Z^{3+}

8 Which molecule has the largest number of electrons involved in covalent bonds?

A C_2H_4
B CO_2
C CH_3OH
D N_2

9 Substance **X** has the following properties:

- melting point above 500°C
- insoluble in water
- conducts electricity only when molten.

What would substance **X** be?

A aluminium oxide
B copper
C graphite
D sodium chloride

[Turn Over

10 1.97 g of an unknown metal carbonate, **M**CO_3, reacts completely with 50.0 cm^3 of 0.400 mol/dm^3 hydrochloric acid.

What is the relative atomic mass of **M**?

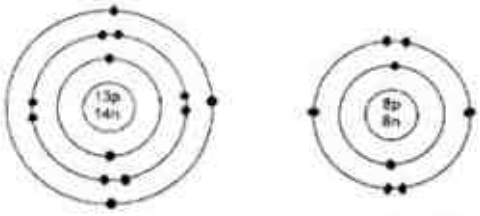
A 35.0
B 94.5
C 137
D 150

11 A metal **Y** forms a sulfate salt with the formula, **Y**SO_4 while a non-metal **Z** forms an ammonium salt with the formula, $(NH_4)_3$**Z**.

What is the formula of the substance formed between **Y** and **Z**?

A **YZ**
B **Y_3Z**
C **YZ_3**
D **Y_3Z_2**

12 The electronic structure of two atoms P and Q are shown.



atom P atom Q

What is the type of chemical bonding and the mass of one mole of compound formed between these two elements?

	type of bonding	mass of one mole of compound / g
A	covalent bonding	70
B	covalent bonding	113
C	ionic bonding	43
D	ionic bonding	102

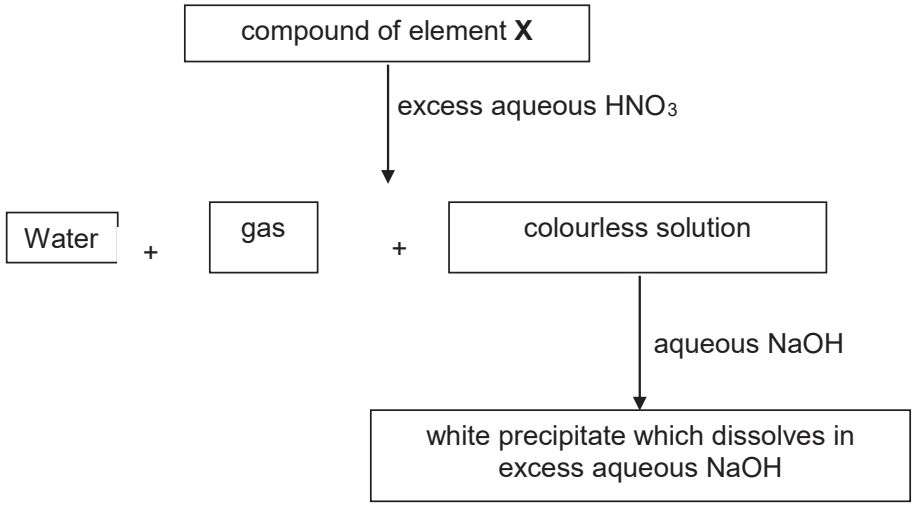
13 Ozone, a gas found in stratosphere, helps to filter the harmful ultraviolet rays from the sun. CFCs from aerosol sprays can cause the ozone layer to decompose as follows:

$$2O_3\ (g) \rightarrow 3O_2\ (g)$$

Which one of the following statements is correct at room temperature and pressure?

A 2 mol of ozone produce 9 x10^{23} oxygen molecules.
B 24 dm^3 of ozone produce 24 dm^3 of oxygen.
C 48 dm^3 of ozone produces 32 g of oxygen.
D 48 g of ozone produce 48 g of oxygen.

14 The scheme below shows some reactions of a compound of element **X**.



What could the compound of element ***X*** have been?

A aluminium sulfate
B calcium sulfate
C copper(II) carbonate
D lead(II) carbonate

[Turn Over

15 Chlorine gas is a severe irritant to the eyes and respiratory system. The maximum safe toleration level of chlorine gas is 0.005 mg/dm^3.

How many molecules of chlorine gas are present in 1 dm^3 of air at this toleration level?

A $\frac{0.005}{6\times10^{23}}\times71$

B $\frac{0.005}{1000}\times\frac{1}{71}\times6\times10^{23}$

C $\frac{0.005}{71}\times6\times10^{23}$

D $\frac{0.005}{1000}\times71\times6\times10^{23}$

16 The equation for the reduction of iron ore in the blast furnace is shown below.

Fe_2O_3 (s) + 3CO (g) → 2Fe (*l*) + 3CO_2 (g)

When 20 tonnes of the iron ore were reduced, 7 tonnes of molten iron were produced.

What is the percentage yield of this reduction?

A 17.5 %
B 54 %
C 50 %
D 70 %

17 Which of the following reactions is **NOT** a redox reaction?

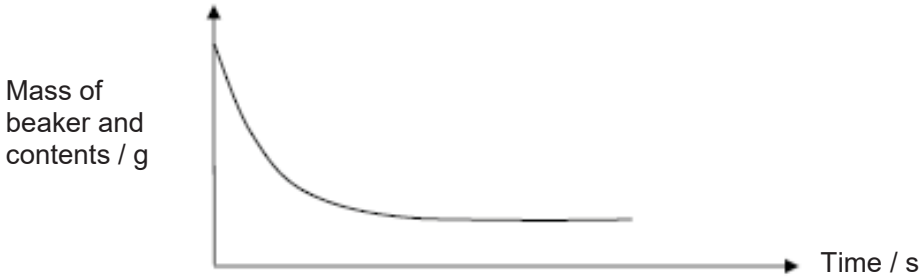
A KI + Br_2 → KBr + I_2

B CuO + H_2SO_4 → $CuSO_4$ + H_2O

C Mg + 2HC*l* → MgCl_2 + H_2

D N_2 + 3H_2 → 2NH_3

18 Two solutions were mixed in a beaker and the mass of the beaker and contents was then recorded at various times. The graph shows the results.



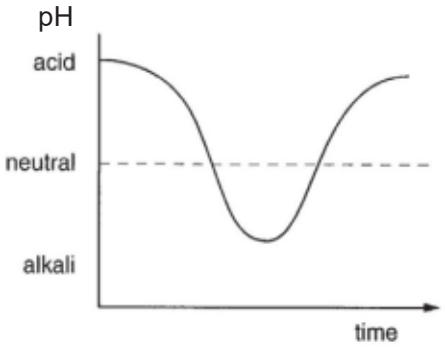
What could the two solutions be?

A aqueous ammonia and aqueous iron(II) nitrate
B dilute hydrochloric acid and aqueous potassium hydroxide
C dilute nitric acid and solid copper(II) carbonate
D dilute sulfuric acid and aqueous barium nitrate

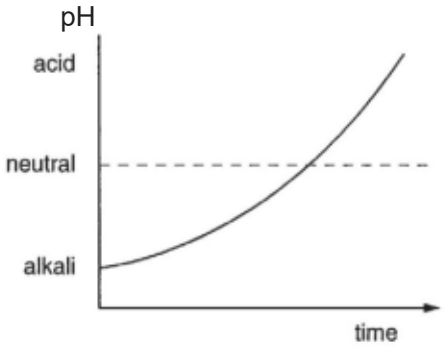
[Turn Over

19 The mouth contains saliva which is a weak alkali. When sweets containing sugar are eaten, bacteria in the mouth change the sugar into acids.

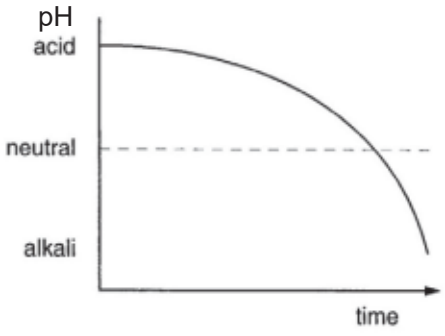
Which graph best shows how the acidity in the mouth changes during and after the eating of sweets?



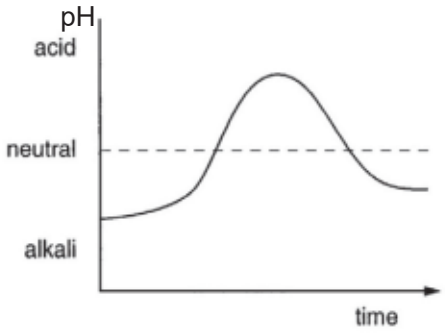
A



B



C



D

20 Solid **Z** was dissolved in dilute sulfuric acid to give a colourless solution and a gas that combusts with a blue flame. When aqueous ammonia solution was added to the colourless solution, a white precipitate was obtained, which dissolved in excess aqueous ammonia. The same colourless solution gave a white precipitate with barium nitrate solution.

What is the identity of solid **Z**?

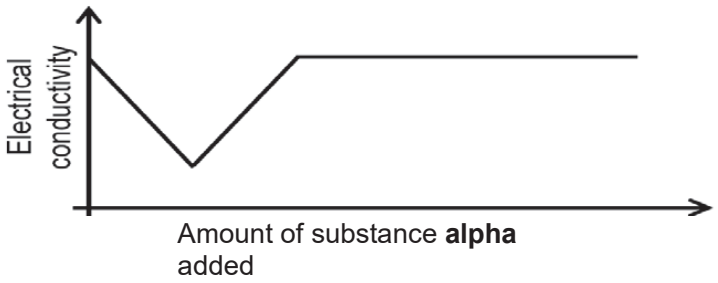
A calcium metal
B zinc metal
C calcium chloride
D zinc sulfate

21 The presence of ethanol vapour in the breath of a person who has very recently consumed alcohol can be detected using a filter paper moistened with acidified potassium dichromate(VI).

If ethanol vapour is present, orange potassium dichromate(VI) spot will turn green. What does this suggest about the property of ethanol?

A Ethanol acts as an indicator.
B Ethanol acts as a drying agent.
C Ethanol is a reducing agent.
D Ethanol is an oxidising agent.

22 A substance alpha is added to lead(II) nitrate solution. The change of conductivity is plotted as shown below.

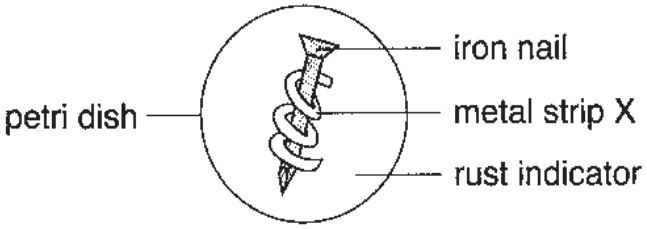


What could substance alpha be?

A potassium
B potassium iodide solution
C potassium manganate(VII) solution
D potassium nitrate solution

[Turn Over

23 Consider the following set-up.



The rust indicator will turn blue in the presence of rust.

Some statements concerning the experiment are given below.

(I) If **X** is copper, the iron nail will not corrode readily.
(II) If **X** is iron, the iron nail will not corrode readily.
(III) If **X** is silver, a blue colour is observed around the iron nail.

Which of the following statements is/are correct?

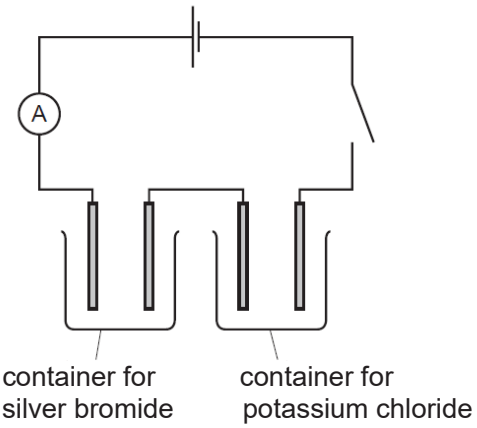
A (I) only
B (III) only
C (I) and (II) only
D (II) and (III) only

24 During the electrolysis of an aqueous solution of a *cerium* salt, 70 g of *cerium* (Ar = 140) is deposited at the cathode by 1 mole of electron.

What is the formula of the cerium ion?

A Ce^{+}
B Ce^{2+}
C Ce^{3+}
D Ce^{4+}

25 The diagram shows the circuit for electrolysing silver bromide and potassium chloride to produce the metal.



To produce a metal, what form must these salts be?

	silver bromide	potassium chloride
A	concentrated solution	molten
B	dilute solution	concentrated solution
C	molten	molten
D	molten	molten

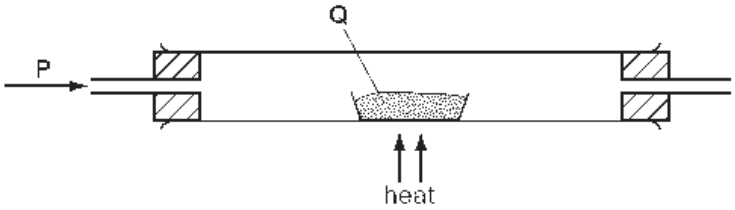
26 Many properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property could **not** be predicted in this way?

A the formula of its oxide
B the nature of its oxide
C the number of isotopes it has
D the number of electron shells of its atom

[Turn Over

27 In the apparatus shown, gas **P** is passed over solid **Q**.



Which of the following identities of **P** and **Q** would **not** result in a reaction?

	P	**Q**
A	carbon monoxide	copper (II) oxide
B	carbon monoxide	lead (II) oxide
C	hydrogen	iron (III) oxide
D	hydrogen	zinc oxide

28 Three elements **X**, **Y** and **Z** belong to the same period in the Periodic Table. The properties of their oxides are given below.

oxide of **X:**	soluble in both nitric acid and aqueous sodium hydroxide
oxide of **Y:**	insoluble in water and aqueous sodium hydroxide but dissolves readily in nitric acid
oxide of **Z:**	changes acidified potassium manganate(VII) from purple to colourless

Based on the statements above, arrange **X**, **Y** and **Z** in order of <u>decreasing</u> atomic number in the Periodic Table.

A **X**, **Y**, **Z**
B **Y**, **X**, **Z**
C **Z**, **X**, **Y**
D **Z**, **Y**, **X**

29 A hand warmer bag purchased by skiers consists of powdered iron, water, salt and sawdust. When the bag is shaken, it becomes hot because the following reaction occurs.

$$4Fe\,(s) + 3O_2\,(g) \rightarrow 2Fe_2O_3\,(s) \qquad \Delta H = -823\ kJ/mol$$

Which statement is **not** true about the reaction above?

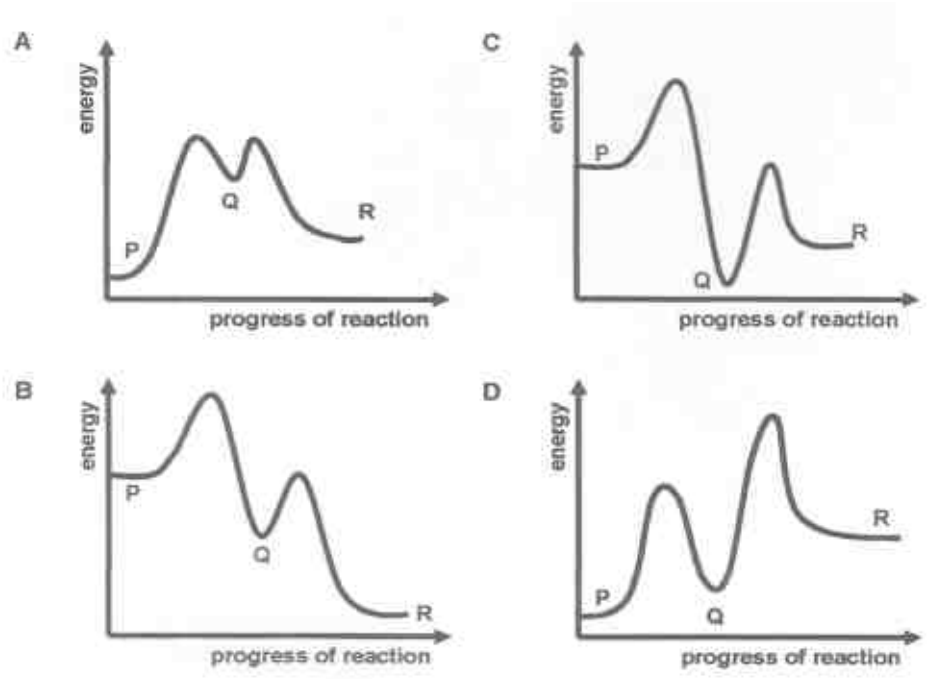
A The energy change involved in bond-forming is more than that in bond-breaking.
B The energy level of products is lower than that of the reactants.
C The energy level of reactants is lower than that of the products.
D The temperature of the reaction mixture increases.

30 In the conversion of compound P into compound R, it was found that the reaction proceeded by way of compound Q, which could be isolated.

The steps involve were:

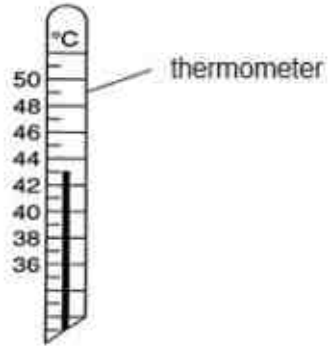
P → Q ΔH = negative
Q → R ΔH = positive

Which one of the following reaction profiles agrees with this data?



[Turn Over

31 A thermometer is placed in water and the temperature measured is shown.



An endothermic change takes place as a solid is dissolved in the water. The temperature change is 4.5 °C.

What would be the temperature reading immediately after the reaction?

A 38.0 °C
B 38.5 °C
C 47.0 °C
D 47.5 °C

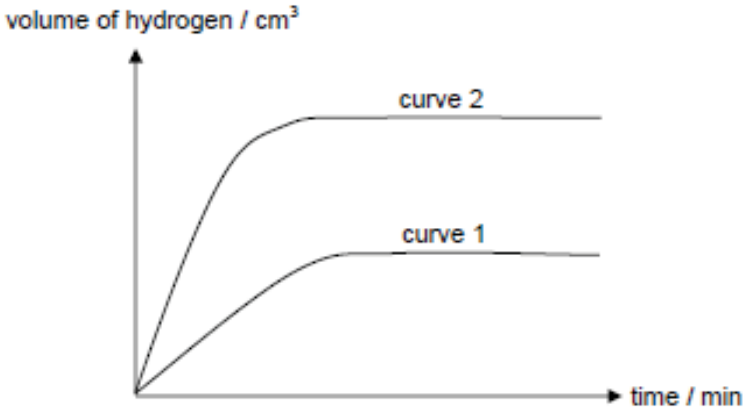
32 A sample of hydrogen peroxide is decomposed by a metal oxide catalyst.

$2H_2O_2$ (aq) → O_2(g) + $2H_2O$(*l*)

What will become larger if the experiment is repeated using a better catalyst?

A The total volume of gas produced at the end of the reaction.
B The amount of hydrogen peroxide left over at the end of the reaction.
C The initial gradient of a graph of total volume of gas produced against time.
D The time needed to produce a particular volume of gas.

33 In the graph below, curve 1 was obtained when 25.0 cm^3 of 1.0 mol/dm^3 of dilute hydrochloric acid is reacted with an excess of magnesium ribbons at 30 ^oC.



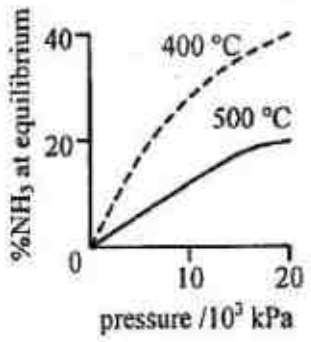
Which of the following changes would result in curve 2?

A adding a catalyst to the reaction
B heating the acid to a higher temperature
C using 25.0 cm^3 of 2.0 mol/dm^3 of dilute hydrochloric acid
D using finely powdered magnesium metal of the same mass

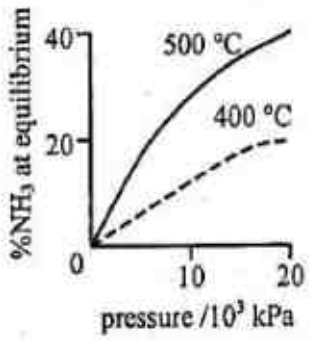
[Turn Over

34 The percentage of ammonia obtained at equilibrium in the Haber Process is plotted against pressure for two temperatures, 400 °C and 500 °C.

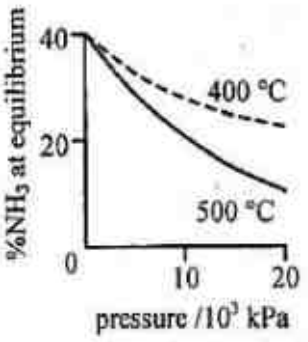
Which of the following correctly represents the two graphs obtained?



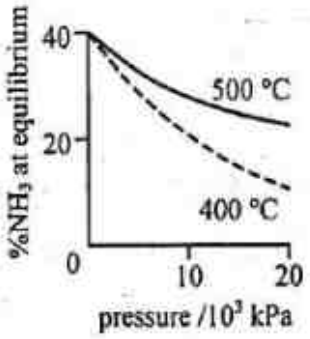
A



B



C



D

35 Which statement about the properties of ammonia is correct?

A It decomposes on heating at high temperature to form nitrogen gas and hydrogen gas.
B It dissolves in water to form an acidic solution.
C It is formed by heating ammonium salts with sulfuric acid.
D It reacts with alkalis to form salts.

36 The table shows the boiling points of four fractions when crude oil is distilled.

fraction	W	X	Y	Z
boiling point /°C	35 – 75	80 – 145	150 – 250	greater than 250

Which statement regarding the fractions is true ?

A Fraction W is more flammable than fraction Y.
B Fraction W is more viscous than fraction Z
C The density of fraction X is greater than that of fraction Z.
D The molecules in X have a longer chain length than those in fraction Z.

37 Which of the following statements about air are true?

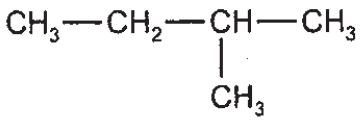
I Clean air has a lower density than carbon dioxide.
II Clean air has a constant composition of oxygen and water vapour.
III Clean air contains mainly argon.
IV Clean air is a mixture of elements and compounds.

A **I** and **III** only
B **I, II** and **III** only
C **I**, **III** and **IV** only
D all of the above

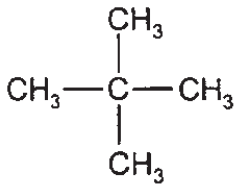
[Turn Over

38 Which structure is not an isomer of the structure shown?

A



B



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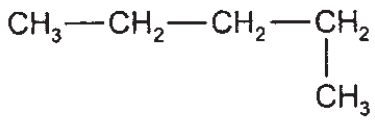
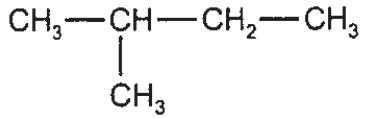


D

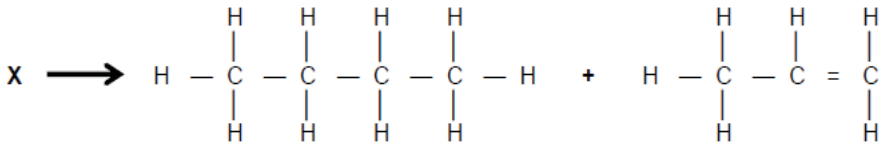


39 Some unsaturated compounds contain more than one carbon-carbon double bond. An example is the compound with the formula $C_{21}H_{26}$.

How many carbon-carbon double bonds are present in one molecule of this compound?

A 3
B 5
C 8
D 9

40 A chemist carried out a cracking reaction on a hydrocarbon, **X** and obtained two products, **Y** and **Z**.



The chemist then wrote the following statements in his notebook.

(1) A molecule of **X** has 7 carbon atoms.
(2) **Y** is unsaturated.
(3) **Z** will decolourise bromine water.

Which statement(s) is/are correct?

A (3) only
B (1) and (2)
C (1) and (3)
D (1), (2) and (3)

- - - End of Paper 1 - - -

[Turn Over

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name | Reg. No | Class

4EX

CHEMISTRY **6092/02**
Paper 2 [80 Marks]

SEMESTRAL ASSESSMENT ONE
May 2018

Additional Materials
Approved Calculator

1 hr 45 mins

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** three questions, the last question is in the form of either/or.
Write your answers in the spaces provided.

FOR EXAMINER'S USE		
Section		**Marks**
MCQ (P1)		**/ 40**
A		**/ 50**
B	**Q 7**	**/ 10**
	Q 8	**/ 10**
	Q 9	**/ 10**
Total		**/ 120**

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table can be found on **page 23.**
At the end of the examination, fasten all your work securely together.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of chemistry than for correct answers.

This question paper consists of **23** printed pages.

Setter: Mr Mohamad Gaddafi Annuar Vetter: Mdm Jarina

Section A [50 Marks]
Answer ALL questions in the spaces provided.

A1 Name the following chemical processes.

	reaction	name of process
(i)	$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$	
(ii)	$H_2SO_4 + CaCl_2 \rightarrow 2HCl + CaSO_4$	
(iii)	$Fe^{2+} \rightarrow Fe^{3+} + e^-$	
(iv)	$MgBr_2 + F_2 \rightarrow MgF_2 + Br_2$	
(v)	$CuCO_3 \rightarrow CuO + CO_2$	

[5]

[Total: 5 marks]

A2 This question concerns the chemistry of carbon and silicon, elements from Group IV of the Periodic Table.
Table 2.1 provides some information on two different forms of carbon (allotropes) and silicon:

Table 2.1

Substance	Melting point / °C	Electrical conductivity	Uses
Carbon allotrope **A**	Above 3000	Poor	Cutting tools, drill bits
Carbon allotrope **B**	Above 3000	Good	Lubricant
Silicon	1414	Good	Semiconductors in electronics

(a) Carbon tends to form covalent compounds.

By drawing the dot-and-cross diagram of a carbon compound of your choice, describe how a covalent bond is formed. You only need to show valence electrons.

……...

……...

……...

……..[3]

(b) Explain, in terms of structure and bonding, why carbon allotrope **A** can be used as a drill bit while carbon allotrope **B** can be used as a lubricant.

……...

……...

……...

……..[2]

(c) Carbon is commonly used as a reducing agent. For example, it can reduce zinc oxide to form zinc.

Explain, using oxidation states, how carbon is acting as a reducing agent in the reduction of zinc oxide.

……...

……...

……..[1]

[Total: 6 marks]

[Turn Over

A3 Table 3.1 shows the results of some of the chemical reactions of **four** unknown metals.

Table 3.1

Metals	Thermal decomposition of metal carbonates	Reaction of metal with cold water
A	Greenish-blue solid turns black. White precipitate formed when gas produced is being passed through limewater	No reaction
B	White solid remains. No gas was produced.	Very vigorous reaction
C	White solid turns yellow, turns back to white after when cooled. White precipitate formed when gas produced is being passed through limewater	No reaction
D	White solid remains white. White precipitate formed when gas produced is being passed through limewater	Little bubbles formed on the surface of the metal.

(a) Arrange the metals in ascending order of their chemical reactivity.

…….[1]

(b) Metal **A** and **D** are placed into two separate beakers of iron(III) sulfate solution. Describe the observations you will see in each beaker.

……...

……...

……..[3]

(c) Pure iron can be extracted using the Blast furnace in the presence of carbon monoxide.

(i) Write a balanced equation for the reaction mentioned above.

……..[1]

(ii) State and explain if the reaction written in **(ci)** is a redox reaction.

……...

……..[1]

(d) Iron oxidises to form iron(III) oxide, which is a reddish-brown deposit commonly known as rust.

Using your knowledge of the reactivity series of metals, describe and explain how rusting of iron can be prevented.

…….....

…….....

……..[2]

[Total: 8 marks]

[Turn Over

A4 A student carried out a series of experiments to determine the rate of reaction between excess zinc and dilute hydrochloric acid (HC*l*) by measuring the volume of gas produced per unit time.

In Experiment **1** (conducted at 25 °C), he used 5 g of zinc granules and 30 cm^3 of 0.5 mol/dm^3 dilute hydrochloric acid.

The experiments were repeated two more times, with different variables.

Experiment **2**: 5 g of zinc powder and 30 cm^3 of 0.5 mol/dm^3 of HC*l*, 25 °C
Experiment **3**: 5 g of zinc granules and **y** cm^3 of **z** mol/dm^3 of HC*l*, 25 °C

Fig 4.1 shows the volume of gas produced over time.

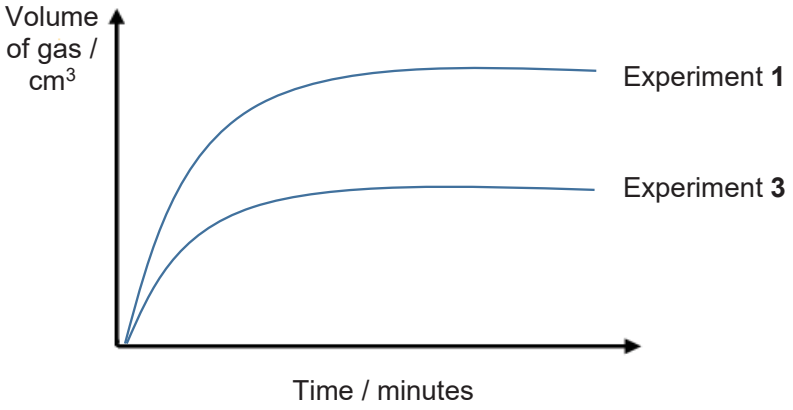
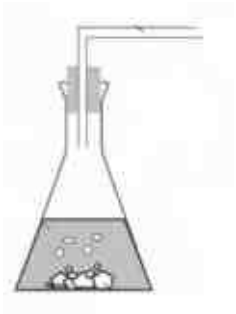


Fig 4.1

(a) Complete the diagram below with the appropriate apparatus used in the experiment.



[1]

(b) Write a balanced equation for the reaction between zinc and dilute hydrochloric acid.

……..[1]

(c) On **Fig 4.1** sketch and label the graph for Experiment **2**.

[1]

(d) Taking reference from the Fig 4.1, suggest appropriate values for **y** and **z** for Experiment 3.

y = …… cm^3

z = ……... mol/dm^3

[2]

(e) The student repeated the experiment at 50 ^oC. Explain in terms of energy and particle collisions how an increase in temperature increases the rate of a reaction.

……...

……...

……...

……...

……..[3]

[Total: 8 marks]

A5 The table shows some information about a homologous series of organic compounds called ketones.

name	**number of carbon atoms**	**formula**
propanone	3	CH_3COCH_3
butanone	4	$C_2H_5COCH_3$
pentanone	5	$C_3H_7COCH_3$

[Turn Over

(a) Deduce the name and formula of the ketone that contains 6 carbon atoms.

name ……

formula ……

[2]

(b) From **(a)**, deduce the general formula for ketones.

……..[1]

(c) The oxygen atom in a ketone forms a double bond with a carbon atom.

Draw the full structural formula of butanone.

[1]

(d) Separate samples of propanone and propene were placed in separate test tubes and each shaken with bromine water.

Predict what will be seen in each test tube after shaken with bromine water.

……...

……...

……..[2]

[Total: 6 marks]

A6 Ozone is considered a pollutant at ground level but is important in the stratosphere.

(a) Explain why the ozone layer is important to us.

……..[1]

(b) Explain why ozone is considered as a pollutant at ground level.

……...

……..[1]

(c) Ozone is destroyed when chlorine atoms from CFCs attack the ozone molecules.

$$2Cl + O_3 \rightarrow Cl_2O + O_2$$

Explain, in terms of oxidation states which element is oxidised.

……...

……...

……..[2]

(d) Nitrogen dioxide can also contribute to the depletion of the ozone layer and must be removed.

(i) Besides breathing issues, describe **one** other harmful effect of nitrogen dioxide.

……...

……..[1]

(ii) Write an equation to show how nitrogen dioxide can be removed in the catalytic converter.

……..[1]

[Total: 6 marks]

A7 Table 7.1 shows the enthalpy of combustion of three fuels.

fuel	enthalpy change of combustion (kJ/mol)
ethanol	- 1370
hydrogen	- 256
octane	- 5510

combustion of ethanol: $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

(a) Use ideas about breaking and forming bonds to explain why the enthalpy change for combustion of ethanol is negative.

……...

……..[2]

[Turn Over

(b) Octane also undergoes combustion to produce carbon dioxide. The equation for the combustion of octane is given below.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

Calculate the volume of carbon dioxide that will be produced when ethanol undergoes combustion to produce 100 kJ of energy.

[2]

(c) Explain why the combustion of hydrogen is considered a 'cleaner' alternative as compared to octane and ethanol.

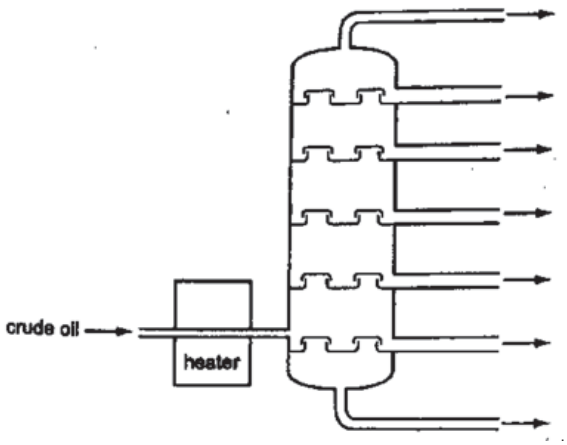
……...

……...

……..[2]

[Total: 6 marks]

A8 The diagram below shows how petroleum can be refined.



(a) Briefly describe how fractions can be separated through the fractional distillation of crude oil.

……...

……...

……...

……...

……...

……..[3]

(b) The flow chart below shows how a sweet smelling compound **Y** can be formed from petroleum (crude oil).

(i) Explain why Stage **A** is an important process in the energy industry.

……...

……...

……..[1]

(ii) A long chain alkane, $C_{12}H_{26}$, undergoes Stage **A** to form ethene, butane and an unsaturated compound **Z**.

Draw the structure of compound Z in the space given below.

[1]

[Total: 5 marks]

---End of Section A---

[Turn Over

Section B [30 Marks]

Answer **all** questions. **Question B11** has a choice of section to answer. Write your answers on the spaces provided.

B9 Fig 9.1 shows the set-up for the electrolysis of a chloride solution containing two metal ions, copper(II) and iron(II).

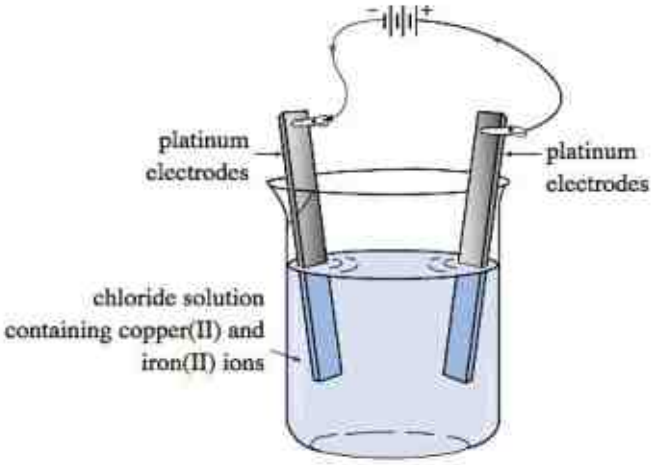


Fig 9.1

An electric current was passed through the cell for a period of time.
The observations at different stages were recorded in the table.

Table 9.2

stage	observations
stage 1 – after 10 mins	A yellowish-green gas is observed at one of the electrodes while a brown solid is deposited at the other electrode. There was no visible change to the electrolyte.
stage 2 – after 1 hour	The same observations in stage 1 at the anode and cathode. The electrolyte became pale green.
stage 3 – after 2 hours	Colourless gases are both evolved at the anode and cathode. The pale green of the electrolyte becomes more visible.

(a) **(i)** Write the equations for the reactions taking place at the respective electrodes in stage 1.

……...

……..[2]

(ii) The total mass of the brown solid deposited was 0.584 g.

Calculate the volume of the yellowish-green gas produced at the other electrode.

[2]

(b) Explain why the electrolyte becomes pale green in stage 2 and then darker in stage 3.

……...

……...

……...

……..[2]

(c) A few drops of Universal Indicator were added **at the cathode** in stage 3.

State and explain the result of the test.

……...

……...

……...

……..[2]

[Turn Over

(d) A total of three different substances were produced at the cathode throughout the whole electrolysis process.

Identify and list the three substances in order of which they are produced. Explain your answer.

……...

……...

……...

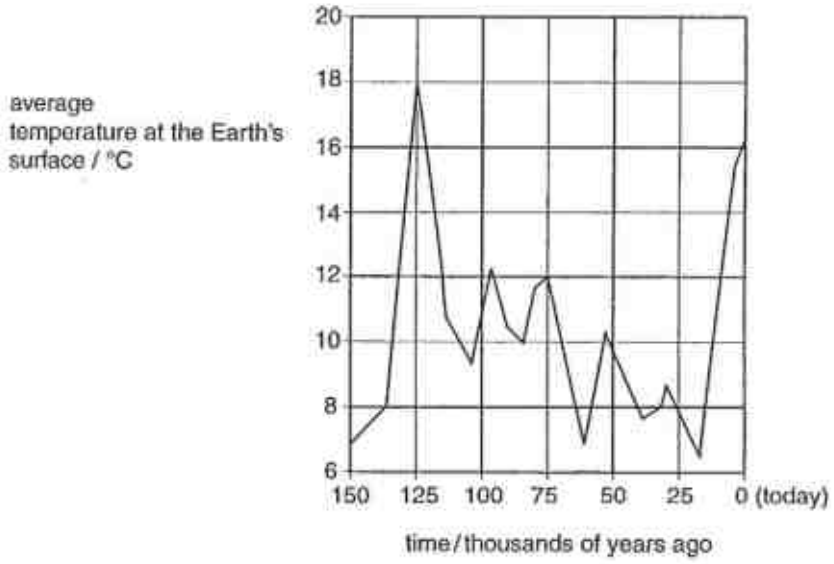
……..[2]

[Total: 10 marks]

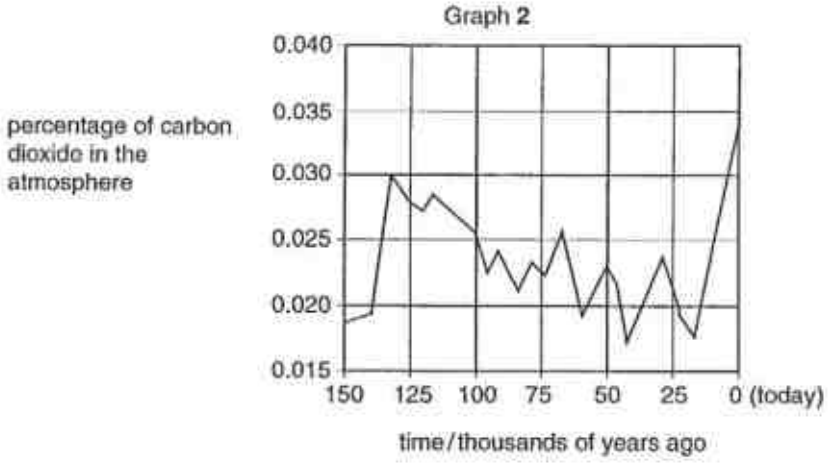
B10 Graph 1 shows how the average temperature of the Earth's surface may have changed over the last 150 thousand years.

Graph 2 shows how the percentage of carbon dioxide in the atmosphere may have changed over the last 150 thousand years.

Graph 1



Graph 2



[Turn Over

(a) Describe and explain the relationship between graph 1 and graph 2.

……...

……...

……...

……[2]

(b) State **two** consequences as a result of the changes in temperature levels shown in graph 1?

……...

……...

……...

……[2]

(c) Explain how the carbon cycle regulates the level of carbon dioxide in the atmosphere.

……...

……...

……...

……[2]

(d) Two most polluting emissions from cars are nitrogen monoxide and carbon monoxide. The actual concentration of each of these components depends on the mode of operation of the vehicle and the proportion of air present in the fuel mixture that is used.

Some typical figures are given in the table [ppm = parts per million].

mode of operation	**proportion of air present in fuel mixture**	**nitrogen monoxide emissions / ppm**	**carbon monoxide emissions / ppm**
idling engine	high	14	2000
Accelerating engine	high	3700	1000
idling engine	low	10	8000
accelerating engine	low	1000	5000

(i) Suggest why

(1) the concentration of nitrogen monoxide is high when the engine is in the accelerating mode; and

(2) the concentration of carbon monoxide is low when the proportion of air present in the fuel mixture is high.

……...

……...

……...

……...

……...

……..[2]

[Turn Over

(ii) Catalytic converters help reduce pollution by converting pollutants to non-polluting products.

The equation shows a typical reaction in a catalytic converter.

$$NO + CO \rightarrow$$

Complete and balance the equation. Explain why this equation represents a redox reaction.

……...

……...

……..[2]

[Total: 10 marks]

EITHER

B11 (a) Citric acid is a white crystalline powder with formula $C_5H_7O_5COOH$
Two samples of 0.1 mol/dm^3 citric acid was prepared, one in water and the other in propanol. It was noticed that when the acid dissolved in water, the solution felt cold.

Dissociation of citric acid in water: $C_5H_7O_5COOH \rightarrow C_5H_7O_5COO^- + H^+$

A piece of magnesium ribbon was added to each of the two solutions. The results are summarised in Table 11.1

Table 11.1

solution	action on magnesium ribbon
citric acid in water	slow but steady formation of gas bubbles
citric acid in propanol	no reaction

(i) What type of energy change takes place when citric acid was dissolved in water?

……..[1]

(ii) Explain the **observations** for the reaction between a solution of citric acid in water and magnesium.

……...

……...

……..[2]

(iii) Write a balanced chemical equation to show the reaction between magnesium and citric acid in water.

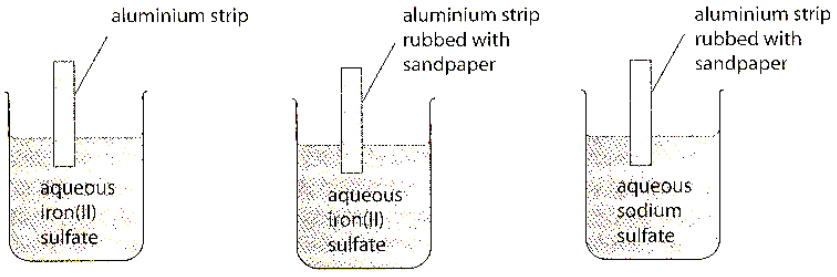
……..[1]

(iv) Explain why there was no reaction between magnesium and a solution of citric acid in propanol.

……...

……..[1]

(b) Fig 11.2 shows three experiments involving aluminium that were set up in the laboratory.



Experiment 1 **Experiment 2** **Experiment 3**

Fig 11.2

(i) Explain why a reaction occurred in Experiment **2** but not in **1**.

……...

……...

……...

……..[3]

[Turn Over

(ii) State and explain the observation(s) if any, that will be seen in Experiment **3**.

……...

……...

……..[2]

[Total: 10 marks]

OR

B11 **(a)** The information in Fig 11.3 is about the elements in Period **3** of the Periodic Table.

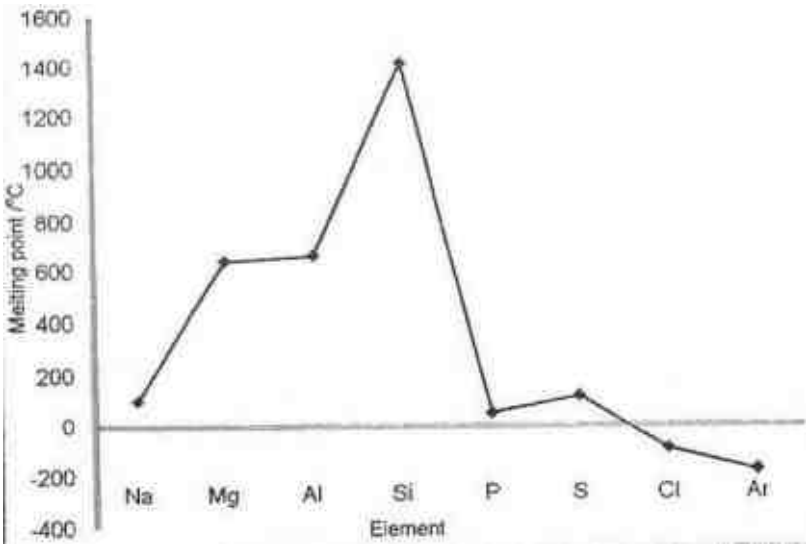


Fig 11.3

(i) Describe the general trends in melting point across Period **3**.

……...

……...

……...

……...

……..[3]

(ii) How does the data show that the first four elements in Period **3** are solids at room temperature and pressure?

……...

……..[1]

(b) Silicon has a structure similar to that of diamond. Explain in terms of structure and bonding why silicon has such a high melting point in Period **3**.

……...

……...

……...

……..[2]

(c) Sketch a graph to show how proton number changes across Period **3**.

[1]

(d) Fluorine, chlorine, bromine and iodine are halogens found in Group VII of the Periodic Table. Table 11.4 lists the bond lengths and average bond energies of the halogens.

Table 11.4

covalent bond	bond length/ nm ($1nm = 10^{-9}m$)	average bond energy (kJ/mol)
F – F	0.142	158
Cl – Cl	0.199	242
Br – Br	0.228	193
I – I	0.267	151

[Turn Over

(i) Describe the **general** relationship between bond length and the average bond energy within Group VII molecules.

……...

……..[1]

(ii) A student made the following comment about the reaction of gaseous propane, gaseous chlorine and gaseous bromine.

"When the same number of moles of gaseous propane is reacted with both gaseous bromine and gaseous chlorine, the rates for the two reactions will be the same."

Do you agree with the student's comment? Explain your reasoning.

……...

……...

……..[2]

[Total: 10 marks]

---End of Section B---

---End of Paper 2---

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanium 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 +															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
+90-103 Actinoid series

Key: a / X / b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

Answers for Sec 4EX Chemistry SA1 EXAMINATION Paper 2018

Paper 1 MCQ: 40 MCQs (40 marks)

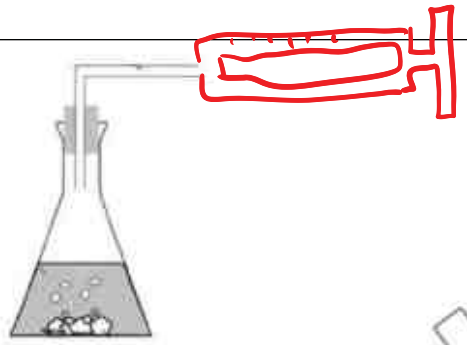
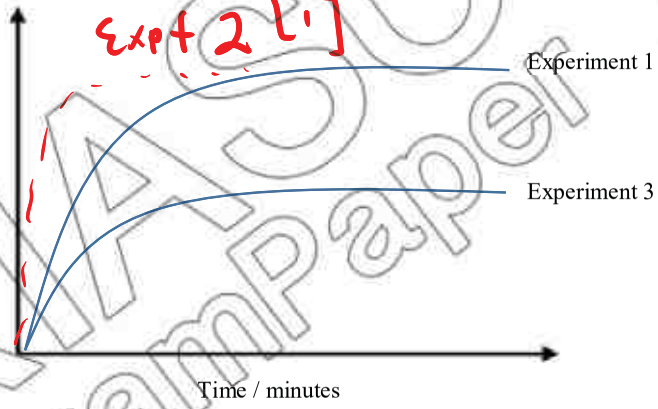
1.	B	**9.**	A	**17.**	B	**25.**	A	**33.**	C
2.	C	**10.**	C	**18.**	C	**26.**	C	**34.**	A
3.	B	**11.**	D	**19.**	D	**27.**	D	**35.**	A
4.	B/D	**12.**	D	**20.**	B	**28.**	C	**36.**	A
5.	A	**13.**	D-	**21.**	C	**29.**	C	**37.**	C
6.	D	**14.**	D	**22.**	B	**30.**	C	**38.**	C
7.	B	**15.**	B	**23.**	B	**31.**	B	**39.**	D
8.	A	**16.**	C	**24.**	B	**32.**	C	**40.**	C

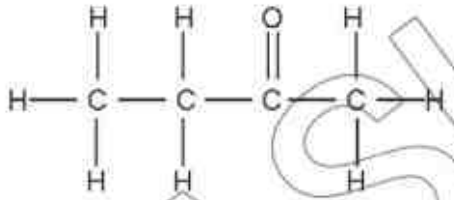
Paper 2 Section A:

Answer all questions (50 marks)

Qn	Part	Answers	Mark allocated	Markers Feedback
1	**(a)**	neutralization	[1 mark]	Very
	(b)	precipitation	[1 mark]	
	(c)	oxidation	[1 mark]	
	(e)	displacement / redox	[1 mark]	
	(f)	thermal decomposition / decomposition	[1 mark]	
A2	**(a)**	Any appropriate compound 1 mark for correct number of electrons on carbon atom 1 mark for correct number of electrons on the other atom(s) Explanation: the carbon atom and X atom share a pair of electrons to attain a noble gas electronic configuration [1]	[3 mark]	

	(b)	In allotrope A, every carbon atom is bonded to 4 other carbon atoms by strong covalent bonds. This makes the whole structure very hard. In allotrope B, every carbon atom is bonded to 3 other carbon atoms in hexagonal layers. Little force is needed to overcome these weak intermolecular forces of attraction between layers, making B slippery.	[1 mark] [1 mark]	
	(c)	Carbon causes the oxidation state of zinc to decrease from +2 in ZnO to 0 in Zn, hence reducing zinc oxide / C itself is oxidized. O.S of C increases from 0 to +2. Hence it's a reducing agent.	[1 mark]	
A3	**(a)**	A,C,D,B	[1 marks]	
	(b)	Metal A: No visible observation [1] Metal D: Metal D dissolves/brown solution becomes colourless/Grey solid produced (Any 2 for 2 marks)	[3 marks]	
	(ci)	$Fe_2O_3(s) + 3CO(g) \rightarrow 3CO_2(g) + 2Fe(l)$	[1 marks]	
	(cii)	Yes it is redox as Fe_2O_3 loses oxygen to form Fe and CO gains oxygen to form CO_2.	[1 marks]	
	(d)	Sacrificial Protection. A **more reactive metal** like magnesium or zinc can be **placed beside iron.** It will **corrode in place of iron**	[1 marks] [1 marks]	

A4	**(a)**		[1 marks]	
	(b)	$2HCl(aq) + Zn(s) \rightarrow ZnCl_2(aq) + H_2(g)$	[1 marks]	
	(c)		[1 marks]	
	(d)	Y = 30.0 cm^3 Z = 0.25 mo/dm^3 Or Y = 60.0 cm^3 Z = 0.125 mol/dm^3	[2 marks]	

	(e)	Increase in temperature, **<u>increases the kinetic energy of the particles [1]</u>**, **<u>more particles have energy greater or equal to the activation energy [1],</u>** **<u>higher frequency of effective collision</u>**,[1] increase speed of reaction	[3 marks]	
A5	**(a)**	name: hexanone formula: $C_4H_9COCH_3$	[1 marks] [1 marks]	
	(b)	$C_nH_{2n+1}COCH_3$	[1 marks]	
	(c)		[1 marks]	
	(d)	Bromine water remains brown in propanone. Bromine water decolourizes / turns colourless in propene.	[1 marks] [1 marks]	
A6	**(a)**	<u>Shields / filters out harmful UV rays from the sun</u> that can cause <u>skin cancer / genetic mutations / eye damage</u>. ;	[1 marks]	
	(b)	Forms photochemical smog which irritates the eyes and lungs which can cause breathing problems.	[1 marks]	
	(c)	<u>Chlorine</u> is oxidised. ; Its O.S. <u>increases</u> from <u>0 in Cl</u> to <u>+1 in Cl_2O</u>. ;	[1 marks] [1 marks]	
	d(i)	Pollutant reacts with rain water to form acid rain that corrodes buildings and harms aquatic life / plants.	[1 marks]	
	d(ii)	$2NO_2 + 4CO \rightarrow 4CO_2 + N_2$	[1 marks]	

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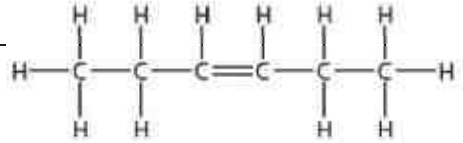
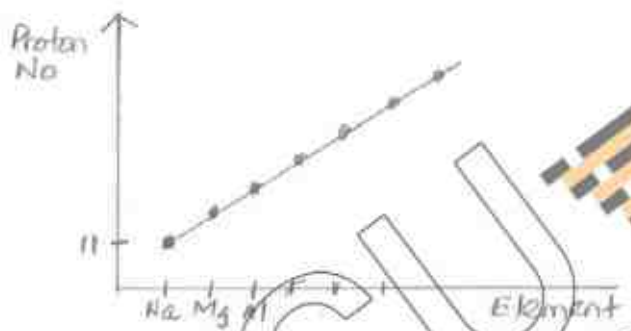
A7	**(a)**	The energy released in the formation of O-H and C=O bonds is larger; than the energy required to break the C-H, O-H, C-C and H-H bonds. ;	[1 marks] [1 marks]	
	(bi)	Moles of ethanol required to produce 100 kJ of energy 100 / 1370 = 0.07299 moles ; From the equation above, 1 mole of C_2H_5OH = 2 moles of CO_2 0.07299 moles of C_2H_5OH = 0.1460 moles of CO_2 Volume of CO_2 produced = 3.50 dm^3 ;	[1 marks] [1 marks]	
	(c)	Combustion of hydrogen produces water which does not contain carbon and produce carbon monoxide which is a pollutant or carbon dioxide which is responsible for global warming.	[1 marks] [1 marks]	
A8	**(a)**	Crude oil enters the heater and is heated up to form a gaseous mixture.; The gaseous mixture enters the distillation column and is cooled and then separated through condensation. ; The fractions with the lower boiling points / the lighter fractions will be collected at the top, while the fractions with the higher boiling points / the heavier fractions will be collected at the bottom of the distillation column.;	[1 marks] [1 marks] [1 marks]	
	(bi)	Longer hydrocarbons are cracked to produce shorter hydrocarbons / smaller molecules (e.g. petrol) that have higher demand in the industries.	[1 marks]	
	(bii)		[1 marks]	

Paper 2 Section B: (30 marks)

B9ai	Cu^{2+} (aq) + $2e^-$ → Cu (s) $2Cl^-$ (aq) → Cl_2 (g) + $2e^-$	[1 mark] [1 mark]	
B9aii	Number of moles of Cu = 0.584 / 64 = **0.009125 mol** For the same amount of electricity (2 mol of e^-), 1 mol of Cu and 1 mol of Cl_2 are produced. Hence, number of moles of Cl_2 produced is also 0.009125 mol. Volume of Cl_2 produced **= 0.009125 x 24 = 0.219 dm^3**	[1 mark] [1 mark]	
B9b	At stage 2, **Cu^{2+} ions were preferentially discharged** leaving behind Fe^{2+} ions in the electrolyte which are pale green in colour. At stage 3, **H^+ and OH^- ions from water are discharged**. Hence the concentration of the electrolyte increases and the solution becomes darker due to the Fe^{2+}.	[1 mark] [1 mark]	
B9c	The Universal Indicator will change colour from **green to violet/ blue**. **H^+ ions are preferentially discharged** at the cathode **leaving behind OH^- ions in solution / concentration of H^+ decreases which thus increases the concentration of OH^- in electrolyte** which makes the solution around the cathode alkaline.	[1 mark] [1 mark]	

B9d	The three substances are **copper, hydrogen gas and iron.** **Any one** of the following explanations : • Copper atoms are the least reactive, followed by hydrogen atoms, then iron atoms. Hence, • Copper(II) ions are preferentially discharged followed by hydrogen ions, then iron(II) ions • Copper(II) ions accept electrons most readily followed by hydrogen ions then iron(II) ions	[2 marks]	
B10a	When the percentage of carbon dioxide increases, the average temperature at the Earth's surface increases. Carbon dioxide is a greenhouse gas. It traps the infrared radiation from the sun and prevents it from going back to the atmosphere. This causes the earth's average temperature at the Earth's surface to increase.	[1 mark] [1 mark]	
b	More occurrences of unusual weather conditions such as warm spells, droughts and storms. Decrease in crop yields because areas covered by vegetation may become deserts. OR Melting of ice cap will cause ocean levels to rise and flood low-lying	[1 mark] [1 mark]	
c	Photosynthesis by plants lowers the level of carbon dioxide while combustion, respiration and decay increase the level of carbon dioxide.	[1 mark] [1 mark]	
di	When the engine is in the accelerating mode, the high temperature of the engine allows nitrogen in the air to react with oxygen to form nitrogen monoxide. When the proportion of air present in the fuel mixture is high, the fuel mixture will burn completely, there is less likelihood of incomplete combustion.	[1 mark] [1 mark]	
dii	$2NO + 2CO \rightarrow N_2 + 2CO_2$ NO loses oxygen and is reduced to N_2. CO gains oxygen and is oxidised to CO_2.	[1 mark] [1 mark]	

Either B11ai	Exothermic		
aii	Formation of bubbles is due to the hydrogen gas evolved when acid react with magnesium metal to form salt and H_2. The reaction is slow as citric acid is a weak acid – less H^+ ions dissociated..	[1 mark] [1 mark]	
aiii	$Mg(s) + 2C_5H_7O_5COOH \rightarrow (C_5H_7O_5COO)_2Mg + H_2$	[1 mark]	
aiv	Propanol is an organic solvent which will not result in hydrogen ions being produced.	[1 mark]	
bi	A reaction occurred in Experiment 2 because the aluminium strip is rubbed with sandpaper to remove the oxide layer and aluminium is more reactive than iron so displacement of iron from its salt solution can occur. A reaction does not occur in Experiment 1 as the aluminium strip is still covered by an inert(unreactive) oxide layer.	[1 marks] [1 marks] [1 marks]	
bii	There will be no reaction seen in Experiment 3 as aluminium is less reactive than sodium. Hence no displacement reaction will take place despite the aluminium strip being rubbed with sandpaper.	[1 mark] [1 mark]	
OR B11ai	1. Melting point increases from Na to Si. 2. It drops drastically from Si to P. 3. There is a gradual drop in melting point from S to Cl.	[1 mark] [1 mark] [1 mark]	
aii	Their melting points are above room temperature.	[1 mark]	
b	Silicon has a giant molecular structure with all the silicon atoms joined together with strong covalent bonds. A lot of heat energy is needed to break the strong covalent bonds between the silicon atoms.	[1 mark] [1 mark]	

c		[1 mark]	
di	as bond length **increases,** the bond energy **decreases**; (with the exception of fluorine).	[1 mark]	
ii	No. Chlorine is **more reactive** than bromine; the **reactivity decreases** down Group VII.	[1 mark] [1 mark]	

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TEMASEK SECONDARY SCHOOL
Mid-Year Examination 2018
Secondary 4 Express

CHEMISTRY **6092/01**

Paper 1 **1 hour**

Question Booklet

Additional Material: OTAS

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Write your name, index number and class on the OTAS.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

You are not required to hand in this booklet at the end of the examination.

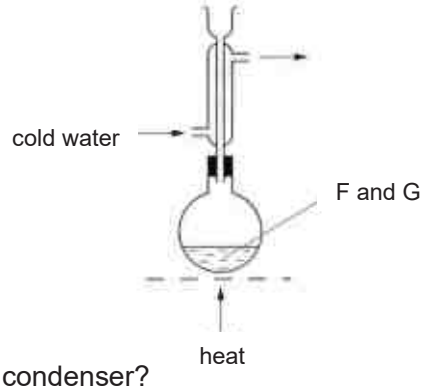
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this booklet.

A copy of the **Periodic Table** is printed on **page 18**.

This document consists of **18** printed pages.

1 The diagram shows the apparatus used for the slow reaction between liquid F (boiling point 57°C) and liquid G (boiling point 80°C).



What is the purpose of the condenser?

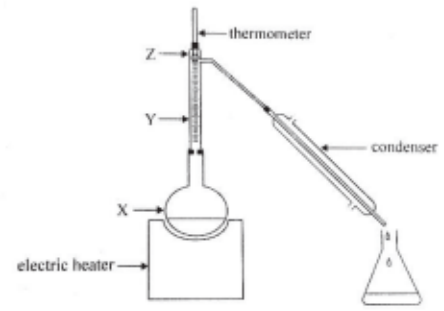
A to enable F and G to mix more efficiently

B to prevent the mixture from getting too hot

C to allow the product to escape as fast as it is formed

D to prevent F and G from escaping before the reaction is complete

2 A liquid mixture of 50% ethanol and 50% water was distilled in the apparatus shown below. The boiling point of ethanol is 78°C and that of water is 100°C. As the mixture was heated the temperature shown by the thermometer initially rose but then remained constant at 78°C for some time.



Which of the following statements about percentage of ethanol in the vapours shown at points X, Y and Z, when the temperature is at a constant 78°C, is true?

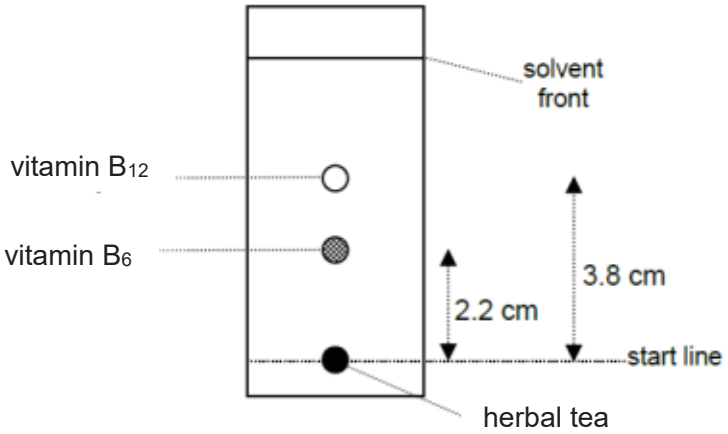
A The percentage of ethanol in the vapour at X is equal to 50%.

B The percentages of ethanol in the vapour increase in order at positions X, Y and Z.

C The percentages of ethanol in the vapour at Y and Z are equal but greater than at X.

D The percentages of ethanol in the vapour at X, Y and Z are equal but greater than 50%.

3 A sample of herbal tea containing two water- soluble vitamins was analysed during chromatography with water as a solvent. When the solvent front reached the position indicated, the chromatogram was placed under ultra-violet light. The following chromatogram was obtained.

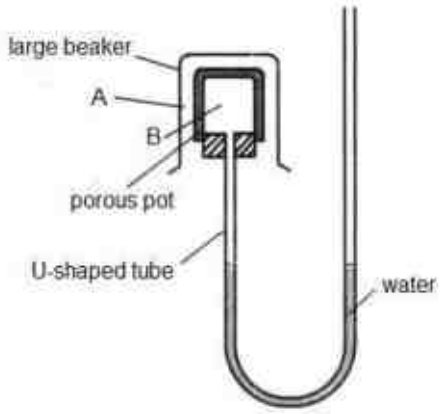


Given that the R_f value of vitamin B_{12} is 0.34, determine the R_f value of vitamin B_6.

A 0.20 **B** 0.50 **C** 0.56 **D** 0.73

4 The following diagram shows a set up.

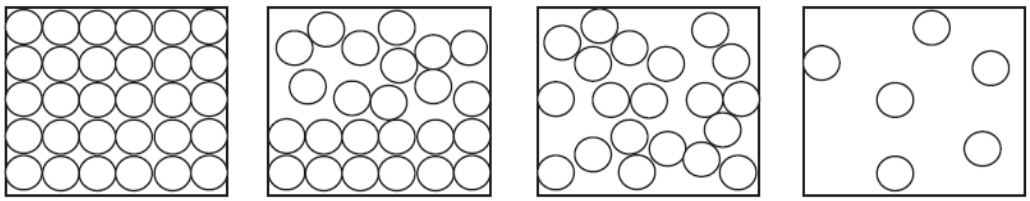
Which pair of gases would cause a fall in the water level at the right side of the U shaped tube?



	gas A	gas B
A	Nitrogen dioxide	Chlorine
B	Carbon Monoxide	Nitrogen
C	Oxygen	Neon
D	Fluorine	Argon

5 Bromine melts at -7°C and boils at 59°C. A tank filled with bromine at 30°C is cooled to -7°C.

Which diagram below best represents the arrangement of bromine particles at -7°C and at 30°C?



1 2 3 4

	-7°C	30°C
A	2	4
B	1	3
C	2	3
D	1	2

6 Fires are categorized into four different classes according to the type of fuel involved. The table below shows the various classes of fire.

class	fuel/heat Source	example
1	ordinarily combustible	solids like wood and coal on fire
2	flammable liquids	petrol, oil on fire
3	flammable gases	natural gas, carbon monoxide on fire
4	combustible metals	sodium or potassium on fire

In a selection test, a potential firefighter is required to match four substances according to their class of fire.

Which of the following has been incorrectly matched?
(Assume room temperature and pressure).

	melting point/°C	boiling point/°C	class of fire
A	98	883	4
B	-184	-164	3
C	-117	78	1
D	5	80	2

7 The table gives data about three different particles.

particle	nucleon number	number of protons	number of neutrons	number of electrons
Xe	131	54	T	54
Se^{2-}	79	U	45	36
Be^{2+}	9	4	5	V

What are the correct values of T, U and V?

	T	U	V
A	54	36	4
B	54	34	2
C	77	36	4
D	77	34	2

8 The table shows details of the particles present in the following 4 atoms or ions.

atoms/ ions	number of neutrons	number of electrons
J^-	17	18
K	16	16
L^{2+}	20	18
M	20	17

Which of the following atoms is an isotope of **J**?

A K **B** L **C** M **D** None of the above

9 A table listing the atomic numbers of 4 elements P, Q, R and S is given below.

element	P	Q	R	S
atomic Number	5	12	15	18

Using the above information only, it can be deduced that

A one atom of Q is heavier than one atom of R.

B the number of neutrons in one atom of R is more than that in one atom of Q.

C R can be converted into Q by removing three electrons from each atom of R.

D Q has a higher tendency to lose electrons than R.

10 The formulae of the ions of some elements are shown below:

P^{3-} O^{2-} Cl^{-} Na^{+} Ca^{2+}

Which of the following statements about these ions is correct?

A All have stable noble gas configuration.

B All have the same number of electron shells.

C All have the same number of neutrons in their nuclei.

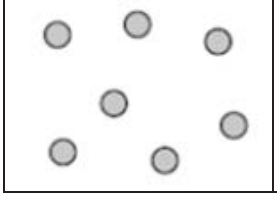
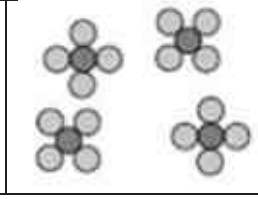
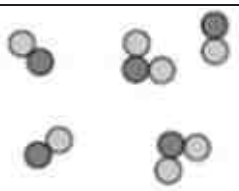
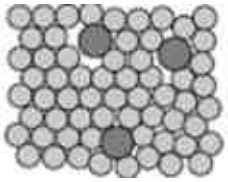
D All have more electrons than protons.

11 Solid iodine readily forms iodine vapour when heated.

What can be deduced about the nature of the particles in these two states of iodine?

	solid	**vapour**
A	atomic	ionic
B	atomic	molecular
C	molecular	atomic
D	molecular	molecular

12 Which of the following diagrams represents a mixture of elements?

A	**B**	**C**	**D**
			

13 A sample of a white crystalline substance is heated in the absence of oxygen. It melts sharply at 120°C, but on further heating, gives off smoky fumes and a black solid remains.

From this information, we may deduce that the white crystalline substance is

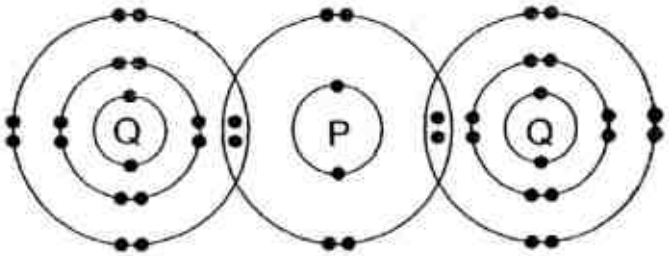
A an element which combusted to form two products.

B a mixture of substances which combined chemically.

C a compound which combusted to form two products.

D a compound which decomposed to form simpler substances.

14 The diagram below shows the bonding between P and Q in the covalent molecule, PQ_2.



What are the electronic structures of atoms P and Q before combining together to form the above molecule?

	P	Q
A	2.6	2.8.6
B	2.4	2.8.7
C	2.6	2.8.7
D	2.8	2.8.8

15 The equation below shows the reaction between a metal E and dilute sulfuric acid.

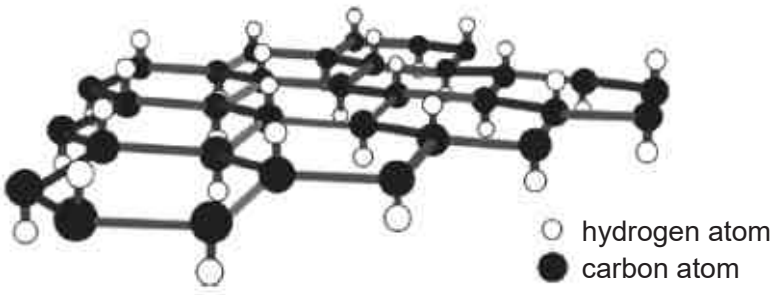
$$E\ (s) + H_2SO_4\ (aq) \rightarrow ESO_4\ (aq) + H_2\ (g)$$

A test on electrical conductivity showed that both the reagents and the resulting solution are good conductors of electricity.

Which particles are responsible for the electrical conductivity in metal E, sulfuric acid and ESO_4?

	Metal E	Sulfuric acid	ESO_4 (aq)
A	Electrons	Cations	Cations and anions
B	Electrons	Cations and anions	Cations and anions
C	Cations	Electrons	Anions
D	Cations and anions	Cations	Electrons

16 Graphane has a similar structure to graphite, except that, it has an additional hydrogen atom attached to each carbon as shown in the diagram.



Which set of properties will graphane have?

1	It has a high melting and boiling point.
2	It has a giant molecular structure.
3	It conducts electricity in the solid state.

A 1 and 2

B 1 and 3

C 2 and 3

D 1, 2 and 3

17 A solution contains 12.60 g/dm^3 of the acid H_3ZO_3.

25.0 cm^3 of this solution reacted with an equal volume of 0.100 mol/dm^3 NaOH as shown in the equation.

$$NaOH + H_3ZO_3 \rightarrow NaH_2ZO_3 + H_2O$$

What is element Z?

A arsenic **B** nitrogen

C silicon **D** sulfur

18 A sample of insecticide DDT, $C_{14}H_9Cl_5$, was found to contain 0.120 g of carbon.

What mass of chlorine was present in the sample?

A 0.127 g **B** 0.253 g

C 0.994 g **D** 1.01 g

19 Nitrogen(II) oxide and chlorine react according to the equation shown below.

$$2NO_2(g) + Cl_2(g) \rightarrow 2NOCl(g) \qquad \Delta H = -38 \text{ kJ}$$

The activation energy for the forward reaction is 62 kJ.

What is activation energy for the reverse reaction?

A - 62 kJ **B** 24 kJ

C 38 kJ **D** 100 kJ

20 The conversion of graphite to diamond has an only small value for enthalpy change as shown.

$$C\ (graphite) \rightarrow C\ (diamond) \quad \Delta H = +2.1\ kJ/mol$$

However, the production of synthetic diamonds using this reaction is very difficult.

Which statement helps to explain this?

A Diamond has a larger number of covalent bonds than graphite.

B Only exothermic reactions can occur readily.

C The activation energy of the reaction is large.

D The reaction between diamond and graphite is reversible.

21 Ammonium chloride dissolves in water according to the equation shown below.

$$NH_4Cl\ (s) \rightarrow NH_4Cl\ (aq) \quad \Delta H = +15.0\ kJ/mol$$

When 0.2 moles of ammonium chloride dissolves in 50.0 cm^3 of water,

1	the concentration of the solution is 4.0 mol/dm^3.
2	the energy level of NH_4Cl increases.
3	the heat liberated is 3.0 kJ.
4	the temperature of the solution falls.

Which one of the following statements are correct?

A 1, 2 and 3 **B** 1, 2 and 4

C 1, 3 and 4 **D** 2, 3 and 4

22 Disproportionation is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

A $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

B $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

C $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

D $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

23 The equation below is one of the reactions which occur in catalytic converters.

$$2C_8H_{18}(g) + 50NO(g) \rightarrow 16CO_2(g) + 25N_2(g) + 18H_2O(g)$$

Which statement is correct?

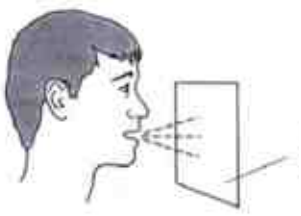
A Carbon dioxide is formed by the reduction of carbon containing compounds.

B Nitrogen is produced by the oxidation of nitrogen monoxide.

C Nitrogen monoxide is a reducing agent.

D C_8H_{18} is a reducing agent.

24 Acidified potassium manganate(VII) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.



A colour change is observed. This shows that ethanol is

A a reducing agent because it reduces the oxidation state of the manganese ions.

B an alkali because the final colour is purple.

C an oxidising agent because the manganese atoms gain oxygen atoms.

D neutralised by acidified potassium manganate(VII) solution.

25 In which of the following pairs is the oxidation number of chromium more than that of manganese?

A	K_2CrO_4	$KMnO_4$
B	$CrCl_3$	MnO_2
C	$Cr_2(SO_4)_3$	$MnSO_4$
D	$K_2Cr_2O_7$	MnO_4^-

26 Which one of the following elements burns in excess oxygen to form a neutral oxide?

A carbon **B** sulfur

C calcium **D** hydrogen

27 The following steps were carried out to prepare magnesium chloride.

I	Add excess magnesium carbonate to hydrochloric acid.
II	Heat the solution until it is saturated.
III	Filter , wash and dry the crystals.

Which of the following steps should be taken to ensure that the procedure is successful in order to obtain the pure salt?

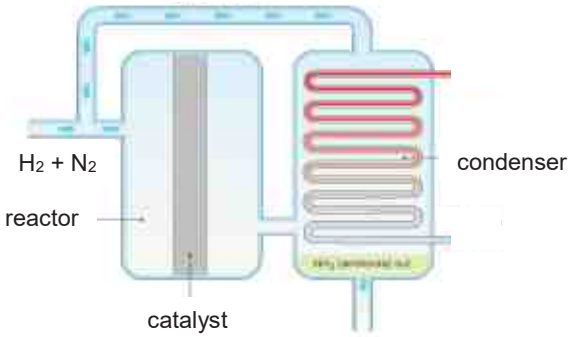
A Filter to get rid of the excess magnesium carbonate before carrying out step II.

B Add excess hydrochloric acid instead of magnesium carbonate in step I.

C Evaporate the solution to dryness in step III.

D The crystals should not be washed in step III.

28 Ammonia is produced by Haber process as shown in the diagram.



Which one of the following processes separates ammonia from the reaction mixture?

A cooling the gaseous mixture

B distillation of the gaseous mixture

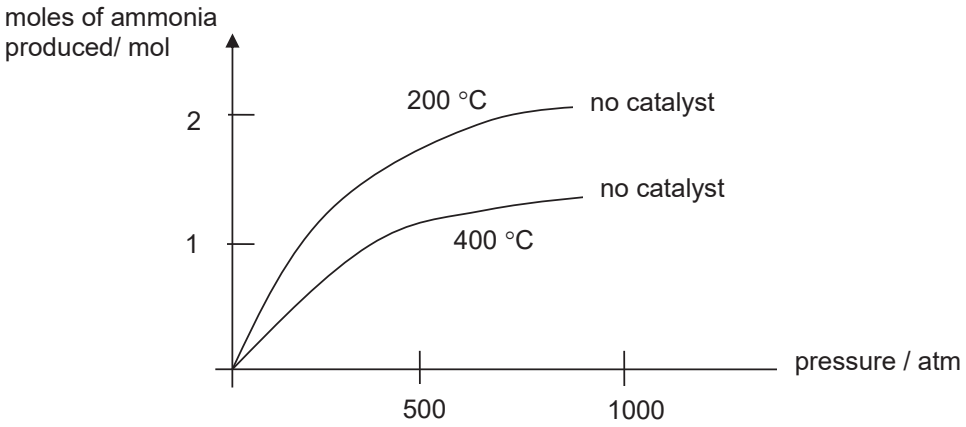
C filtering out the other gases by passing through the condenser

D pass the gaseous mixture through fused calcium oxide

29 When heated, nitrogen and hydrogen react according to the equation:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The graph below shows the number of moles of ammonia produced from 1 mole of nitrogen at different temperatures and pressures.



Which one of the following statements may be deduced from this information?

1	At 500 atm pressure, the number of moles of ammonia produced is greater at 200 °C than at 400 °C.
2	An increase of pressure increases the number of moles of ammonia produced both at 200 °C and at 400 °C.
3	At 500 atm pressure and 300 °C, the number of moles of ammonia produced is likely to be greater than one.

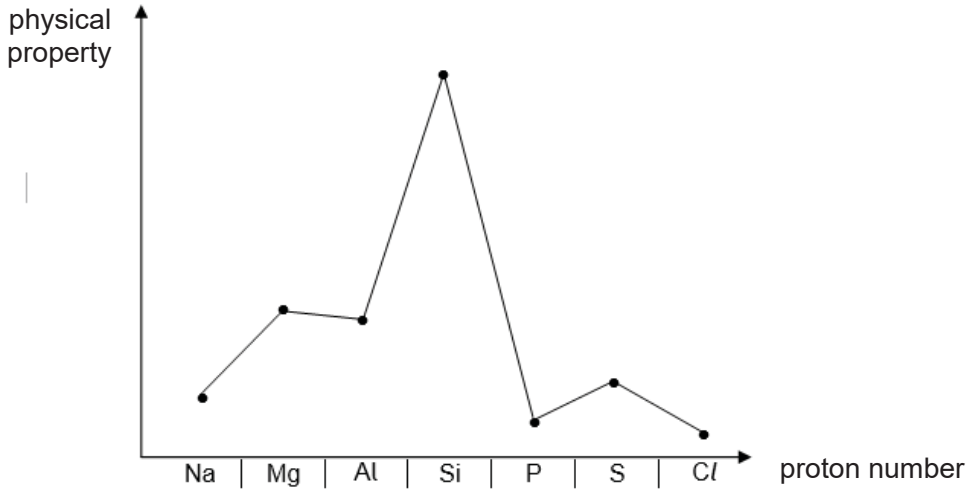
A 1, 2, and 3 are correct

B 2 and 3 only are correct

C 1 and 2 only are correct

D 1 only is correct

30 The graph shows the variation of a physical property with proton number for the elements from sodium to chlorine in the Periodic Table.



What is the physical property that varies?

A atomic radius **B** electrical conductivity

C melting point **D** density

31 An element R forms compounds with the following chemical formulae:

MgR H_2R CR_2 Li_2R

In which group of the Periodic Table would element R be placed?

A Group II **B** Group IV

C Group V **D** Group VI

32 Transition metals are often used as catalysts in industries.

Which of the following is not an example of a transition metal acting as a catalyst?

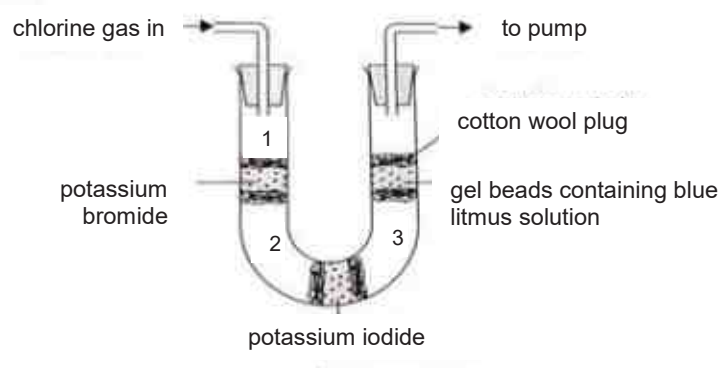
A platinum in catalytic converters

B iron in Haber Process

C aluminium in catalytic cracking

D nickel in making of margarine

33 Gaseous chlorine was passed through the following apparatus. The apparatus was continuously heated and the observations were recorded below.



Which of the following observations would be made at regions 1, 2 and 3?

	region 1	region 2	region 3
A	red-brown gas	black solid	violet gas
B	violet gas	red-brown gas	black solid
C	yellow-green gas	red-brown gas	violet gas
D	yellow-green gas	violet gas	brown gas

34 The diagram shows the positions of elements L, M, Q, R and T in the Periodic Table. These letters are not the chemical symbols of the elements.

Which statement about the properties of these elements is correct?

A M reacts more vigorously with water than does L.

B Q, R and T are all metals.

C T is more reactive than R.

D T exists as diatomic molecules.

35 Which of the following combinations below correctly states how the increase in the percentage of carbon in steel affects its properties?

	strength	malleability	melting point	brittleness
A	↑	↑	↓	↓
B	↑	↓	↑	↓
C	↑	↓	↓	↑
D	↓	↑	↑	↓

Key:

↑ = increase

↓ = decrease

36 The positions of three metals X, Y and Z are indicated in the reactivity series below.

Most reactive	potassium
	X
	sodium
	zinc
	Y
	iron
Least reactive	Z

How are the metals obtained from their ores?

	electrolysis	reduction with carbon	found uncombined
A	X	Y	Z
B	X	Z	Y
C	Y	X	Z
D	Z	X	Y

37 The table shows a list of metal carbonates and the time taken for a fixed volume of carbon dioxide to be collected upon heating a fixed mass of each metal carbonate.

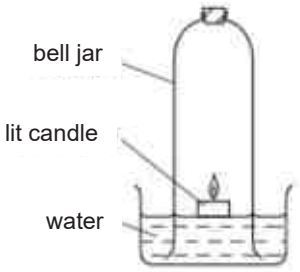
metal carbonate	time taken / min
WCO_3	0.5
XCO_3	2
Y_2CO_3	10
ZCO_3	5

Using the results shown, arrange the order of the metals in order of increasing reactivity.

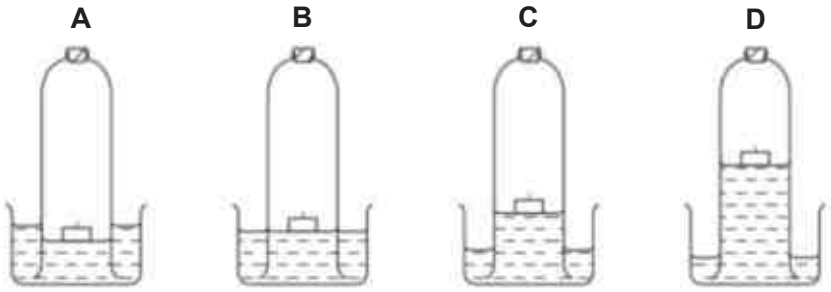
A W, Z, X, Y **B** W, X, Z, Y

C Y, X, Z, W **D** Y, Z, X, W

38 The diagram shows an experiment to determine the percentage of oxygen in air.



Which diagram shows the correct level of water after the candle stops burning?



39 Acid rain contains sulfuric acid and can cause lakes to become acidic. Acidic lakes may be treated with powdered limestone, impure $CaCO_3$, to neutralize the acidity forming calcium sulfate. If large lumps of limestone are used, instead of powder, the reaction starts but soon stops, leaving most of the limestone unreacted.

Which statement explains why the reaction starts but soon stop?

A Limestone only contains small amounts of calcium carbonate.

B The acid reacts with calcium sulfate instead of the calcium carbonate.

C Powdered limestone is more reactive that lumps of limestone.

D A layer of insoluble calcium sulfate forms on the surface of the lumps.

40 Which of the following is not responsible for the destruction of the ozone layer in the stratosphere?

A CFCs

B fluorine atoms

C chlorine atoms

D UV light

END OF PAPER 1

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____ Index Number:_____ Class: _____

TEMASEK SECONDARY SCHOOL
Mid-Year Examination 2018
Secondary 4 Express

CHEMISTRY **6092/02**

Paper 2 (Section A) **Total duration for Sections A and B: 1 hour 45 minutes**

Question and Answer Booklet

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Hand in this booklet at the end of the paper.

Write your name, index number and class in all the work you hand in.
Write in dark blue or black pen.

Answer all questions in the spaces provided on the question paper.

At the end of the examination, submit **Section A and B separately**.

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on **page 12**.

FOR EXAMINER'S USE	
Section A	/50

This document consists of **12** printed pages.

Section A
Answer all the questions in this section in the spaces provided.
The total mark for this section is 50.

A1 The table below shows some information about substances **A** to **F**.

substances	melting point/°C	boiling point/°C	conducts electricity when solid	dissolves in water
A	Turns directly from solid to gas		No	slightly
B	1583	2862	Yes	No
C	1873	2230	No	No
D	-114	78	No	Yes
E	0	100	No	-
F	-97	40	No	No

Using the information provided, suggest the best separation technique to separate the following mixture.

(a) **A** and **B** ……

(b) **C** and **D** ……

(c) **D** and **E** ……

(d) **E** and **F** ……

[4]

A2 This question is about ammonia.

(a) Describe briefly how you would prepare ammonia using an ammonium salt.

……

…… [1]

(b) Explain why it is not advisable to dry ammonia using concentrated sulfuric acid.

……

…… [1]

(c) Suggest a suitable substance to dry ammonia.

……..…… [1]

(d) When dry ammonia is passed over heated sodium, hydrogen and solid sodamide ($NaNH_2$) are formed.

Suggest why ammonia must be dried before reacting with sodium?

……

……..…… [1]

(e) Explain how hydrogen can be collected from the gaseous mixture from **(d)**.

……

……

……

……..…… [2]

(f) Construct the equation for the reaction between sodium and ammonia. Include state symbols.

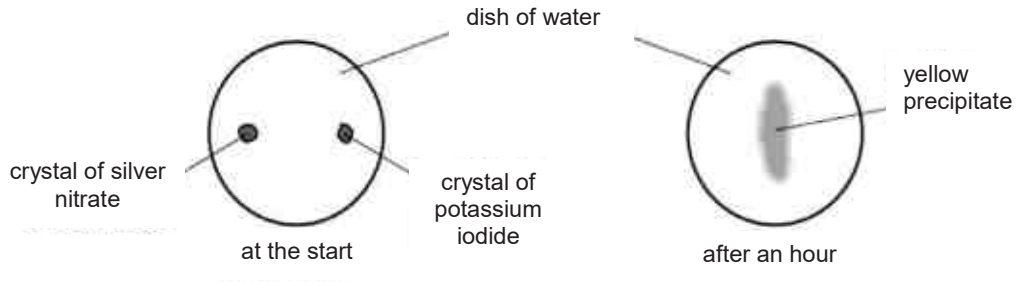
……..…….…. [2]

(g) If 240 cm^3 of hydrogen were formed at room temperature and pressure, calculate the mass of sodamide obtained.

[2]

A3 A student placed a crystal of silver nitrate and a crystal of potassium iodide in a dish of water.

After an hour she observed that the crystals had disappeared and a yellow precipitate had appeared near the middle of the dish.



Use your knowledge of the kinetic particle theory and reactions between ions to explain these observations.

……

……

……

……

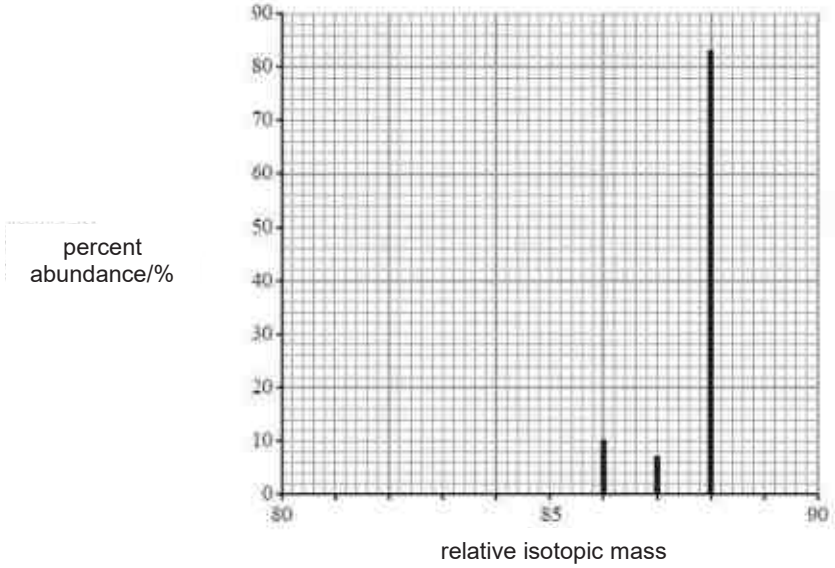
……

……

……

…… [3]

A4 The graph below shows the percent abundance (%) and relative masses of three naturally occurring isotopes of element **Z**.



(a) Define the term 'isotopes'.

……

…… [1]

(b) Using the graph, calculate the relative atomic mass of element **Z**.

[2]

(c) **(i)** **Z** has a melting point of 777°C and a boiling point of 1382°C.

A solid sample of **Z** was heated from room temperature to 1500°C. There was a larger increase in volume at the boiling point than at the melting point.

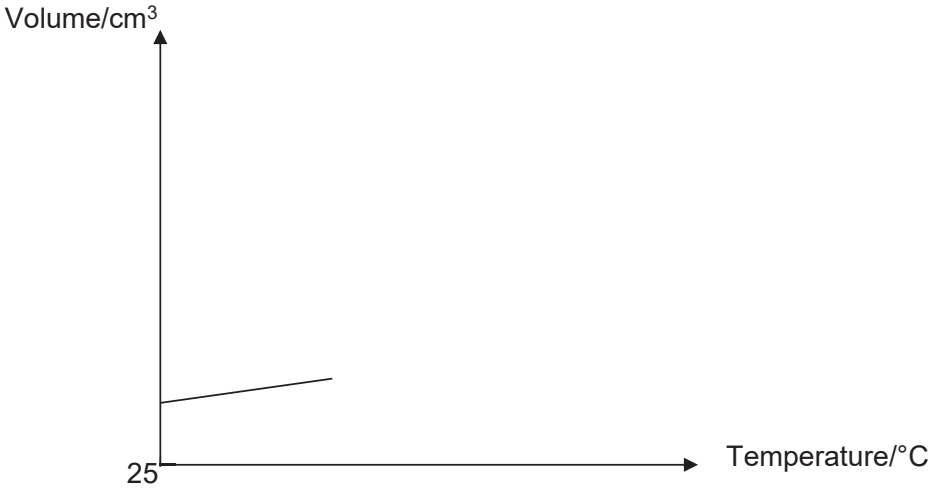
Explain, in terms of arrangement and movement of the particle, why there was a larger increase in volume at the boiling point.

……

……

…… [2]

(ii) Complete the graph below to show changes in volume of solid sample Z against temperature. Label all temperatures clearly.



[1]

A5 The labels of eight substances below had fallen off from their containers.

Zn(s)	Na_2CO_3(aq)	HCl(aq)	$BaCO_3$(s)
$CuSO_4$(aq)	NaOH(aq)	H_2SO_4(aq)	NH_4Cl(aq)

A qualitative analysis was conducted in an attempt to identify the eight substances.

	substance 1	substance 2	substance 3	substance 4
substance 5	Soluble salt formed by titrating substances 1 & 5.	Effervescence seen. Soluble salt formed.	Effervescence seen. Soluble salt formed.	Effervescence seen. Soluble salt formed.
substance 6	Blue precipitate formed.	Green insoluble salt formed.	No visible observation.	Pink solid formed.
substance 7	Soluble salt formed by titrating substances 1 & 7.	Effervescence seen. Soluble salt formed.	Effervescence seen. Insoluble salt formed.	Effervescence seen. Soluble salt formed.
substance 8	Alkaline gas formed.	No visible observation.	No visible observation.	No visible observation.

Identify substances 1 to 8.

Substance 1 …….. [1]

Substance 2 …….. [1]

Substance 3 …….. [1]

Substance 4 …….. [1]

Substance 5 …….. [1]

Substance 6 …….. [1]

Substance 7 …….. [1]

Substance 8 …….. [1]

A6 Hydrazine, N_2H_4, is commonly used as a liquid rocket fuel. It reacts with oxygen in the equation shown below.

$$N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$$

(a) Suggest why the combustion of hydrazine has negligible adverse environmental impact.

……

…… [1]

(b) Do the reactants or products have stronger bonds? Explain your answer.

……

……

……

…… [3]

(c) Sketch a labeled energy profile diagram for the above reaction.

[2]

(d) 10 g of hydrazine was burnt in 50 dm^3 of air.

(i) Did the hydrazine undergo complete combustion? Show your working.

[3]

(ii) Given that 194 kJ of energy was involved in the burning of 10g of hydrazine, calculate the enthalpy change in kJ/ mol for the reaction of hydrazine with oxygen.

[2]

A7 The reactivity of some metals can be compared using the data in the table below.

metals	displacement reactions	reaction with water and steam	observations during reaction with steam
mercury	Mercury does not displace any of the metals.	Has no reaction with steam	Silvery metal remains unchanged.
magnesium	$Mg + Zn(NO_3)_2 \rightarrow Mg(NO_3)_2 + Zn$	Reacts slowly with cold water. Burns in steam.	Grey solid turns white.
nickel	$Ni + Hg(NO_3)_2 \rightarrow Ni(NO_3)_2 + Hg$	Has no reaction with water. Reacts slowly with steam.	Silvery solid turns green.
zinc	$Zn + Ni(NO_3)_2 \rightarrow Zn(NO_3)_2 + Ni$	Has no reaction with water. Reacts slowly with steam.	Grey solid turns yellow when hot.

(a) Using the data from the table, arrange the metals in increasing order of reducing ability.

…… [1]

(b) **(i)** Solution containing nickel(II) ions are green.

State what you would expect to observe when magnesium is added to nickel(II) nitrate solution.

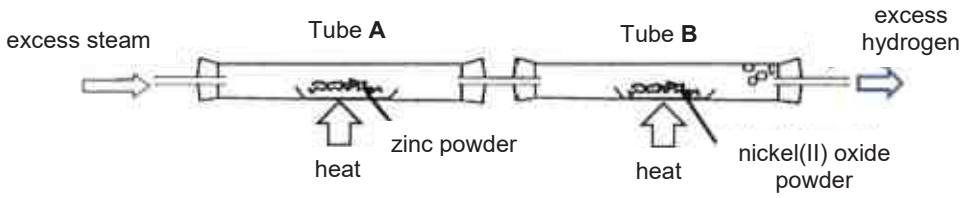
……

……..……. [2]

(ii) Write an ionic equation for the reaction in **(b)(i)**. Include state symbols.

……..……. [2]

(c) Steam was passed through the apparatus set up below.



(i) Write an equation for the reaction that occurred in Tube **A**.

……..…… [1]

(ii) Given that nickel lies between iron and lead in the reactivity series, what would you observe in Tube **B**?

Explain your answer.

……..……

……..……

……..…… [2]

END OF SECTION A

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____ Index Number:_____ Class: _____

TEMASEK SECONDARY SCHOOL
Mid-Year Examination 2018
Secondary 4 Express

CHEMISTRY **6092/02**

Paper 2 (Section B) **Total duration for Sections A and B: 1 hour 45 minutes**

Question and Answer Booklet

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Hand in this booklet at the end of the paper.

Write your name, index number and class in all the work you hand in.
Write in dark blue or black pen.

Answer **three questions** from this section.
Question B10 is in the form of either/or and only one of the alternatives should be attempted.

Write your answers in the spaces provided.

At the end of the examination, submit **Section A and B separately**.

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on **page 12** of **Section A**.

FOR EXAMINER'S USE	
Section B	/30

This document consists of **11** printed pages and **1** blank page.

Section B
Answer three questions from this section.
Question B10 is in the form of either/or and only one of the alternatives should be attempted.
Write your answers in the spaces provided.

B8 The table below shows some physical properties and common oxidation states of the Period 4 metals.

name of element	chemical symbols of element	density (g/cm^3)	melting point (°C)	common oxidation state(s)
potassium	K	0.9	64	+1
calcium	Ca	1.5	842	+2
scandium	Sc	3.0	1541	+3
titanium	Ti	4.5	1660	+2,+3,+4
vanadium	V	6.1	1917	+2,+3,+4,+5
chromium	Cr	7.9	1857	+2,+3,+4,+5,+6
manganese	Mn	7.2	1244	+2,+3,+4,+5,+6,+7
iron	Fe	7.9	1537	+2,+3,+4,+6
cobalt	Co	8.7	1494	+2,+3,+4
nickel	Ni	8.9	1455	+2,+3,+4
copper	Cu	8.9	1084	+1,+2

(a) Quoting data from the table above, state two ways the main group metals, potassium and calcium differ in their physical properties from the transition metals, titanium to copper.

……

……

……

……

……

…… [2]

(b) State two differences that can be observed when the metals potassium and iron are added to dilute hydrochloric acid respectively.

……

……

……

……

…… [2]

(c) Describe the general pattern for the oxidation states exhibited by the transition metals from titanium to copper.

……

……

…… [1]

(d) Explain why the main group metals, potassium and calcium have only one oxidation state of +1 and +2 respectively.

……

……

…… [1]

(e) Manganese(II) nitrate decomposes upon strong heating to form manganese(IV) oxide and nitrogen dioxide gas.

Explain, with the aid of an equation, whether the decomposition of manganese nitrate is a redox reaction in terms of oxidation state.

……

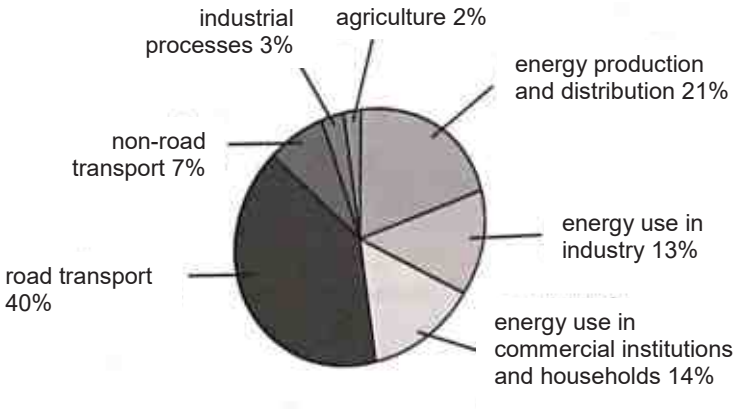
……

……

……

…… [3]

(f) The pie chart below shows how oxides of nitrogen, NO_x production is contributed by the different activities.



(i) Describe how oxides of nitrogen are formed in car engines.

……

…… [1]

(ii) Based on the statistics given in the chart, suggest one way to drastically reduce NO_x emissions.

……

……

…… [1]

(iii) Describe an impact of NO_x emissions on the environment.

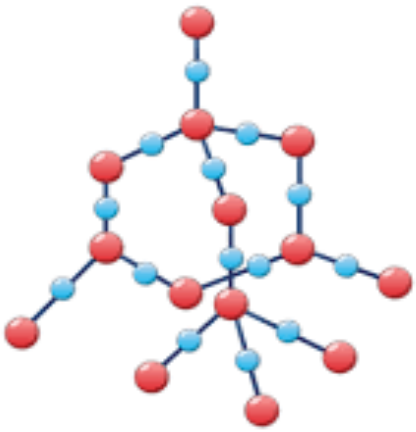
……

…… [1]

[Total: 12 marks]

B9 Silicon dioxide, also known as silica, is a chemical compound that is an oxide of silicon. Silica, in the form of sand is used as the main ingredient in sand casting for the manufacture of various metallic components in engineering.

A diagram of a silicon dioxide is shown below.



(a) State one similarity and one difference between the structure of silicon dioxide and structure of diamond.

……

……

……

…… [2]

(b) Both diamond and silicon dioxide are poor electrical conductors.

State the name of another form of carbon which can conduct electricity.

How is this form of carbon different in structure from silicon dioxide which allows it to conduct electricity?

……

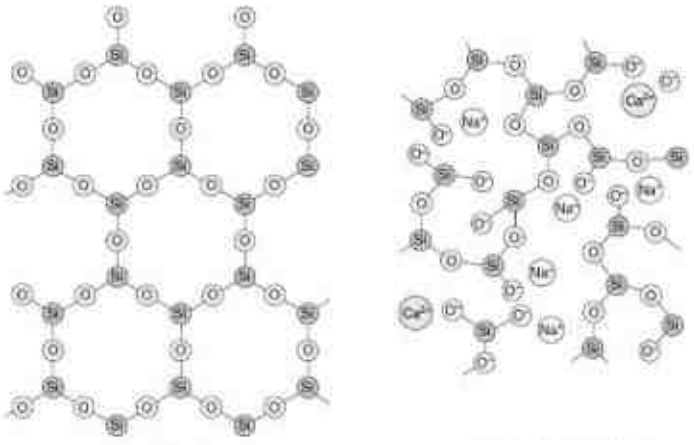
……

……

…… [2]

(c) Soda-lime glass is made by heating a mixture of calcium carbonate, sodium carbonate and sand in a furnace to a high temperature.

Other glasses contain compounds called silicates. The structures of soda-lime glass and silicate are shown in **Fig. 9**



silicate soda- lime glass

Fig.9

(i) State one structural difference between soda-lime glass and silicate.

……

…… [1]

(ii) Is soda-lime able to conduct electricity? Explain your answer.

……

……

……

……

……

…… [3]

[Total: 8 marks]

B10 Either

Read the information below about the oxides of elements in Period 3 of the Periodic Table.

Elements and their oxides

The table below show the properties of the oxides formed by elements in Period 3.

element	formula of oxide	melting point of oxide/°C	boiling point of oxide/°C
Na	Na_2O	1132	1950
Mg	MgO	2852	3600
Al	Al_2O_3	2072	2977
Si	SiO_2	1600	2230
P	P_4O_6	24	173
	P_4O_{10}	340	360
S	SO_2	-72	-10
	SO_3	17	45
Cl	Cl_2O	-121	2
	Cl_2O_7	-92	82

(a) Describe the pattern for the ratio of each metallic element to oxygen across period 3. Include ratios in your answer.

……

…… [1]

(b) Account for the melting and boiling points of the oxides formed by elements in Period 3 in terms of structure and bonding.

……

……

……

……

……

……

……

…… [3]

(c) Suggest a reason for the difference in the melting and boiling points between the two oxides of sulfur.

……

……

…….…… [2]

(d) The table below shows the variation of atomic and ionic radius across Period 3.

element	atomic radius/nm	simple ion	ionic radius/nm	number of electron shells in simple ion
Na	0.191	Na^+	0.102	
Mg	0.160	Mg^{2+}	0.072	
Al	0.130	Al^{3+}	0.054	
Si	0.118	*	-	-
P	0.110	P^{3-}	0.212	
S	0.102	S^{2-}	0.184	
Cl	0.099	Cl^-	0.181	
Ar	0.095	-	-	-

*Si does not form simple ions and thus the data is omitted from the table

(i) Complete the table above to show the number of shells of electrons in the ions of period 3 elements. [1]

(ii) Use the information from the table to explain the difference between the radii of anions and cations in the same period.

……

……

……

……..…. [2]

(iii) Suggest why there is no value stated for the ionic radius of argon.

……

……..…. [1]

[Total: 10 marks]

B10 OR

Read the information below about the chlorides of elements in Period 3 of the Periodic Table.

Elements and their chlorides

The formulae and chemical properties of the chlorides of the elements change across Period 3.

The chlorides behave differently when they are added to water. Some the chlorides dissolve in water to form a solution. Some hydrolyse when they are added to water. This means that they react chemically with water to produce new products.

element	metal / non-metal	formula of main chloride	bonding in chloride	effect of adding chloride to water	products of adding chloride to water
Na	metal	$NaCl$	ionic	dissolves	$NaCl(aq)$
Mg	metal	$MgCl_2$	ionic	dissolves	$MgCl_2(aq)$
Al	metal	$AlCl_3$	covalent	hydrolyses	Complex mixture of products including $HCl(aq)$
Si	non-metal	$SiCl_4$	covalent	hydrolyses	$SiO_2(s)$ $HCl(aq)$
P	non-metal	PCl_3	covalent	hydrolyses	$H_3PO_3(aq)$ $HCl(aq)$
S	non-metal	S_2Cl_2	covalent	hydrolyses	complex mixture of products including $HCl(aq)$
Cl	non-metal	Cl_2	covalent	hydrolyses	$HClO(aq)$ $HCl(aq)$

The chlorides have a different formulae and the ratio of the element to chlorine changes across Period 3. Some examples are shown in the table below.

formula of chloride	ratio of element to chlorine
$NaCl$	1:1
$MgCl_2$	1:2
$AlCl_3$	1:3

(a) Describe the pattern for the ratio of each element to chlorine across period 3. Include ratios in your answer.

……

……

…….…… [2]

(b) **(i)** Which chloride forms a precipitate when it is added to water?

…….....…. [1]

(ii) Write a balanced equation for the reaction of phosphorus (III) chloride with water.

…….....…. [1]

(c) Two students talk about the data.

Student 1: 'I think that whether or not the chloride hydrolyses is linked to the metal or non-metal character of the element.

Student 2: 'I think that whether or not the chloride hydrolyses is linked to the bonding of the chloride.'

Does the information in the table support the ideas of the students?

Explain your reasoning.

……

……

……

……

…….…… [3]

(d) Another student performs an experiment to test whether some other chlorides dissolve or hydrolyse when they are added to water.

He adds each chloride to water and tests the pH of the mixture.

Explain how the result of a pH test shows whether or not a chloride has hydrolysed.

……

……

……

…… [2]

(e) Suggest a reason why argon is not included in the table of information about Period 3 chlorides.

……

…… [1]

[Total: 10 marks]

END OF SECTION B

Sec 4E Chemistry 6092
Mid Year Examination 2018
Mark Scheme

Paper 1

1	D	**11**	D	**21**	B	**31**	D
2	B	**12**	D	**22**	C	**32**	C
3	A	**13**	D	**23**	D	**33**	C
4	C	**14**	C	**24**	A	**34**	A
5	C	**15**	C	**25**	C	**35**	C
6	C	**16**	A	**26**	D	**36**	A
7	D	**17**	A	**27**	A	**37**	B
8	C	**18**	A	**28**	A	**38**	C
9	D	**19**	D	**29**	A	**39**	D
10	A	**20**	C	**30**	C	**40**	B

Paper 2 Section A

A1 **(a)** Sublimation [1]

(b) Filtration [1]

(c) Fractional distillation [1]

(d) Using separating funnel [1]

A2 **(a)** Heating of ammonium salt with an alkali. [1]

(b) Ammonia is an alkaline gas and will react with /be neutralized by concentrated sulfuric acid, forming a salt. [1]

(c) Calcium oxide/fused calcium chloride [1]

(d) Sodium will react vigorously with water to form sodium hydroxide and hydrogen gas. [1]

(e)
- Pass the gaseous mixture through water / collect by displacement over water. [1] [2]
- As ammonia is very soluble in water, it will be absorbed by the water. Only hydrogen will be collected as it is insoluble in water. [1]

(f) $2NH_3\ (g) + 2Na\ (s) \rightarrow H_2\ (g) + 2NaNH_2\ (s)$ [2]

[1] for balanced equation
[1] for correct state symbols

(g) No of moles of hydrogen
= 0.24/ 24
= 0.0100 [1]

Mole ratio of H_2 : $NaNH_2$
1 : 2
0.0100 : 0.0200

Mass of sodamide
= 0.0200 x (23+14+ 2)
= 0.780 g [1]

[2]

A3 Crystal of silver nitrate and potassium iodide dissolve in the dish of water [1] and form ions which diffuse from a region of higher concentration at the 2 spots to a region of lower concentration at the middle of the dish [1].
Silver ions and iodide ions react to form insoluble silver iodide [1] which is yellow in colour

A4 **(a)** Isotopes are atoms of the same element with same number of proton but different number of neutrons. [1]

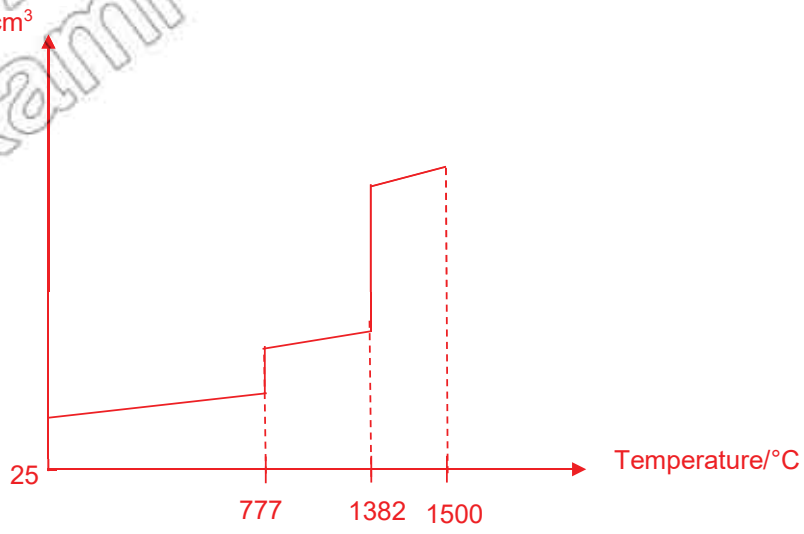
(b)

A_r of Z = $\frac{(10 \times 86) + (7 \times 87) + (83 \times 88)}{100}$ [1]

= 87.7 (3sf) [1]

(c) **(i)** There was a change in state from liquid to gas.
The particles moved faster in all directions / randomly [1]
and were spaced further apart / large spaces between particles. [1]

(ii)



The vertical line at 1382 must be longer than that at 777.
All the 3 values (777, 1382 and 1500) must be indicated clearly.

A5

Substance 1	NaOH / sodium hydroxide	[1]
Substance 2	Na_2CO_3 / sodium carbonate	[1]
Substance 3	$BaCO_3$ / barium carbonate	[1]
Substance 4	Zn / zinc	[1]
Substance 5	HCl / hydrochloric acid	[1]
Substance 6	$CuSO_4$ / copper(II) sulfate	[1]
Substance 7	H_2SO_4 / dilute sulfuric acid	[1]
Substance 8	NH_4Cl / ammonium chloride	[1]

A6

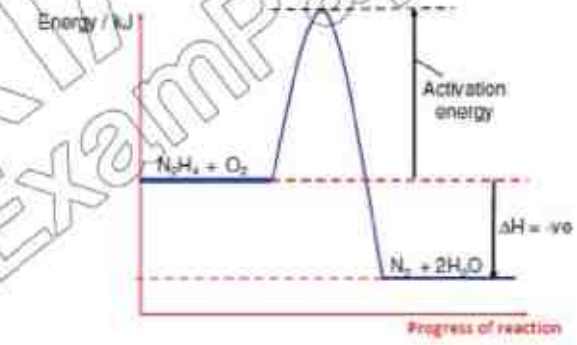
(a) The only products of the combustion are nitrogen and water vapour which are components of clean air. [1]

(b)

- The products have stronger bonds. [no marks] [3]
- The total energy absorbed during the breaking of bonds in N_2H_4 and O_2 is less than the the total energy released during the forming of bonds in N_2 and H_2O
- as reaction of hydrazine with oxygen is an exothermic reaction. [1]

[1] for idea that energy absorbed during bond breaking is less than energy released released during bond forming
[1] correct relation of substances in bond breaking and bond forming

(c) [2]



[1] for correct energy profile

[1] for labeled axes, reactants, products, activation energy & ΔH

(d) **(i)** No of moles of hydrazine
= 10 / (14x2 + 4)
= 0.313 [1]

Volume of oxygen in air
= 21% x 50
= 10.5 dm^3

No. of moles of oxygen
= 10.5/24
= 0.438 [1]

Mole ratio of O_2 : N_2H_4
1 : 1
0.438 : 0.438

Since 0.438 moles of N_2H_4 is required and only 0.313 moles is available, N_2H_4 is the limiting reagent and is completely used up and hence, underwent complete combustion. [1]

[3]

(ii) 0.313 moles of hydrazine releases 194 kJ of energy
1 mole of hydrazine releases 194/ 0.313 [1]
= 621 kJ

Hence, ΔH = - 621 kJ/mol [1]

[2]

A7 **(a)** Mercury, nickel , zinc , magnesium [1]

(b) **(i)** Solution changes from green to colorless. [1] [2]

Silvery solid is formed. [1]

(ii) $Mg\ (s) + Ni^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Ni\ (s)$

[2]

[1] for balanced ionic equation
[1] for state symbols

(c) **(i)** $Zn + H_2O \rightarrow ZnO + H_2$ [1]

(ii) Silvery solid is formed. [1] [2]

Nickel(II) oxide has been reduced to grey solid nickel by hydrogen [1]

Paper 2 Section B

B8 (a) The density of main group metals, potassium and calcium, are lower (0.9 g/cm^3 and 1.5 g/cm^3 respectively) than the transition metals (ranges from 4.5 g/cm^3 to 8.9 g/cm^3) or vice versa. [1m with quoted data from table]

The melting points of the main group metals, potassium and calcium, (64^{o}C and 842 ^{o}C) are lower than that of the transition metals (1084 ^{o}C and above/ranges from 1084 ^{o}C to 1917 ^{o}C) [1m with quoted data from table]

(b)

- For potassium, the solution remains colourless but for iron, the solution changes from colourless to green.
- Potassium took a shorter time to disappear than iron.
- The rate of effervescence for potassium with dilute hydrochloric acid is greater as compared with iron.

Any 2 observations [2m]

(c) The oxidation states exhibited by the elements increase from titanium with 3 different oxidations states to manganese with 6 different oxidations states and then decreases from manganese to copper with 2 different oxidation states.

1 mark for correct trend + quoted evidence

(d) Potassium and calcium has a fixed number of valence electrons of 1 and 2 respectively and lose their valence electrons

to achieve a stable octet configuration/noble gas configuration [1m].

This explains why they have only one oxidation state at +1 and +2 respectively.

(e) $Mn(NO_3)_2 \rightarrow MnO_2 + 2NO_2$ [1]

$Mn(NO_3)_2$ is oxidised to MnO_2 as the oxidation state of manganese increases from +2 to +4. [1]

$Mn(NO_3)_2$ is reduced to NO_2 as the oxidation state of nitrogen decreases from +5 to +4. [1]

Since oxidation and reduction occurs simultaneously, this a redox reaction.

(f) **(i)** Under high temperature, the nitrogen and oxygen in the air of car engine reacts to form oxides of nitrogen.

(ii) The largest contributor of 40% to the production of NOx is road transport. Hence we can,

- Fit catalytic converters in the exhaust pipes of cars
- Reduce vehicular activity by encouraging greener transportation activities such as public transport and cycling

Any 1

(iii) NO_x dissolve in rain water and react with oxygen to form acid rain which leads to:

- weathering of limestone buildings and metal structures.
- causing soil to be acidic and leaches nutrients from soil, resulting in poor plant growth, damaging trees and forests
- water being acidic and destroying aquatic life

Any one impact.

B9 **(a)** Both has a giant tetrahedral arrangement. OR
There are strong covalent between atoms in both silicon dioxide and diamond. [1]

Silicon dioxide is made of silicon and oxygen atoms covalently bonded together whereas diamond is made up of only carbon atoms covalently bonded together. [1]

(b) Graphite. [correct but no marks]

Each carbon atom in graphite uses only 3 out of its 4 valence electrons for covalent bonding. There is one delocalized electron form each carbon atom which is free to move to carry electric charges whereas

there are no free electrons in silicon dioxide to carry electric charges. [1]

(c) **(i)**

silicate	soda-lime glass
Has regular arrangement of atoms/ arranged in hexagonal rings	Has irregular arrangement of atoms /ions
Absence of ions	Presence of calcium/ sodium ions
All the oxygen atoms are each covalently bonded to 2 silicon atoms	Some oxygen atoms are covalently bonded to only one silicon atom

Contains covalent bonds	Contains covalent and ionic bonds

Any one difference

(ii) It is not able to conduct electricity in the solid state but is able to conduct electricity in the molten state. [1] ***[Reject aqueous state]***

In the solid state, the calcium and sodium ions are in fixed positions and are not free to move to conduct electricity.[1]

In the molten state, the ions are free to move to conduct electricity. [1]

B10 Either

(a) The ratio of each metallic element to oxygen across period 3 decreases from 2:1 to 2:3 from sodium to aluminium.

(b) Na_2O, MgO and Al_2O_3 has a giant ionic lattice structure. Large amount of energy is needed to overcome the strong electrostatic forces of attraction between the oppositely charged ions. [1] Thus they have a high melting and boiling point.

SiO_2 has a giant molecular structure. Large amount of energy is needed to overcome the strong covalent bond between the silicon and oxygen atoms. [1] Thus it has a high melting and boiling point.

Oxides of P, S and Cl have a simple molecular structure. Small amount of energy is needed to overcome the weak intermolecular forces of attraction/weak van der waals forces between molecules. [1] Thus they have a low melting and boiling point.

if ans does not relates to m.p and b.p minus 1m

(c) SO_3 has a higher melting and boiling point compared to SO_2 because it has a higher relative molecular mass [1]
Thus the intermolecular forces of attraction is stronger. More energy is needed to overcome it. [1]

(d) **(i)** 2;2;2;
3;3;3

(ii) The radii of anions are generally larger than that of cations
+ quoted evidence from table eg average radii of cation vs anions [1]

as anions consist of 1 more electron shells [1] compared to cations.

Thus radii of anions are generally larger.

(ii) Argon has a stable electronic configuration/stable octet configuration and thus do not gain or lose electrons to form ions/ chemically unreactive/inert [1] and will not affect the radius.

B10 OR

(a) Across period 3, the ratio of each element to chlorine decreased from 1:1 in NaCl to 1:4 in $SiCl_4$ respectively [1]
and then increased from 1:3 to 1:1 in PCl_3 to S_2Cl_2. [1]

(b) **(i)** Silicon tetrachloride or silicon(IV) chloride or $SiCl_4$

(ii) $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3\ HCl$

(c) The information supports the idea of student 2 but not student 1.

The information supports student's 2 idea as covalent chlorides formed from aluminium to sulfur hydrolyse [1] whereas ionic chlorides like those of sodium and magnesium only dissolve. [1]

The information does not support student 1 as chlorides of both metals like aluminium and non-metals from silicon to sulfur hydrolyse. [1]

(d) Based on the information in the table, if a chloride has hydrolysed, dilute hydrochloric acid will be produced.
Hence, a pH level lower than 7 will mean that the chloride has hydrolysed. [1]
If the chloride is not hydrolysed, the pH remains at 7. [1]

(e) Argon has a attain a stable electronic configuration of 8 electrons in the outermost shell/ stable octet configuration.
Hence, it is chemically unreactive/inert and will not react with chlorine to form a chloride.