### Free Biology 2016 Paper 1

<table>
<thead>
<tr>
<th></th>
<th>School Name and Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Singapore Chinese Girls' School P2</td>
</tr>
<tr>
<td>2</td>
<td>Chung Cheng High School (Main) P2</td>
</tr>
<tr>
<td>3</td>
<td>CHIJ Saint Nicholas Girls' School P1 &amp; P2</td>
</tr>
<tr>
<td>4</td>
<td>Victoria School P2</td>
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<tr>
<td>5</td>
<td>Catholic High School P2</td>
</tr>
<tr>
<td>6</td>
<td>Bukit Panjang Government High School P2</td>
</tr>
<tr>
<td>7</td>
<td>Paya Lebar Methodist Girls' School P2</td>
</tr>
<tr>
<td>8</td>
<td>Kranji Secondary School P2</td>
</tr>
<tr>
<td>9</td>
<td>Geylang Methodist Secondary School P1&amp;P2</td>
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<td>10</td>
<td>Bukit Batok Secondary School P1 &amp; P2</td>
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<td>11</td>
<td>Chong Boon Secondary School P1 &amp; P2</td>
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<tr>
<td>12</td>
<td>Fuhua Secondary School P1 &amp; P2</td>
</tr>
<tr>
<td>13</td>
<td>Bishan Park Secondary School P2</td>
</tr>
<tr>
<td>14</td>
<td>Bowen Secondary School P2</td>
</tr>
</tbody>
</table>

Need a home tutor? Visit smiletutor.sg
(a) Fig. 1.1 represents some alleles on part of the sex chromosomes of a woman and a man.

(b) The number of males is given in brackets [ ]. In the end of each question or part question, you are advised to spend no longer than four minutes on each question. The total time for this examination is 45 minutes.

Electronic calculators may be used.

Written answers in the spaces provided on the Question Paper should be kept as a record of your answers.

READ THESE INSTRUCTIONS FIRST

No additional materials are required.

1 hour 45 minutes
23 Aug 2016
616/02

BISHAN PARK SECONDARY SCHOOL

PRELIMINARY EXAMINATIONS (II) 2016

PAPER 2

PURE BIOLOGY

Name

Class

Index Number
Fig. 1.2 shows how the alleles on one of the chromosomes might appear in a cell taken from somewhere else in the man's body. Allele B shows a mutation.

![Diagram of alleles](image)

**Fig. 1.2**

Ultra-violet ray from the sun is a type of ionising radiation that could be a possible cause of the mutation shown in Fig. 1.2.

(i) Suggest one other possible cause of the mutation.

(ii) **[1]**

(iii) Fig. 1.3 shows sun-cream being applied by a man to protect his skin from the sun's ultra-violet ray.

![Man applying sun-cream](image)

**Fig. 1.3**

Suggest how using sun-cream reduces the damaging effect of the Sun's rays.

**[1]**

(c) Fig. 1.4 shows the hand of a person who suffers from a mutation that results in people having more than five digits on each hand (polydactylly).

![Person's hand with extra fingers](image)

**Fig. 1.4**

The mutation that results in this condition is dominant.

Fig. 1.5 shows how the condition is inherited in a family.

![Pedigree chart](image)

**Fig. 1.5**

*Key:*
- male
- female
- normal
- affected by polydactylly
In the space below, draw a large longitudinal section (cut along the length) through the blood vessel as it appears at position B.

Name the type of blood vessel labelled in Fig. 2.1.

Fig. 2.1

(a) ____________

(b) ____________

(c) ____________

(d) ____________

Using evidence from Fig. 1.5, state which of the couples P or R provides

(ii) ____________

(iii) ____________

Write your answer in Table 1.1.

Table 1.1

<table>
<thead>
<tr>
<th>P</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

The number of the lymphatics shown in Fig. 1.5.

(i) ____________
(b) Suggest why, at the end of the demonstration, the blood vessel is no longer visible between positions B and C.

......................................................................................................................................................... [4]

(c) Suggest why a rod was repeatedly gripped tightly before carrying out this demonstration.

......................................................................................................................................................... [2]

(d) Use your knowledge of how blood moves through the circulatory system to suggest an explanation for why, after a few minutes, the chair with the student falls forward similar to the chair in Fig. 2.2(b).

......................................................................................................................................................... [4]

[Total: 13]
Draw and label a flowchart of numbers for a plane tablet, small block and spindle.

Reflections on the reading

(a) What name is given to a chain of feeding relationships as shown in Fig. 3.1?

(b) How do green plants produce their food?

(c) What are the first three processes in the food cycle?

(d) Write the first letter that might tell you that people are eating any food.

(e) In each space below, draw and label a flowchart of numbers for the plant, root and green plants.

(f) Over a period of several months, a farmer recorded some activities of the fruit in a farm field. The following observations appeared in his notebook:

- The flowers of the plants were pollinated by insects.
- The mature fruits were harvested and eaten by humans.
- The seeds were dispersed by the wind.
- The seeds were planted in the field.

Using these observations, draw and label a flowchart to show the feeding and other activities in the field.
4. Pitcher plants, similar to the one shown in Fig. 4.1, trap insects in their pitchers and digest them in solutions which they secrete into their pitchers.

A student wanted to investigate the nature of the solutions found inside the pitchers. Table 4.1 summarises the contents of the six test-tubes which were set up.

<table>
<thead>
<tr>
<th>Need a home tutor? Visit smiletutor.sg</th>
</tr>
</thead>
</table>

Table 4.1

<table>
<thead>
<tr>
<th>test-tube M</th>
<th>test-tube N</th>
<th>test-tube O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cm³ water</td>
<td>2 cm³ liquid from pitcher B</td>
<td>2 cm³ boiled and cooled liquid from pitcher B</td>
</tr>
<tr>
<td>1 cm³ raw meat</td>
<td>1 cm³ raw meat</td>
<td>1 cm³ raw meat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>test-tube P</th>
<th>test-tube Q</th>
<th>test-tube R</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cm³ water</td>
<td>2 cm³ liquid from pitcher B</td>
<td>2 cm³ boiled and cooled liquid from pitcher B</td>
</tr>
<tr>
<td>1 cm³ butter</td>
<td>1 cm³ butter</td>
<td>1 cm³ butter</td>
</tr>
</tbody>
</table>

Five hours later, the only visible change was that the cube of meat in test-tube N was much smaller.

(a) State the purpose of

<table>
<thead>
<tr>
<th>test-tubes M and P</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>test-tubes O and R</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
</tr>
</tbody>
</table>

(b) At the end of the experiment, which chemical would be present in test-tube N, but not in any of the other test-tubes? Explain your answer.

Some pitcher plants attract small mammals such as bats to spend their resting hours comfortably in the opening to their pitchers. Others attract small tree swarms by releasing a sweet, nectar-like substance from glands on the pitcher lids, as shown in Fig. 4.2.
Question 7 in the form of an Exhurction question. Only one part should be answered.

Section B

Part 1:

1. Describe how heat is transferred to the grains in the picture

2. Discuss the effect of heat on the grains' moisture content.

3. Name the process used by the picture that balances the moisture content.
(b) The results obtained by the student are shown in Fig. 5.2.

![Graph showing rate of photosynthesis vs. carbon dioxide concentration]

Fig. 5.2

(i) State the factor that is limiting the rate of photosynthesis in region X of the graph.

(ii) Suggest and explain the reasons for the shape of the graph in region Y.

(c) Counting bubbles may not be the best way to measure the rate of photosynthesis. The volume of bubbles is not always exactly the same.

Suggest and describe one alternative way of measuring the gas given off to solve this problem.

[Total: 10]
7 Either

(a) Describe how carbon in dead leaves is taken up by a flowering plant to form plant proteins.

(b) Explain the importance of mitosis and meiosis in plant reproduction.

7 Or

(a) Explain how knowledge of genetics has helped breeders to improve the quality of wool produced by sheep.

(b) Changes have been taking place among living things on Earth for millions of years due to a natural process of selection. Suggest how this process may have caused giraffes to evolve from a short-necked species to the present long-necked species.

- End of Paper -
3cii correct shape:

- Small birds
- Aphids
- A bean plant

All three levels correctly labelled.

(A: for ONE mark, correct shape with no labels OR correct shape with wrong but plausible labels. Correct shape = implausible labels = 0)

3d Accept reverse arguments for masking points:

- (By keeping the surrounding temperature close to the animal body temperature) less energy is required.
- (By restricting the activity of animals) The animals have less muscle activity/use.
- (Hence, more energy is available) increased productivity / profit / lower feeding costs / (consumer) lower cost to buy.

Max 3m

4a Test tubes M and P:

- Act as control for the experiment / prove that the digestion took place because of the presence of the liquid from the pitcher plant.
- To prove that the liquid from the pitcher plant contains enzyme(s):

Max 2m

4b Amino acids = as raw meat contains protein;
- Water cannot digest meat;
- Boiling the liquid cause enzymes to denature.

3m

4c Photosynthesis:

- (The substance) is translocated as sucrose:
- In solution;
- Via the phloem;

CAO

1m

4d Tree swarms and bats may egies; their waste / feces, and urine / nitrogenous waste (into the pitcher plant);
- These waste undergo decomposition;
- Releasing carbon dioxide;
- * for photosynthesis;
- * to make glucose / carbohydrate;
- Enzymes (in the liquid of pitcher plant) can also break down the digested waste / nitrogenous waste;
- Releasing nitrates / salts / ions
- which can be absorbed by the pitcher plant;
- and be used to make proteins / amino acids;

Max 4m

For growth / repair:
- Carbon dioxide released from respiration of the small animals;
- * can be used by the plant for photosynthesis;
- * to make glucose / carbohydrate;

*mark once only
<table>
<thead>
<tr>
<th>Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Need a home tutor? Visit smiletutor.sg</td>
</tr>
<tr>
<td>2</td>
<td>Need a home tutor? Visit smiletutor.sg</td>
</tr>
</tbody>
</table>
Section A

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

1. Fig. 1.1 shows some of the steps carried out by a farmer in the reproduction of a certain species of plant.

(a) What is the purpose of
   (i) removing the immature anthers.
   (ii) covering the flower with a plastic bag?

Describe the main events that lead to the formation of the zygote after pollen grains are brushed onto the stigma.

(c) Suggest the advantage of employing the procedure by means shown in the above diagrams for reproducing the plant.

2. Fig. 2.1 shows the changes in the mass of DNA from a haploid nucleus of a mammalian egg to the time, after fertilization, when it undergoes cell division to form into an embryo.

(a) What is the relationship between chromosome and DNA?

Turn over
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Fig. 3.1 shows the process within the sewage treatment plant.

Diagram:

(a) Explain the function of beds in the filter bed.

(b) Draw a labelled diagram illustrating the sewage treatment plant. Mark the location of each component.
Type 2 diabetes (insulin-independent diabetes) is a non-infectious disease.

If not treated, this disease is characterised by large fluctuations in the concentration of glucose in the blood.

Maltaise is an enzyme that completes the digestion of starch in humans. Molecules of maltase are bound to the membranes of the microvilli of epithelial cells in the small intestine.

Ascorbate is a drug used in the treatment of type 2 diabetes. Molecules of ascorbate have a very similar shape to that of the substrate for maltase.

(a) Explain how ascorbate acts to slow down the action of those membrane-bound enzymes.

(b) Suggest why ascorbate can be used to treat people who have type 2 diabetes.

Esther went hiking along the Marang Trail at the Southern Ridges on a hot afternoon.

After walking for half an hour, Esther's face became flushed.

(a) (i) Explain why Esther's face was flushed after walking for half an hour.

(ii) Why is this response important?

(b) After 4 hours of walking, she had drunk all the water she brought along and her sweat production became greatly reduced. Her body temperature increased significantly. This might lead to heatstroke. Account for the rise of her body temperature.
(i) Name the number of the heart through which blood in structure A flows first.

(ii) Name the structure labeled A in Fig. 6.4.1.

Fig. 6.4.1

6. Fig. 6.4.1 shows a kidney and its associated structures. The arrows show the direction of flow of fluid in these structures.

(a) Explain how the relative concentrations of glucose might change in structures B and C.

(b) Table 6.1 shows the relative concentrations of various substances in structures A and C.

<table>
<thead>
<tr>
<th>Substance</th>
<th>A</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Urea</td>
<td>0.25</td>
<td>0.20</td>
</tr>
<tr>
<td>Creatinine</td>
<td>0.10</td>
<td>0.15</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>0.05</td>
<td>0.02</td>
</tr>
</tbody>
</table>

(c) Table 6.2 provides some information on the water content of the solutions at the glomerular filtrate.
Section B

Answer all the questions.

Question 9 is in the form of an Either/Or question.
Answer only question 9 Either or question 9 Or.

Write your answers in the spaces provided.

7 Four experiments were carried out to investigate the distribution of stomata on the upper and lower surfaces of the leaf of a leafy shoot. Fig. 7.1 shows the set up for these experiments.

Fig. 7.1

Each set up was left in a windy place and weighed at 4-hour intervals for 24 hours.

Table 7.1 records the treatment of the plants and the weights of each set up during this 24 hours.

<table>
<thead>
<tr>
<th>set-up</th>
<th>treatment on leaves</th>
<th>weight of the set-ups (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 h</td>
</tr>
<tr>
<td>A</td>
<td>no treatment</td>
<td>72</td>
</tr>
<tr>
<td>B</td>
<td>upper leaf surface smeared with vaseline</td>
<td>74</td>
</tr>
<tr>
<td>C</td>
<td>lower leaf surface smeared with vaseline</td>
<td>78</td>
</tr>
<tr>
<td>D</td>
<td>both upper and lower leaf surfaces smeared with vaseline</td>
<td>78</td>
</tr>
</tbody>
</table>
3 (a) A person looks up from focusing on a near object to focus on an object further away. Describe how changes that take place in named components of the person's eye produce a focused image of the distant object.

(b) Suggest why these changes that take place in the eye are controlled by the nervous system, rather than by a hormone.

9 Either
(a) Describe the two forms of variation found within a natural population. Include examples in your answer.

(b) Explain how variation is important for the long-term survival of the species.
**2016 BIOLOGY PRELIMINARY EXAMINATION MARKING SCHEME**

**Question 9 Either**

<table>
<thead>
<tr>
<th>Continuous variation</th>
<th>Discontinuous variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>any two for continuous variation</td>
<td>any two for discontinuous variation</td>
</tr>
<tr>
<td>gradual changes / range / intermediate phenotypes</td>
<td>between extremes</td>
</tr>
<tr>
<td>genes + environment</td>
<td>any two for discontinuous variation</td>
</tr>
<tr>
<td>few and distinct/clear cut differences</td>
<td>controlled by genes alone</td>
</tr>
<tr>
<td>any correct example of one or the other correctly linked: [RE] if one e.g. correct, the other incorrect</td>
<td></td>
</tr>
</tbody>
</table>

**Question 9 Or**

| a | blood goes through heart twice (in one complete circuit of the body): |
|   | circulation to/from lungs/pulmonary; |
|   | circulation to/from (rest of) body/systemic; |
|   | lungs + low pressure; |
|   | body + high pressure; |

| b | two sides to the heart / heart completely divided /septum: |
|   | our chambers / two atria + two ventricles / all 4 named chambers + beats continually; |
|   | right side / atrium + receives blood from body; |
|   | right side / ventricles + pumps blood to lungs; |
|   | left side / atrium receives blood from lungs; |
|   | left side / ventricle + pumps blood to (rest of) body; |
|   | left ventricle thicker-walled / more muscular + than right ventricle; |
|   | ventricles thicker-walled / more muscular + than atria; |
|   | further to pump blood / generate higher pressure; |
|   | ref. valves + one-way flow / prevent backflow; |
This paper consists of 25 printed pages.

For examiners use only:

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

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

Electronic calculators may be used.

Write your answers in the spaces provided on the Question Paper.

Answer all questions.

Section A

Section B

Do not write on the margins.

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

You may use a pencil for any diagrams, graphs or rough working.

Write your name, index number and class on the work you hand in.

Read these instructions first.

Paper 2

Biology

Secondary 4 Preliminary Examination

Student Name: [Name]

Class: [Class]

Index Number: [Index Number]
Scientists investigated digestion in different species of mammals. The mammals that they studied ranged in size from an elephant shrew, *Elephantulus advena*, with a mass of 50 g to an ox, *Bos taurus*, with a mass of 220 kg.

The scientists added indigestible particles to the animals' food and timed how long the particles stayed in the digestive system. The results for 24 different mammal species are shown in Figure 1.2.

The scientists concluded that food stays longer in the digestive systems of larger mammals compared with smaller mammals.

(c) Discuss the evidence from Figure 1.2, for and against the statement that food stays longer in the digestive systems of larger mammals.

<table>
<thead>
<tr>
<th>function</th>
<th>letter on Figure 2.1</th>
<th>name</th>
</tr>
</thead>
<tbody>
<tr>
<td>structure that separates oxygenated and deoxygenated blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>structure that prevents backflow of blood from ventricle to atrium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>blood vessel that carries deoxygenated blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>chamber of the heart that contains deoxygenated blood</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.1

Complete Table 2.1.

[Total: 9 marks]
(a) Define the terms gene and gene mutation.

(b) Some organisms known as archaea are able to oxidize hydrogen peroxide inside cells. Red blood cells contain archaea. Cells possess an enzyme that breaks down hydrogen peroxide inside cells. Red blood cells contain an enzyme that breaks down hydrogen peroxide inside cells.

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(b) A geneticist was asked to investigate the inheritance of acatalasia in dogs. The normal allele is represented by B and the mutant allele is represented by b.

The geneticist made the diagram in Figure 3.1 to show the inheritance of acatalasia in a family of dogs. The shaded symbols indicate the dogs with acatalasia.

![Genetic diagram](image)

**Figure 3.1**

(i) State the genotypes of the dogs identified as 1, 2 and 3 in Figure 3.1. [3]

1: 
2: 
3: 

(ii) The geneticist crossed dog 4 with dog 5. Approximately half of the offspring had acatalasia and half the offspring did not have acatalasia. Construct a genetic diagram to show how this is possible.

(iii) State the name given to the type of cross that you have completed in (b)(ii). [1]

- End of Section A1 -
Carousell

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**Figure 1:** Shows diabetes treatment

- Diabetics can be used to treat people whose kidneys do not function properly.
- Some people with kidney failure are given a kidney transplant.

**Key**

- Fluid
- Trash
- Inlet
- Outlet
- Insulin

**Explanation**

- The concentration of insulin in the body is 5 g dm⁻³.
- The human body is one of the main excretion organs of the body. Its role is to filter.

**Exercise**

1. **Figure 4:** Is the process of removing waste products of metabolism from the body.
(a) Describe how the location and organisation of genetic material in the human cell shown in stage K of Figure 5.1 is different from that in the bacterial cell shown.

(b) Use your knowledge of cells to name two structures that the transformed plasmid must pass through to form a transformed bacterium in stage L of Figure 5.1.

(c) State the type of reproduction that takes place in stage M of Figure 5.1. Use your knowledge of the process of cell division to explain why it is important that this type of reproduction occurs.

(d) Name the condition in humans that is treated using insulin produced by the bacteria in stage M of Figure 5.1.

- End of Section A2 -
Table E shows the results of the investigation.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Treatment A</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Treatment B</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

Twenty people were tested before and after consuming a drink containing the substance.

The person being tested looked at a coloured block on a computer screen as soon as the drink was consumed. They then had to press the buttons on the right as fast as possible.

In an investigation into the effects of alcohol on the nervous system, people were asked to copy out a list of words from the right to the left as fast as possible.

**Question B:** In the form of an essay, discuss any part that should be answered.

Section B

---

This paper consists of 20 printed pages.

<table>
<thead>
<tr>
<th>Section A</th>
<th>Section B</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>70</td>
</tr>
</tbody>
</table>

For examiners use only:

Write your answers in the spaces provided on the Question Paper.

Answer all questions.

---

Biology

Secondary 4 Preliminary Examination 2

Friday, 15 September 2016

5.15.02

Class: [ ]

Index Number: [ ]

Name: [ ]
(a) Calculate the mean for the reaction time after consuming alcohol. Write your answer in Table 6.1. [1]

(b) Plot a bar chart to show the mean reaction time of the people tested before and after consuming alcohol. [4]

(c) The range of reaction times recorded before consuming alcohol is 180-310 milliseconds. Use Table 6.1 to identify the range of reaction times recorded after consuming alcohol.

(d) Describe effects on the body of long-term, excessive consumption of alcohol. [3]

(e) Suggest one social implication of alcohol misuse. [1]

[Total: 10 marks]

7. Figure 7.1 shows an area of forest where some of the trees have been cut down.

Figure 7.1
(b) Describe advantages and disadvantages of asexual reproduction for flowering plants with reference to a named commercially important application.

[Total: 10 marks]

Or

(a) Describe what happens at ovulation.

[2]

(b) If an embryo implants in the uterus, the embryo secretes a hormone known as hCG that stimulates the reproductive organs of the woman to continue to secrete progesterone. Describe what happens after fertilisation until the time that the embryo secretes hCG.

[7]

(c) Fertility drugs are taken to increase the chance that a woman may become pregnant. Suggest how these drugs improve the chances of becoming pregnant.

[1]

- End of Section B -
<table>
<thead>
<tr>
<th><strong>(a)</strong></th>
<th><strong>(b)</strong></th>
<th><strong>(c)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(d)</strong></td>
<td><strong>(e)</strong></td>
<td><strong>(f)</strong></td>
</tr>
</tbody>
</table>

**Section A (50 marks)**

**Section B (40 marks)**

**Total (90 marks)**

---

**2016 Secondary 4 Biology Preliminary Examination**
Section B (30 marks)

6 (b) A axes labelled
y-axis: mean reaction time / ms
x-axis: before drinking alcohol and after drinking alcohol / before and after / or key given
x-axis labels approximately under each bar
S columns at least half the grid on y-axis + equal scale / 1
F both plots accounts on a small square / 1
C columns not touching + of same width / 1

6 (c) 220–350 + milliseconds / 1

6 (d) cirrhosis (of liver) / chronic liver disease / 1
cancer of the liver / stomach / mouth (oral) / throat / 1
pancreatitis / kidney failure / liver failure / 1
stomach ulcers / 1
brain damage / 1
heart disease / heart attack / stroke / high blood pressure / 1
reduced fertility / 1
depression / A/W / 1
addiction / dependence / 1
[max 3]

6 (e) violent crime / domestic violence / 1
road accidents / drink driving / 1
(petty) crime / vandalism / 1
family breakdown / divorce / relationship breakdown / 1
mp 13 inhibition of FSH (secretion / release) [1]
mp 14 prevents production of more eggs / production of follicles [1]
[max 7]

8.0 (c) (named) drug (e.g. FSH / clomiphene / clomide) + injected / taken [1]
stimulates production / development / maturation / release + follicles / eggs / ovulation / oocytes [1]
more eggs are released [1]
A: inhibits action of oestrogen
A: makes sure that FSH concentration is high enough
A: LH stimulates ovulation / release of eggs.
[max 1]
(e) Explain how studying or doing exercise can help improve the yield.

(f) Write a sentence indicating in the diagram the areas of similarity or difference in the leaf cell.

(g) Name the letters A and S.

(h) Label the area removed in the second view.

Fig 3

---

(a) Name the diagram.

(b) Label the leaf or leaf part.

(c) Label the diagram.

---

Fig 1

---

NAME: ___________________________

DATE: ___________________________

SECTION A

80

---

TOTAL

SECTION B

70

SECTION A

60

---

INSTRUCTIONS FOR CANDIDATES

Write your name in the space provided on the cover page.

Write your answers in the space provided on the question paper.

Remember the question numbers in the top of each column.

Do not open this booklet until you are told to do so.

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

For examiner's use.

---

INFORMATION FOR CANDIDATES

Write your name, class and register number in the space provided on the cover page.

Do not remove this booklet until you are told to do so.

---

INFORMATION FOR CANDIDATES

Write your name, class and register number in the space provided on the cover page.

Do not remove this booklet until you are told to do so.

---

INFORMATION FOR CANDIDATES

Write your name, class and register number in the space provided on the cover page.

Do not remove this booklet until you are told to do so.

---
(d) During girdling, tissue S may be damaged if the cut made was too deep. Predict what would happen to the tree and explain why.


2. Fig 2.1 shows a kidney nephron and its blood supply.

![Fig 2.1](http://www.example.com/fig2.1.png)

- Name structures X, Y and Z.
  - X: ____________________________
  - Y: ____________________________
  - Z: ____________________________

- Name the blood vessel which brings blood toward and away at points P and Q respectively.
  - P: ____________________________
  - Q: ____________________________

- Using an 'X', indicate on the structure(s) in Fig 2.1, where the anti-diuretic hormone (ADH) acts on during homeostasis.

(d) Table 2.1 below shows the composition of the plasma and glomerular filtrate in the nephron.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Plasma</th>
<th>Glomerular Filtrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Salts</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Urea</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Protein</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

(i) Account for the difference between the composition of plasma and glomerular filtrate.


(ii) The average rate of the formation of glomerular filtrate is 27.5 litres per hour, whereas average rate of the formation of urine is 0.65 litres per hour. Name and describe the process which results in this difference and explain why this process is important.


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Suggest a homologous pair of chromosomes.

(a) \( \text{Describe the role of centromeres.} \)

(b) \( \text{Explain why the cell requires normal metaphase plate.} \)

(c) \( \text{Describe why the age of olive oil matters.} \)

(d) \( \text{Explain why the body needs vitamin A.} \)

(e) \( \text{Explain why the body needs vitamin E.} \)

(f) \( \text{Explain why the body needs vitamin C.} \)

(g) \( \text{Explain why the body needs vitamin D.} \)

(h) \( \text{Explain why the body needs vitamin K.} \)

(i) \( \text{Explain why the body needs vitamin B12.} \)

(j) \( \text{Explain why the body needs vitamin B6.} \)

(k) \( \text{Explain why the body needs vitamin B3.} \)

(l) \( \text{Explain why the body needs vitamin B2.} \)

(m) \( \text{Explain why the body needs vitamin B1.} \)

(n) \( \text{Explain why the body needs vitamin B7.} \)

(o) \( \text{Explain why the body needs vitamin B9.} \)

(p) \( \text{Explain why the body needs vitamin B13.} \)

(q) \( \text{Explain why the body needs vitamin B14.} \)

(r) \( \text{Explain why the body needs vitamin B15.} \)

(s) \( \text{Explain why the body needs vitamin B16.} \)

(t) \( \text{Explain why the body needs vitamin B17.} \)

(u) \( \text{Explain why the body needs vitamin B18.} \)

(v) \( \text{Explain why the body needs vitamin B19.} \)

(w) \( \text{Explain why the body needs vitamin B20.} \)

(x) \( \text{Explain why the body needs vitamin B21.} \)

(y) \( \text{Explain why the body needs vitamin B22.} \)

(z) \( \text{Explain why the body needs vitamin B23.} \)
5. Fig 5.1 shows the percentage of infants born at low and very low birthweights in a study on mothers who are cigarette smokers and non-smokers.

![](chart.png)

(a) Describe the relationship between cigarette smoking and birth weight as presented in Fig 5.1.

(b) Explain why smoking has an effect on birthweight.
1. **Figure 1.1:**

   - Table 1.1 contains the measured data for the experiment. The table lists the input values and the corresponding output values.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

2. **Table 1.1:**

   - Table 1.1 shows the experimental data for the experiment. The table lists the input values and the corresponding output values.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
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<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

3. **Conclusion:**

   - The results obtained from the experiment are presented in Table 1.1. The data shows a clear correlation between the input and output values, indicating that the hypothesis is supported.

4. **Question:**

   - Explain the relationship between the input and output values in Table 1.1.

5. **Discussion:**

   - The observed relationship can be explained by the following equation:

   $$ y = mx + b $$

   where $y$ is the output, $x$ is the input, $m$ is the slope, and $b$ is the y-intercept.

6. **Conclusion:**

   - The experiment successfully demonstrates the relationship between the input and output values, validating the hypothesis.
(a) Using Table 7.1, plot a graph of heart rate against time in the grid below. [3]

(b) Using the graph in (a), calculate the percentage change in heart rate before and during exercise. [1]

(c) Explain why there is a change in heart rate before and during exercise. [3]

(d) Explain the rise in temperature and describe how his body regulates his body temperature.

(e) Predict, by drawing on Fig 7.1, how the core body temperature would change when the man stops exercising for the next 8 minutes. [4]

Geranium species are cultivated for horticultural use and for pharmaceutical products. Geranium plants produce a unique chemical compound in its petals to defend itself from Japanese beetles. Within 30 minutes of ingestion, the chemical paralyses the herbivore. Fig 8.1 shows a flower of one of the Geranium species.

Fig 8.1

(e) Suggest the agent of pollination and list two observable features to support your answer. [3]
9. Carbon flows through the ecosystem in the carbon cycle whereas energy flows in a non-cyclic manner.

Explain how carbon, in the form of organic matter, flows through the ecosystem.

(b) List two other differences between the flow of carbon and energy in a food chain.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (a)</td>
<td>No change in the number of</td>
</tr>
<tr>
<td></td>
<td>red blood cells.</td>
</tr>
<tr>
<td>2. (b)</td>
<td>No change in the number of</td>
</tr>
<tr>
<td></td>
<td>red blood cells.</td>
</tr>
<tr>
<td>3. (c)</td>
<td>The number of red blood</td>
</tr>
<tr>
<td></td>
<td>cells decreases.</td>
</tr>
<tr>
<td>4. (d)</td>
<td>No change in the number of</td>
</tr>
<tr>
<td></td>
<td>red blood cells.</td>
</tr>
<tr>
<td>5. (e)</td>
<td>The number of red blood</td>
</tr>
<tr>
<td></td>
<td>cells decreases.</td>
</tr>
</tbody>
</table>

---

Section A (5 marks)

Max. marks: 5

Instructions: Answer any one of the questions. Each question is worth 5 marks.

1. Explain the function of red blood cells and their role in the body.

2. Describe the process of blood clotting.

3. Discuss the importance of blood pressure regulation in the body.

Section B (5 marks)

Max. marks: 5

Instructions: Answer any one of the questions. Each question is worth 5 marks.

4. Explain the process of osmosis and its importance in the body.

5. Discuss the role of vitamins in maintaining overall health.

---

Section C (5 marks)

Max. marks: 5

Instructions: Answer any one of the questions. Each question is worth 5 marks.

6. Explain the process of photosynthesis and its importance in the ecosystem.

7. Discuss the role of enzymes in the digestive system.

---

Section D (5 marks)

Max. marks: 5

Instructions: Answer any one of the questions. Each question is worth 5 marks.

8. Explain the process of respiration and its importance in the body.

9. Discuss the role of hormones in regulating bodily functions.

---

Section E (5 marks)

Max. marks: 5

Instructions: Answer any one of the questions. Each question is worth 5 marks.

10. Explain the process of excretion and its importance in maintaining homeostasis.

11. Discuss the role of blood in maintaining body temperature.
**Kranji Secondary School**  
**Preliminary Examination II (2019)**  
**4 Express Biology 5158**  

**Answer Key**

1. Caroussel

2. SmileTutor.sg

3. Need a home tutor? Visit smiletutor.sg

---

(c) Hormonal – slower effect / Nervous – faster response OR  
Hormonal – long lasting / Nervous – short lived

Insulin: transported in the bloodstream

Nervous system: electric impulse is transmitted through neurons

Insulin: carry out the effects until it is destroyed by the liver

Nervous system: transmission of electric impulse will stop once it reaches target organ

(d) No as there is no pain felt and not aware of the danger/ stop doing the activity

The person might suffer from internal bleeding without knowing its painful/ The person might fracture bones, resulting in poor healing of bone/ body will be hurt

---

4. (a) Homologous chromosomes are similar in shape and size (with the exception of sex chromosomes).

They have exactly the same sequence of gene loci/ genes occupy the same loci

(b) Deoxyribonucleic acid

Basic unit is a nucleotide made of polynucleotide and has a double helix structure

Complementary base pairing where adenine pairs with thymine  
Guanine with cytosine

Sugar phosphate backbone/ anti-parallel arrangement of nucleotides

---

5. (a) There is a higher percentage of babies having low birthweight from mothers who smoke compared to those who don't smoke

State % difference:

eq. 12.7 - 12.2 = 0.5 % (difference)
eq. 5.2 / (12.7 x 100) = 41% (Percentage increase)

OR

There is a higher percentage of babies having low birthweight from mothers who smoke compared to those who don't smoke

State % difference:

eq. 13.8 - 9.8 = 4 % (difference)
eq. 6 / 13.8 x 100 = 31.9% increase

(b) Carbon monoxide binds with mother's haemoglobin to form haemoglobin, instead of oxygen. Haemoglobin has a higher affinity for carbon monoxide and lesser oxygen binds with it

Supply of oxygen to foetus decreases. R: no oxygen, hence less energy released by cells in foetus for growth. Shows down the development of foetus resulting in lower birth weight

---

6. (a)(i) All population of organisms living and interacting with one another in a particular habitat.

(b) Insecticide is passed along the food chain as consumers/ water spills傍晚 contaminated/ dying mayflies  
Cannot be excreted from the body as it is fat soluble/ not water soluble

Increasing in concentrations along the trophic levels/ food chain kills the kingfisher known as bioaccumulation
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**Question 6B (a)**

Pancreatic duct:
- Lesser pancreatic juice secreted into duodenum

Digestive enzymes:
- Trypsin (protein -> polypeptide)
- Amylase (starch -> maltose)
- Lipase (fat -> fatty acids + glycerol)

If only mention T, A, L but not specific in terms of substrate and products or Lesser digestion of starch/protein/fat with no mention of specific enzymes (I'm only)

Bile duct:
- Lesser bile released/secreted

Emulsification of fat reduced/less fats broken to smaller fat globules, reducing fat digestion by lipase

**OR**

- Stomach acids might burn the internal lining of the duodenum as not neutralised by the alkaline pancreatic juice and bile

**Question 6B (b)**

Carbonic anhydrase in the red blood cell:
- Carbon dioxide converted to carbonic acid:
  - (Carbonic acid dissociates into hydrogen carbonate ions and diffuse out into the plasma of the blood)

Alcohol dehydrogenase in liver:
- Alcohol is broken down into acetyl aldehyde and then into water and carbon dioxide (deoxygenation)

Thrombokinase released by damaged tissue and platelets:
- Converts prothrombin to thrombin:

Thrombin:
- Converts fibrinogen to soluble fibrinogen to insoluble fibrin:

Gelatins:
- Break down hydrogen peroxide into oxygen and water

**Question 6B (c)**

Plants contain carbon in the form of organic matter such as starch/ protein/fat/cellulose

Glucose in the plant is used oxidised during respiration, releasing carbon dioxide into the atmosphere

Animal feed on plant and carbon is incorporated into body tissues (fats, proteins, glycogen)

Glucose in the animal is used oxidised during respiration to release carbon dioxide into the atmosphere

**Answer Key**

- Death of animals/plant result in decomposition
- Respiration by decomposers release carbon dioxide into the atmosphere
- Combustion of fossil fuels, formed from animals/plants, release carbon dioxide into the atmosphere
- Photosynthesis by green plants removes/uses carbon in the carbon dioxide gas in the atmosphere to form glucose/organic matter again

- Principal source of energy is the sun. Light energy converted to chemical energy
- Vs Carbon is found in organic matter and inorganic carbon dioxide
- Loss of energy (50%) from one trophic level to the next as heat/undigested matter/uneaten parts
- Vs there is no loss of carbon, only a transfer/conversion between organisms or environment
Fig. 1: Shows the lower surface of a leaf, label A, B, and C.

(a) Fig. 2 below shows the labelled diagram of C. A.

(b) The number of males is given in brackets ( ) at the end of each question or part question.

(c) The end of the examination. Leave Section A and B empty.

(d) Write your name in the spaces provided in the section.
2. Atmospheric air contains oxygen and carbon dioxide.
   (a) Complete Table 2 to show the percentage of carbon dioxide and oxygen found in inhaled and exhaled air.
   
<table>
<thead>
<tr>
<th>Gas</th>
<th>Carbon dioxide / %</th>
<th>Oxygen / %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhaled Air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaled Air</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
   
   Table 2

   (b) Explain how oxygen reaches a muscle cell from the alveoli and how it is used by the muscle cells.

   (c) Explain what happens in a muscle cell when it lacks oxygen.

   (d) At higher altitude, oxygen is less available than it is at low altitudes. Suggest modifications of the circulatory and respiratory systems that might help people that live for many years at high altitude.

   [Total: 11 marks]
   [Total: 12 marks]
Fig. 2.2 shows a polyploid plant grown from a seed. The leaves that produce flowers are green.

Fig. 2.1 shows a plant callus. Multiplanting took a mangrove diagram of the plant.

Explain why the rooted plant needs to have lungs for the flow of nutrients.

From the appearance of the root, suggest how this plant is pollinated.

How leaves are formed from the underground stems in polyploids.
4. Fig. 4.1 shows two varieties of moth, Biston betularia with pale speckled wings and a second variety with black wings. There are no intermediate forms. Equal numbers of both varieties were released into a forest made up of trees with light-coloured bark.

![Fig. 4.1](image)

After two weeks, scientists tried to catch as many moths as possible and the results are as shown in Table 4.2.

<table>
<thead>
<tr>
<th>wing colour of moth</th>
<th>number of moths released</th>
<th>number of moths caught</th>
</tr>
</thead>
<tbody>
<tr>
<td>pale, speckled</td>
<td>100</td>
<td>87</td>
</tr>
<tr>
<td>black</td>
<td>100</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 4.2

(a) Account for the difference in the number of varieties of moths caught, in relation to the colour of the bark.

(b) A scientist experimented and inter-bred two moths of the same phenotype and found out that he was able to get many more pale speckled moths as compared to black moths in the next generation.

(i) Using the letters G and g to represent the dominant and recessive alleles respectively, determine the genotypes of the two moths he had inter-bred.

(ii) In the space below, construct a genetic diagram to predict the proportion of black-winged moths present in the next generation.

(c) In the early 19th century, the moths were mostly pale speckled wing. By 1895, due to factories that covered the land with sooty black smoke, 95% of the moths were black. Describe and explain what leads to the phenomenon described in the above paragraph.

[Total 10m]
Section B

[30 marks]

Answer three questions.

Question 8 is in the form of an Either / Or question. Only one part should be answered.

6 Table 6 below shows heat production and heat loss by a person over 50 minutes during and after vigorous exercise.

<table>
<thead>
<tr>
<th>Time/min</th>
<th>Heat production / arbitrary units</th>
<th>Heat loss / arbitrary units</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>13</td>
<td>280</td>
<td>280</td>
</tr>
<tr>
<td>20</td>
<td>300</td>
<td>260</td>
</tr>
<tr>
<td>25</td>
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<td>100</td>
<td>80</td>
</tr>
<tr>
<td>45</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 6

(a) Plot and draw graphs on the space given in Page 12 to show the heat loss and production over 50 min.
(e) Describe and explain how eukaryon cells in the atmosphere can become part of the

FIG 2.7

Based on the graph, suggest when the exercise occurs and explain the changes in

Tempurality of the protein over the 30 minutes.
(b) Fig. 7.2 shows a diagram of a nearby town and a factory nearby.

Fig. 7.2
Factory R has been disposing traces of mercury into the river which flows into the town and provides fish for the people living in the town. Explain why there are reports of people in the town who suffer from mercury poisoning.

8 EITHER
(a) Compare the processes of mitosis and meiosis.

(b) Compare the advantages of asexual reproduction in plants to genetic variation with reference to a commercial application.

[Total: 10m]

[Turn over]
<table>
<thead>
<tr>
<th>Sec A</th>
<th>Expected Answer</th>
<th>Mark</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>P: Epidermal cell</td>
<td>Max 3</td>
<td>R: Stoma</td>
</tr>
<tr>
<td>Q: Guard cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R: Stoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Open: potassium ions lowers the water potential of the cell Q, causing water molecules to move into the guard cell by osmosis. This causes the guard cells to be turgid and hence opening the stoma. Close: Potassium ions leaving the cell Q increases the water potential, causing water molecules to move out of the cell by osmosis. This causes the guard cells to plasmolysed and hence closing the stoma.</td>
<td>Max 2</td>
<td>each</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sec A</th>
<th>Expected Answer</th>
<th>Mark</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2(a)</td>
<td>Exhaled - CO₂ 0.03% and O₂ 21%</td>
<td>1</td>
<td>Either 1 or 2 marks only. Allow 3 - 4% for CO₂</td>
</tr>
<tr>
<td>2(b)</td>
<td>O₂ diffuses from the alveoli into the haemoglobin of RBC at the blood capillaries surrounding the alveoli. Oxygen-rich blood is transported to the heart and then blood pumped by the heart to the muscles. At the muscles, (aerobic) respiration; release energy from glucose; for contraction;</td>
<td>Max 4</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Anaerobic (respiration); less energy released; (produces) lactic acid; (muscle) becomes fatigued / tired / ref. cramp / pain</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Rapid breathing mechanism / deeper breathing; modified lung structure or described; more efficient haemoglobin; increase O₂ carrying capacity; more efficient blood supply to organs / tissues or e.g. larger heart/thicker heart muscles; more red blood cells; faster heart rate; faster circulation of blood</td>
<td>Max 4</td>
<td></td>
</tr>
</tbody>
</table>

| Total | 12 | |

**Marking Scheme**

1. Separate marking points
2. Alternatives
3. Contents of brackets are not required but should be implied
4. Reject
5. Accept (for answers correctly used by the question or guidance for examiners)
6. Alternative wording (where responses vary more than usual)
7. Alternative valid point (where a greater than usual variety of responses is expected)
8. Underline (actual word underlined must be used by candidate, grammatical variants excepted)
9. Max indicates the maximum number of marks that can be given
10. Statements on both sides of the + are needed for that mark

**Total**

<table>
<thead>
<tr>
<th>Mark</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Must state one property and how it helps</td>
</tr>
<tr>
<td>1</td>
<td>Allow for large central vacuoles, allowing the changes in water potential</td>
</tr>
<tr>
<td>Max 2</td>
<td>Both have the ability to respond to a stimulus. Examples have a nervous system that transmits nerve impulses to effector for response, but plants do not have a nervous system and respond to changes by changing the turgor pressure in their cells.</td>
</tr>
<tr>
<td>Max 2</td>
<td>A. Speed of responses Complexity of coordination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mark</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inhalation - CO₂ 0.03% and O₂ 21%</td>
</tr>
<tr>
<td>1</td>
<td>Exhaled - CO₂ 4% and O₂ 16%</td>
</tr>
<tr>
<td>1</td>
<td>Either 1 or 2 marks only. Allow 3 - 4% for CO₂</td>
</tr>
<tr>
<td>Max 4</td>
<td>Produce JIV energy</td>
</tr>
<tr>
<td>Max 4</td>
<td>Anaerobic (respiration); less energy released; (produces) lactic acid; (muscle) becomes fatigued / tired / ref. cramp / pain</td>
</tr>
<tr>
<td>Max 2</td>
<td>Rapid breathing mechanism / deeper breathing; modified lung structure or described; more efficient haemoglobin; increase O₂ carrying capacity; more efficient blood supply to organs / tissues or e.g. larger heart/thicker heart muscles; more red blood cells; faster heart rate; faster circulation of blood</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
</tr>
<tr>
<td>TOIL 1</td>
<td>TOIL 2</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Index 4</td>
<td>Index 4</td>
</tr>
</tbody>
</table>

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![Diagram]

**Problem**: Find the number of peaks of each block.

**Solution**: The number of peaks of each block can be found by solving the given equations.

**Graphs**: Graphs showing the number of peaks for each block are provided.

**Diagram**: Diagrams illustrating the structure of the blocks for better understanding.
| 6a | A: labelling of axes; [Time: temperature °C; Y: heat loss/production]
|    | S: scale; [needs to be even and to fill more than half of the printed grid]
|    | P: plot; [+/- half a small printed square]
|    | L: line; [an accurate curve connecting all points or joined point to point by a ruled line and no extrapolation] | max. 5m
| B  | During vigorous exercise, from 0 min to 20 min respiration occurs at a higher rate to release large amounts of energy. Some of the energy is lost as heat energy, causing the body temperature to rise. This causes the thermoreceptor to send a nervous impulse to the hypothalamus which starts a corrective mechanism for heat loss to decrease body temperature back to normal. | 1
|    | Vasodilatation of arteries near the skin
|    | - Increase blood flow to the skin
|    | - Heat can be lost through conduction, convection & radiation
|    | Production of sweat
|    | - Removes heat through latent heat of vaporisation
|    | As the heat production is higher than heat loss, as the person stop exercising, heat production decrease and heat loss continues to be higher than heat production to bring body temperature back to normal. | Max 5m
| Total 10 |

| 5a | Lower concentration of carbon dioxide in the intercellular air space of leaf and higher concentration of carbon dioxide in the atmosphere.
|    | Carbon dioxide diffuse the leaf through the stomata into the intercellular air space
|    | Dissolve in the thin film of moisture and enter into the mesophyll cells
|    | Glucose is formed by photosynthesis and stored as starch in the leaf
|    | Caterpillar ingest the leaf and takes in the starch
|    | Starch is digested by the caterpillar and used to build new body cells, or stored.
|    | Caterpillar is ingested by the bird, protein is digested to amino acids
|    | Excess amino acid is degraded and converted to urea and glucose, glucose is stored as glycogen. | Max 7

| 5b | Mercury is taken in by the fish/organisms/plants found in the river.
|    | Fish eats the plants/other fish
|    | Mercury cannot be excreted is stored in tissues of fish
|    | Passed down via food chains
|    | The concentration of mercury increases as we move along the trophic level.
|    | Results in the bioaccumulation of mercury in people who are the top consumers and hence they suffer from mercury poisoning as the concentration is high | Max 3
| Total: 10M |

| 8b | Mitosis maintains chromosome number/diploid AVV, whereas for meiosis chromosome number halved/haploid AVV. | 1
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| While GE is more efficient as transgenic organisms grow faster and may require less food, selective artificial breeding can also result in inbreeding, and an accumulation of recessive alleles in the population. The recessive alleles are not expressed in the heterozygous parents. They are more likely to be passed down to the offspring. If the recessive alleles code for a genetic disease, the homozygous offspring will suffer from the disease. | Max 5 |
4(a) More black moths are consumed by their predators and hence not caught by the scientists. This is because the black moths are not able to camouflage / blend in with the tree bark.

Most candidates who got it wrong, did not refer to the diagram and explained how the black moth is better camouflaged. Black moth is less camouflaged than the speckled according to the diagram.

Bi Both moths have a heterozygous genotype. Gg.

<table>
<thead>
<tr>
<th>Parental phenotype</th>
<th>pale speckled moth</th>
<th>pale speckled moth</th>
<th>Need to have the proper labels in order to gain the full marks, including the proportion.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental genotype</td>
<td>Gg</td>
<td>gG</td>
<td></td>
</tr>
<tr>
<td>Gametes</td>
<td>Gg</td>
<td>gg</td>
<td></td>
</tr>
<tr>
<td>Random fertilisation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Offspring genotype G3 Gg, Gg gg

Offspring phenotype pale speckled, pale speckled black, speckled black

Proportion of black moth: 1/4 or 25%

C

The trees were blackened with soot air pollution; white moth more easily seen and get eaten by predators.

Black moth adapt better to the environment as they are better camouflaged.

Black moths survive to reproduce and pass on their alleles to the next generation.

Frequency of alleles for black pigment increases as natural selection selects for these alleles causing an increasing number of black moth over many generations.

Reverse argument applies. Many candidates were able to explain up till the moths were able to reproduce, but did not explain how the numbers increase due to an increase in the frequency of the alleles over generations. This is necessary as it shows how the proportion of the population changes. Note that the differences in the moth colours occurred as a result of an earlier mutation and not due to the soot.

Furthermore, the soot covering the moth, does not cause the moth to be permanently black and to produce offspring that are black if their genotype does.
<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carousell</td>
<td>Home Tutor Service</td>
</tr>
<tr>
<td>SmileTutor.sg</td>
<td>Online Tutoring Platform</td>
</tr>
</tbody>
</table>

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| BC a | Mitosis maintains chromosome number diploid whereas for meiosis chromosome number halved/ haploid.  
Mitosis produces 2 daughter cells whereas meiosis produces 4 daughter cells  
Mitosis occurs in all organ/body cells whereas meiosis is only in gametic producing cells  
Mitosis is for growth / asexual reproduction whereas meiosis is for production of gametes.  
Mitosis produces genetically identical cells / clones whereas meiosis results in genetically different cells. | Mitosis and meiosis are cellular processes; nuclear divisions.  
Hence description of processes should be done in terms of daughter/parent cells, not offspring.  
Candidates should compare one difference at a time, not group multiple differences into a single point.  
The phrase 'Genetically similar' should be avoided, as it is not the same as genetically identical. |
|---|---|
| BC c | Molecular genetics can be used to mass produce insulin for patients suffering from Type 1 diabetes.  
The human insulin gene is isolated and cut using restriction enzymes to produce sticky ends.  
A plasmid/vector DNA from bacteria is cut using the same restriction enzymes to produce complementary sticky ends.  
The human insulin gene is inserted into the plasmid and the ends are joined together by DNA ligase.  
The recombinant plasmid is inserted into bacteria.  
The transgenic bacteria are cultured in mass quantities in fermenters.  
Insulin produced through this method is better as previously used animal insulin is different from human insulin.  
Development of antibodies against the animal insulin after prolonged treatment will not occur.  
This method will also prevent diseases being transferred from animals to humans. | Most candidates were able to provide the steps to produce transgenic bacteria, although some were lacking specific terms such as recombinant plasmid, DNA ligase, restriction enzymes, transgenic bacteria in their answers.  
Most students were unable to describe how this benefitted humans.  
Students who provided other commercial applications (other than insulin which is prescribed in the syllabus) were unable to provide specific details to gain marks.  
Bacteria is plural. Bacterium is the singular term.  
Some candidates stated that insulin produces would be cheaper, but this must be accompanied by the idea that it is because it is produced in mass quantities, thus making it affordable and available. The process itself is expensive. |
| b | For asexual reproduction, offspring are genetically identical to the parent. Hence will always express the advantageous traits of the parent plant. Unlike genetic variation where offspring may or may not exhibit the advantageous traits of the parent plant. For example, maize which are disease resistant, when reproduced asexually will produce offspring that are also resistant to the disease. However, offspring produced by sexual reproduction will show genetic variation and may not be disease resistant. (provide one e.g. of a viable commercial plant for both scenarios)  
Asexual reproduction also requires only one parent plant, however genetically variable offspring may require more than one parent plant for sexual reproduction.  
Asexual reproduction is a faster process as it is not dependent on pollination, however genetic variation in plants produced by sexual reproduction require pollination to occur. | Candidates who did not compare the processes with focus on how asexual reproduction is advantageous over genetic variation did not gain marks.  
Some candidates confused asexual reproduction with self-pollination. |
| b | In artificial selection, organisms with desired traits are selected by humans for selective breeding.  
Alleys that code for desired traits are passed to offspring.  
Traits of the offspring may vary due to different allele combinations. Offspring | Most candidates were unable to appropriately describe the process of artificial selection.  
Some candidates general gave differences without specifying if it
Section A
Answer all questions. Write your answers in the spaces provided.

Fig. 1.1 shows a diagram that represents the mode of action of enzymes.

Fig. 1.1

Table 1.1 shows the relative amounts of molecules P, Q, R and T involved in a series of experiments undertaken at 35 °C and an optimum pH.

Table 1.1

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Number of P</th>
<th>Number of Q</th>
<th>Number of R</th>
<th>Number of T</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

(a) Which molecule will remain in the same numbers at the start and end of each experiment? Explain your answer. [1]

(b) Using information from Table 1.1, deduce which molecule is the limiting factor. Explain your answer. [3]
[Fig. 2.1]

After a period of time, the water drops are seen on the inner surface of the bulb. The diagram shows an experimental setup to investigate the process of condensation in a gramophone.

Explain how each of the diagrams is associated with the role of the lamp:

- Diagrams and labels indicate the direction of the air flow.
- The lamp is in the center.
- Olly reflects

Some symptoms of complete tear failure include:
(b) Describe how you would set up a control for this experiment. [1]

(c)(i) Predict the observations when the set-up in Fig. 3.1 is moved to a dark room for 24 hours. [1]

(iii) Explain your answer in (c)(i). [3]

4 Fig. 4.1 shows the changes in pressure in the left side of the heart during the cardiac cycle.

(a) Using the information in Fig. 4.1, state the ratio of the duration of the atrial systole to the ventricular diastole. [1]

(b) On Fig. 4.1, label X when the semi-lunar valves first open. [1]

(c) Using your answer in (b), describe the change in pressure in line 1 from 0.15 s to 0.3 s and state the importance of this change. [2]

(d) State one difference in pressure if line 2 is recorded in the right side of the heart. [1]

(e) Explain the change in pressure from 0.1 s to 0.2 s in line 3. [1]
Table 5.1

Table 5.1 shows the percentage of normal person at rest and during exercise.

(a) The diaphragm

(b) The ribcage

(c) Diaphragm

(d) Ribs and diaphragm

(e) Ribs and diaphragm

(f) Ribs and diaphragm

(g) Ribs and diaphragm

(h) Ribs and diaphragm

(i) Ribs and diaphragm

(j) Ribs and diaphragm

(k) Ribs and diaphragm

(l) Ribs and diaphragm

(m) Ribs and diaphragm

(n) Ribs and diaphragm

(o) Ribs and diaphragm

(p) Ribs and diaphragm

(q) Ribs and diaphragm

(r) Ribs and diaphragm

(s) Ribs and diaphragm

(t) Ribs and diaphragm

(u) Ribs and diaphragm

(v) Ribs and diaphragm

(w) Ribs and diaphragm

(x) Ribs and diaphragm

(y) Ribs and diaphragm

(z) Ribs and diaphragm

{| No. Rows | Width | Height | Length | Volume |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 - 90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(e) Using information from Fig. 6.1 and Table 6.1, suggest and explain how damaging the glomerulus in the kidney nephrons leads to kidney failure after a prolonged period of time. [4]

(b) Suggest why patients who suffer from glomerular damage will often also

(i) develop a high blood pressure in the kidneys. [1]

(ii) have traces of blood in their urine. [1]

Fig. 7.1 shows the structures of two flowers, X and Y.

Flower X (magnified by 15 times)        Flower Y (magnified by 1.5 times)

(a) Name the labelled structures below. [2]

A ........................................
C ........................................
G ........................................
H ........................................

(b) With reference to Fig. 7.1, suggest how the following common parts assist in the process of pollination for each flower. [2]

<table>
<thead>
<tr>
<th></th>
<th>Flower X</th>
<th>Flower Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
[a] State one role of the endoplasmic reticulum.

[2] Explain how the toxin is affected when it encounters the ER.

[3] Label the parts labeled A, B, and P.

Fig. 8.1 shows a mammalian foetus developing in its mother's womb.

[1] Fig. 7.2 shows the concentration change in graph (DNA) content in a single cell.
Fig. 9.1 shows a food web in an ecosystem.

(a) Draw a pyramid of numbers for a food chain involving caterpillars. [1]

(b) Which of the organisms, bees or caterpillars, are biologically beneficial to the tree? Explain your answer. [2]

(c) Explain the following observations:

(i) The bee population remains relatively constant when there is a sudden decrease in the population of caterpillars. [1]

(ii) The grasshopper population increases initially but decreases afterwards when snakes are removed from the food web. [1]

Section B
Answer three questions.

Question 12 is in the form of an Either/Or question. Only one part should be answered.

10 The rate at which blood glucose concentration changes is affected by the food eaten by a person. In an experiment, a healthy person ate two slices of white bread.

The increase in her blood glucose concentration from her initial concentration was recorded over the next 120 minutes. The experiment was then repeated with two slices of wholemeal bread. The results of the experiment are shown in Table 10.1.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Increase in blood glucose concentration from initial concentration in mg/100cm³ of blood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>white bread</td>
</tr>
<tr>
<td>20</td>
<td>4.4</td>
</tr>
<tr>
<td>40</td>
<td>8.0</td>
</tr>
<tr>
<td>60</td>
<td>11.4</td>
</tr>
<tr>
<td>80</td>
<td>12.0</td>
</tr>
<tr>
<td>100</td>
<td>6.0</td>
</tr>
<tr>
<td>120</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question:** Explain why modified bread is a better choice for diabetics.

**Table:**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Instructions:** Enter the information from Table 10.1 and contrast the changes in blood glucose concentration.

**Diagram:**

[Diagram not visible in text]
Actions can be coordinated by different nervous pathways. Two such actions are shown below:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action 1</td>
<td>A student is touching a kettle of water to feel whether it is hot.</td>
</tr>
<tr>
<td>Action 2</td>
<td>A student accidentally touches a kettle of hot water and withdraws his hand immediately.</td>
</tr>
</tbody>
</table>

(a) Outline three ways in which Action 1 is different from Action 2. [3]

(b) Explain how P, Q and R would respond when the eye is exposed to increased light intensity. Identify P, Q and R in your answers. [4]

(c) Indicate on Fig. 11.1, with a labelled arrow, the location of a muscle which is important in producing focused images of near and far objects. [1]
The corneal eye colour is brown and the iris colour is blue.

Fig. 12.2 shows retinal detachment and normal retinae in different colour of the iris in each eye.

Table: The symptoms of glaucoma

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Page 79
Fig. 12.2 shows the inheritance of heterochromia in a family.

![Genetic diagram showing the inheritance of heterochromia.](Diagram)

**Fig. 12.2**

(b) Explain how heterochromia is passed down from individual 2 to some of his offspring.

(c) Using suitable symbols, construct a genetic diagram to show the outcome of the offspring if mutation did not occur at the first generation, and individual 2 remains blue-eyed.

---

Read the following extract below regarding 'designer babies':

The Fertility Institutes clinic in Los Angeles has just started offering prospective parents the opportunity to select physical traits of future offspring thanks to 'cosmetic medicine'.

But other fertility experts are outraged that the clinic is seeking to capitalise on dramatic advances in embryo cell analysis designed to identify dangerous diseases and defects in the unborn. They are angered that the so-called 'cosmetic medicine' is distracting public attention from how the pioneering medical technology can have children free of debilitating genetic conditions.

Clinic director Dr Jeff Steinberg, who as a young medic was part of the team involved in the birth in Britain in 1978 of Louise Brown, the world's first test tube baby, is undeterred.

"It's incredibly exciting," he told The Sunday Telegraph. "I live in LA and everyone here wants to have a straight nose, different and unique eye colours and high cheekbones and are perfectly happy to pay for cosmetic surgery."

"I understand the ethical concerns, but we cannot escape the fact that genetic engineering is moving forward. If I have to get smacked around by people who think it is inappropriate, then I'm willing to live with that."

Reported by Philip Sharwell for The Telegraph, Feb 2016

(d) Describe how a unique trait could be utilised for designer babies given the fact that genetic engineering is moving forward.

(e) List two ethical concerns with regards to the science of designer babies.
Section A

Answer all questions.

Write your answers in the spaces provided.

1. Fig. 1.1 shows a diagram that represents the mode of action of enzymes.

![Diagram](image)

Table 1.1 shows the relative amounts of molecules P, Q, R and T involved in a series of experiments undertaken at 35°C and an optimum pH.

Table 1.1

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Number of P</th>
<th>Number of Q</th>
<th>Number of R</th>
<th>Number of T</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

(a) Which molecule will remain in the same numbers at the start and end of each experiment? Explain your answer. [1]

P. Enzymes (quantity/shape) remain unchanged at the end of a reaction since they can be reused. [1]

(b) Using information from Table 1.1, deduce which substance is the limiting factor. Explain your answer. [3]

Substance Q is the limiting factor [1]

- Using experiments C and D, increasing number of P does not cause the number of T (main product) to increase. [1] (Therefore P is not a limiting factor).
- Using experiments D and E, increasing number of Q will lead to an increase number of T [1] (Therefore Q is the limiting factor).
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(b) Describe how you would set up a control for this experiment.
Set up the same experiment without the green plant with leaves removed from green plant.

(c) (i) Predict the observations when the set-up in Fig. 3.1 is moved to a dark room for 24 hours.
Lesser water droplets.

(ii) Explain your answer in (c)(i).
In the dark, the guard cells (which do not photosynthesise) have a higher water potential than the cells around them; water leaves via osmosis across a selectively permeable membrane; the guard cells become flaccid and stomata close, (resulting in a lower rate of transpiration).

4. Fig. 4.1 shows the changes in pressure in the left side of the heart during the cardiac cycle.

(a) Using the information in Fig. 4.1, state the ratio of the duration of the arterial systole to the ventricular diastole.
9:1 or 3:1

(b) On Fig. 4.1, label X when the semi-lunar valves first open.

(c) Using your answer in (b), describe the change in pressure in line 1 from 0.15 s to 0.3 s and state the importance of this change.
Pressure in Line 1 increases; this allows blood to flow from left ventricle to aorta (and then to all parts of the body).

(d) State one difference in pressure if line 2 is recorded in the right side of the heart.
The maximum pressure is lower in the right side.

(e) Explain the change in pressure from 0.1 s to 0.2 s in line 3.
The sudden closure of the tricuspid valves prevents the backflow of blood back into the atrium, causing the blood pressure to increase in the atrium momentarily.
Table 6.1

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-99</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 6.2 (continued)…

Fig. 6.1

Number of nodes indicates the relative amount of fluid being rejected.

Fig. 5.1 shows the thoracic section of the human body.

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(a) Using information from Fig. 6.1 and Table 5.1, suggest and explain how damaging the glomerulus in the kidney nephrons leads to kidney failure after a prolonged period of time.

- Lower pressure causes blood not to filter out sufficiently small molecules completely from glomerulus [1]
- Y constricts and makes it harder for the blood to leave the glomerulus. [1]
- Raises blood pressure within glomerulus and hence increases the efficiency of ultrafiltration. [1]
- For prolonged period of time, the pressure becomes so large that bigger molecules are filtered if and go into the urine. This leads to kidney failure. [1]

(b) Suggest why patients who suffer from glomerular damage will often also

(i) develop a high blood pressure in the kidneys

- Higher blood pressure leaving glomerulus due to constriction of Y.

(ii) have traces of blood in their urine.

- Pressure created by constriction of Y will also create greater ultrafiltration effect and allow red blood cells to be filtered cut through the glomerulus into the nephron.

---

(b) With reference to Fig. 7.1, suggest how the following common parts assist in the process of pollination for each flower.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Flower X</th>
<th>Flower Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure B</td>
<td>Stigma is large, extended and feathery so that pollen grains from insects can be captured easily</td>
<td>Stigma is smaller, enclosed inside flower and has a sticky surface so that pollen grains from insect's body can stick.</td>
</tr>
<tr>
<td>Structure D</td>
<td>Pendulous and protrude out of petals to allow wind to assist pollen grains</td>
<td>Non-pendulous and does not protrude – pollen grains can stick onto insects when they search for nectar</td>
</tr>
</tbody>
</table>
We conclude that the degree of movement is a major factor in promoting and reducing risk during childbirth. Problems arise when physical restraint is employed.

Sections and conclusions of the future clinical projection.

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(a) The relationship between fetal growth and time is critical in understanding the role of fetal development.

(b) Explain how the fetus is modeled when studying its development.

(c) Draw a diagram of the stages of fetal development, including major milestones.

(d) Label the graph in Fig. 1 to show the relationship of cell division to DNA replication.

(e) Name the main structures in the fetus.

(f) Fig. 1 shows the incomplete changes in general (DNA) content in a single cell.
Section B

Answer three questions.

Question 12 is in the form of an Either / Or question. Only one part should be answered.

The rate at which blood glucose concentration changes is affected by the food eaten by a person. In an experiment, a healthy person ate two slices of white bread.

The increase in her blood glucose concentration from her initial concentration was recorded over the next 120 minutes. The experiment was then repeated with two slices of wholemeal bread. The results of the experiment are shown in Table 10.1.

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</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>4.4</td>
</tr>
<tr>
<td>40</td>
<td>8.0</td>
</tr>
<tr>
<td>60</td>
<td>11.4</td>
</tr>
<tr>
<td>80</td>
<td>12.0</td>
</tr>
<tr>
<td>100</td>
<td>6.0</td>
</tr>
<tr>
<td>120</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 10.1

(a) Draw a pyramid of numbers for a food chain involving caterpillars.

(b) Which of the organisms, bees or caterpillars, are biologically beneficial to the tree? Explain your answer.

Bees:
They help pollinate the tree, since the tree is a flowering plant.

(c) Explain the following observations:

(i) The bee population remains relatively constant when there is a sudden decrease in the population of caterpillars.

They do not compete for the same type of food, i.e. bees feed on nectar while caterpillars feed on leaves.

(ii) The grasshopper population increases initially but decreases afterwards when snakes are removed from the food web.

No predators (snakes), thus grasshoppers can reproduce more; overpopulation leads to intense competition for food, thus insufficient food to support rapid growth and population decline.
Find the equation of the line that passes through the points (2, 3) and (4, 7). Plot the points and the line on the graph.

<table>
<thead>
<tr>
<th>x</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

(a) Write the equation of the line in the form $y = mx + c$.

(b) Describe the graph in words.

(c) Explain why graphing lines is a better choice for doodling.

(d) [Graph with points plotted and line drawn]

(e) [Graph with data points and line graphed]
Actions can be coordinated by different nervous pathways. Two such actions are shown below.

<table>
<thead>
<tr>
<th>Action 1</th>
<th>Action 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A student is touching a kettle of water to feel whether it is hot.</td>
<td>A student accidentally touches a kettle of hot water and withdraws his hand immediately.</td>
</tr>
</tbody>
</table>

(a) Outline three ways in which Action 1 is different from Action 2. [3]

<table>
<thead>
<tr>
<th>Action 1</th>
<th>Action 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary action</td>
<td>Involuntary action / Reflex action;</td>
</tr>
<tr>
<td>Brain is involved / under control of the will</td>
<td>Brain not involved / not under the control of the will;</td>
</tr>
<tr>
<td>Slower &amp; deliberate action</td>
<td>Immediate, instantaneous action</td>
</tr>
<tr>
<td>Involves:</td>
<td>Involves:</td>
</tr>
<tr>
<td>- brain</td>
<td>sensory / receptor neuron</td>
</tr>
<tr>
<td>- relay / intermediate neuron</td>
<td>relay / intermediate neuron</td>
</tr>
<tr>
<td>- effector / motor neuron (NO SENSOR NEURONE)</td>
<td>effector / motor neuron</td>
</tr>
</tbody>
</table>

1 pair [1], Max [3]

Fig. 11.1 displays the structures in the human eye after it is dissected.

(c) ciliary muscles (either location)

(b) Explain how P, Q and R would respond when the eye is exposed to increased light intensity.

Identify P, Q and R in your answers. [4]

- Q, which is cones, has no response;
- The circular muscles of the iris, P, will contract and the radial muscles of the iris will relax;
- The pupil will **constrict** / aperture decreases;
- Photoreceptors on R, the retina, will be stimulated (by increased light intensity) and an impulse transmitted to the brain for pupil reflex to take place.

(c) Indicate on Fig. 11.1, with a labelled arrow, the location of a muscle which is important in producing focused images of near and far objects. [1]
Fig. 12.1

The corneal e is down, and the necessary e is blue.

FIG. 12.2 shows the structure of a normal eye and an eye with symptoms of glaucoma.

FIG. 12.3 shows the accumulation of aqueous humor fluid.
Fig. 12.2 shows the inheritance of heterochromia in a family.

(fig. 12.2)

(b) Explain how heterochromia is passed down from individual 2 to some of his offsprings.

Mutation occurs in the *gametes* / *sperm* / *haploid cells*, and are passed down during fertilisation (to form a diploid zygote).

(c) Using suitable symbols, construct a genetic diagram to show the outcome of the offsprings if mutation did not occur at the first generation, and individual 2 remains blue-eyed.

Let the allele for brown eye colour be T
Let the allele for blue eye colour be t
Parental phenotype brown x blue
Parental genotype T T x t t
Gametes T T x T T
Random fertilisation
F1 genotype T T T T
F1 phenotype brown brown brown brown
F1 ratio 100% brown

---

Read the following extract below regarding 'designer babies':

The Fertility Institute's clinic in Los Angeles has just started offering prospective parents the opportunity to select physical traits of future offspring thanks to "cosmetic medicine".

But other fertility experts are outraged that the clinic is seeking to capitalise on dramatic advances in embryo cell analysis designed to identify genetic diseases and defects in the unborn. They are arguing that the so-called 'cosmetic medicine' is distracting public attention from how the pioneering medical technology can have children free of debilitating genetic conditions.

Clinic director Dr Jeff Steinberg, who as a young medic was part of the team involved in the birth in Britain in 1978 of Louise Brown, the world's first test tube baby, is unimpressed.

"It's incredibly exciting," he told The Sunday Telegraph. "I live in LA and everyone here wants to have a straight nose, different and unique eye colours and high cheekbones and are perfectly happy to pay for cosmetic surgery."

"I understand the ethical concerns, but we cannot escape the fact that genetic engineering is moving forward. If I have to get smacked around by people who think it is inappropriate, then I'm willing to live with that."

[Reported by Philip Sherwell for The Telegraph, Feb 2015]
End of Paper

[Image 0x0 to 595x842]
Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided.

1. Fig. 1.1 shows the drawings of two cells, A and B, from the gaseous exchange system. Both are specialized cells found in specific structures of the respiratory tract.

(a) Explain what cell specialization is.

(b) (i) Name a structure of the respiratory system where both cells are found.

(ii) Give two observable structural differences between the cells in Fig. 1.1.

(iii) Describe how both cells aid in protecting the respiratory system.
Graph 2.1

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3 Fig. 3.1 shows some of the feeding relationships in an oak woodland.

(c) The leaves of the oak tree are the only part of this food web capable of trapping energy by photosynthesis. Calculate the percentage of the energy trapped by the oak leaves, which becomes part of the tissues of the primary consumers. Show your working clearly.

----------------------------- % [2]

(d) Suggest what will happen if there was a decline in the numbers of winter moth larvae.

[Total: 8]

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(a) Name the following consumers in this food web.
   Secondary consumer: ........................................... [2]
   Tertiary consumer: ........................................... [2]

(b) Based on Fig. 3.1, draw a pyramid of biomass for a food chain that consists of 4 trophic levels.
1. Provide the corresponding base sequence on the DNA template which codes for AUGGCAUGG

2. The base sequence of a segment of molecule R in Fig. 4.1 is given below.

3. Explain why the sequence of nucleotides T come first.

Fig. 4.1

4. Table 1:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>T</td>
</tr>
<tr>
<td>s</td>
<td></td>
</tr>
</tbody>
</table>

5. State a number cell in which translation does not occur.

Fig. 4.1 illustrates translation, a molecular process that occurs in cells.
5. A small tube called a catheter is inserted into the body through a vein. It is then threaded through the heart until its tip lands in the pulmonary artery. Here, a tiny balloon at the tip is used to measure the pressure changes.

Fig. 5.1a shows a section through the heart with the catheter in place. Fig. 5.1b shows the graph of pressure changes recorded in the pulmonary artery.

(a) Name the chamber of the heart labelled P in Fig. 5.1a. 

(b) Complete the table below by placing a tick (✓) in the appropriate boxes to show which of the valves will be open at time X indicated on the graph in Fig. 5.1b.

<table>
<thead>
<tr>
<th>Valve</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

(c) Explain one way in which the pulmonary artery is adapted to cope with the condition it experiences at time X on the graph in Fig. 5.1b.

6. A delicate balance is necessary between the tendency to clot to prevent blood loss and the tendency to form clots unnecessarily.

To prevent unnecessary blood clot formation, anti-thrombin III, a protein which inhibits the formation of thrombin circulates in the blood.

(a) Explain how anti-thrombin III prevents inappropriate clot formation.

(b) In a scientific study, a group of mice were injected with a chemical that prevents the production of anti-thrombin III.

(i) A significant number of the mice died of cardiac arrest.

Explain this outcome with regards to coronary heart disease.

(ii) Another group of mice in the same scientific study as in (b)(i) were instead fed pellets containing anti-thrombin III. These mice also did not survive.

Explain what happened to the anti-thrombin III which were fed to the mice.
Table 4:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
<td>10000</td>
<td>11000</td>
<td>12000</td>
<td>13000</td>
<td>14000</td>
</tr>
</tbody>
</table>

Table 5 shows the annual counts of two species of fish.
(b) (i) Describe the general trend in catch size of the fish from 1970 to 1984.

(ii) Suggest two reasons for this trend.

(c) Account for the possible change in catch size in both fish species after 1962.

In humans:

(b) (i) Compare and contrast active transport with diffusion.

(ii) Salting is a common method used in food preservation as it prevents bacterial and fungal growth. Food that is preserved in this manner is immersed in concentrated salt solution.

Explain why salting is a good method of food preservation.
Carbon dioxide combines with water to form carbonic acid.

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \]

Carbonic acid dissociates into bicarbonate and hydrogen ions.

\[ \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2 + \text{H}^+ \]

Hypothesis: Increasing the concentration of carbon dioxide in water will result in a higher pH.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Carbon Dioxide Level</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Low</td>
<td>6.5</td>
</tr>
<tr>
<td>Test 1</td>
<td>Medium</td>
<td>6.8</td>
</tr>
<tr>
<td>Test 2</td>
<td>High</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Conclusion: The hypothesis is supported, as the pH increases with the concentration of carbon dioxide in water.
3 (a) Secondary consumer: Carabid beetle/ Great tit.
Tertiary consumer: Sparrow hawk

(b) Sparrow hawk
Great tit
Speckled moth
Oak tree

(c) \( \left( \frac{110 + 104}{900} \right) \times 100\% = 21.8\% \)

(d) Both carabid beetle and great tit will depend on the speckled moth as the only source of food; moth number will decline rapidly.

5 (a) Right ventricle
(b) 2 and 4 ticked.
(c) It has thick muscular walls; To prevent rupturing/ to withstand high pressure.
OR
It has elastic walls; to accommodate high volume of blood by stretch and recoil.

6 (a) Prevents the formation of insoluble fibrin; which entrap red blood cells.
(b) (i) Blood clot occurred in coronary artery; preventing flow of blood; to cardiac tissue; which dies; due to oxygen deprivation.
(ii) They were digested; by proteases; in the stomach/ small intestine.

7 (a) SD only manifested in generation III/ IV SD skipped generations; parents of affected individual are carriers; indicating that the allele for the disease is masked/ suppressed.
(b) SD | Down Syndrome
---|---
Affected chromosome 5 | Affected chromosome 21
Result of gene mutation | Result of chromosomal mutation.
<table>
<thead>
<tr>
<th>(a)</th>
<th>(i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)</td>
<td>(j)</td>
</tr>
<tr>
<td>(c)</td>
<td>(k)</td>
</tr>
<tr>
<td>(d)</td>
<td>(l)</td>
</tr>
<tr>
<td>(e)</td>
<td>(m)</td>
</tr>
<tr>
<td>(f)</td>
<td>(n)</td>
</tr>
<tr>
<td>(g)</td>
<td>(o)</td>
</tr>
<tr>
<td>(h)</td>
<td>(p)</td>
</tr>
</tbody>
</table>

**Table:**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column 3</td>
<td>Column 4</td>
</tr>
<tr>
<td>Column 5</td>
<td>Column 6</td>
</tr>
<tr>
<td>Column 7</td>
<td>Column 8</td>
</tr>
<tr>
<td>Column 9</td>
<td>Column 10</td>
</tr>
</tbody>
</table>

**Notes:**

- For each row, fill in the appropriate columns.
- Ensure that all entries are consistent and accurate.
- Review all calculations and cross-check for any errors.
- If any row is missing, provide a reason or explanation.
Section A [50 marks]

Answer all the questions.
Write your answers in the spaces provided.

1. Many growers of crops in glasshouses use carbon dioxide enrichment to improve yields.
   
   (a) Explain the advantages of carbon dioxide enrichment of glasshouses.

   [Answer space provided]

   Fig. 1.1 shows the carbon dioxide concentrations inside three glasshouses, D, E and F, on a hot day with bright sunlight.

   - Glasshouses D and E received carbon dioxide enrichment and were ventilated by opening the windows.
   - Glasshouse F did not receive any extra carbon dioxide and the windows were closed.

   The carbon dioxide concentrations in the glasshouses and in the atmosphere were measured. The concentration in the atmosphere was 0.039%.

<table>
<thead>
<tr>
<th>Glasshouse</th>
<th>Concentration of CO₂ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>0.841%</td>
</tr>
<tr>
<td>E</td>
<td>0.070%</td>
</tr>
<tr>
<td>F</td>
<td>0.002%</td>
</tr>
</tbody>
</table>

   [Diagram of glasshouses D, E, and F]

   Fig. 1.1

   The rate of uptake of carbon dioxide by the crop plants was measured in grams of carbon dioxide absorbed per square metre of glasshouse per hour.

   These results are shown in Table 1.1.
Table 1.1

<table>
<thead>
<tr>
<th>glasshouse</th>
<th>rate of uptake of carbon dioxide by crop plants / g per m² per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>2.5</td>
</tr>
<tr>
<td>E</td>
<td>5.7</td>
</tr>
<tr>
<td>F</td>
<td>1.0</td>
</tr>
</tbody>
</table>

(b) Suggest one reason why it may not be cost effective to maintain a high concentration of carbon dioxide in glasshouse E compared to the concentration of carbon dioxide in the atmosphere.

(c) (i) Concentrations of carbon dioxide in all three glasshouses in Fig. 1.1 increased at night. State why this happened.

(ii) Explain why it is important to ventilate glasshouses by opening the windows.

Table 2.1 shows some of the top ten causes of death in parts of the world during 2010.

<table>
<thead>
<tr>
<th>cause of death</th>
<th>percentage of the deaths of adult males</th>
<th>percentage of the deaths of adult females</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancer (lung, alimentary canal, breast, prostate and others)</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>coronary heart disease</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>stroke (blood clot in brain)</td>
<td>17</td>
<td>10</td>
</tr>
</tbody>
</table>

Fig. 2.1 shows the data for the adult males.
The production of gastric juice is controlled by both nervous and hormonal stimulation.

After a meal, the stomach produces gastrin which

\[ 	ext{units} \quad \text{production/gastric juice} \]

\[ \text{time/hours} \]

**Fig. 2.1**

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (ml)</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1. **(a)**
   - Draw the graph of gastric juice production/gastric juice.

2. **(b)**
   - Determine the percentage of males dying from causes other than those in Table 2.1.
3. (b) (ii) Suggest why gastric juice stops being produced 4.5 hours after the meal has been eaten.

(c) The secretion of gastric juice is an example of a simple reflex.

The taste buds in the mouth are the receptors and the glands in the stomach are the effectors in this reflex.

Outline the reflex that occurs when gastric juice is produced.

4. Fig. 4.1 shows part of a capillary network and some cells of the surrounding tissue.

(a) (i) State two ways in which the blood at Y differs from the blood at X, other than the difference in concentration of carbon dioxide.

(ii) Explain how capillaries are adapted for their function as exchange vessels.

Enzyme Z in red blood cells catalyses the reaction between carbon dioxide and water as blood flows through respiring tissues.

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^- \]

(b) (i) Name enzyme Z that catalyses this reaction.

(ii) Explain the significance of this reaction in the transport of carbon dioxide.
Fig. 6.2 shows how the condition is inherited in a family. The mutation that results in this condition is dominant.

Fig. 6.1 shows the hand of a person who suffers from a mutation that results in syndactyly. The mutation leads to the fusion of fingers on each hand.

(a) List the genes that are involved in the process shown in Fig. 6.1.

(b) Name and explain two ways in which meiosis can lead to variation in the offspring.

(c) Draw the stage of meiosis II as shown.
6 (b) (i) State the genotype of the individuals shown in Fig. 6.2.
Use AA, Aa or aa.
Write your answers in Table 6.1.

<table>
<thead>
<tr>
<th>numbered person on Fig. 6.2</th>
<th>genotype of person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

(ii) Using evidence from Fig. 6.2, state which of the couples, P, Q or R, provides proof that the mutation is not recessive.

couple ______________ [1]

(iii) Explain the reason for your answer.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

[Total: 6]

7 In 1970, scientists started counting different groups of birds living on a large island.

Fig. 7.1 shows how the numbers of four of these bird groups changed between 1970 and 2010.

(a) Compare the results for seabirds with the results for woodland birds.

(b) Suggest a reason for the change in the numbers of woodland birds since 1990.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

[Total: 5]

(c) The results for farmland birds are a particular cause for concern.
Describe why it is important to conserve species and their habitats.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

[Total: 2]
Section B [30 marks]

Table 8.1

The results are shown in Table 8.1.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Water uptake</th>
<th>Water loss</th>
<th>Water uptake - Water loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>0400</td>
<td>11</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>0700</td>
<td>20</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>1000</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>1600</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Question 10 is an EITHER/OR question. Only one part should be answered.

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8. (b) Explain how a decrease in temperature and humidity would affect the water loss by this plant.

(i) temperature

(ii) humidity

[Total: 10]

9. (a) Describe the role of natural selection in evolution.

(b) Explain, using one named example, how mutation can affect phenotype.

[Total: 10]
Section A

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</tbody>
</table>

Section B

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Section C

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Examination Use

The number of marks is shown in brackets at the end of each question or part question.

To indicate the answer to a question, cross out the answer on the corresponding question or part question and then write your answer in the corresponding space provided in the answer spaces provided on the question paper.

Time allowed: 1 hour 15 minutes.

1. **Answer all questions.**

2. **Write your answers in the spaces provided on the question paper.**

3. **Do not use line numbers or question numbers.**

4. **Read these instructions first.**

---

**5 May 2016**

**Secondary 4**

**Express**

**Paper 2**

**Biology**

---

**Preliminary Examination 1**

**S158/02**

---

**Surname**

**Given Name**

**Class**

**Index Number**
SECTION A

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

A1 Fig. 1.1 shows a vertical section of the stomach, together with parts of the alimentary canal leading into and out of it.

(a) Name the parts A and B.

A: .................................................................

B: ................................................................. [2]

The stomach is a bag-like structure with very muscular walls.

(b) Describe the role of the muscles in the stomach wall in digestion.

................................................................. [2]

(c) Pepsin is a substance produced in the stomach. An investigation was carried out into the action of pepsin on proteins.

The test-tubes were set up as shown in Table 1.2 and placed in a water bath at 37°C for ten minutes.

<table>
<thead>
<tr>
<th>Test-tube</th>
<th>Egg white suspension</th>
<th>Hydrochloric acid</th>
<th>Sodium hydroxide</th>
<th>Pepsin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1.2

At the beginning of the investigation, the contents of both test-tubes were cloudy. At the end of the experiment, only test-tube 1 became clear.

Explain the processes that caused the change in appearance of test-tube 1, but not in test-tube 2.
1. Describe and explain how the experiment can be modified to increase the rate of
   water movement in the stem.

2. State one important precaution in setting up the experiment. Give a reason for the
   precaution.

3. The stem of a plant. Fig. 2.1 shows an experimental setup to find the part and rate of water movement in
   a plant. Fig. 2.2 shows a transverse section of a stem of a dicotyledonous plant.
A3 A student completed his 2.4 km run for his NAPFA test in 10 minutes and then rested for another 10 minutes. Fig 3.1 shows the lactic acid and muscle glycogen concentration in blood samples of the student taken at different time intervals.

![Graph showing muscle glycogen and lactic acid concentration over time.]

**Fig. 3.1**

(a) Define anaerobic respiration.

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(b) Explain the decrease in muscle glycogen concentration during the 2.4 km run.

(c) Explain the change observed in lactic acid concentration during rest.

---

[Total: 9]

---

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(c) Explain how the negative feedback mechanism prevents the body temperature from
becoming too high.

(d) Explain the effects of the negative feedback mechanism on the body temperature.

(e) Explain the effects of the negative feedback mechanism on the body temperature.

(f) Explain the effects of the negative feedback mechanism on the body temperature.

(g) Explain the effects of the negative feedback mechanism on the body temperature.

(h) Explain the effects of the negative feedback mechanism on the body temperature.

(i) Explain the effects of the negative feedback mechanism on the body temperature.

(j) Explain the effects of the negative feedback mechanism on the body temperature.

(k) Explain the effects of the negative feedback mechanism on the body temperature.

(l) Explain the effects of the negative feedback mechanism on the body temperature.

(m) Explain the effects of the negative feedback mechanism on the body temperature.

(n) Explain the effects of the negative feedback mechanism on the body temperature.

(o) Explain the effects of the negative feedback mechanism on the body temperature.

(p) Explain the effects of the negative feedback mechanism on the body temperature.

(q) Explain the effects of the negative feedback mechanism on the body temperature.

(r) Explain the effects of the negative feedback mechanism on the body temperature.

(s) Explain the effects of the negative feedback mechanism on the body temperature.

(t) Explain the effects of the negative feedback mechanism on the body temperature.

(u) Explain the effects of the negative feedback mechanism on the body temperature.

(v) Explain the effects of the negative feedback mechanism on the body temperature.

(w) Explain the effects of the negative feedback mechanism on the body temperature.

(x) Explain the effects of the negative feedback mechanism on the body temperature.

(y) Explain the effects of the negative feedback mechanism on the body temperature.

(z) Explain the effects of the negative feedback mechanism on the body temperature.
A5 In an experiment, a person looked at the same light source from various different distances. The diameter of their pupil was measured at each position. Fig. 5.1 shows how the diameter varied.

![Graph showing relationship between light intensity and pupil diameter](image)

**Fig. 5.1**

(a) Describe the relationship between light intensity and pupil diameter shown in Fig. 5.1.

(b) Explain how the response in pupil diameter is brought about as the light intensity increases from 2 to 4 arbitrary units.

A6

(c) Albino people lack colouring material (pigment) in their bodies and are advised to avoid the sun.

Suggest the reason behind this advice.

(a) (i) State the name for chemicals that are secreted by glands into the blood and that affect organs elsewhere in the body.

(ii) State the term used to name the organs that are affected by these chemicals.

(b) Fig. 6.1 shows the blood glucose concentrations of three different people, G, H and J, over a 48-hour period.

![Graph showing blood glucose concentrations for three different people](image)

**Fig. 6.1**
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Table 7.1

The results are shown in Table 7.1.

END OF SECTION A

Reason:

(a) The person with diabetes

(b) The person who produces no insulin

(c) The person with insulin-dependent diabetes

Suggest how insulin taken by injecting it into the body

Insulin can also be taken by breathing it in.

Diabetes can be treated by injection of insulin.

The role of a drug

The role of a drug is to

The ideal size for the section is 30

Question. Is in the form of a statement question.

Answer all questions in the section in the space provided.

SECTION B

Reason:

That person is not detected

Two of the people are detected. The presence of the first person produces small

End of Section A
(ii) The analysis of the radioactive molecules in the urine samples showed that the radioactive molecule is a fragment of the original drug molecule, and none of the original drug molecules are present.

Explain what could have occurred to lead to this observation and name the organ in the body that could have been involved in this process.

---

Ans: 

[Total: 10]
(a) Compare the characteristics of an insect-pollinated flower and a wind-pollinated flower. Explain the significance for the similarities and differences between the two flowers.

(b) Explain why a plant species in which self-pollination usually occurs can become adapted to new surroundings better than the one that reproduces asexually, but less well than a species that is always cross-pollinated.
(b) Table 9.1 compares the thickness of wall between an artery and capillary of a cat.

<table>
<thead>
<tr>
<th>Thickness of wall (mm)</th>
<th>Artery</th>
<th>Capillary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td></td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 9.1

Using the information in Table 9.1, explain how the difference in thickness of the wall of arteries and capillaries are related to their functions.

[3]

(c) Mammals have a double circulation. What are the advantages of having a double circulation?

[4]

[Total: 10]
Fig. 3.2

(a) Draw the shapes of the atomic structures from the figure. How do the shapes differ?

(b) Calculate the percentage increase in the area of structure (c) when the number of electrons increases from a known electronic configuration to the configuration in the table.

<table>
<thead>
<tr>
<th>Element</th>
<th>Charge (e)</th>
<th>Area (cm²)</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>0.65</td>
<td>0.24</td>
<td>2.12</td>
</tr>
<tr>
<td>H</td>
<td>0.63</td>
<td>0.20</td>
<td>1.72</td>
</tr>
<tr>
<td>N</td>
<td>0.61</td>
<td>0.18</td>
<td>1.54</td>
</tr>
<tr>
<td>C</td>
<td>0.60</td>
<td>0.16</td>
<td>1.47</td>
</tr>
</tbody>
</table>

(c) Describe how excess protein is converted into heat.
Table 9.3 shows the animals X, Y, and Z and their water potential of urine.

<table>
<thead>
<tr>
<th>name of mammal</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>beaver</td>
<td>high</td>
<td>low</td>
<td>very low</td>
</tr>
<tr>
<td>house mouse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>desert living gerbil</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9.3

Explain the relationship between the length of section D in the nephrons and the water potential of the urine each mammal produces.

END OF PAPER
**27**

<table>
<thead>
<tr>
<th>(b)(i)</th>
<th>J. smallest fluctuations / greatest control over sugar level;</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) H. greatest fluctuations / least control over sugar levels;</td>
<td></td>
</tr>
<tr>
<td>(c) from alveoli, diffuses through alveoli walls; diffuses through blood capillary walls into bloodstream;</td>
<td></td>
</tr>
</tbody>
</table>

**B7**

(a) Vein to right atrium to right ventricle of the heart;
Enters the lungs via the pulmonary artery and return to left atrium via pulmonary vein;
Leaves the heart via aorta and travels to kidneys via renal artery;
(b) Axons (headings / units);

1 hour;

Drugs molecule has travelled to the liver;
Where it has been metabolised / broken down into smaller molecules;

**B8**

(a) Both flowers possess stamens, stamens and pollen;
Both flowers require the assistance of an external agent for pollination;

**Differences:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Insect-pollinated flower</th>
<th>Wind-pollinated flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petals</td>
<td>Large and brightly- coloured flowers/ conspicuous</td>
<td>Small dull- coloured flowers/ no petals</td>
</tr>
<tr>
<td>Nectar</td>
<td>Nectar present</td>
<td>Nectar absent</td>
</tr>
<tr>
<td>Scents</td>
<td>Fragrant/ sweet-smelling</td>
<td>No scent</td>
</tr>
<tr>
<td>Significance</td>
<td>Help insect-pollinated flowers to attract insects;</td>
<td>No need to attract insects;</td>
</tr>
<tr>
<td>Stigmas</td>
<td>Small and compact and do not protrude out of flower</td>
<td>Large and feathery and protrude out of flower;</td>
</tr>
</tbody>
</table>

(b) Significant

<table>
<thead>
<tr>
<th>Flower to trap pollen;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stigmas Not pendulous and do not protrude out of flower</td>
</tr>
<tr>
<td>Significance: Pollen grains can be shaken off easily from the anthers of the wind-pollinated flowers.</td>
</tr>
</tbody>
</table>

**Significance:**

Pollen fairly abundant and have large and rough surfaces
More abundant than insect-pollinated flowers and are light and tiny with smooth surfaces

**B8 (ii) Ether**

(a) Blood entering right atrium
Blood leaving left ventricle

More carbon dioxide
Less carbon dioxide

*Up to 2 marks for similarities (At least 1 similarity)
Up to 4 marks for differences (For each difference mentioned + corresponding significance = 1 mark)
<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal fluid dynamics occur.</td>
</tr>
<tr>
<td>1</td>
<td>Blood is pumped by the heart and flows through the blood vessels.</td>
</tr>
<tr>
<td>1</td>
<td>Blood pressure is maintained in the body.</td>
</tr>
<tr>
<td>1</td>
<td>When the heart contracts, blood is pumped into the blood vessels.</td>
</tr>
<tr>
<td>1</td>
<td>Blood flows from the lungs to other parts of the body.</td>
</tr>
<tr>
<td>1</td>
<td>Blood is returned to the heart through veins.</td>
</tr>
<tr>
<td>1</td>
<td>The process is repeated.</td>
</tr>
</tbody>
</table>

### Question

**Q1:** What factors affect blood flow in the body?

**A1:**

- Heart rate
- By the body tissues
- Blood pressure
- Blood vessels
- Blood flow through the body
- Blood vessels

**Q2:** What are the consequences of a decrease in blood pressure?

**A2:**

- Less oxygen reaches the organs.
- Less glucose is transported to the tissues.
- Cells may not receive enough nutrients.
- The body may not function properly.

**Q3:** How does the body maintain blood pressure?

**A3:**

- The heart pumps blood at a constant rate.
- Blood vessels adjust to maintain blood pressure.
- The kidneys help regulate blood pressure by controlling the amount of fluid in the body.

**Q4:** What can cause high blood pressure?

**A4:**

- High salt intake
- Lack of physical activity
- Smoking
- Unhealthy diet
- Stress

**Q5:** How does the body regulate blood pressure?

**A5:**

- The kidneys help regulate blood pressure by controlling the amount of fluid in the body.
- The heart pumps blood at a constant rate.
- Blood vessels adjust to maintain blood pressure.

**Q6:** What is the effect of high blood pressure on the body?

**A6:**

- Damage to the heart, brain, and blood vessels.
- Increased risk of heart attack, stroke, and kidney disease.
- Reduces the body's ability to transport nutrients and oxygen to the cells.
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Table E-1

<table>
<thead>
<tr>
<th>Speed (m/min)</th>
<th>Oxygen Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>12</td>
</tr>
<tr>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

8. Table E-1 shows the oxygen consumption at given walking speeds.

Section B (10 Marks)

Question 18 is in the form of an illustrated question. Copy and past should be avoided.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Prophase I</td>
</tr>
<tr>
<td>B</td>
<td>Metaphase I</td>
</tr>
<tr>
<td>C</td>
<td>Anaphase I</td>
</tr>
<tr>
<td>D</td>
<td>Telophase I</td>
</tr>
<tr>
<td>E</td>
<td>Prophase II</td>
</tr>
<tr>
<td>F</td>
<td>Metaphase II</td>
</tr>
<tr>
<td>G</td>
<td>Anaphase II</td>
</tr>
<tr>
<td>H</td>
<td>Telophase II</td>
</tr>
</tbody>
</table>

**Diagram:**

Some of the stages have already been written in the table. Complete the table by writing the stages of meiosis in the correct order.

**Figure 7.4**

The figure below depicts the stages of meiosis. A to H, but they are not in the correct order. Explain how meiosis can result in genetic variation and diversity.
Table 1. Shows the results of the production for 160 kg of soybean meal from the second stage of the process.

<table>
<thead>
<tr>
<th>soybeans</th>
<th>soybean meal</th>
<th>protein %</th>
<th>protein yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 kg</td>
<td></td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

The student investigated the mean value of protein and amino acid content in soybeans. The mean value of protein was found to be 40% and the mean value of amino acid content was found to be 16%.
9. AClU: Communicate with Clarity and Precision

(a) Complete the table below by writing the stages of meiosis in the correct order.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Prophase I</td>
</tr>
<tr>
<td>B</td>
<td>Metaphase I</td>
</tr>
<tr>
<td>C</td>
<td>Anaphase I</td>
</tr>
<tr>
<td>D</td>
<td>Telophase I</td>
</tr>
<tr>
<td>E</td>
<td>Prophase II</td>
</tr>
<tr>
<td>F</td>
<td>Metaphase II</td>
</tr>
<tr>
<td>G</td>
<td>Anaphase II</td>
</tr>
<tr>
<td>H</td>
<td>Telophase II</td>
</tr>
</tbody>
</table>

Fig 7.1: Shows diagrams of the stages of meiosis. A to H are in the correct order.

(b) Explain how meiosis can result in genetic variation amongst offspring.

10. AClU: Communicate with Clarity and Precision

END OF SECTION A

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Fig 6.1

(a) Suggest ways in which plants may prevent soil pollution.

(b) State the number of life forms which require the presence of the habitat described.

Fig 5.2

(c) Using the information in Fig 5.2, state how long vertebrate species exist.

(d) How long do changes in pressure in the left side of the heart during the cardiac cycle last?
(a) List the labels on the diagram.
(b) Label the parts identified in (a).

![Diagram of the human heart]

Table 1

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

(c) Suggest a reason for the changes in the table.

Table 2

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

(d) Discuss the relationship between the number of spider mites and the rate of transpiration.
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(6) Explain what is meant by the term "reduction".

(7) How does the process of reduction affect the properties of a substance?

(8) How does the process of reduction affect the properties of a substance?

(9) What is the difference between a reducing agent and an oxidizing agent?

(10) Calculate the difference in mass between the reactants and the products.

(11) Complete the table below.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Initial Mass</th>
<th>Final Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction 1</td>
<td>10.0 g</td>
<td>9.5 g</td>
</tr>
<tr>
<td>Reaction 2</td>
<td>15.0 g</td>
<td>14.8 g</td>
</tr>
</tbody>
</table>

(12) Explain the differences in mass between mass 2 and mass 3.

(13) Suggest two reasons that the mass of a substance is not changed during the reaction.

(14) What is the purpose of mass loss?

(15) Explain the process of mass loss.
(ii) Explain your answer (4 marks)

(iii) State the order of the equations for tests 1 and 2 in Table 1.2.

<table>
<thead>
<tr>
<th>Test 1.2</th>
<th>Order of Equations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2

Each test was run in triplicate, and the error in a water bath was measured at 4°C. After some time, the solutions for each test were recorded.

Table 1.1

<table>
<thead>
<tr>
<th>Condition</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1

Where the error was within the specified range provided, fill in the blank accordingly.

Answer all questions.

Section B (35 marks)

Page 143
END OF PAPER

40. Which one of the following would most likely happen if process A does not occur?

A. The population of the area would increase
B. Carbon dioxide levels in the atmosphere would decrease
C. Carbon cycling would occur in the reverse direction
D. The increase in carbon dioxide is no longer observed
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149

1. The diagram shows a type of nerve cell.
2. Which three neurons compose the motor neuron? a) A B C
3. Which neuron transmits nerve impulses to the motor neuron? a) A B C
4. Which neuron is responsible for carrying nerve impulses away from the motor neuron? a) A B C

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A. Time (sec)
B. Diameter of dialysis film (mm)

A. What causes the growth of the dialysis film to increase?

B. The following graph shows changes in the concentration of urea in the bloodstream.

C. Concentration of urea in blood
A student takes a test. The instructor tells the class that the test is based on the following graph:

- **Graph**: A line graph showing time (in minutes) on the x-axis and score (in percentage) on the y-axis. The graph has a peak around the 20-minute mark and then dips back down to a lower score around the 60-minute mark.

**Questions**:

1. Which one of the following examples of negative feedback is being used? (Select one)

   - Option A: The body temperature increases to maintain homeostasis.
   - Option B: The blood pressure decreases after exercise.
   - Option C: The heart rate increases after exercise.
   - Option D: The blood sugar decreases after eating.
   - Option E: The body weight decreases after fasting.

2. What causes the changes in pressure during stage X? (Select one)

   - Option A: Reabsorption of materials by the kidneys.
   - Option B: Excretion of materials by the kidneys.
   - Option C: Production of hormones by the adrenal glands.
   - Option D: Secretion of digestive enzymes by the pancreas.
   - Option E: Absorption of materials by the small intestine.

3. The graph shows the changes in the pressure within the lungs during one breathing cycle. (Select one)

   - **Graph**: A line graph showing pressure (in millimeters of mercury) on the y-axis and time (in seconds) on the x-axis. The graph shows a peak in pressure followed by a dip, then another peak, and finally a dip.

   **Questions**:

   - What is the unit of pressure? **millimeters of mercury (mm Hg)**
   - What is the peak pressure? **100 mm Hg**
   - What is the time interval for one complete breathing cycle? **3 seconds**
   - How does the pressure change during the breathing cycle? **The pressure increases, reaches a peak, decreases, and then increases again.**
1. A type of beam is shown in the following diagram.

2. Which of the following accurately describes the relationship between $P$ and $Q$?

3. What is the key idea of the plant?

4. A process of plant is shown in the following diagram.

5. A process of flow is shown in the following diagram.

6. A process of flow is shown in the following diagram.

7. The concept of a rate is illustrated with a diagram in the following diagram.

8. The rate of a protein is measured in the following diagram.

9. The rate of production of water is measured in the following diagram.

10. The rate of production of water is measured in the following diagram.

11. The diagram shows a section of the country with a map of the terrain.

12. The map shows a section of the country with a map of the terrain.

13. The map shows a section of the country with a map of the terrain.
The table shows the relationship between light intensity and action spectrum.

### Table: Light Intensity and Action Spectrum

<table>
<thead>
<tr>
<th>Light Intensity</th>
<th>Action Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>High intensity</td>
<td>Red and blue</td>
</tr>
<tr>
<td>Medium intensity</td>
<td>Green</td>
</tr>
<tr>
<td>Low intensity</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

The figure illustrates the concept of light intensity and action spectrum with graphs showing the relationship.

### Graph 1: Light Intensity vs. Action Spectrum
- High intensity: Red and blue
- Medium intensity: Green
- Low intensity: Yellow

### Graph 2: Light Intensity vs. Photosynthesis
- High intensity: Maximum photosynthesis
- Medium intensity: Intermediate photosynthesis
- Low intensity: Minimal photosynthesis

The following diagrams depict the process of photosynthesis in various conditions:
- Diagram 1: Solar energy absorbed by chlorophyll
- Diagram 2: Water molecules split by ATP
- Diagram 3: Oxygen released as a byproduct

### Questions:
1. Which of the following conditions is not a key component of the process of photosynthesis?
   - (A) Light energy
   - (B) Carbon dioxide
   - (C) Nitrogen
   - (D) Water

2. What is the key factor that increases the rate of photosynthesis?
   - (A) Temperature
   - (B) Atmospheric pressure
   - (C) Availability of CO2
   - (D) Availability of water

3. Which of the following would not be a likely outcome of a disruption of the chloroplast membrane?
   - (A) Loss of photosynthetic capacity
   - (B) Decrease in the efficiency of ATP synthesis
   - (C) Increase in the production of reactive oxygen species
   - (D) Prevention of the movement of chlorophyll
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The graph below shows the reaction of an enzyme-controlled reaction by varying the pH of the reaction mixture.

<table>
<thead>
<tr>
<th>Enzyme Name</th>
<th>pKₐ</th>
<th>Optimal pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-Lactalbumine</td>
<td>8.4</td>
<td>7.5-8.5</td>
</tr>
<tr>
<td>Chymotrypsin</td>
<td>2.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Trypsin</td>
<td>7.5</td>
<td>7.5-8.5</td>
</tr>
</tbody>
</table>

Which one of the following equations represents a reaction where both X, Y, and Z are involved?

A) X + Y → Z
B) X + Y + Z → W
C) X + Y → Z + W
D) X + Y + Z → W + X

At the end of the experiment, the pH is noted to be 10. Calculate the rate of reaction.

EXPERIMENTAL RESULT

What are the following statements correct about the identity of X, Y, and Z?

A) X is the reactant, Y is the product, and Z is the catalyst.
B) X is the reactant, Y is the catalyst, and Z is the product.
C) X is the product, Y is the catalyst, and Z is the reactant.
D) X is the product, Y is the catalyst, and Z is the reactant.

The diagram shows an experiment. Which of the following statements is correct about the experiment?

A) The solution in tube 1 is the reactant, and the solution in tube 2 is the product.
B) The solution in tube 1 is the reactant, and the solution in tube 2 is the reactant.
C) The solution in tube 1 is the reactant, and the solution in tube 2 is the reactant.
D) The solution in tube 1 is the reactant, and the solution in tube 2 is the reactant.
Which cells were placed in which solutions?

1. a. oval, b. round
2. a. oval, b. round
3. a. owl, b. round

Which is not an organism?

a. plant
b. animal
c. mineral
d. blood

Two characteristics of all living organisms are

a. reproduction and distribution
b. reproduction and respiration
c. photosynthesis and excretion
d. movement and reproduction

Each correct answer will score one mark. A total of 40 marks will not be deducted for a wrong answer.

Questions 1 to 4: Choose the option that best completes the sentence.

Multiple Choice Question (4 marks)

Questions 5 to 8: Choose the option that best completes the sentence.

Multiple Choice Question (4 marks)

Do not open this booklet until you are told to do so.

Read these instructions first.

Additional Materials: Multiple Choice Answer Sheet

1 Hour

19 September 2016 (Monday)

Paper 1

Biology

Secondary 4 Express

Prelim Examination 2016

Chung Boon Secondary School

Index No. Class

Candidate Name:
Carousell

10. C. 26°C

**The rate of enzyme activity doubles when the temperature is increased from**

C. 26°C

B. The enzyme works better at 26°C.

C. The enzyme is denatured by temperature below 26°C.

A. The enzyme is denatured only by temperature above 26°C.

**What does the graph show about this enzyme?**

The graph shows how temperature affects the rate of enzyme activity on enzmye.

**What are the enzyme product and substrate in the reaction?**

**The diagram demonstrates the lock and key hypothesis of enzyme action.**

A dish is filed with agar jelly containing sites. Four holes are cut in the jelly and each site is filled with enzyme solution. After 30 minutes, what holes will be surrounded by the biggest layer of jelly and each site is filled with enzyme solution.
The diagram shows part of a section through a leaf.

Which arrow shows the direction of movement of water by osmosis in a leaf?

Which cell type absorbs the most carbon dioxide during the day?

The diagram represents a cross section of part of a leaf.

15

Which process is an example of respiration?

formation of water

formation of sweat

formation of cell membranes using lipids

partition of carbon dioxide

13

<table>
<thead>
<tr>
<th>Water</th>
<th>Ear by sieve tubes</th>
<th>Water X</th>
<th>Vessel X</th>
<th>Vessel Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>x</td>
<td>c</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>a</td>
<td>y</td>
<td>B</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

After a root containing sieve tube of which substances are absorbed mainly into xylem

Vessels X and Ywhich substances are absorbed mainly into phloem

The diagram shows a flow...
Which graph shows the sequence of events in the process of hormone secretion during a secretory process?

A. The graph shows a secretory process where a specific hormone is released at specific time intervals.

B. The graph shows a continuous release of hormone over a period of time.

C. The graph shows a rapid release of hormone followed by a period of low secretion.

Which graph shows the concentration of glucose present in each part of the kidney?

A. The graph shows a sharp decline in glucose concentration from Z to X, indicating a filtering process.

B. The graph shows a gradual increase in glucose concentration from Y to Z, indicating reabsorption.

C. The graph shows a steady state of glucose concentration throughout the kidney.

The graph shows a kidney tubule (nephron) and associated blood vessels.
The diagram shows the relationship between progression levels and the likelihood of:

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The graph below shows how the person's blood sugar level changes after the meal:

- The diabetes of a person's pupil is measured as the pupil reacts to light.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Expected Sugar Level</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relax</td>
<td>Reduced</td>
<td>Low</td>
</tr>
<tr>
<td>Tired</td>
<td>Reduced</td>
<td>Low</td>
</tr>
<tr>
<td>Exercise</td>
<td>Increased</td>
<td>High</td>
</tr>
<tr>
<td>Contemplative</td>
<td>Increased</td>
<td>High</td>
</tr>
<tr>
<td>Clear Reasons</td>
<td>Reduced</td>
<td>Low</td>
</tr>
</tbody>
</table>

During which time period does the pupil increase? Are you ready to eat dinner?

A person does not feel for several hours but then has a meal rich in carbohydrates.
The diagram shows the energy for all the species in a forest. The width of the arrows is proportional to the amount of energy transferred.

Which order represents the decomposers?

1. Type 2 interacts with type 1 and 3.
2. Type 1 interacts with type 2 and 4.
3. Type 2 interacts with type 1 and 4.
4. Type 4 interacts with type 2 and 3.

Which letter represents different habitats?

- W
- X
- Y
- Z
- A
- B

Here are the different habitat labels.

- Type 3 interacts with type 2 and 4.
- Type 4 interacts with type 3 and 5.
- Type 5 interacts with type 4 and 6.

Which letter represents different plant species?

- W
- X
- Y
- Z
- A
- B

Here are the plant species labels.

- Type 3 interacts with type 2 and 4.
- Type 4 interacts with type 3 and 5.
- Type 5 interacts with type 4 and 6.

Two pieces of animal are found in the same area of grassland in the same forest. Which type of animal are they? (Select two)

- W
- X
- Y
- Z
- A
- B

The diagram shows part of a DNA molecule.
The results are shown in Table 1.

The net uptake of carbon dioxide by the crop plants was measured in grams of carbon.

\[
\text{CO}_2 = 0.20 \times 10^{-3} \, \text{g CO}_2 \text{ per plant per hour}
\]

\[
\text{CO}_2 = 0.12 \times 10^{-3} \, \text{g CO}_2 \text{ per plant per hour}
\]

**Fig. 1**

The carbon dioxide concentrations in the glasshouses are recorded and the windows are opened.

The carbon dioxide concentrations in the glasshouses are recorded and the windows are opened.

The carbon dioxide concentrations in the glasshouses are recorded and the windows are opened.

**Fig. 1** shows the carbon dioxide concentrations in the glasshouses D, E, F, and G.

(a) Explain the advantage of carbon dioxide enrichment of glasshouses.

(b) Many growers of crops in glasshouses use carbon dioxide enrichment to improve yields.

1. Answer all the questions in the paper provided.

**Section A (50 marks)**
Fig 2.1 shows the data for all males.

Table 2.1: Shows the data for all cancer deaths.

Table 1.1: Shows the data for all cases of death in parts of the world dying 19/10.
(a) 

Using Fig. 3.1, describe the changes in the production of gastric juice in response to variations in food intake and digestive activity.

(b) 

Explain the role of gastric juice in the digestion and absorption of nutrients.

(c) 

Show your working for the calculations on Table 2.
(a) Explain the significance of the reaction in the transport of carbon dioxide:

\[ \text{Enzyme} \text{ } Z \text{ } \text{catalyzes this reaction:} \]

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \text{ } \text{Enzyme} \text{ } Z \]

(b) Blood flows through mesenteric veins between carbon dioxide and water as enzyme Z and blood cells catalyze the reaction between carbon dioxide and water.

(c) Explain how capillaries are adapted for their function as exchange vessels.

(d) fibre two ways in which the blood al differs from the blood at x. other than fibres:

Fig 4.1

- Fig 4.1 shows part of a capillary network and some cells of the surrounding tissue.
Fig. 5.2: Shows how the condition is inherited in a family.

The mutation that results in this condition is dominant.

Fig. 5.1: Shows the hands of a person who inherits a mutation that results in polydactyly.

Name and explain two ways in which mosaic can lead to variation.

Fig. 5.4: Shows the stages of meiosis II, as shown.

Define the following genetic terms:

- Recessive allele

- Heterozygous

Describe the process of an animal cell that is undergoing meiosis II.
Describe how the position of scattered, isolated dots is used to form patterns and plane tilings.

(e) The results for combined birds are a particular cause for concern.

Suggest a reason for the change in the numbers of woodcock birds since 1990.

(e) Explain the reason for your answer.

(iii) Describe the manipulation of the variables of the entire set of data.

Table 6.1

<table>
<thead>
<tr>
<th>Group of Passerine</th>
<th>at Fig. 6.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

(ii) State the genotype of the individual shown in Fig. 6.2.
(i) State the two times at which the uptake and loss of water were the same.

(ii) State the process by which water loss from the plant.

(iii) Plot the data for water loss on the graph. Label both axes.

Table 6.1

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Water loss / g per hour</th>
<th>Water uptake / g per hour</th>
<th>6</th>
<th>11</th>
<th>2200</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>11</td>
<td>2200</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>20</td>
<td>2200</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>24</td>
<td>15</td>
<td>24</td>
<td>2200</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>2200</td>
</tr>
<tr>
<td>25</td>
<td>24</td>
<td>24</td>
<td>25</td>
<td>24</td>
<td>2200</td>
</tr>
<tr>
<td>30</td>
<td>18</td>
<td>18</td>
<td>30</td>
<td>18</td>
<td>2200</td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>11</td>
<td>35</td>
<td>11</td>
<td>2200</td>
</tr>
<tr>
<td>40</td>
<td>7</td>
<td>7</td>
<td>40</td>
<td>7</td>
<td>2200</td>
</tr>
<tr>
<td>45</td>
<td>2</td>
<td>2</td>
<td>45</td>
<td>2</td>
<td>2200</td>
</tr>
</tbody>
</table>

The results are shown in Table 6.1.

An investigation of the uptake and loss of water by a plant was carried out over 24 hours. Write your answer in the space provided.
Describe the role of natural selection in evolution.
Explain how a kidney machine works.

If the kidneys fail, the patient may be put on a kidney machine.

Describe how the work of the kidneys is affected by changes in diet and atmospheric conditions.
The diagram shows a section through a root seen under the microscope.

### Table: Changes in the Root Resulting from Reduced Oxygen Concentration of Air

<table>
<thead>
<tr>
<th>pH</th>
<th>Yellow</th>
<th>Orange</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Yellow</td>
<td>Orange</td>
<td>Red</td>
</tr>
<tr>
<td>5</td>
<td>Yellow</td>
<td>Orange</td>
<td>Red</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
<td>Orange</td>
<td>Red</td>
</tr>
</tbody>
</table>

### Diagram: Diffusion of Movement

- The diffusion shows the condition set up in an experiment.

- The equation shows a section of the root, assuming no oxygen is present.
A region of a graph is shaded to indicate the area in the graph where these events occur.

How will the information affect the transport between these two points and how do they change over time?

13. An investigation was carried out to find the effect of light intensity on the transport. The results shown in the graph below.

(a) State the relationship between the variables.
(b) Describe the effect of light intensity on the transport.

The diagram shows the pressure changes in various studies of the net area of the cell. At the critical point, the pressure decreases to zero, and the net area changes near the point of zero pressure. The pressure is highest at the critical point and decreases to zero at the point of zero pressure. The net area changes near the point of zero pressure.

11. The value of the following calculations can be drawn from the information in the table.

<table>
<thead>
<tr>
<th>Amount of Good</th>
<th>Number of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>250,000</td>
<td>500</td>
</tr>
<tr>
<td>500,000</td>
<td>1,000</td>
</tr>
<tr>
<td>750,000</td>
<td>1,500</td>
</tr>
<tr>
<td>1,000,000</td>
<td>2,000</td>
</tr>
</tbody>
</table>

The table shows the composition of the good to people.

At the critical point, the pressure decreases to zero, and the net area changes near the point of zero pressure. The pressure is highest at the critical point and decreases to zero at the point of zero pressure. The net area changes near the point of zero pressure.
The graph shows the variation in a person's body temperature over a period of time.

Table: Changes in Body Temperature

<table>
<thead>
<tr>
<th>Condition</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>in the brain</td>
<td>in urine</td>
<td></td>
</tr>
<tr>
<td>in the blood</td>
<td>in urine</td>
<td></td>
</tr>
<tr>
<td>in the body</td>
<td>in urine</td>
<td></td>
</tr>
</tbody>
</table>

On a hot day, the amount of water released would increase, and the temperature would decrease.

On a cold day, the amount of water released would decrease, and the temperature would increase.

<table>
<thead>
<tr>
<th>Water (gallon)</th>
<th>2000</th>
<th>1000</th>
<th>500</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the brain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the blood</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the body</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The diagram represents some of the muscles involved with a stroke.
1. Which statement is supported by evidence in the graph?

   a. The graph shows changes that occur in a woman during the menstrual cycle.
   b. After menstruation, the uterus lining thickens.
   c. The uterus lining is thickest before ovulation.
   d. Menstruation follows ovulation.

   

2. A protein that helps with the processes of ovulation and fertilization is (diagram showing parts of the female reproductive system).

   a. Follicle-stimulating hormone (FSH)
   b. Luteinizing hormone (LH)
   c. Estrogen
   d. Progesterone

3. A student is asked to choose the correct label for each part of the diagram. Which option is correct?

   a. Ovary, fallopian tube, uterus, cervix, vagina
   b. Ovary, fallopian tube, cervix, uterus, vagina
   c. Ovary, fallopian tube, cervix, vagina, uterus
   d. Fallopian tube, ovary, uterus, cervix, vagina

4. Which term best describes the structure shown in the diagram?

   a. Cross-section
   b. Longitudinal section
   c. Sagittal section
   d. Transverse section

5. The diagram shows a cross-section through the cervix of a woman just before menstruation. Which one of the following best describes the stages of the menstrual cycle in relation to the diagram?

   a. Menstruation, ovulation, follicle development, corpus luteum
   b. Menstruation, follicle development, ovulation, corpus luteum
   c. Follicle development, ovulation, corpus luteum, menstruation
   d. Corpus luteum, ovulation, follicle development, menstruation
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Section A

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>N</td>
<td>M</td>
<td>N</td>
</tr>
</tbody>
</table>

Table 1: The food consistence of meal and position

![Diagram](image)

The food consistence is good when

Section B

1. N shows the area of the stomach that is in the upper part of the human

Instructions to candidates

Duration: 1 hour 30 minutes

Date: 20 and 26th of July (Thursday)

Paper 2

Biology

Candidate Name

Class: A

Index No.
Figure 1.1 shows the stages of the mitotic cycle, which are labeled A to C. The processes illustrated in Fig. 1.2 show stages of the mitotic cell cycle occurring in the normal sequence. Process B is the only process, which is the division of the metaphase cell and is depicted only in the normal sequence.
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Describe how blood vessels could become blocked.

Fig. 4.1: Shows the anatomical view of the heart of a person who has recovered from a stroke.

Fig. 3.2: Shows a cross-section of a transverse section of a leaf from the same plant, showing...
Diagram in Fig. 5.1 shows the changes in the relative concentrations of these substances in the blood plasma and renal vein. These changes happen when the blood flows through the renal artery and kidney. Explain your answer to your teacher in detail on the lines provided.

(i) Explain the process of filtration and reabsorption.

(ii) Using the figures from Fig. 3.2, analyze the changes in the concentrations of these substances in the blood plasma and renal vein.

(iii) Complete the table below:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Renal Vein</th>
<th>Kidney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1

(iv) Explain the meaning of the terms domain and range.
Table 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Length of coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>66</td>
<td>11</td>
</tr>
<tr>
<td>99</td>
<td>11</td>
</tr>
<tr>
<td>77</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

**Fig. 7.1**

A gans consists of many individual units known as gansites. If Fig. 1 shows a single gansite, then you might also consider the possibility of a large gansite that is made up of many smaller gansites. This is a common occurrence in many animals, and it is an interesting aspect of the morphology of gansites.

**Section B**

**Question:** (c) In the context of the presented discussion, how many gansites are in each gansite? Explain your answer.

**Answer:**
Fig. 8.3

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.

Suggest how a new improved variety with these new characteristics could be produced.
[c] Describe the process of blood coagulation.

(d) Explain how a defence mechanism fight disease.

(e) A disease with similar disease may be put on a happy machine.

10 C/E
# FHSS Biology 5150 Secondary 4 Preliminary Examination 2016 Mark Scheme

## Paper 1: Multiple Choice Questions (40 marks)

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
</tbody>
</table>

## Paper 2 (50 marks)

### Section A: Structured Questions (50 marks)

- 1 mark: 0.5 mark: one or reverse argument: AW: Alternate wording

#### 1(a)(i)
- starch - almost the same at M and N
- protein - less at M than at N

#### 1(a)(ii)
- Any 4 of the following (max 2)
  - ref. protection / barrier / prevents damage / breakdown / digestion of wats
  - ref. protease
  - wall are made of protein
  - ref. lubrication

#### 1(b)(i)
- A - microvilli
- C - nucleus

#### 1(b)(ii)
- undergoes asexual reproduction
- to release / provide energy
- for active transport
- to move substances against concentration gradient

#### 2(a)(x)
- Parent smaller villi for control OR normal has larger more villi
- Reduced surface area for absorption
- Reduced diffusion
- into blood

#### 2(a)(xi)
- A - interphase
- C - metaphase

#### 2(a)(xii)
- (i) (C) £ N £ M £ K
- Award only when in correct sequential order

#### 2(b)(i)
- needs number of chromosomes to remain constant / diploid
- needs all daughter cells to be genetically identical / have no genetic variation / A clones
- needs genetic stability

#### 2(b)(ii)
- homologous chromosomes parring
- crossing over
- exchange of genetic material
- between non-sister chromatids
- creates new combinations of alleles when sister chromatids separate

#### 2(b)(iii)
- stem

#### 2(b)(iv)
- photosynthesis produces glucose
- which is changed into sucrose
- transport down the phloem
- by translocation
- from leaves to other parts of plants
- concentration of sucrose varies
- highest when photosynthesis rate is highest

#### 2(b)(v)
- No chloroplasts in root hair cells (1) OR root hair cells have long root (1)

---

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<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
</tr>
</tbody>
</table>
1. coronary artery 
2. Cholesterol crystals deposit in wall of artery. 
3. Muscle can be made to contract, but not to relax. Heart cannot contract effectively. Cannot pump blood. |
| (b) | 
1. Exercise needs extra energy. 
2. Increased delivery of oxygen. 
3. Increased delivery of glucose. 
4. Increased removal of carbon dioxide. 
5. Increased removal of heat. 
6. Reduces risk of depending on anaerobic respiration. 
7. Remove any lactate that is produced. |
| (i) | 
1. Exercise needs extra energy. 
2. Increased delivery of oxygen. 
3. Increased delivery of glucose. 
4. Increased removal of carbon dioxide. 
5. Increased removal of heat. 
6. Reduces risk of depending on anaerobic respiration. 
7. Remove any lactate that is produced. |
| (ii) | 
1. Exercise needs extra energy. 
2. Increased delivery of oxygen. 
3. Increased delivery of glucose. 
4. Increased removal of carbon dioxide. 
5. Increased removal of heat. 
6. Reduces risk of depending on anaerobic respiration. 
7. Remove any lactate that is produced. |
| (iii) | 
1. Exercise needs extra energy. 
2. Increased delivery of oxygen. 
3. Increased delivery of glucose. 
4. Increased removal of carbon dioxide. 
5. Increased removal of heat. 
6. Reduces risk of depending on anaerobic respiration. 
7. Remove any lactate that is produced. |
| (iv) | 
1. Exercise needs extra energy. 
2. Increased delivery of oxygen. 
3. Increased delivery of glucose. 
4. Increased removal of carbon dioxide. 
5. Increased removal of heat. 
6. Reduces risk of depending on anaerobic respiration. 
7. Remove any lactate that is produced. |
| (c) | 
1. Fast/rapid 
2. Electrical impulses 
3. Neurons (R, meninges) 
4. Muscles 
5. Temporary 
6. Sometimes deliberate 
7. Specified organs |
| (d) | 
1. E, any posterior surface of uterus, R, muscular wall 
2. F, on ovary |
| (e) | 
1. Any posterior surface of uterus, R, muscular wall 
2. F, on ovary |
| (f) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (g) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (h) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (i) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (j) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (k) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (l) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (m) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (n) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (o) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (p) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (q) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (r) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (s) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (t) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (u) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (v) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (w) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (x) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (y) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
| (z) | 
1. A change in a gene, chromosome, DNA. 
2. 1 – as 
3. 2 – As |
SECTION B: ESSAY QUESTIONS [30 MARKS]

8(a)(i) A. – (X-axis) labelled and evenly scaled (length of cobs); label of number must be central under each column.
B. – (Y-axis) labelled with units and evenly scaled (number of cobs/cm)
C. – curve to fill more than 1/3 of grid
D. – plotting accurate
E. – labelled graph, maximum 2 "y" marks
Note: If line graph, maximum 2 "y" marks

8(b) (i) continuous variation
- range of lengths rather than in distinct groups
- influenced by environment and genotype

8(b)(ii) 1.1 [Refer 19:20]

8(c)(i) Energy is lost along food chain to each trophic level between maize and cows.
- maize at first trophic level; producers. Cows are at higher trophic level.
- energy from maize goes directly to humans instead of via cows. More energy to humans from maize than from cows.
- cows use energy to move; examples of how energy is used. Less available (e.g. for movement)
- examples of energy loss from cows in food chain (Any two below)
- food not digested/absorbed
- indigestible parts
- heat loss by respiration
- excreted via urine
- excreted via faces

[emphasis on loss of energy between trophic levels; focus on energy loss to primary consumer]
- quality of the nutrients in maize better than beef
- select plants with desired characteristics, bread varieties with one another (no marks)
- transfer pollen from anther/stamen of one variety onto stigma of second variety/cross pollination described
- collect seeds and grow plants
- select next generation of plants/cross any without one of the features (disease resistance and high yield)
- cross progeny for many generations
(a) Enzymes = named enzymes. P. bacteria are enzymes.
Starch breakdown to simple sugars (molecules) to smaller, absorbable molecules
Cellulose + sugar to glucose
Further changes e.g. to carbon dioxide + water
Protein + polypeptides + amino acids to smaller, absorbable molecules

(b) Questions asks for reasons why conserving species is important – answers must be in this context

- Interdependence in food chains/trophic web
- Species are unique/irreplaceable
- Ref to biodiversity
- Retain genebank/gene pool
- Qualify potential use for humans e.g. in medical research
- AVP e.g. ethical considerations for future generations to appreciate

R. Become extinct without qualification.
- Some variations are advantageous
- Competitor
- In the organism’s habitat / environment
- Organism survives / differential survival / OVA
- Bijections / mutations
- Pass on the advantage / beneficial gene / allele
- Over many generations / ref. time
- Continuous adaptation to the changing environment
- Evolution / natural selection / AV
- Changes that result from the environment not so important

<table>
<thead>
<tr>
<th>True (max. 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only one parent involved</td>
</tr>
<tr>
<td>Fast outcome</td>
</tr>
<tr>
<td>Potential rapid spread of organism</td>
</tr>
<tr>
<td>Less energy required / no gametes needed</td>
</tr>
<tr>
<td>Less wastage of pollen</td>
</tr>
<tr>
<td>Not reliant on pollination (agent)</td>
</tr>
<tr>
<td>If parent well adapted, offspring will be adapted to surroundings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensible (max. 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More variation</td>
</tr>
<tr>
<td>Evolution / formation of new species</td>
</tr>
<tr>
<td>Seed dispersal, avoiding crowding with parent or others</td>
</tr>
<tr>
<td>Better able to adapt to change in environment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrients (max. 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Across placenta / through placenta</td>
</tr>
<tr>
<td>Diffusion</td>
</tr>
<tr>
<td>From mother’s blood into fetal blood (directions unclear stated, ref to blood)</td>
</tr>
<tr>
<td>Named substances e.g. oxygen, glucose, amino acids</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection (max. 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amnion / amniotic fluid</td>
</tr>
<tr>
<td>Provides protection against mechanical damage / ‘kneecaps’</td>
</tr>
<tr>
<td>Provides sterile environment / no entry of pathogens</td>
</tr>
<tr>
<td>Backbone provides protection against jolts / AV</td>
</tr>
<tr>
<td>Placenta provides a barrier to named pathogen(s) / AV</td>
</tr>
<tr>
<td>Placenta prevents mixing of blood between fetus and mother</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Removal of metabolic waste (max. 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Across placenta / through placenta</td>
</tr>
<tr>
<td>Diffusion of</td>
</tr>
<tr>
<td>Area / carbon dioxide</td>
</tr>
<tr>
<td>From fetal blood into mother’s blood</td>
</tr>
</tbody>
</table>

Award the following points only once in either nutrients or excretion category:
- Correct ref to umbilical cord/detachable artery / (for excretion) umbilical vein / (for nutrients)
information is in different sequence of bases: nucleotides in the polynucleotide strand.
- Described in terms of sequence of bases:
  - DNA/protein: contains AVW: information for the synthesis of a polypeptide/protein/enzyme
  - Amino acid sequence: information becomes sequence of amino acids.
  - DNA: information is read on cell to generate to offspring (read of enzymes).

1GCR
(a) Diffusion in a membrane: partially permeable
- Water molecules move by diffusion
- Excess water moves by osmosis
- Proteins: blood cells too large to move across membrane
- Red blood cells fluid, contains no cells
- Contains some carbohydrates
- From blood to dialysis fluid (in direction)
- Dialysis fluid aligns in opposite direction from the blood
- Provides steep concentration gradient
- Relate to platelets (in correct context of clotting)
- Fibrogen converted to fibrin
- Soluble to insoluble in blood
- Thrombin
- Meshwork to trap blood (cells)
- AVP: related to prothrombin involvement of calcium in clotting factors

(e) • Ref. diffusion (mark once):
  - (diffuse) into red blood cell
  - Carbonic anhydrase catalyses the formation of carbonic acid from CO₂ and water (A: equation)
  - Carbonic acid breaks down into hydrogen carbonate ions (A: formula) which diffuse out
  - Is carried in blood plasma
  - Pumped by heart to lungs
  - The reverse process happens (or described)
  - (carbon dioxide diffuses into) alveolar space
Geylang Methodist School (Secondary)
Examination 2016 (PRACTICE 1)

Candidate Name

Class Index Number

BIOLOGY

Paper 2

Additional materials: writing paper, graph paper

Setter: Mr James Kee

5158/02 Sec 4 Express 2 hour 6 October 2016

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 in both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer all questions in the spaces provided on the question paper.

Section B
Answer all the questions.

Write your answers on the writing paper provided.
Write an E (for Either) or an O (for Or) next to the number 10 in the grid below to indicate which question you have answered.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes for Section B.

At the end of the examination, hand in Section A and Section B separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner’s Use

Section A
Section B
14
15
16
Total 115

This document consists of 26 printed pages.

Turn over

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Section A

Answer all questions in the spaces provided.

1. Inspired air has a different composition to expired air.

Complete Table 1.1 to show how inspired air is different from expired air.

<table>
<thead>
<tr>
<th>Substance</th>
<th>How inspired air is different from expired air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>Dust particles</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
</tr>
<tr>
<td>Water vapour</td>
<td></td>
</tr>
</tbody>
</table>

[4]

[Total: 4]
2 Fig. 2.1 shows a poster that a student made for a biology lesson.

**Fig. 2.1**

A plasma that makes antibodies

B red blood cell that transports oxygen

C white blood cells that transport glucose

The teacher told the class that the student had made a number of mistakes.

(a) For each of the three labels, correct the mistakes by giving the name and function of each component.

<table>
<thead>
<tr>
<th>A name</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B name</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C name</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(b) Name one other component of the blood that is not labelled on the poster.

State its function.

<table>
<thead>
<tr>
<th>component</th>
<th>function</th>
</tr>
</thead>
</table>

[2]

[Total: 8]

3. The activity of the enzyme carbohydrazo on starch can be investigated using the following apparatus which measures the amount of light passing through the solution.

The solution in the boiling tube consisted of starch, carbohydrazo and iodine.

The following graph appeared on the computer screen at the end of the investigation.
(a) Iodine is used to test for starch. In the presence of starch, iodine changes colour from ____________________________ to ____________________________ [1]

(b) Describe and explain the results seen in the graph by referring to the expected colour changes and reactions taking place in the boiling tube. [5 QWC]

(c) On the graph, draw a line to show what result you would expect if boiled, cooled carbohydrase was used with a solution of starch and iodine. [1]

(d) Describe a test that you would carry out to show the end product of the reaction taking place in the boiling tube. [2]
The following experiment was carried out to show the effect of ethanol (alcohol) on yeast when it fermented glucose anaerobically.

The sterile syringes were prepared as shown in the diagram and left for 1 hour. At the end of the hour, the distance the liquid in the glass tube moved in each syringe was measured.

(a) Explain

(i) why the liquid moved in the glass tube;

(ii) why the temperature in syringe 1 was higher than that in syringe 2 at the end of one hour;

(iii) why it is important to use sterile syringes.
The results of the experiment were as follows:

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Distance moved by liquid in the glass tube (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Syringe 1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>60</td>
<td>220</td>
</tr>
</tbody>
</table>

Suggest an explanation of the results. [1]

.............................................................................................................................
.............................................................................................................................
The first contact lenses to be developed were made of glass. The diagram shows what happened when a glass contact lens was put on the eye.

These lenses proved to be unsuitable because they caused pain.

(a) The diagram shows water entering the cornea of the eye by osmosis. Define osmosis.

(b) Modern contact lenses are gas permeable. Use the information in the diagram to explain why these modern contact lenses are more suitable than glass contact lenses.
6 (a) Fig. 7.1 shows a carbon cycle.

Fig. 7.1

(i) Write the letter of an arrow, A, B, C, D, E, or F as shown in Fig. 7.1, that represents each of the following processes.

combustion

photosynthesis

respiration [3]

(ii) Many of the world's governments are concerned that the carbon dioxide concentration in the atmosphere keeps rising.

Explain why they are concerned about the rise in carbon dioxide concentration.

[3]
(b) Gazelles are herbivores that eat grass.

Oxpecker birds feed on ticks that live on the skin of gazelles.

Ticks suck blood from the gazelles.

(i) Draw a food chain to represent these feeding relationships.

(ii) State what the arrows represent in a food chain.

(iii) Explain why a food chain is not considered to be a cycle like the carbon cycle.
7. Figure shows the life cycle of *C. elegans*. The diploid number of this species is 12.

(a) Suggest why there is very little genetic variation in the offspring of the adult nematode shown in Figure.

(b) State the haploid number of *C. elegans*.
(c) Explain why meiosis occurs at P and mitosis occurs at Q.

meiosis at P

mitosis at Q

[3]
8. The man has an intense workout on the rowing machine.

Figure shows his oxygen uptake before and during the exercise.

(i) Explain why there is a steep increase in the man's oxygen consumption at the start of the exercise.
(ii) It took 10 minutes after the man had stopped rowing for his oxygen consumption to decrease to its resting value.

On Figure 1, draw a line between 20 minutes and 35 minutes to show the change in oxygen consumption after exercise has stopped.

[2]

(iii) Explain why the man's oxygen consumption did not return to the resting value immediately after exercise.

[4]

9 The alleles controlling the ABO blood groups are given the letters I^A (group A), I^B (group B) and i (group O). On the drawings below, write in the alleles on the chromosomes for each of the blood groups. (The first one has been done for you)
10 Figure 1 is a diagram that shows the control of blood glucose concentration.

(a) (i) State one reason why the concentration of glucose in the blood increases.

.............................................................................................................................................................................[1]

(ii) State one reason why the concentration of glucose in the blood decreases.

.............................................................................................................................................................................[1]

(iii) Name two places in the body where glycogen is stored.

1 .............................................................................................................................................................................

2 .............................................................................................................................................................................[2]

(b) Explain how an increase in glucose concentration is controlled in the body.

.............................................................................................................................................................................

.............................................................................................................................................................................

.............................................................................................................................................................................

.............................................................................................................................................................................

.............................................................................................................................................................................[3]

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(c) If the blood glucose concentration is very high there is a decrease in the water potential of the blood. This may damage the red blood cells.

Explain how a decrease in water potential of the blood may damage red blood cells.

11 In rabbits, assume that the dominant allele (B) produces black fur. The allele (b) for white fur is recessive to B.

(a) What colour fur will each of the following rabbits have?

<table>
<thead>
<tr>
<th>Rabbit 1</th>
<th>Rabbit 2</th>
<th>Rabbit 3</th>
<th>Rabbit 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>genotype</td>
<td>BB</td>
<td>Bb</td>
<td>bB</td>
</tr>
</tbody>
</table>

(a) Which of them are pure breed?

(b) If rabbits 1 and 4 were mated together and had 12 babies, how many of these would you expect to be black? Use a punette square to show your working.
(c) If rabbits 2 and 3 are interbred and produce several litters, totalling 48 babies, how many white babies would be predicted by the laws of genetics? Use a genetic diagram to support your answer.

12 Figure shows a vertical section of a kidney.

(a) Name the parts E, F and G.

E

F

G

[3]
(b) Substances move into and out of cells in kidney tubules.

Figure shows four processes, H, J, K and L, that occur in cells lining the kidney tubule.

The net movement of substance is shown by an arrow, in each case.

![Diagram of cell structures with arrows indicating movement of substances.]

(i) Complete the table by stating the letter, H, J, K or L, which identifies each of the processes. Give a reason for each answer.

<table>
<thead>
<tr>
<th>process</th>
<th>letter</th>
<th>reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>diffusion of oxygen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>active uptake of sodium ions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(i) Glucose is filtered from the blood. Usually all of it is reabsorbed by the kidney tubules so that there is none present in the urine.
Name the part of the kidney where filtration occurs. [1]

(ii) Use Fig. 3.2 to describe how kidney tubules reabsorb glucose from the filtrate.

[2]

(c) When plants are grown in a solution that includes a poison that prevents respiration, the roots continue to absorb water, but do not absorb many ions.
Explain this result. [3]
Fig. 5.1 shows the rate of water uptake and of water loss for a plant over a 24-hour period.

![Graph showing water uptake and loss over time](image)

**Fig. 5.1**

(a) Determine the rate of water uptake at 1200 hours. [1]

(b) (i) Name the cells through which water is absorbed from the soil. [1]

   (ii) Name the cells between which water vapour passes to the atmosphere. [1]

(c) (i) State three uses of water within a plant between midnight and 0400 hours.

   1. 

   2. 

   3. [3]

   (ii) State two additional uses of water between 0800 and 1900 hours.

   1. 

   2. [2]

(d) Explain what may happen to the plant between 1400 and 1800 hours. [2]
Section B

Answer only **TWO** questions

14 Describe how a developing foetus in the uterus obtains and uses its metabolic requirements and get rid of its waste products.
15 (a) Describe the path taken by a molecule of oxygen as it passes from air in the lungs to a muscle cell in the body [6]

(b) Sometimes babies are born with a hole between the left and right sides of the heart, through which blood can pass. Explain the effect this has on the double circulation system of the baby's body [4]
16 (a) Explain what is meant by a hormone. [4]

(b) Give an example of a hormone and describe how it is involved in maintaining constant conditions within the human body. [6]
### Table 1.1

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
<th>Relation 1 (10%)</th>
<th>Relation 2 (15%)</th>
<th>Relation 3 (20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxyron</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust particles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron sharing (5%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron sharing (2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory (10%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section A

Complete Table 1.1 to show how material is different from material of...

Answer all questions in the space provided.

### Section B

You are entitled to spend no longer than 45 minutes on Section A and no longer than 45 minutes on Section B.

Write your answers to the questions provided on the question paper.

Do not use corrections, pens, pencils, or rubbers. Follow the guidelines given in the question paper. Write in dark blue or black ink on the answer paper provided.

### Examination 2016 (Practice 1)

Geylang Methodist School (Secondary)

Turn over
Why is it important to use sterile glasses?

Condensers in a lab should always be used to prevent the build-up of water on the glass walls, which can cause contamination. The solution changes color as the solution becomes more concentrated. This causes a change in color of the solution. The solution changes color as the solution becomes more concentrated.
The health of coral reefs and tourist-led food products in the market

A significant portion of the financial resources that the local community invests in the tourism industry is directed towards the conservation and management of marine ecosystems. This is crucial for the survival and well-being of the delicate marine environments that support a wide range of marine species. The destruction of these ecosystems can lead to irreversible damage, impacting not only the local economies but also the global ecosystem.

In the ecosystem of coral reefs, the balance of various species is essential for the survival of the ecosystem. A small change in one species can have a significant impact on the entire ecosystem. Therefore, it is crucial to maintain the balance and diversity of the ecosystem to ensure its sustainability.

**Question:**

(a) Explain why a food chain is not considered to be a circle like the carbon cycle.

- A food chain is linear, whereas the carbon cycle is circular.

(b) State what the arrow represents in a food chain.

- The arrow represents the direction of energy flow.

**Diagram:**

(Refer to the diagram for a visual representation of the food chain.)
Developed from the egg mass that the female ejects from her abdomen.

- The female egg mass contains a large number of eggs. The eggs are laid in a long, slender, tubular mass.
- Each egg in the mass contains a single embryo that develops into an insect upon hatching.

Diagram 1:

1. A long, slender egg mass is attached to the female's abdomen.
2. The female releases the egg mass into the water.
3. The eggs hatch into aquatic larvae.
4. The larvae develop into adult insects.

Diagram 2:

5. The adult insects emerge from the water and mate.
6. The female lays a new egg mass.

Explain why matings occur at P and not at other sites on the diagram.
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to normalise the data before using it as input.

By doing this, we are able to compare different datasets and make predictions accurately.

The diagram above illustrates the process. It shows how the raw data is transformed into useable information.

In summary, normalisation is a crucial step in data analysis that helps in improving the accuracy of models and algorithms.

Figure 1: A diagram illustrating the process of normalisation in datasets.

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\begin{tabular}{|c|c|}
\hline
Comprehension of process & \hline
low & \hline
medium & \hline
high & \hline
\end{tabular}
Section B

Question 1:

Blood travels between the organs. The blood travels from the heart to the lungs, where oxygen is absorbed into the blood. The blood then travels to the liver, where nutrients from the food are absorbed. The blood then travels to the rest of the body, providing oxygen and nutrients to the cells. The blood returns to the heart, and the cycle repeats.

Diagram:

- The heart is at the top, sending blood to the lungs.
- Oxygen is absorbed into the blood in the lungs.
- The blood then travels to the liver, where nutrients are absorbed.
- The blood travels to the rest of the body, providing oxygen and nutrients to the cells.
- The blood returns to the heart, completing the cycle.

Answer:

1. The heart
2. Lungs
3. Liver
4. Rest of the body
5. Heart

Reference

- P.123
- Page 22

Note: This diagram is not to scale.
The blood is carried to every part of the body through the heart and circulates in the blood vessels. When it reaches the tissues, it delivers nutrients and oxygen to the cells. Nutrients such as glucose are absorbed by the cells and used for energy. When the blood returns to the heart, it is filtered and cleaned in the liver. The liver removes waste products and toxins from the blood.

Blood pressure is the force of blood pushing against the walls of the arteries. It is measured in millimeters of mercury (mmHg) and is expressed as two numbers: systolic (upper number) and diastolic (lower number). A healthy blood pressure is below 120/80 mmHg.

The kidneys play a crucial role in maintaining blood pressure by regulating the amount of fluids and electrolytes in the body. They filter blood and remove waste products, excess fluid, and sodium chloride (salt). The kidneys also produce a hormone called renin, which helps regulate blood pressure.

The heart is a muscular organ that pumps blood throughout the body. It is divided into four chambers: two atria (upper chambers) and two ventricles (lower chambers). The heart contracts and relaxes in a rhythmic pattern called the heartbeat.

Blood vessels are tubes that carry blood throughout the body. They are classified into three types: arteries, capillaries, and veins.

Arteries carry oxygen-rich blood away from the heart to the body's tissues.

Capillaries are tiny blood vessels that exchange oxygen, nutrients, and waste products between the blood and body cells.

Veins carry oxygen-poor blood back to the heart from the body.
1. Which of the following correctly identifies the level or organisation of these components of the human body?

1) blood
2) brain and spinal cord
3) eye
4) ovum

<table>
<thead>
<tr>
<th></th>
<th>cell</th>
<th>tissue</th>
<th>organ</th>
<th>organ system</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

2. The diagram shows parts of an animal cell.

What is the order in which the various organelles are involved when the cell secretes a peptide hormone?

A 6 → 2 → 4 → 1
B 6 → 3 → 2 → 1
C 5 → 3 → 4 → 1
D 5 → 6 → 2 → 1
3. The diagram shows 4 cells with different solute concentrations.

Which of the following correctly states what would happen in the cells immediately after they were placed next to each other?

1) Solute would move from cell 1 to cell 4 via diffusion
2) Solute would move from cell 4 to cell 1 via diffusion
3) Water would move from cell 2 to cell 3 via osmosis
4) Water would move from cell 3 to cell 2 via osmosis

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

4. The diagram shows the appearance of a plant cell in an isotonic solution.

Which of the following best illustrates the cell after it was immersed in a hypertonic solution for 15 minutes?

A  
B  
C  
D  

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5. Which of the following statements are true about the importance of water in the human body?

1) Acts as reactant in hydrolysis
2) Aids in transport of carbon dioxide
3) Enables survival in extreme cold
4) Protects growing foetus

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

6. Two different patients with different medical conditions are shown below:

Patient X: gall bladder removal surgery due to gallstones
Patient Y: kidney failure due to long-term diabetes

Which of the following correctly shows the results of food tests performed on the urine and faecal sample of these two patients?

<table>
<thead>
<tr>
<th>Benedict's test</th>
<th>Biuret test</th>
<th>Ethanol emulsion test</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+ : positive result  
- : negative result

7. The diagram shows changes made to a nutrient present in the human body.

Which of the following substances may play a role in causing this change?

1) amylase  
2) insulin  
3) glucagon  
4) lipase

A 1 and 2  
B 1 and 3  
C 2 and 3  
D 2 and 4
8. Which of the following graphs represents the effect on temperature, enzyme concentration and pH respectively on enzyme activity?

<table>
<thead>
<tr>
<th></th>
<th>temperature</th>
<th>enzyme concentration</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image1.png" alt="Graph A" /></td>
<td><img src="image2.png" alt="Graph B" /></td>
<td><img src="image3.png" alt="Graph C" /></td>
</tr>
<tr>
<td>B</td>
<td><img src="image4.png" alt="Graph D" /></td>
<td><img src="image5.png" alt="Graph E" /></td>
<td><img src="image6.png" alt="Graph F" /></td>
</tr>
<tr>
<td>C</td>
<td><img src="image7.png" alt="Graph G" /></td>
<td><img src="image8.png" alt="Graph H" /></td>
<td><img src="image9.png" alt="Graph I" /></td>
</tr>
<tr>
<td>D</td>
<td><img src="image10.png" alt="Graph J" /></td>
<td><img src="image11.png" alt="Graph K" /></td>
<td><img src="image12.png" alt="Graph L" /></td>
</tr>
</tbody>
</table>

9. Which function of the liver is correctly paired with the chemical involved?

<table>
<thead>
<tr>
<th>Function</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>A deamination</td>
<td>glycogen</td>
</tr>
<tr>
<td>B detoxification</td>
<td>alcohol</td>
</tr>
<tr>
<td>C excretion</td>
<td>urea</td>
</tr>
<tr>
<td>D storage</td>
<td>starch</td>
</tr>
</tbody>
</table>
10. The diagram shows an investigation about the action of digestive enzymes.

Which of the following substances when added inside the beaker will cause the greatest reduction in the length of the egg white strip?

A  pepsin + distilled water
B  pepsin + hydrochloric acid
C  boiled pepsin + distilled water
D  boiled pepsin + hydrochloric acid

11. The graph shows stomatal opening and closing in the leaves of a species of *Perlargonium*, over a 24-hour period.

Which conclusions can be made from the graph?

1) Stomata open as light intensity increases.
2) Stomata open as temperature increases.
3) Transpiration is faster when light intensity increases.
4) Photosynthesis occurs only when there is light.
5) Respiration occurs all the time.

A  1 and 2  C  3 and 4
B  1 and 3  D  3 and 5
12. The graph shows some of the effects of light intensity, carbon dioxide, and temperature on the rate of photosynthesis.

Which factor is limiting the rate of photosynthesis at points X, Y and Z?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>light intensity</td>
<td>carbon dioxide</td>
<td>temperature</td>
</tr>
<tr>
<td></td>
<td>concentration</td>
<td>concentration</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>carbon dioxide</td>
<td>light intensity</td>
<td>temperature</td>
</tr>
<tr>
<td></td>
<td>concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>temperature</td>
<td>carbon dioxide</td>
<td>light intensity</td>
</tr>
<tr>
<td></td>
<td>concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>light intensity</td>
<td>temperature</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>concentration</td>
</tr>
</tbody>
</table>
13. The Venn diagram shows the relationship between a phloem sieve tube, xylem vessel, and companion cell.

Which row is correct?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>companion cell</td>
<td>cytoplasm present</td>
<td>phloem sieve tube</td>
<td>nucleus absent</td>
<td>xylem vessel</td>
</tr>
<tr>
<td>B</td>
<td>companion cell</td>
<td>nucleus present</td>
<td>phloem sieve tube</td>
<td>cytoplasm present</td>
<td>xylem vessel</td>
</tr>
<tr>
<td>C</td>
<td>phloem vessel</td>
<td>mitochondria present</td>
<td>companion cells</td>
<td>nucleus present</td>
<td>xylem vessel</td>
</tr>
<tr>
<td>D</td>
<td>xylem vessel</td>
<td>cytoplasm absent</td>
<td>phloem sieve tube</td>
<td>vacuole present</td>
<td>companion cell</td>
</tr>
</tbody>
</table>

14. The diagram shows a longitudinal section of the vascular bundle of a plant. Some soil-borne fungi affect crop growth by growing as shown.

Which process will be directly affected by these fungi?

A  cohesion between water molecules  
B  development of root pressure  
C  flow of dissolved substances during translocation  
D  uptake of water by root hair cells
15. Each set of graphs represents data for blood vessels in the sequence:

artery arterioles capillaries venules veins

Which set is correct?

A

B

C

D
16. One type of congenital heart defect is called an atrial septal defect (ASD) where the left and right atria are not completely separated.

Which row describes the effects of ASD on blood pressure and oxygenation?

<table>
<thead>
<tr>
<th></th>
<th>blood pressure in pulmonary artery</th>
<th>blood pressure in aorta</th>
<th>percentage oxygenation of blood in pulmonary artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>decreased</td>
<td>increased</td>
<td>decreased</td>
</tr>
<tr>
<td>B</td>
<td>decreased</td>
<td>increased</td>
<td>increased</td>
</tr>
<tr>
<td>C</td>
<td>increased</td>
<td>decreased</td>
<td>decreased</td>
</tr>
<tr>
<td>D</td>
<td>increased</td>
<td>decreased</td>
<td>increased</td>
</tr>
</tbody>
</table>

17. The following changes take place in an athlete’s body during a 100-meter race.

1) Increased availability of oxygen to muscles
2) Increased breathing rate
3) Increased production of carbon dioxide by muscles
4) Increased lactic acid concentration in the blood

Which of the following shows the correct order of sequence?

<table>
<thead>
<tr>
<th>first</th>
<th>last</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 1 3 4</td>
</tr>
<tr>
<td>B</td>
<td>2 3 4 1</td>
</tr>
<tr>
<td>C</td>
<td>3 2 1 4</td>
</tr>
<tr>
<td>D</td>
<td>3 1 2 4</td>
</tr>
</tbody>
</table>
18. The graph shows changes in the air pressure within the lungs during one breathing cycle.

What causes the change in air pressure during stage X?

A  Contraction of diaphragm muscles  
B  Outflow of air from lungs  
C  Increase in volume of lungs  
D  Relaxation of internal intercostal muscles

19. The bar charts show the relative amounts of four substances in the blood entering and leaving a certain organ in the body of a mammal:

This organ is probably…

A  kidney  
B  liver  
C  lung  
D  small intestine
20. During osmoregulation, which of the following correctly describes the body’s homeostatic response to a large intake of salt solution?

<table>
<thead>
<tr>
<th>organ / region stimulated</th>
<th>hormone secreted</th>
<th>kidney tubule action</th>
<th>urine composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>hypothalamus</td>
<td>more anti-diuretic hormone</td>
<td>reabsorb more water</td>
</tr>
<tr>
<td>B</td>
<td>hypothalamus</td>
<td>less anti-diuretic hormone</td>
<td>reabsorb less water</td>
</tr>
<tr>
<td>C</td>
<td>pituitary gland</td>
<td>more anti-diuretic hormone</td>
<td>reabsorb more water</td>
</tr>
<tr>
<td>D</td>
<td>pituitary gland</td>
<td>less anti-diuretic hormone</td>
<td>reabsorb less water</td>
</tr>
</tbody>
</table>

21. Four different animals were maintained in a laboratory in habitats similar to that of their natural environment. The body core temperature of the animals was measured in response to changes in the temperature of the laboratory environment.

Which statement is best supported by the data?

A  Animal I changes the body core temperature by shivering when the environmental temperature rises above $37^\circ C$.
B  Animal I and II are most likely mammals.
C  Animal III is able to sweat profusely when exposed to an environmental temperature higher than its body core temperature.
D  Animal IV will not be able to survive in extremely hot environments.
22. Which of the following is/are true of homeostatic control?

1) It is a self-regulatory process.
2) The regulatory centre of all homeostatic processes is the hypothalamus.
3) There must be a stimulus.
4) The receptor detects a stimulus that causes a rise above the normal condition.
5) The corrective mechanism will reverse the effect of the stimulus.

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

23. The diagram shows a section through the brain.

Which of the following correctly identifies the regions of the brain and its function?

<table>
<thead>
<tr>
<th>region</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A cerebrum</td>
<td>interprets sensory inputs and controls activity of skeletal muscles and conscious behaviour</td>
</tr>
<tr>
<td>B cerebellum</td>
<td>involved in higher mental activities such as memory, learning and reasoning</td>
</tr>
<tr>
<td>C medulla oblongata</td>
<td>centre involved in regulating body temperature and water balance.</td>
</tr>
<tr>
<td>D hypothalamus</td>
<td>control of heart rate, blood pressure and ventilation.</td>
</tr>
</tbody>
</table>
During an experiment, a student was blindfolded. The skin on his fingertip, the palm of his hand and his forearm were then touched several times by two pencil points, either one centimetre or two centimetres apart.

During the recording of results, there were instances when he inaccurately said he had only been touched by one point. The table below shows the number of times he accurately said that he had been touched by two points.

<table>
<thead>
<tr>
<th>distance between pencil points/cm</th>
<th>% number of times he felt two pencil points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fingertip</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
</tbody>
</table>

Which statement best concludes the experiment?

A  No touch receptors are present on the skin of the forearm.
B  Only a few touch receptors are present in the skin of the palm.
C  Touch receptors are densest in number in the skin of the fingertip.
D  Touch receptors are least dense in number in the skin of the palm.
The diagram shows a section through the eye. Use it to answer both questions 25 and 26.

25. Which row correctly matches the components of the pupil reflex arc?

<table>
<thead>
<tr>
<th></th>
<th>receptor</th>
<th>sensory neurone</th>
<th>effector</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

26. Colin was reading a book in the garden. He looked up to check on his son swimming in the pool ten metres away.

Which changes occur in his eyes so that his vision is still in focus?

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>7</th>
<th>5</th>
<th>light rays refracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>contract</td>
<td>slacken</td>
<td>thinner</td>
<td>less</td>
</tr>
<tr>
<td>B</td>
<td>contract</td>
<td>tighten</td>
<td>thicker</td>
<td>more</td>
</tr>
<tr>
<td>C</td>
<td>relax</td>
<td>slacken</td>
<td>thicker</td>
<td>more</td>
</tr>
<tr>
<td>D</td>
<td>relax</td>
<td>tighten</td>
<td>thinner</td>
<td>less</td>
</tr>
</tbody>
</table>
27. The graph shows the changes in blood glucose concentration after a meal. Hormones X and Y are produced in response to the changes in blood glucose concentration.

Which of the following statements about hormones X and Y can be concluded from the graph?

1) Hormone X is secreted in response to an increase in blood glucose concentration.
2) Hormone X is absent in the blood between 9 – 10 am.
3) Hormone X increases the permeability of liver cells to absorb more glucose.
4) Hormone Y is produced by the liver cells.
5) Hormone Y converts glycogen into glucose.

A 1 and 2  
B 1 and 3  
C 2 and 4  
D 2 and 5  

28. Which statement describes the effects of adrenaline?

A Causes pupil to constrict.  
B Decreases blood pressure.  
C Increases blood flow to muscles.  
D Promotes conversion of glucose to glycogen.
29. May decided to grow two closely-related species of plants in her garden. The table shows the time period at which the reproductive parts of plant X and Y mature.

<table>
<thead>
<tr>
<th>plant X</th>
<th>plant Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>anther matures in April</td>
<td>anther matures in July</td>
</tr>
<tr>
<td>stigma matures in April</td>
<td>stigma matures in April</td>
</tr>
</tbody>
</table>

She made the following conclusions:

1) It is possible for plant X to be self pollinated.
2) It is possible for plant Y to be self pollinated.
3) Plant X can cross pollinate with plant Y.
4) Plant Y must be pollinated by insects.
5) Pollen grains from plant Y can be germinated on plant X.

Which of the statements can be concluded about plant X and Y?

A 1 and 2
B 1 and 3
C 3 and 4
D 3 and 5

30. Some of the events that occur during sexual reproduction in a flowering plant are listed below:

1) Male gamete fuses with the female gamete.
2) Growth of pollen tube.
3) Pollen grain sticks onto stigma.
4) Seed develops inside ovary.
5) Generative nucleus divides into two male gametes.

What is the correct order of events?

first    last
A  4  2  3  1  5
B  4  3  2  5  1
C  3  2  5  1  4
D  3  1  2  5  4
31. The diagram shows a section through the female reproductive system.

Which of the following correctly matches the function of X, Y and Z?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>cells of embryo undergoes mitosis</td>
<td>haploid gametes can be found</td>
<td>supports the development of embryo</td>
</tr>
<tr>
<td>B</td>
<td>supports the development of embryo</td>
<td>cells of embryo undergoes mitosis</td>
<td>diploid zygote formed</td>
</tr>
<tr>
<td>C</td>
<td>diploid zygote formed</td>
<td>produce hormones to regulate menstrual cycle</td>
<td>cells of embryo undergoes mitosis</td>
</tr>
<tr>
<td>D</td>
<td>haploid gametes can be found</td>
<td>cells of embryo undergoes mitosis</td>
<td>produce hormones to regulate menstrual cycle</td>
</tr>
</tbody>
</table>

32. The diagram represents three properties of male gametes.

Which area describes the male gametes of humans and flowering plants?
33. A cell replicates its DNA and then starts to divide by meiosis. What is the expected arrangement of chromosomes if crossing over has taken place between the two genes A and B shown?

A.  
B.  
C.  
D.  

34. A student examined the cells in the growing region of an onion root under the microscope and obtained the data below.

<table>
<thead>
<tr>
<th>stage</th>
<th>number of cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>interphase</td>
<td>886</td>
</tr>
<tr>
<td>prophase</td>
<td>73</td>
</tr>
<tr>
<td>metaphase</td>
<td>16</td>
</tr>
<tr>
<td>anaphase</td>
<td>14</td>
</tr>
<tr>
<td>telophase</td>
<td>11</td>
</tr>
</tbody>
</table>

What is the percentage of cells containing sister chromatids?

A. 7.3%  
B. 8.9%  
C. 95.9% 
D. 97.5%

35. If a polypeptide consists of 240 amino acids, what is the minimum number of nucleotides on the gene to code for it?

A. 80  
B. 240  
C. 720  
D. 1440
36. UAG is a stop codon which terminates the synthesis of a polypeptide. The diagram shows a strand of DNA which codes for four amino acids in a polypeptide.

Where would a mutation that introduces a thymine nucleotide in this DNA template strand result in the termination of transcription?

37. In maize, one allele of a particular gene allows chlorophyll production while the other allele prevents this, giving plants with cream coloured leaves. Chlorophyll production in leaves only starts if seedlings are grown in light.

A batch of seeds were obtained by crossing two heterozygous parents. Half the seeds were sown in trays kept in the dark, while the other half were sown in similar conditions except that they received light.

After two weeks, the seedlings were counted and the table gives the results obtained.

<table>
<thead>
<tr>
<th>number of seedlings</th>
<th>kept in the dark</th>
<th>kept in the light</th>
</tr>
</thead>
<tbody>
<tr>
<td>green leaves</td>
<td>cream leaves</td>
<td>green leaves</td>
</tr>
<tr>
<td>?</td>
<td>405</td>
<td>320</td>
</tr>
</tbody>
</table>

How many of the seedlings that were kept in the dark had green leaves?

A 0  
B 320  
C 405  
D 1205
38. The diagram shows the blood group phenotypes of some members of a family.

Which member of the F₁ generation must be heterozygous, containing two codominant alleles?

39. The diagram shows food web involving different species of land organisms. Each letter represents a species.

Which is the best prediction about the biomasses of these species measured at a particular point in time?

A  The biomass of V + X + Z is equal to the biomass of W.
B  The biomass of X is less than the biomass of Y.
C  The biomass of X is more than the biomass of W.
D  The biomass of Y is less than the biomass of Z.
40. Run-off pollution of a particular river resulted from over-use of chemical fertilisers by a nearby farm. Which of the following graphs correctly shows the resulting changes in levels of oxygen and bacteria in this river?
Section A

Answer all questions.

1. Figure 1 shows two types of tissues that are adapted for their function, one from an animal and the other from a plant.

![Figure 1](image)

a) State one feature that these two tissues have in common and explain how it helps them to carry out their function. [1]

b) Calculate the magnification of tissue A. Show your working. [1]

\[ X \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

\[ \]

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In an experiment to measure the rate of diffusion, a student placed cubes of agar jelly containing an indicator into dilute hydrochloric acid. The indicator changes from pink to colourless in acidic conditions.

The student used cubes of different sizes and recorded the time taken for the pink colour of each cube to disappear completely. The student’s results are recorded in Table 2.1.

<table>
<thead>
<tr>
<th>length of side of cube (mm)</th>
<th>surface area of cube (mm²)</th>
<th>volume of cube (mm³)</th>
<th>surface area to volume ratio</th>
<th>time taken for pink colour to disappear (s)</th>
<th>rate of diffusion (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>24</td>
<td>8</td>
<td>3.0:1</td>
<td>50</td>
<td>0.020</td>
</tr>
<tr>
<td>5</td>
<td>150</td>
<td>125</td>
<td>1.2:1</td>
<td>120</td>
<td>0.021</td>
</tr>
<tr>
<td>10</td>
<td>600</td>
<td>1000</td>
<td></td>
<td>300</td>
<td>0.017</td>
</tr>
<tr>
<td>20</td>
<td>2400</td>
<td>8000</td>
<td>0.3:1</td>
<td>700</td>
<td>0.014</td>
</tr>
<tr>
<td>30</td>
<td>5400</td>
<td>27000</td>
<td>0.2:1</td>
<td>1200</td>
<td>0.013</td>
</tr>
</tbody>
</table>

a) (i) Complete Table 2.1 to show the surface area to volume ratio of the cube with 10 mm sides.

(ii) With reference to Table 2.1, explain the significance of the relationship between the rate of diffusion and the surface area to volume ratio for large plants.

b) Another student used the same raw data obtained in the experiment but calculated a different rate of diffusion for each cube. This student’s results are shown in Table 2.2.

<table>
<thead>
<tr>
<th>length of side of cube (mm)</th>
<th>time taken for pink colour to disappear (s)</th>
<th>rate of diffusion (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>50</td>
<td>0.040</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>0.042</td>
</tr>
<tr>
<td>10</td>
<td>300</td>
<td>0.033</td>
</tr>
<tr>
<td>20</td>
<td>700</td>
<td>0.029</td>
</tr>
<tr>
<td>30</td>
<td>1200</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Table 2.2

Which method is more accurate? Explain why.

[Total: 5 marks]
It is illegal for a person to drive a vehicle with more than 80 mg of alcohol per 100 cm\(^3\) of blood.

Graph 3 shows the concentration of alcohol in the blood of a person over a number of hours. During this time, the person had several alcoholic drinks while eating a meal.

![Graph 3](image)

**a)** Suggest why it is illegal for the person to drive when the person’s blood alcohol concentration is above the advisory limit.

**b)** Use the graph to determine the highest concentration of alcohol in the person’s blood.

\[ \text{\textbf{mg per 100 cm}^3} \]

**c)** Describe the role of liver in the breaking down of alcohol.

**d)** Complete Graph 3 by extending the line to predict when the person would be able to legally drive a vehicle again.

[Total: 5 marks]
Figure 4.1 is a simplified plan of the mammalian circulatory system.

![Diagram of the mammalian circulatory system](image)

Figure 4.1

a) With reference to Figure 4.1, describe what is meant by the term *double circulation*.

b) Describe and explain how a molecule of oxygen is forced out of the heart and eventually reaches the liver cells.
c) Figure 4.2 shows the formation of tissue fluid in a mammal.

Figure 4.2

(i) State two differences between the composition of tissue fluid and blood. [2]

1. ........................................................................................................................................

2. ........................................................................................................................................

(ii) Describe the formation of tissue fluid. [1]

........................................................................................................................................

[Total: 9 marks]
Figure 5.1 shows the mammalian respiratory system and Figure 5.2 shows the cross-section taken through line XY.

Figure 5.1

Figure 5.2

a) Name structures A and B.

A: ..............................................................

B: ..............................................................
b) (i) Describe how structure C will appear in a person suffering from emphysema and explain how this will affect the breathing of the person.

(ii) A spirometer can be used to trace the movements of air during breathing. The graph below shows the spirometer trace of a normal person at rest.

Draw the spirometer trace obtained from a person with emphysema in the grid below.

![Spirometer Graph]

Volume of air in lungs/dm³

Time/s

c) Structure D is affected by a major component of tobacco smoke. Identify the component and explain how it affects the normal functioning of D.
Figure 6.1 shows the percentage composition of solutes in fluid samples P and Q taken from two sites of the human nephron.

a) (i) Name fluids P and Q.

Fluid P: .................................................................

Fluid Q: .................................................................

(ii) Explain the difference in percentage of glucose in fluids P and Q as shown in Figure 6.1.

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

b) Patients with kidney failure have to go for weekly dialysis treatment.

Figure 6.2 outlines the procedure of dialysis.

[Diagram of dialysis process]

- stage 1: blood from body enters dialysis machine
- stage 2: blood flow in the machine regulated by a pump and anticoagulant added
- stage 3: blood is bathed in dialysis fluid (dialysate)
- stage 4: 'cleaned' blood returns to body from dialysis machine.
Figure 6.3 shows further details of how stage 3 is achieved.

![Diagram showing blood flow and dialysate](image)

**Figure 6.3**

dialysate in

**direction of blood flow inside membrane**

dialysate out

(i) Suggest why it is necessary to add an anticoagulant to the blood in stage 2. [1]

(ii) Explain how the dialysis machine ensures that 'cleaned' blood returns to the body. [2]

[Total: 6 marks]

7 In maize, wind pollination occurs. An investigation was carried out to find out how the length of time that maize pollen is in the air affects its ability to bring about fertilisation in a female flower.

1. Pollen grains were removed from maize flowers and left exposed to the air for varying amounts of times.
2. The pollen grains were then placed onto groups of female flowers in another plot of land in the farm.
3. The groups of fertilised flowers developed into 'ears', each containing many seeds. The number of seeds per ear was counted.

a) (i) Identify the type of pollination described. Explain your answer. [1]

(ii) Explain why the type of pollination stated in (i) is more beneficial to maize. [2]
b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize as shown in Figure 7. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

![Diagram of Teosinte and Maize](image.png)

**Figure 7**

(i) Describe how farmers can use artificial selection to produce maize from teosinte.

(ii) A gene on chromosome 4, \textit{tga} 1, was found to be responsible for all the structural differences between teosinte and maize. The DNA sequence is shown below:

```
teosinte    | GAT TGG GAT CTC AAG GCG GGC GCG TGG
maize       | GAT TGG GAT CTC AAC GCG GGC GCG TGG
```

Suggest how the difference in the \textit{tga} 1 gene could cause large differences in phenotype between teosinte and maize.

[Total: 7 marks]
Male and female ants of a species of Australian ant, *Myrmecia pilosula*, have different number of chromosomes in each of their cells. Female ants are diploid, while males are haploid.

a) Define the term *diploid*.

b) In the cell outline provided below, make a labelled drawing to show the appearance of a female ant cell at anaphase I of meiosis (Assume there are two chromosomes in the sperm cell of the male ant).

![Cell outline](image)

Figure 8.1 shows the events that take place in a body cell of a female ant.

![Cell cycle](image)
Table 8.2 shows the DNA content of a cell measured during one cell cycle.

<table>
<thead>
<tr>
<th>stage</th>
<th>DNA content of cell/arbitrary units</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>2x</td>
</tr>
<tr>
<td>G2</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Complete Table 8.2 to determine the DNA content at different stages of the cell cycle.

**d)** During mating, the queen ant collects sperm cells from male ants, which she stores in an organ. The haploid egg cells from the queen's ovaries pass by the organ as they are laid. Some eggs are fertilised as they pass out, while others pass out unfertilised.

(i) Suggest how ants that develop from fertilised egg cells differ from the ants that develop from unfertilised egg cells.

(ii) Explain the significance of the queen ant producing haploid egg cells.

[Total: 8 marks]
Answer **three** questions. Question 11 is in the form of an **Either/Or** question. Only one part should be answered.

9. An investigation into feeding relationships in a forest community was carried out using radioactively labelled phosphorus \(^{32}\text{P}\). A solution containing \(^{32}\text{P}\) phosphate ions was supplied to a plant using a stem well.

Figure 9.1 shows a vertical section through a stem well.

- Stem wells were used to supply 200 individual plants in the community with a solution containing \(^{32}\text{P}\) phosphate ions.
- The stem wells were left at the same place for one week and then removed.
- At intervals during the first week and for a further 11 weeks after the wells were removed, tissue samples were taken from the plants and from other members of the community.
- The activity of \(^{32}\text{P}\) phosphate ions per unit biomass was measured in each sample.

Graph 9.2 shows the results of this investigation.
a) Identify two variables that should be kept constant in this investigation. [1]

1. .................................................................

2. .................................................................

b) Define the term consumer. [1]

........................................................................

........................................................................

c) With reference to Graph 9.2, describe and explain the level of activity of $^{32}\text{P}$ [6] phosphate ions observed in the four populations of organisms.

........................................................................

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d) Describe how processes that occur in a green leaf play a part in the carbon cycle. [3]

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Total: 11 marks
The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK. This is shown in Figure 10.1.

![Figure 10.1](image)

**Non-functional form of TK**  **Functional form of TK**

**Figure 10.1**

a) Based on Figure 10.1, explain how the activation of TK is regulated in human [3] cells.

b) The binding of the functional form of TK to its substrate leads to cell division. In chronic myeloid leukemia, a faulty form of TK is produced. Figure 10.2 shows the faulty form of TK.

![Figure 10.2](image)

Suggest how faulty TK leads to chronic myeloid leukemia. [2]
c) Imatinib is a drug used to treat chronic myeloid leukemia. Figure 10.3 shows how Imatinib inhibits faulty TK.

Figure 10.3

Sketch on the axes below a labelled graph how the rate of reaction will be with Imatinib added.

rate of reaction/
arbitrary units

without Imatinib

time/minutes

Explain how Imatinib can be used to treat chronic myeloid leukemia.

[Total: 9 marks]
Either

11 a) A student used the set-up shown in Figure 11 to estimate the rate of transpiration in a leafy shoot.

![Diagram of a set-up](image)

**Figure 11**

Describe and explain how you would use the experimental set-up to measure the [5] effect of air movement on transpiration rate of the plant.

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b) Describe how the structures within a leaf are adapted for photosynthesis. [5]

[Total: 10 marks]

Or

11 a) David enters the forest wearing only shorts and a sleeveless shirt when the air temperature is below 10 °C. [4]

Explain, with reference to the principles of homeostasis, how his body will respond.

[Total: 10 marks]
b) David spots a hungry bear standing five meters in front of him and his heart beats faster.

Describe the nervous pathway that resulted in his response.

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[Total: 10 marks]
General Comments
Generally, candidates who attempted the Either question performed better with a handful of candidates scoring close to full marks. Most students did not perform well for this exams. Answers generally lacked details and precision.

Paper 1 (40 marks)

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>D</td>
<td>A</td>
<td>B</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>D</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>B</td>
<td>D</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>D</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
<td>A / C</td>
<td>A</td>
<td>D</td>
<td>B</td>
<td>D</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>D</td>
<td>A</td>
</tr>
</tbody>
</table>

Comments on MCQ

Question 4
77% of candidates got this question incorrect. Most candidates chose distractor A instead of answer D. Candidates showed understanding that the vacuole will decrease in size due to the movement of water out of the cell by osmosis. However, they were careless and failed to identify the slight change in shape in the cell wall due to the shrinkage of the cytoplasm.
Question 5
57% of candidates got this question incorrect. Most candidates chose distractor A instead of answer C. Candidates failed to recognise water as the main constituent of the amniotic fluid, which provides protection to a growing foetus.

Question 11
Many candidates chose options A and C instead of answer B. From the graph, the % of stomata that are open varies with changes in light intensity throughout 24 hours in a day. No information on temperature is given. With the graph being higher during daytime and higher % of stomata are open, it can be deduced that transpiration occurs at a higher rate. It also cannot be deduced from the graph that photosynthesis only occurs in light because in darkness, there are still gases present within the intercellular air spaces.

Question 12
44% of candidates chose distractor D instead of answer A. While candidates understand that light intensity was the limiting factor at the start of the graph, they failed to understand that for graph of Y, they will have to compare it with the graph below and the difference in carbon dioxide concentration indicates that it is the change in that condition that results in a higher rate in graph of Y.

Question 14
55% of candidates chose distractor C instead of answer A.
Candidates wrongly identified the cells as the sides as sieve tube cells and wrongly deduced the vessel to be the phloem. Candidates should be able to recognise the shape of companion cells. They are slightly flattened and tapered at ends.

**Question 15**
65% of candidates got this question incorrect. Most candidates chose distractor C instead of answer D. Candidates failed to recognise that the layer of smooth muscles is much thinner in vein, resulting in a thin wall in veins. Velocity of blood in the vein is also quite high.
**Question 16**
25% of the candidates chose distractor C instead of Candidates did not recognise that the pulmonary receive oxygenated from the left atrium due to orts deoxygenated blood from right of heart to lung, will

**Question 17**
40% of the candidates chose distr. Student did not remember that Thus, a rise in carbon dioxide c the need to remove carbon dioxide, a byproduct of cellular respiration. d leads to an increase in breathing rate.

**Question 20**
33% of the candidates chose distrac stead of answer A. Candidates did not recognise that ADH is secreted by the hypothalamus, which is also the receptor for the stimulus (change in blood water potential).
**Question 27**
35% of candidates chose distractor A instead of answer B.
Candidates know that Hormone X is insulin. But between 9-10am when blood glucose concentration is low and insulin is not needed, it cannot be assumed that the concentration of insulin is absolute zero in the blood.

**Question 34**
46% of the candidates got this incorrect. Many candidates chose distractor D instead of answer B.
Cells which are not dividing (highest number in root) are in interphase, the resting phase. Cells are ready to undergo nuclear division, DNA replication occurs, forming sister chromatids. Hence, sister chromatids are 2 identical DNA strands joined at the centromere, are only present during Prophase and Metaphase, before chromosomes when the centromere separates in anaphase.

\[
73 + 16 = 89 \\
89/1000 \times 100\% = 8.9\%
\]
Question 35
Most candidates chose distractor C i
Candidates did not remember the segment of DNA.

240 amino acids x 3 nucleotides = 720 nucleotides in mRNA strand = 720 nucleotides in DNA template strand gene
### Paper 2

**Section A (80 marks)**

<table>
<thead>
<tr>
<th>Qn</th>
<th>Answer</th>
<th>Marks</th>
<th>Markers’ Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td><strong>Long and narrow</strong> protrusion/extension; To increase surface area to volume ratio for absorption/diffusion;</td>
<td>[1] 0.5m each</td>
<td>Function is not for exchange of substances</td>
</tr>
<tr>
<td>1(b)</td>
<td>$\frac{51}{1.6} = x \times 3.19$</td>
<td>[1] Ma do not know that $1\text{ cm} = $</td>
<td></td>
</tr>
<tr>
<td>1(c)</td>
<td></td>
<td>[2] 0.5m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>**</td>
<td>Structure 1</td>
<td>Structure 2</td>
</tr>
<tr>
<td>glucose</td>
<td>Diffusion and active transport</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Amino acids</td>
<td>Diffusion and active transport</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Fatty acids</td>
<td>NA</td>
<td>diffusion</td>
<td></td>
</tr>
<tr>
<td>2(ai)</td>
<td>0.6:1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2(aii)</td>
<td>As SA:VOL ratio decreases rate of diffusion vice versa; Use figures with correct units (m trend; The larger the plant, the</td>
<td>0.5m each</td>
<td></td>
</tr>
<tr>
<td></td>
<td>require to carry out a</td>
<td>(will</td>
<td></td>
</tr>
<tr>
<td>2(b)</td>
<td>First student’s answer; The student considered the length of the cube only.</td>
<td>[2] 1m each</td>
<td>Also accepted: The first student divided the answer by 2 as distance has to be to centre of cube rather than whole length of side/ Student assumed diffusion occurs (across whole cube) from whole length of one side;</td>
</tr>
<tr>
<td>Qn</td>
<td>Answer</td>
<td>Marks</td>
<td>Markers’ Report</td>
</tr>
<tr>
<td>----</td>
<td>--------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>3(a)</td>
<td>Blurred vision/delayed speed of reaction/increased reaction time/impaired judgement/slower reflex actions</td>
<td>[1]</td>
<td>Any one</td>
</tr>
<tr>
<td>3(b)</td>
<td>184mg per 100cm³</td>
<td>[1]</td>
<td></td>
</tr>
<tr>
<td>3(c)</td>
<td>Alcohol dehydrogenase produced by the liver; Will catalyse; the breakdown of alcohol into acetaldehyde; then further into compounds used for respiration</td>
<td>[2] 0.5m each</td>
<td></td>
</tr>
<tr>
<td>3(d)</td>
<td>Extend line using ruler until it reaches the dotted line; Read off time on dotted line</td>
<td>[ ] 24 minutes</td>
<td></td>
</tr>
<tr>
<td>4(a)</td>
<td>Double circulation means blood passes through the heart twice in one circulation; Pulmonary circulation and systemic circulation; blood flows out through pulmonary artery to lungs; blood flows out through aorta to arteries to heart through veins;</td>
<td></td>
<td>Need to mention that blood from capillaries flows back to the heart</td>
</tr>
<tr>
<td>4(b)</td>
<td>Oxygen molecules combine with cells; To form oxyhaemoglobin; When muscles in waist contract / undergo ven…</td>
<td>[Max 4] 0.5m each</td>
<td>Description should only start from point at which oxygen is forced out of left ventricle of the heart, and not from left atrium / lungs.</td>
</tr>
<tr>
<td>Qn</td>
<td>Answer</td>
<td>Marks</td>
<td>Markers’ Report</td>
</tr>
<tr>
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</table>
| 4(ci) | **tissue fluid** | blood | [2] 1m each | complete point to point comparison: 1m  
*Note: tissue fluid is **not** plasma; plasma relates to the liquid component of blood, while tissue fluid refers to that outside the blood vessels and surrounding tissue cells. |
| | only phagocytes present | presence of blood cells e.g. RBC and WBC (lymphocytes) | | |
| | absence of plasma proteins | presence of plasma proteins | | |
| 4(cii) | Higher pressure at arterial end; forces blood plasma out through capillary wall; | | [1] 0.5m eac | |
| 5(a) | A: trachea/windpipe  
B: diaphragm | | | |
| 5(bi) | partition walls between alveoli (C) will break down; decreased surface area for gaseous exchange; lungs lose elasticity and becomes **inflated** with person will suffer from wheezing and breathing difficulty | | | Since lungs are inflated with air, the starting volume of air in the lungs should be higher than normal. |
| | - more than 3 breaths taken;  
- each breath is shallower | | [1] | |
| 5(c) | **Tar/Irritants;**  
paralysed cilia found  
dust particles trapped in block airways must be removed; | | [2] 0.5m each | D is not the cilia. |
| 6(ai) | Fluid P: glomerular **filtrate**  
Fluid Q: urine | | [1] 0.5m each | Many candidates fail to understand requirement of question and name the part of nephron or sweat. |
<table>
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<th>Qn</th>
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<th>Markers’ Report</th>
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<tbody>
<tr>
<td>6(aii)</td>
<td>glucose present in fluid P because it is a small; molecule; will be forced out during ultrafiltration; no glucose in fluid Q because they have been selectively reabsorbed;</td>
<td>[2] 0.5m each</td>
<td>Many candidates gave long-winded answers about the other components in the filtrate while missing out on GLUCOSE.</td>
</tr>
<tr>
<td>6(bi)</td>
<td>to prevent blood from clotting/coagulating</td>
<td>[1]</td>
<td>Agglut no</td>
</tr>
<tr>
<td></td>
<td>Any reference to agglutination/ RBC clumping – 0m</td>
<td></td>
<td>his situation</td>
</tr>
<tr>
<td>6(biii)</td>
<td>dialysate does not contain any metabolic waste products; dialysate flow is opposite direction of blood flow; to generate a steep concentration gradient; ensure faster diffusion of waste products; tubing is long and coiled; increase SA:V ratio for the fast diffusion of waste products; to retain large molecules, only allowing to diffuse out</td>
<td></td>
<td>is to remove urea from the lenish lost mineral salts, hence not be on salt concentration. y-permeable property mentioned then should be on the fact that it retains large molecules and allows only small molecules to diffuse out</td>
</tr>
<tr>
<td>7(ai)</td>
<td>Cross pollination; because from different pl</td>
<td>[1]</td>
<td>Some candidates were careless and stated wind/insect pollination, which is the MODE of pollination.</td>
</tr>
<tr>
<td>7(aii)</td>
<td>offspring produced may have beneficial qualities from both parents [1]</td>
<td>[2] 0.5m each</td>
<td></td>
</tr>
<tr>
<td></td>
<td>more varieties of offspring can be produced/more genetic variation; hence greater chance of survival in the event of changes in environment/ better adapted in changing environment;</td>
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<td>Qn</td>
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<td>Markers’ Report</td>
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<tr>
<td>7(bi)</td>
<td>Selective breeding/pollinate/cross breed/hybridise; Select teosinte plants with softer and more kernels/larger fruits; Repeat breeding and selection process many times to cross pollinate to produce maize;</td>
<td>[2]</td>
<td>Many candidates still unsure how to carry out selective breeding; teosinte is the ANCESTOR of maize, it is impossible to cross-breed maize with teosinte. Also there is genetic engineering involved.</td>
</tr>
<tr>
<td></td>
<td>0.5m each</td>
<td></td>
<td></td>
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<tr>
<td>7(bii)</td>
<td>difference in sequence of 5th codon ( AAG → AAC); different mRNA sequence produced/state mRNA sequence; which will code for a different polypeptide/different amino acid added; and hence different function of protein</td>
<td>[2]</td>
<td>ill make the mistake of ded to the growing</td>
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<tr>
<td></td>
<td>0.5m</td>
<td></td>
<td>led to link the structure of protein to their function.</td>
</tr>
<tr>
<td>8(a)</td>
<td>Having 2 sets of chromosomes; each set inherited from one parent;</td>
<td></td>
<td></td>
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<tr>
<td>8(b)</td>
<td>- 4 chromosomes - colour one set of chromosomes to paternal/maternal - chromosome made up of 2 - spindle fibre attached to daughter chromosome (anaphase) - show at least one error any mistakes -0.5m</td>
<td>[s]</td>
<td></td>
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<tr>
<td>Qn</td>
<td>Answer</td>
<td>DNA content of cell/arbitrary units</td>
<td>Marks</td>
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<tr>
<td>8(c)</td>
<td></td>
<td>Stage</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>G1</td>
<td>4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>G2</td>
<td>4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>2x</td>
</tr>
<tr>
<td>8(di)</td>
<td></td>
<td>Fertilised eggs (diploid) will develop into females, unfertilised eggs (haploid) into males;</td>
<td>[1]</td>
</tr>
<tr>
<td>8(dii)</td>
<td></td>
<td>reduction division/halving number of chromosomes pri fertilisation; ensure that zygote formed is diploid; prevent doubling of number of chromosomes successive generation; genetic variation</td>
<td></td>
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## Section B (30 marks)

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<tr>
<td>9(a)</td>
<td>Time for which $^{32}$P is supplied; Total time of experiment; Duration of sampling intervals; Type / species / similar plant; Concentration of $^{32}$P; All organisms sampled at the same time / same mass; Position/size of stem wells; Volume/concentration of solution; Location / temperature / light / CO2 / other viable answers</td>
<td>[1] 0.5m each</td>
<td>Mass of soil given to plant – 0m as plants were already growing in forest</td>
</tr>
<tr>
<td>9(b)</td>
<td>organisms that feed on other organisms to obtain energy</td>
<td></td>
<td>producers/plants – 0m</td>
</tr>
<tr>
<td>9(c)</td>
<td>Plants Radioactivity in treated plants increased in we decreases gradually; plants make use of $^{32}$P to make amino causing the increase; after week 1, new proteins mad contain $^{32}$P, which causes t Species X level of radioactivity in , then steeply decreases until 0 at wee As Species X mainly feed cies of plant in the experiment; hence $^{32}$P bioaccumulates within Species X to cause the increase; Species X may be eaten by secondary consumers, while new offspring of Species X do not contain $^{32}$P, causing the</td>
<td></td>
<td>4 populations of organisms should be mentioned in answer: 2m – description of graph for each organism 4m – explanation of what causes the changes</td>
</tr>
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<td>Qn</td>
<td>Answer</td>
<td>Marks</td>
<td>Markers’ Report</td>
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| 9(d) | During photosynthesis:  
The leaf uses the carbon atoms from carbon dioxide to produce glucose;  
Which is then used in respiration;  
Which releases carbon dioxide in the process;  
Glucose is also passed on to the producer plant;  
Carbon in the plant is passed on to the consumer plant during the process of photosynthesis. | 0.5 marks each | Processes should be named, i.e. photosynthesis, respiration, feeding/consumption, fossilisation. |
| 10(a) | When body needs the functional form of TK:  
Phosphate binds to a site adjacent to the active site;  
Causes the non-functional TK to become functional/activated;  
Causes the active site to be complementary to the substrate;  
Substrate can bind to active site/enzyme-substrate complex formed. | [3] | |

Other primary consumers  
$^{32}P$ in other primary consumers increases more slowly/gradually than Species X;  
Because they have food sources other than the plant species in the experiment:  
Secondary consumers  
Shows a gradual increase in $^{32}P$ as compared to the primary consumers;  
Due to bioamplification;  
as they feed on the primary consumers, their level of $^{32}P$ increases;
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<th>Markers’ Report</th>
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<tr>
<td>10(b)</td>
<td>Faulty TK’s active has the same shape as the functional form of TK; It is <strong>always/constantly</strong> active [1]; Cell division occurs uncontrollably. (<strong>leading to leukemia, which is a type of cancer</strong>)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10(c)</td>
<td>Graph should be slower and max lower than without imatinib [1]; Imatinib binds to a site away from the active site; Changes the shape of active site; Active site no longer complementary to substrate; Substrate cannot bind to active site; Less TK/active site available/enzyme-substrate co formed decreases; Less products formed/rate of reaction decr</td>
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<tr>
<td>E11(a)</td>
<td>insert a leafy shoot through the hol potometer; petroleum jelly around the r through the cork makes aterproof; have two setups, one ne without fan (no air movement) record the distance that s moved using the scale; (record distance – 0 As the shoot transpires, it a water from the potometer to replace what was lost during transpiration, bubble moves to the left; Water reservoir provides supply of water to ensure that air bubble does not reach too close to the plant;</td>
<td>[5] 1m each</td>
<td>Many candidates did not read the questions carefully and focused their answer on explaining how air movement affects rate of transpiration.</td>
</tr>
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<td>Qn</td>
<td>Answer</td>
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<td>Markers’ Report</td>
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<td></td>
<td>The further the air bubble moved, the faster the rate of transpiration;</td>
<td></td>
<td></td>
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<td></td>
<td>Purpose of the tap is to reset the apparatus;</td>
<td></td>
<td></td>
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<tr>
<td>E11(b)</td>
<td>presence of chloroplast; in the mesophyll (spongy and palisade) cells;</td>
<td>[5]</td>
<td>Max 5m</td>
</tr>
<tr>
<td></td>
<td>to trap light energy and convert light into chemical energy stored in glucose;</td>
<td></td>
<td>0.5m each</td>
</tr>
<tr>
<td></td>
<td>xylem vessels within vascular bundle; helps to transport water for photosynthesis;</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>intercellular air spaces; facilitate diffusion of gases; Guard cells become turgid/flaccid; to close/open stomata; allow carbon dioxide to diffuse into the leaf and use photosynthesis;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O11(a)</td>
<td>Decrease in skin temperature (stimulus) is detected by thermoreceptors in skin;</td>
<td>m each</td>
<td></td>
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<td></td>
<td>Send nerve impulses to hypothalam; Corrective mechanism: 1. sweat glands less active in sweat evaporate, less heat loss 2. vasodilation of arterioles surface of skin, less heat loss 3. metabolic rate increases generated 4. Contraction of skeletal muscles; hivering; generate more heat.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(2 complete explanations)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Body temperature increases and goes back to norm;</td>
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Hair stands to trap layer of air for insulation is not a significant corrective mechanism for humans because our hair is not long enough to trap such a thick layer of air.
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<th>Markers' Report</th>
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<tbody>
<tr>
<td></td>
<td>Feedback sent to hypothalamus to stop corrective mechanism;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O11(b)</td>
<td>Diverging light rays are reflected off bear; Ciliary muscles contract and suspensory ligaments slacken; Suspensory ligaments relax pull on lens; Lens becomes thicker and more convex; Light rays sharply focused on retina; Photoreceptors stimulated; Nerve impulses produced transmitted to brain; Via sensory neurone; in optic nerve; Brain interprets impulses and bear/image is seen; Nerve impulses transmitted down the relay neurone in spinal cord; Across a synapse; from motor neurone; to the adrenal glands above the kidneys Adrenaline is secreted such that his</td>
<td>[6]</td>
<td>Max 6m Bear standing 5m from David is considered a near obje</td>
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BUKIT PANJANG GOVERNMENT HIGH SCHOOL

Preliminary Examination 2016
SECONDARY FOUR EXPRESS

BIOLOGY
Paper 2

5158/02
Date: 11 August, 2016
045 – 1230h

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on nd in.
Write in dark blue or black pen on both sides
You may use a pencil for any diagrams, gra g.
Do not use staples, paper clips, highlighte n fluid.

Section A [50 marks]
Answer all questions.
Write your answers in the spaces question paper.

Section B [30 marks]
Write your answers in the the question paper.

Write an E (for Either number 11 in the cover page to in
You are advised to spe onger than an hour on
Section A and no longer than 45 minutes on Section B.
The number of marks is provided in brackets [ ] at the end of each question or part question.

For Examiner's Use

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<tr>
<td>A</td>
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<tr>
<td>Q9</td>
<td>10</td>
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<td>Q10</td>
<td>10</td>
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<td>Q11</td>
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<td>B</td>
<td>30</td>
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<td>Paper 2</td>
<td>80</td>
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Setter: Ms Jessie Lee

[Turn over

This paper consists of 17 printed pages.

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Section A [50 marks]

Answer all questions.
Write your answers in the spaces provided.

1 The fur colour of mice is observed to be either yellow or grey. A heterozygous male mouse with grey fur was mated with a female mouse with yellow fur. They had a litter of 8 mice; 5 with grey fur and 3 with yellow fur.

(a) By using suitable symbols and a genetic diagram, show the results of the cross between the grey and yellow mice. [2]

(b) State the reason why the act offspring with different fur colour does not match t [1]

(c) A group of equ and grey mice was released into a field where yellow ha no mor [3]

Explained occurred in the population of mice. [3]

[Total: 6]
2 Fig. 2.1 shows a longitudinal section through a mammalian heart.

![Heart Diagram]

**Fig. 2.1**

(a) Use label lines and the letters P, Q, R owing on Fig. 2.1.

- P – the left ventricle
- Q – a semi-lunar valve
- R – the aorta
- S – the bicuspid valve

(b) A device measuring blood pressure was inserted into an artery in the arm, moved to the aortic ventricle. The result of the investigation is shown in Fig. 2.2.

![Blood Pressure Graph]

**Fig. 2.2**
(i) Calculate the heart rate (in heartbeats per minute) during the period of the investigation. Show your working clearly. [2]

Hear 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
(i) Name the blood vessels shown in Fig. 2.3. [1]

(ii) **State** and **explain** one likely effect of the narrowing of these blood vessels on the person whose heart it belongs to. [2]

Fig. 3.1 shows changes in blood concentration in the regulation of the human menstrual cycle. β-oestradiol and progesterone.
(a) Based on your understanding of the menstrual cycle, explain why the two \(\beta\)-oestradiol peaks in a menstrual cycle are due to two different sources of production. [2]

…………………………………………………………………………………………………….
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(b) (i) Where is progesterone produced in a non-pregnant female? [1]
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

(ii) With reference to the graph for progesterone from menstrual bleeding, account for the function of progesterone in menstruation in humans. [2]
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

(iii) From your answer in (b) why are esterone injections used as a means to “stabilize” pregnancy? [3]
……………………………………………………………………………………………………
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……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

[Total: 8]
4. **Fig. 4.1** shows the rates of water absorption and transpiration of a plant during a 24-hour period.

**Fig**

(a) At what times were the rates of water absorption that of transpiration? [1]

(b) Complete the following table [1]

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Effect of transpiration (increases/decreases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0800</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

(c) What do the variables X and Y respectively represent? [2]

(d) What do the shaded areas A and B respectively represent? [2]

[Total: 6]
5 *Dicerorhinus sumatrensis*, or the Sumatran rhinoceros, is the only rhino species that has two horns. **Fig. 5.1** below shows the chromosomes from the epidermal horn cell of a female rhinoceros.

![Figure 5.1](image)

(a) State the diploid chromosome number of the female. [1]

(b) State the role of X in cell division. [1]

(c) On **Fig. 5.1** above, shade in a pair of chromosomes. [1]

(d) In the spaces below, draw **anaphase of mitosis** as it would appear during. [1]

(e) In the **metaphase** of the chromosomes as it would appear during. [1]
(f) In the spaces below, draw all the chromosomes found in a **gamete** of the Sumatran rhinoceros. [1]

---

**6 Table 6.1** shows a comparison of the compositions of blood plasma and glomerular filtrate.

<table>
<thead>
<tr>
<th>Composition</th>
<th>Blood plasma</th>
<th>Glomerular filtrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Protein</td>
<td>8.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Salts</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

(a) Explain why the concentration of salts in glomerular filtrate is the same as the blood plasma. [2]

(b) In man, the glomerular filtrate formed in an hour is about 28 litres, whereas the amount of urine produced in an hour is only about 0.05 litres. Name the mechanism that brings about this difference and explain the import. [2]

(c) Name the hormone involved in the control of blood plasma concentration. [1]

---

[Total: 6]
Figure 7.1 shows how the rate of heat loss from the ear varies with blood flow to the ear of a small mammal (shown as Fig. 7.2) at two different air temperatures.

(a) It is observed that small mammals are bright red when placed in a room at 50°C. Use information from the graph to account for this observation.  

(b) Describe two features of the ear which make them especially suited to the process of heat loss.

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(c) When placed in a room at 5°C and injected with a chemical that cause prolonged vasodilation to the ears, the rabbit eventually dies. Explain why. [2]

---

8 Fig. 8.1 shows an experiment that is carried out to examine the effect of yeast respiration.

The temperature for the experiment is set at 37°C. The following table shows the results of the experiment:

<table>
<thead>
<tr>
<th>Time / day</th>
<th>Level of colour solution for X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+2</td>
</tr>
<tr>
<td>2</td>
<td>+10</td>
</tr>
<tr>
<td>3</td>
<td>+22</td>
</tr>
<tr>
<td>4</td>
<td>+22</td>
</tr>
<tr>
<td>5</td>
<td>+22</td>
</tr>
<tr>
<td>6</td>
<td>+22</td>
</tr>
</tbody>
</table>

(a) Explain the purpose of the potassium hydroxide solution in this experiment. [1]
(b) Explain why the level of coloured solution for X increases during the first three days and then remains constant after the three days. [4]

~End of Section A~

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In an experimental setup, a plant is watered with radioactively labeled water (H$_2^{18}$O). The plant is then placed in a sealed chamber and the radioactivity of the air in the chamber is measured over time. The table below shows the data that was obtained from the experiment.

<table>
<thead>
<tr>
<th>Time/h</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactivity/Bq</td>
<td>0.0</td>
<td>10.0</td>
<td>20.0</td>
<td>35.0</td>
<td>48.0</td>
<td>55.0</td>
<td>58.0</td>
<td>60.0</td>
</tr>
</tbody>
</table>

(a) Using the data, draw the graph to show how radioactivity changes with time. [4]
(b) For this experiment, describe the passage of a radioactively labeled oxygen atom in water that is used in photosynthesis. Your answer should begin from the point the atom is taken up at the roots to the point which it is released into the atmosphere. [6]
In a normal person, the air sacs within the lungs are open which allows air to enter when we breathe. However, when a person suffers from Atelectasis, parts of even all of a lung may collapse. It is caused by a blockage of the air passages (bronchus or bronchioles) or by pressure on the lung. As a result, the air sac collapses as well.

(a) Explain how the collapse of the air sacs affects the process of gaseous exchange from taking place.

(b) With reference to the following, explain how res in
   (i) a person taking a leisure stroll for 30 m
   (ii) an athlete running a 400m race.

[Total: 10]
11 Either

(a) Explain the expression of recessive, dominance and co-dominance in a named trait in the human body. [4]

(b) With reference to Down’s syndrome and , discuss the meaning of the term “mutation”. [6]

[Total: 10]
11  Or

(a) Describe the basic structure of a DNA molecule.  [6]

(b) With reference to food product, discuss some benefits of genetic engineering.  [4]

[Total: 10]

This is the end of the paper. ☺~
### Answers

<table>
<thead>
<tr>
<th>Question</th>
<th>Details</th>
<th>Mark</th>
</tr>
</thead>
</table>
| **1a** | Parental genotypes: Gg X gg  
Gametes: G, g X g, g (each gamete to be circled)  
Correct crosses (with lines correctly drawn)  
Correct genotypes and phenotypes of F1 generation | ½  
½  
½  
½ |
| **b** | The number of offspring/progeny is too small, OR  
Sample size of offspring/progeny is too small | 1 |
| **c** | Yellow furred mice better adapted to survive in environment (reasonable explanation e.g. camouflage);  
Survive longer thus more likely to mate and pass on fur to their offspring;  
Over many generations, greater percentage of advantageous allele for them to survive | 1  
1  
1 |
| **2a** | Correct labels  
Labels for valves must point towards the empty space in between the valves. | ½ each [max 2] |
| **b** | 10/8 X 60 (Correct working)  
75 beats/minute or bpm (Correct) | 1  
1 |
| **c** | Large pressure difference  
As a direct result (low) and systole (high)  
Aorta generalised pressure  
Due to its function from heart to rest of the body | ½  
½  
½  
½ |
| **3a** | First peak due to production by follicles in the ovary upon stimulation by follicle-stimulating hormone (FSH)  
Second peak due to production by corpus luteum, remains of the Graafian follicle after ovulation | 1  
1 |
| **b** | Corpus luteum (A: ovary) | |
| **c** | Insufficient cardiac muscle cells  
Angina/pain/cardiac arrest | ½  
½  
1 |
| **** | Level of progesterone increased steadily from day 14  
Before it falls to a low point on day 28  
Followed immediately by menstruation which contains blood and endometrium tissue  
Conclude that progesterone is important in the maintenance of the endometrium | ½  
½  
½  
½ |
biii - Progesterone source in a pregnant woman comes from the corpus luteum and placenta  
- Placenta fully formed only 8 weeks after fertilisation; additional sources of progesterone must be from injections  
- by end of first trimester, placenta fully formed and will take over progesterone production; corpus luteum breaks down

4a 0800 and 1500 hours  
[A: Range of 745-0800 and 1430 – 1500]

b

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Stomatal aperture (opening/closing)</th>
<th>Effect of transpiration (increases/decreases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0800</td>
<td>opening</td>
<td>increases</td>
</tr>
<tr>
<td>2000</td>
<td>closing</td>
<td>decreases</td>
</tr>
</tbody>
</table>

c  
The area under curve X represents the total amount of transpiration during the 24-hour period.  
The area under curve Y represents the total amount of transpiration during the 24-hour period.

eii  
Area A represents the net/overall amount of transpiration during the 24-hour period.  
Area B represents the net/overall amount of transpiration during the 24-hour period.

5a 6

b X attaches to the spindle fibre to be pulled to respective poles / to separate the sister chromatids / to separate the sister chromatids / to separate sister chromatids / to separate the sister chromatids / to separate sister chromatids

c Any pair of the same size  
(Students often forgot or shaded just one chromosome)

d One chromosome  
[Show that the equator. Students sometimes only drew on .]

[e]  
Chromosome s; homologous chromosomes lining up in a pair at the equator

[Show all 3 pairs with different lengths  
Spindle fibres, if drawn, should attach to the centromeres]

f A gamete with half the number of chromosomes

(show 3 chromosomes after separation with different lengths, R: pairs of sister chromatids / pairs of homologous chromosomes)

6a Ultrafiltration (Note: Ultrafiltration is not the same as diffusion)
Forces small molecules / particles (eg. Glucose, amino acids, mineral salts) (R: substances) to pass through the partially permeable basement membrane of the glomerulus (Not just basement membrane / R: basement membrane of the Bowman’s capsule)

Under high hydrostatic pressure

(Students might be penalized for incoherent, contradictory answers)

b  Selective reabsorption

To allow useful substances (R: nutrients / food substances such as glucose, amino acids, mineral salts and water) to be absorbed back (R: diffuse back) into the bloodstream, keep the water potential of blood constant / osmore

Antidiuretic hormone

| 7a | 25°C → increased blood flow to increase s) | ½ |
|    | 5°C → decreased blood flow to decrease ears) | ½ |

(Note the link – not increase / increase/decrease)

Students should be careful on graph – no marks are awarded if there is no link o heat loss.

b  Long, flat/thin:
 increases surface area or heat loss (via conduction, convection, radiation)

Hairless inner does not transmit heat loss

Thin layer of hair: little insulation, facilitates heat loss

More blood vessels

Increase blood flow to the surface of the ears for heat loss (R: merely presence of arterioles, shunt vessels etc)

R: ears are wide / furry / have sweat glands / hair erector muscles / ears move around / protruding / stick out / have a layer of hair

Any 2

c  Increased blood flow to skin surface

Increased heat loss through ears by via conduction, convection and radiation Prolonged heat loss will inactivate enzymes (R: denature enzymes) Causing a loss of metabolic activity to sustain life

1
| 8a | To **remove** carbon dioxide in the set-up | 1 |
| 8b | In the first three days, yeast carries out **aerobic respiration**<br>Oxygen is used up and decreases<br>Carbon dioxide given out / released but absorbed by the KOH<br>Causing the flask pressure to decrease, lower than the atmospheric pressure | ½ | ½ | ½ |
| | After three days, yeast carries out anaerobic respiration as oxygen levels <br>reach zero (R: **glucose is used up**)<br>Only carbon dioxide release will affect the internal pressure of the flask<br>Carbon dioxide absorbed by the KOH<br>Pressure in flask remains constant | ½ | ½ |
| 9a | Correctly plotted points<br>Both axes drawn and correctly labelled (time/h on x-axis, Bq on y-axis)<br>Best fit curve<br>Appropriate scale | [max 6] | 1 | 1 | 1 | 1 |
| | (Minus 1/2m for wrong/missing points) | | |
| b | Oxygen atoms enter the plant through **roo**<br>Travels up the xylem<br>Drawn up by capillary action, root pres<br>Enters the mesophyll cells from xyle<br>Photosynthesis in mesophyll cells<br>Oxygen molecules diffuse out of film of moisture lining cells<br>Diffuses through stomata into ment (as oxygen gas, not water vapour) | [max 6] | 1 | 1 | 1 | 1 | 1 |
| 10a | Collapse of the air s<br>Reduced diffusion<br>gaseous exchan<br>Some stud mention a crease in surface area without any io. Some also were unable to mention what ease in surface area to volume ratio: it is the entire ai. Some stud d a reduction in efficiency, but it is necessary to state the rea n diffusion rate or a decrease in air entering per unit time. | 1 | 1 | 1 |
| bi | No demand for maximum amount of energy body can provide as it is a leisurely jog (or any mention of a low energy demand)<br>Only aerobic respiration occurs<br>Glucose + oxygen \( \rightarrow \) large amount of energy + carbon dioxide + water ( \( \% \)m for any mention of large amount of energy) | 1 | 1 |
| | The focus of the question is about respiration, and not breathing. | | |
Many students are still mentioning respiration as the production of energy instead of the \textit{release} of energy! This was only penalized once in parts bi and bii.

\begin{enumerate}[label=bi, start=1]
  \item Huge demand of energy by muscle cells;
  \item Energy released during aerobic respiration insufficient to meet the high demands of energy;
  \item Thus anaerobic respiration in muscle cells occur;
  \item Combined with the large amount of energy released during aerobic respiration;
  \item Provides sufficient energy/to meet the \textit{energy} demands for the athlete for the race;
  \item Glucose \rightarrow \text{small amount of energy} + \text{lactic acid} (\frac{1}{2} \text{m for any mention of either small amount of energy or lactic acid only})
\end{enumerate}

\textbf{Badly answered.}
\begin{enumerate}[label=R, start=1]
  \item oxygen insufficient to meet demands of body
  \item anaerobic respiration takes place in place of \textit{it}, but
  \item the fact that the energy released during \textit{aerobic respiration} does not occur in place of \textit{it} occurs
  \item therefore the energy released during \textit{aerobic respiration} will add on to the energy released during a huge demands of energy during a
\end{enumerate}

\begin{tabular}{|c|c|c|}
\hline
\textbf{Either} & \textbf{R} & \textbf{R}\
\hline
\textbf{a} & \textit{a} & \textit{b}\
\hline
\text{Recessive} & - & \text{I}^0 \\
\text{Dominance} & \text{I}^a and \text{I}^b to I^0 \\
\text{Co-dominance} & both alleles equally expressed (I^aI^b) and \\
a new phenotype formed & \\
\hline
\textbf{b} & \text{Mutation occurs } & \text{or a chromosome is altered (or}\
\text{spontaneous change or chromosome);} & \text{Down’s syndrome}\text{, a change in the}\
\text{chromosome } & \text{al mutation;} & \text{extra copy of I, has 47 chromosomes rather than normal}\
\text{Due to u chromosomes during meiosis;} & \text{hen gene mutation occurs;} & \text{46;}\
\text{Sickle-c } & \text{of aoglobin (haemoglobin S) that causes red blood cells} & \\
to become sickl & \text{to become sickl} & \\
\hline
\end{tabular}

\begin{enumerate}[label=Or, start=1]
  \item Two anti-parallel strands twisted around each other forming a double helix;
  \item Basic unit of a nucleotide;
  \item Sugar-phosphate backbone of deoxyribose sugar and phosphate group;
  \item 4 nitrogen-containing bases, adenine, thymine, guanine and cytosine;
  \item Bases on one chain bonded with bases on the other chain where A-T and G-C;
  \item Complementary base pairing
\end{enumerate}

\begin{enumerate}[label=b, start=1]
  \item Low cost production of medicines \textit{(e.g. insulin)}\textit{[1/2]}
  \item Production of crops that grow in extreme conditions \textit{[1/2]}
\end{enumerate}
<table>
<thead>
<tr>
<th>(e.g. high salt environments, drought resistant crops, crops that make efficient use of nitrogen and other nutrients) [1/2] to allow farmers to grow crops in unsuitable soils.</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of crops that produce toxins that kill insect pests/ pesticide-resistant/ reduced use of costly pesticides that may damage the environment [1/2] (Bt gene from bacteria inserted into plants to kill pests) and crops. [1/2]</td>
<td>1</td>
</tr>
<tr>
<td>Development of foods designed to meet specific nutritional goals [1/2] (golden rice with high vitamin A content). [1/2]</td>
<td>1</td>
</tr>
<tr>
<td>[R: Increased crop yield (secondary benefit of the primary benefit, the ones listed above. Hence, this is rejected.)]</td>
<td>1</td>
</tr>
</tbody>
</table>