<table>
<thead>
<tr>
<th></th>
<th>School Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>St. Margaret's Secondary School</td>
</tr>
<tr>
<td>2</td>
<td>Anglo-Chinese School (Barker Road)</td>
</tr>
<tr>
<td>3</td>
<td>Zhonghua Secondary School</td>
</tr>
<tr>
<td>4</td>
<td>First Toa Payoh Secondary School</td>
</tr>
<tr>
<td>5</td>
<td>Temasek Secondary School</td>
</tr>
<tr>
<td>6</td>
<td>Saint Patrick's School</td>
</tr>
</tbody>
</table>
What is the difference in activation energy of the reaction when the catalyst is present and when it is absent?

The graph shows the energy level when hydrogen peroxide is broken down into water and oxygen.

What are the identities of structures J, K, and L correctly?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

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Which statements are incorrect?

I. The experimental aims to compare pulse rate of different individuals.
II. The results obtained in pulse rate is X and Y for the same during exercise.
III. X and Y breath per minute are greater than exercise.
IV. Some comments were made about the graph.

The graph represents the pulse rate of two men (X and Y) before, during and after exercise.

The table compares physiological and metabolic respiratory in humans.

Volume of oxygen in (ml) in 1 minute.

16. The diagram shows an experiment which records the volume of carbon dioxide produced.

Which liquid nutrient will yield the highest volume of carbon dioxide?

A. 6h glucose
B. 8h glucose
C. 6h amino
D. 8h amino

Which option best describes the structure and function of the root tip?

A. Leaf (T)
B. Root tip (C)
C. Root tip (P)
D. Leaf (T)

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The following statements about the observations made are correct:

- A. The ants in the image are moving around actively.
- B. The ants are carrying food items.
- C. The ants are part of a colony that works together.
- D. The ants are engaging in natural foraging behavior.

Which of the following statements about the observations made is incorrect?

- A. The ants are searching for food.
- B. The ants are working together to build a nest.
- C. The ants are communicating using pheromones.
- D. The ants are not following any specific pattern.

The table below shows the distribution of ants across different areas of a colony:

<table>
<thead>
<tr>
<th>Area</th>
<th>Ants</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>15</td>
</tr>
</tbody>
</table>

The following statements about the ants are true:

- A. All the ants are of the same species.
- B. The ants are all working on the same task.
- C. The ants are part of a larger social system.
- D. The ants are not interacting with each other.

The following statements about the ants are false:

- A. The ants are all doing the same activity.
- B. The ants are not communicating with each other.
- C. The ants are not part of a colony.
- D. The ants are not following any specific pattern.
“Cancer is a disease of the cells which are the body’s basic building blocks. The body constantly makes new cells to help us grow, replace worn-out tissue and heal injuries. Normally, cells multiply and die in an orderly way. Sometimes cells don’t grow, divide, and die the usual way. This may cause blood or lymph fluid in the body to become abnormal, or form a lump called a tumour.”

Cancer Council Victoria

Fig. 1.1 shows how cancer develops.

(a) (i) Name the structure which controls cell division.

(ii) Which organelle contains the structure named in (i)?

(b) Based on the text and Fig 1.1, suggest the effects of cancer on the liver.
(a) Explain how the conversion of carbon dioxide to bicarbonate ions in red blood cells facilitates the removal of carbon dioxide from body cells.

(b) How does the bicarbonate ions move back into the red blood cells? Describe the role of the enzyme carbonic anhydrase in this process.

(c) Name a cellular process occurring in mitochondria that produces energy in the form of ATP.

(d) Identify C and R in Fig. 2.1.

(e) Describe the function of oxygen in the cell.

(f) What is the function of a villus in the small intestine?

(g) How does the function of a villus contribute to the function of the small intestine as a whole?

(h) Identify C and R in Fig. 2.1.
(a) Write the balanced equation for photosynthesis:

\[ \text{Net Equation: } \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \]

(b) In Fig. 4.2, the plant was kept in bright light for 24 hours and then the cover was removed. The leaf was transferred to Fig. 4.3, where it was kept in the dark for 4 hours. What was observed? Describe the effect of light on photosynthesis.

(c) Based on the above information, describe the effect of an increase in the concentration of CO₂ on the rate of photosynthesis. Explain the reasoning behind your observations.

(d) In the reaction of photosynthesis, explain the role of chlorophyll a and chlorophyll b. How do they contribute to the absorption of light energy?
Complete missed and revise.

(a) The point on the graph is labeled B. Explain your answer.
(b) Mark on Fig. 5.1, with the letter C, the point where the graph is taking place.
(c) Mark on Fig. 5.1, with the letter D, the point where interval is taking place.

(a) Fig. 5.1.
(b) Fig. 5.1.
(c) Fig. 5.1.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Suggested my student explains the graph in Fig. 4.2, would continue explain after Fig. 4.2.
Section E

(a) Using the data above, draw a graph on the grid provided to show how radiation changes over time.

(b) Table 7.1 shows the data that was obtained from the experiment. The data is then plotted in a graph and the trend of the data is observed. In an experimental setup, the data is recorded with accurate measurements taken. Answer the questions:

Table 7.1

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Radiation (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>3.0</td>
</tr>
<tr>
<td>6</td>
<td>3.5</td>
</tr>
</tbody>
</table>

(c) Figure 6.1 is a graph that shows the concentration of oxygen in the sample taken before and after the experiment. Explain your answer.

(d) Figure 6.2 shows the concentration of oxygen in the sample taken before and after the experiment. Explain your answer.

(e) Explain the change in the size of the population of bacteria after the experiment.

(f) Suggest what may have caused the increase in the size of the population of bacteria after the experiment. Explain your answer.

(g) The growth curve of organisms X and Z is shown in figure 6.3. Explain the changes in size of these populations over a period of time.

(h) In figure 6.3, organisms X and Z are shown in a graph. Explain the changes in size of these populations over a period of time.

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(b) Describe the nervous pathway that allows the image to be focused.

The tree is planted 20 m away from a person. Describe how the image of the tree can be focused in the eye.

Fig. 8.1

Adapted from http://www.aop.org.uk/visual-health.

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(a) Explain why female flowers can bear fruits but not the male flowers.

Hint: Flowers which do not have an ovary but possess stamens. The female flowers can bear flowers which do not have an ovary but possess stamens. These flowers produce male gametes.

Fig 9.3

Two different plants

Fig. 6.2 shows the cross-section of flowers A and B. (Not drawn to scale), obtained from

Fig. 6.3.
Instructions to Candidates:

Time: 1 hour

1 hour

Biology Paper 1

Secondary Four Express

Preliminary Examination 2015

(barker road)

Anglo-Chinese School

This question paper consists of 18 printed pages.

[Logo]
5. Identify the following structures in the model of a animal cell:

- a. cytoplasm
- b. cell membrane
- c. nucleus
- d. endoplasmic reticulum
- e. mitochondria
- f. ribosomes
- g. lysosome
- h. golgi apparatus

6. Some structures are labeled below. Which of these are labeled correctly?

<table>
<thead>
<tr>
<th>Label</th>
<th>Correct Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Nucleus</td>
</tr>
<tr>
<td>B</td>
<td>Mitochondria</td>
</tr>
<tr>
<td>C</td>
<td>Ribosomes</td>
</tr>
<tr>
<td>D</td>
<td>Endoplasmic reticulum</td>
</tr>
<tr>
<td>E</td>
<td>Lysosome</td>
</tr>
</tbody>
</table>

7. What are the advantages of using a model for learning about the cell?

- A. It helps visualize complex structures.
- B. It allows for hands-on exploration.
- C. It can be used for multiple topics.
- D. It is easy to clean and maintain.

8. Which of the following statements is true?

- A. Photosynthesis occurs in the nucleus.
- B. The mitochondria are responsible for cellular respiration.
- C. The cell membrane is not essential for the cell's survival.
- D. The nucleus is the smallest organelle in the cell.
Which characteristic(s) of enzymes is/are displayed by the diagram above?

- [ ] specificity
- [ ] presence of active site
- [ ] ability to catalyze reversible reactions

The diagram shows an example of a reaction model used to illustrate an enzyme.

Which tube shows the most appropriate design?

The activity of an enzyme can be measured in an investigation to determine the effect of pH on the reaction rate.
Which of the below occurs as the inspiration can take place?

A. In the middle of the trachea
B. In the end of the trachea
C. At the top of the trachea
D. At the bottom of the trachea

The diagram shows a human heart in external section. Structures 1 and 2 are the:

A. Right atrium
B. Right ventricle
C. Left atrium
D. Left ventricle

A) Nitrogen was added
B) Oxygen was added
C) Amino acids were added
D) Water was added

After a few weeks, a swelling formed above the egg. Which of the following best explains the appearance of such a swelling?

A) The eggshell was cracked
B) The yolk was pressed against the shell
C) The albumen expanded
D) The white was damaged
Which of the following conditions can be mediated by the hormone insulin?

a. Increase in blood glucose levels
b. Decrease in blood glucose levels
c. Increase in liver glycogen breakdown

The formula (ADH) indicates the action of the hormone ADH.

a. To increase water intake
b. To decrease water intake

In a healthy person, which structure would contain the highest mitotic index?

a. Skin
b. Skeletal muscle
c. Brain

d. Fat tissue

The diagram below shows a feedback loop to regulate body temperature.

a. The feedback loop shows a response to an increase in body temperature.

b. The feedback loop shows a response to a decrease in body temperature.

The table below shows the effect of various factors on the concentration of ADH in the blood.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect on ADH Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water in Blood</td>
<td>Decreased</td>
</tr>
<tr>
<td>Antidiuretic Hormone</td>
<td>Decreased</td>
</tr>
<tr>
<td>Amount of Water</td>
<td>Increased</td>
</tr>
<tr>
<td>Amount of Osmolality in Blood</td>
<td>Decreased</td>
</tr>
</tbody>
</table>

21. The table above the exam involves the action of the hormone ADH.
The diagram below shows the cross section of the human eye. Which of the following structures are involved in adjusting the pupil size under bright light?

(a) Iris
(b) Cornea
(c) Lens
(d) Retina

Which of the following statements describes reproduction in plants?

(a) Plants reproduce asexually. Reproductive organs are present.
(b) Plants reproduce sexually. Reproductive organs are present.
(c) Plants reproduce asexually. Reproductive organs are absent.
(d) Plants reproduce sexually. Reproductive organs are absent.

Which of the following is not a characteristic of eukaryotic cells?

(a) Nucleus
(b) Cell wall
(c) Mitochondria
(d) Endoplasmic reticulum

Which of the following statements is true about the table below?

(a) The table shows the function of different parts of a eukaryotic cell.
(b) The table shows the number of eukaryotic cells per liter.
(c) The table shows the location of eukaryotic cells.
(d) The table shows the number of eukaryotic cells per gram.

The diagram below shows the cross section of a eukaryotic cell. Which of the following structures is correctly labeled?

(a) Z - Nucleus
(b) X - Cell wall
(c) Y - Nucleus
(d) W - Mitochondrion
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Sec 4 Biological Science

The figure below represents a molecular model of a molecule. Which of the following is the correct identity of the molecule represented?

- A. DNA molecule
- B. Protein molecule
- C. RNA molecule
- D. Carbohydrate molecule

Which of the following statements about the process of transcription is correct?

- A. mRNA is synthesized from the template DNA strand.
- B. DNA is synthesized from the template RNA strand.
- C. RNA is synthesized from the template DNA strand.
- D. DNA is synthesized from the template mRNA strand.

Which of the following correctly shows the events that occur in the stage of a cell cycle?

- A. DNA synthesis, mitosis, cytokinesis
- B. Mitosis, DNA synthesis, cytokinesis
- C. Cytokinesis, DNA synthesis, mitosis
- D. Mitosis, cytokinesis, DNA synthesis

How many alleles of the gene are present at each pole of the spindle in meiosis?

- A. 1
- B. 2
- C. 2
- D. 4

The diagram shows part of the female reproductive system. Which of the following describes the location of the oocyte?

- A. B
- B. C
- C. D
- D. E

The process of meiosis is an example of what?

- A. Reproduction
- B. Protein synthesis
- C. Translation
- D. Transcription
The primary source of energy for most ecosystems is the sun. Energy is passed down the food chains. Energy cannot be lost, so the ecosystem is locked in a higher trophic level and cannot be returned to.

A. Initial community support to many energy levels
B. There is a competition of space between the different populations. Hence a predator-prey relationship needs to be established to support the population levels.
C. There is a struggle to get more energy to hit the next level. Each level has a top predator. The trophic level decreases, the number of organisms decreases. Top predators have more energy to hit the next level. What is the following best describes the ecosystem level? (i) Initial community support to many energy levels
(ii) There is a competition of space between the different populations. Hence a predator-prey relationship needs to be established to support the population levels.
(iii) There is a struggle to get more energy to hit the next level. Each level has a top predator. The trophic level decreases, the number of organisms decreases.

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The number of marks is shown in brackets. Fill in the end of each question on the separate answer paper provided.

SECTION A

<table>
<thead>
<tr>
<th>Mark</th>
<th>Section A</th>
<th>Section B</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please note that you are allowed to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

Read these instructions first.

TIME: 1 HOUR 45 MINUTES

51/5212

BIOLOGY PAPER 2

SECTION B

SECONDARY FOUR EXPRESS

PRELIMINARY EXAMINATION 2016

Barker Road

Anglo-Chinese School

INDEX NO.
Section A (60 marks)

Answer all questions in the space provided.

1. Fig 1 below shows the change in concentration of glucose in the nephron during renal filtration. Complete the table to show the estimated concentration of glucose in the filtrate.

<table>
<thead>
<tr>
<th>Time</th>
<th>Glucose mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>0m</td>
<td>120</td>
</tr>
<tr>
<td>2m</td>
<td>118</td>
</tr>
<tr>
<td>4m</td>
<td>144</td>
</tr>
<tr>
<td>12m</td>
<td>164</td>
</tr>
</tbody>
</table>

2. Table 2 shows the clearance time of some substances for a given plasma.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Clearance Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>12</td>
</tr>
<tr>
<td>Urea</td>
<td>15</td>
</tr>
<tr>
<td>Creatinine</td>
<td>10</td>
</tr>
</tbody>
</table>

3. Calculate the average hourly rate at which urine is removed from the body of a 50 kg person.

Average hourly rate = 

4. With reference to Fig 1, explain the rate in concentration of glucose in the filtrate.

Hepatic vein

5. Suggest a reason and method which could have led to the rise in the concentration of glucose in the nephron.

Table 2
(a) Examine the retina when \( r = 6 \) for pixelation.

(b) Explain the retinal conditions for people with the following retina.

(c) List the possible causes for the retina in the above image.

(d) What is the function of the retina in the eye?

(e) Explain the relationship between the retina and the pupil.

(f) Why is the retina important for vision?
Figure 4 shows a diagram of a developing mammalian fetus and part of the uterus.

(a) Label structures A, B, and C in the diagram.

(b) Explain the function of structure C during prenatal development.

(c) Describe how the placenta transfers nutrients and waste products between the mother and fetus.

(d) Explain how the fetus regulates its body temperature and oxygen levels.

(e) Discuss the role of the umbilical cord in nutrient and waste exchange.

(f) Explain the process of birth and the role of the placenta in this process.

(g) Discuss the psychological and social changes that occur during pregnancy.

(h) Explain the importance of prenatal care and the role of a birthing partner.

(i) Describe the role of the afterbirth in maternal health following pregnancy.

(j) Discuss the potential risks and benefits of cesarean delivery.

(k) Discuss the role of postpartum care in the recovery of the mother.

(l) Discuss the importance of breastfeeding in maternal and infant health.

(m) Discuss the role of diet and exercise in maternal health during pregnancy.

(n) Discuss the potential long-term effects of pregnancy on maternal and fetal health.
Figure 6 shows the inheritance of coat colour in a family of rats. The coat colour is determined by two alleles: "with" (W) and "black" (B). The genotypes are:

- WW: White
- Wb: White
- Bb: Black
- BB: Black

The Punnett square shows the possible genotypes and their phenotypes:

<table>
<thead>
<tr>
<th></th>
<th>W</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>WW (White)</td>
<td>Wb (White)</td>
</tr>
<tr>
<td>b</td>
<td>Wb (White)</td>
<td>Bb (Black)</td>
</tr>
<tr>
<td>W</td>
<td>WW (White)</td>
<td>Wb (White)</td>
</tr>
<tr>
<td>B</td>
<td>BB (Black)</td>
<td>Bb (Black)</td>
</tr>
</tbody>
</table>

Genotype: WW, Wb, Bb, BB
Phenotype: White, White, Black, Black

Figure 7 shows a section through a tissue sample labeled A-D.
Name the two predators in this food web.

Figure 6

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

(i) 

(j) 

(k) 

(l) 

(m) 

(n) 

(o) 

(p) 

(q) 

(r) 

(s) 

(t) 

(u) 

(v) 

(w) 

(x) 

(y) 

(z)
<table>
<thead>
<tr>
<th>#</th>
<th>d</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>b</td>
<td>64</td>
<td>65</td>
<td>66</td>
<td>67</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>2</td>
<td>c</td>
<td>82</td>
<td>83</td>
<td>84</td>
<td>85</td>
<td>86</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>g</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>95</td>
<td>96</td>
<td>97</td>
</tr>
<tr>
<td>4</td>
<td>h</td>
<td>102</td>
<td>103</td>
<td>104</td>
<td>105</td>
<td>106</td>
<td>107</td>
</tr>
<tr>
<td>5</td>
<td>j</td>
<td>112</td>
<td>113</td>
<td>114</td>
<td>115</td>
<td>116</td>
<td>117</td>
</tr>
<tr>
<td>6</td>
<td>k</td>
<td>122</td>
<td>123</td>
<td>124</td>
<td>125</td>
<td>126</td>
<td>127</td>
</tr>
<tr>
<td>7</td>
<td>l</td>
<td>132</td>
<td>133</td>
<td>134</td>
<td>135</td>
<td>136</td>
<td>137</td>
</tr>
<tr>
<td>8</td>
<td>m</td>
<td>142</td>
<td>143</td>
<td>144</td>
<td>145</td>
<td>146</td>
<td>147</td>
</tr>
</tbody>
</table>

**Figure 7**

- Bottle top
- Water
- Petri dish
- Leaf stalk

**Question 6: (20 marks)**

(a) Draw and label the root system of a typical plant. (2 marks)

(b) Explain the function of each part of the root system. (4 marks)

(c) Discuss the importance of water in plant growth. (4 marks)

(d) Describe the process of photosynthesis. (4 marks)

(e) Why are nutrients important for plant growth? (4 marks)

(f) Explain how plants can adapt to different environments. (4 marks)
(i) Predict the shape of the curve if the experiment was conducted under doubled conditions.

(ii) Explain the results for set-ups A and B.

(iii) What conclusion can be drawn from the results of A and B? Explain your answer.
Need a home tutor? Visit smiletutor.sg
Q3a: Absorb 107 to 108
Q3b: Rate = 10/6 = 8.33
Correct units = mg/dl
Q3c: The bath fluid contains the same concentration of mineral salts
Q3d: No net movement of these substances
Q3e: Trend should show a straight horizontal line/constant
Proteins are too large to pass through the tubing, hence no change in concentration
Q3f: Increase the number of coils or convective tubing
Q3g: Larger surface area to speed up diffusion of area

Q3h (question in syllabus):
- Parallel lines
  - Light rays merge before retina

Q3i (question in syllabus):
- Contact lens outside cornea
- Light rays reflected outwards by lens and focuses onto retina

Q3d: The presence of dirt particles causes impulses to be sent by the receptors in the eye.
These impulses travel along the sensory neurones through proximate/intermediate neurones and finally to the brain and pain is sensed.

Q3b: Protease to break down the proteins/tearionic salt solution to wash away the dirt or build up of foreign particles (similar to tear consists)
Q3c: Contact lenses block of oxygen molecules from reaching and diffusing into the cells of the cornea.
This leads to decreased respiration
And lack of energy
Glands build up between the cornea and lens could also damage the eye

Q4a: A: Amnion/Amniotic sac
B: Umbilical cord
C: Placenta
Q4b: R is the amniotic fluid that protects the fetus against mechanical injury as it cannot be compressed.
Supports and cushions the fetus
Acts as a shock absorber
Buys up the embryo to allow it to move freely

Q4d: Produces hormones (estrogen and progesterone)
Q4e: W: Umbilical artery
X: Umbilical vein
Q5b

Set-up D did not lose any mass and maintained at a mass of 64 g as water vapour cannot escape from the leaf surfaces as they are completely sealed by Vaseline.

Q7a

Lower surface loses more water than upper surface as the drop in weight in set-up B is greater (12 g) than in set-up C (6 g).

Q7b

Lower surface has more stomata/inner cuticle/no stomatal hair (any one)

Q7c

Curves A, B and C will rise to be almost parallel with curve D.

Q7d

In darkness, stomata closes as photosynthesis does not take place hence no transpiration occurs which result in minimal water loss.

Q8a

A hormone is a chemical substance that is produced in minute quantities by an endocrine gland.

Q8b

Is transported via the blood stream.

Q8c

To target organ where it exerts its effects.

Q8d

When blood glucose concentration is too high, it is detected by the islets of Langerhans of the pancreas, causing it to release insulin into the blood stream.

Q8e

To convert excess glucose into glycogen.

Q8f

To be stored in the liver.

Q8g

When blood glucose is too low, it is detected by the islets of Langerhans of the pancreas, causing it to release glucose into the blood stream.

Q8h

To increase the conversion of glycogen into glucose.

Q8i

As tissue cells respire, carbon dioxide is evolved. Carbon dioxide diffuses into the blood and into the red blood cells due to the presence of a concentration gradient.

Q9a

Carbon dioxide dissolves in the water in the red blood cells to form carbonic acid, and then dissociates to hydrogen carbonate/ bicarbonate ions.

Q9b

This is catalyzed by the enzyme carbonic anhydrase.

Q9c

Most of the hydrogen carbonate/bicarbonate ions will diffuse back into the plasma.
Which transport mechanism is an example of active transport?

A. Oxidation
B. Osmosis
C. Diffusion
D. Facilitated diffusion

2. A cell is said to contain a large amount of stored endosymbiont residue when its cell

A. exhibits fermentation
B. undergoes photosynthesis
C. enters the plasma membrane
D. has many mitochondria

3. Which statement best describes the function of a root hair cell that aids in its function?

A. It absorbs nutrients from the solution of water, minerals, and oxygen.
B. It captures nutrients to allow a larger surface area to capture water across the plasma membrane.
C. It has a single or multiple flagellum.
D. It brings nutrients to aid in access of water transport of minerals across the plasma membrane.
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The diagram shows the structures that regulate blood pressure. The smooth muscle cells are responsible for regulating blood flow, and the arterioles are the smallest blood vessels that control blood flow. The kidneys regulate blood pressure through the renin-angiotensin-aldosterone system (RAAS), which affects blood volume and pressure. The heart pumps blood throughout the body, and the blood vessels help maintain blood pressure by adjusting their diameter and tone.
Which statement best describes a negative feedback?

- Always reverts the change in body parameter back to normal level.
- Always maintains the change in body parameter.
- Always causes a further decrease the change in body parameter.
- Always causes a further increase the change in body parameter.

The graph shows John walking from a place of 28°C to a place of 15°C.

The table shows substances moving between tissues and their surrounding capillaries.

In an experiment, the relative concentration of a given substance in urine and renal vein is measured. Which option shows the correct results?

- Lower
- Higher
- Same
- Variable

Which of the following parts of the body does this tissue belong to?

- Skin
- Bone
- Muscle
- Nervous

The table shows substances moving between tissues and their surrounding capillaries.
### Table 1

<table>
<thead>
<tr>
<th>Number</th>
<th>Nucleotide</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

### Question

How many different nucleotides will there be on the strand of DNA that is complementary to this strand?

### Answer

There are 3 different nucleotides: A, C, and T.

### Question

(a) The graph below shows the movement of a chromosome within a cell during mitosis. Curve A shows the distance between the centromeres of a chromosome and the plate after the sister chromatids have moved to opposite sides of the cell. Which of the following best describes the movement of chromosome A during mitosis?

(b) The graph below shows the movement of a chromosome within a cell during meiosis. Curve A shows the distance between the centromeres of a chromosome and the plate after the sister chromatids have moved to opposite sides of the cell. Which of the following best describes the movement of chromosome A during meiosis?

### Answer

(a) During mitosis, chromosome A moves to opposite sides of the cell as sister chromatids, followed by cytokinesis. The process is known as anaphase.

(b) During meiosis, chromosome A moves to opposite sides of the cell as homologous pairs, followed by cytokinesis. The process is known as anaphase of meiosis I or II, depending on the stage.
What is the probability of a 15-year-old brother (number 2) of being a carrier?

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

The diagram shows a genetic pedigree. Name the disorder.

A Cystic Fibrosis
B Sickle Cell Anemia
C Huntington's Disease
D Down Syndrome

Which cell are differentiated leukocytes of the blood?

A Erythrocytes
B Granulocytes
C Lymphocytes
D Platelets

What are the blood groups of a married couple?

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Type of Couple</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and A</td>
<td>Compatible</td>
</tr>
<tr>
<td>A and O</td>
<td>Incompatible</td>
</tr>
<tr>
<td>AB and A</td>
<td>Compatible</td>
</tr>
<tr>
<td>O and AB</td>
<td>Incompatible</td>
</tr>
</tbody>
</table>

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<th>Type of Couple</th>
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</tr>
<tr>
<td>A and O</td>
<td>Incompatible</td>
</tr>
<tr>
<td>AB and A</td>
<td>Compatible</td>
</tr>
<tr>
<td>O and AB</td>
<td>Incompatible</td>
</tr>
</tbody>
</table>

The table shows the blood groups of a married couple.
Turn over

The diagram shows a sewage treatment process. Which stage involves anaerobic bacteria?

Which circle represents the product?

In the diagram below, arrows represent the movements of carbon compounds in the carbon cycle. The circles represent carbon compounds in animals, decomposers, plants, and the atmosphere. Which organisms occupy the same trophic level?

End of Paper
<table>
<thead>
<tr>
<th>Section A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>Class</td>
</tr>
<tr>
<td>Name</td>
</tr>
</tbody>
</table>

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Fig. 7.2 shows the results of these processes. Changes in DNA amount and chromosome numbers were monitored during and after cell division.

Explain why some homologous chromosomes are not attached at any part of homologous chromosomes are not attached at any part of homologous chromosomes are not attached.

Explain the diagram of homologous chromosomes before crossing over.

Fig. 7.1 shows a part of homologous chromosomes during the formation of gametes. Fig. 7.1 shows a part of homologous chromosomes during the formation of gametes.

The camera is not an accurate representation of the human eye. Based on your observations of the diagram, suggest two exercises that support the statement above.

Describe how the images formed on the film in camera is similar to the image formed on the film in camera is similar to the image formed on the film in camera is similar to the image formed on the film in camera is similar to the image.
(a) Plot the data for both plant A and plant B in the table provided.

(b) Table 10.1

<table>
<thead>
<tr>
<th></th>
<th>Plant A</th>
<th>Plant B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(c) Write your answers in the space provided.

(d) Which of the potting plants will you choose to be an indoor decorative plant?

(e) Why?

(f) In an experiment, the rate of oxygen production of two different indoor plants A and B were measured at various light intensities. The conditions for both studies were similar. The results are shown in Table 10.1. Compare and contrast the rates of oxygen production between plant A and B.
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<table>
<thead>
<tr>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Tier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Definition</strong></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>The Description</strong></td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td><strong>The Examples</strong></td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td><strong>The Conclusion</strong></td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

---

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<table>
<thead>
<tr>
<th>Need</th>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Exercise</td>
<td>Aerobic exercises improve cardiovascular fitness.</td>
</tr>
<tr>
<td>Mental</td>
<td>Learning</td>
<td>Cognitive exercises enhance brain function.</td>
</tr>
<tr>
<td>Emotional</td>
<td>Stress Management</td>
<td>Relaxation techniques reduce stress levels.</td>
</tr>
<tr>
<td>Social</td>
<td>Interpersonal Skills</td>
<td>Communication skills aid in social interactions.</td>
</tr>
</tbody>
</table>

---

**Similes**

<table>
<thead>
<tr>
<th>Biblical</th>
<th>Historical</th>
<th>Cultural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jesus as the light</td>
<td>Roman Emperor</td>
<td>Wise King</td>
</tr>
<tr>
<td>Love as the gift</td>
<td>Trade</td>
<td>Marriage</td>
</tr>
<tr>
<td>Freedom as the air</td>
<td>Liberty</td>
<td>Breath</td>
</tr>
<tr>
<td>Peace as the river</td>
<td>River</td>
<td>Tranquility</td>
</tr>
</tbody>
</table>

---

**Examples**

1. **Example 1**
   - The teacher explained the concept of photosynthesis thoroughly.
   - Students were encouraged to participate actively.

2. **Example 2**
   - The school organized a cultural festival to promote diversity.
   - Students were given opportunities to express their talents.
Section A

1. (a) Explain your answer to (a)(i) with reference to the figure below.

2. (i) State the changes in the activity of lactase, pro tease and amylase after

3. (a)(i) Explain your answer to (a)(i) with reference to the figure below.

Diagram: Figure 1.1

<table>
<thead>
<tr>
<th>Week</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Suggest a suitable diet for a young pig to lose 5 weeks old.
(a) Between 10 am and 1 pm.

Explain the changes in dry weight of leaf discs.

<table>
<thead>
<tr>
<th>Time</th>
<th>Dry weight (mg)</th>
<th>Length of leaf</th>
<th>Treatment of leaf</th>
<th>Control to ZLog</th>
<th>24h to 72h</th>
<th>48h to 72h</th>
<th>72h to 96h</th>
<th>96h to 120h</th>
</tr>
</thead>
<tbody>
<tr>
<td>120h</td>
<td>180</td>
<td>18mm</td>
<td>Control</td>
<td>140</td>
<td>160</td>
<td>150</td>
<td>140</td>
<td>130</td>
</tr>
<tr>
<td>120h</td>
<td>180</td>
<td>18mm</td>
<td>Treatment</td>
<td>140</td>
<td>160</td>
<td>150</td>
<td>140</td>
<td>130</td>
</tr>
</tbody>
</table>

(b) ... (c) ...
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Part 1:

(a) Pressure is very low

(b) Explain how vessels E contract to reduce the amount of blood in the vessels.

(c) Name organs P and explain how you derived your answer.

(d) Identify vessels P and explain how you derived your answer.

Part 2:

(a) Which of the ways A, B or C represents the sphenoid volume of a subject.

(b) When food is eaten, gastric juice is released into the stomach.

(c) This is illustrated in Fig. 4.1 below:

(d) Explain how food produces when the food passes the stomach.
The budding yeast, **Saccharomyces cerevisiae**, has both sexual and asexual reproduction by budding.

### Sexual reproduction

Under **favourable** conditions, **sexually** mature yeast cells will **germinate**, producing **haploid** cells. **Fertilization** occurs when two haploid cells combine. The resulting cells are **haploid** and contain the **complete** set of chromosomes from both parental cells. The **zygote** then undergoes **meiosis** to produce **spores**, which **germinate** to form the next generation of **haploid** yeast cells. This **asexual** means of reproduction is summarized in Fig. 5.

### Asexual reproduction

**Budding** is a common mode of reproduction in yeast. Each cell can produce a new cell that can germinate and produce a new cell cycle. A **zygote** can be formed by the combination of two haploid cells.

---

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Task 7:

(a) English marks would be the outcome of the experiment.

(b) The experiment is performed differently by changing all species and one factor.

(c) Explain why this is so.

(i) Which species in the food chain will get the least energy?

(ii) Construct a food chain to show the passing relationships of the four species.

(iii) The death of species B in photo II.

(iv) The disappearance of species a in photo I.

Suggest reasons for the following:

<table>
<thead>
<tr>
<th>Species</th>
<th>death</th>
<th>injured</th>
<th>unaffected</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>d</td>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>B</td>
<td>a</td>
<td>c</td>
<td>b</td>
</tr>
<tr>
<td>C</td>
<td>c</td>
<td>a</td>
<td>d</td>
</tr>
<tr>
<td>D</td>
<td>b</td>
<td>d</td>
<td>c</td>
</tr>
</tbody>
</table>

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The results are shown in Table 6.2.

<table>
<thead>
<tr>
<th>Weeks</th>
<th>20</th>
<th>100</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>Week 2</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

The totals for each week are equal, as many of the numbers were counted as possible.
(a) Suggest what causes the change in the level of adrenaline between 0 to 2 minutes.

(b) State two reasons why nicotine may be regarded as a poison considering its effects on the body.

c) Describe and explain how your answer in (b) will affect the

d) Sketch and draw from your answer in (c) well under the

(e) Calculate the median change in the rate of the artery in minutes.

(f) The graph shows the amount of adrenaline released into the blood and the change in

(g) Diameter of the blood vessels

(h)artery in minutes

(i) Diameter in mm

(j) Draw the information shown in Fig. 2. Describe how these information

(k) Answer the question.
5. (a) How do molecules of oxygen from the atmosphere reach the cells of our body?

(b) The myo-keratins and collagens of the human body.

6. (a) Predict and explain the relative lengths of the long bones in a neonate of a human.

(b) What are the possible reasons for a child to have a growth rate slower than normal?

7. (a) How does the heart function to ensure that oxygen is delivered to the body tissues?

(b) How does the heart function to ensure that carbon dioxide is removed from the body tissues?
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Outline the relationship between chromosomes, genes and DNA.</td>
<td>DNA is used to eventually carry out protein synthesis.</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Describe the importance of complementary base pairing in gene expression where DNA is used to eventually carry out protein synthesis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Explain why there is genetic variation in the offspring through sexual reproduction in plants.</td>
<td>DNA is used to eventually carry out protein synthesis.</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question 1

1. a. Define the term "evolution." Evolution is the gradual change in the characteristics of a species over generations, usually due to natural selection.

b. State one example of evolution in action. The evolution of antibiotic resistance in bacteria is a classic example where bacteria develop resistance to antibiotics due to natural selection pressure.

c. Explain the significance of genetic variation in evolution. Genetic variation provides the raw material for natural selection to act upon, allowing populations to adapt and evolve.

2. a. State one advantage of sexual reproduction over asexual reproduction. Sexual reproduction allows for the exchange of genetic material between parents, leading to genetic diversity and potentially new combinations of traits.

b. Explain how sexual reproduction can lead to new species. Sexual reproduction allows for the formation of new species through a process called speciation, where genetic isolation of populations leads to the evolution of reproductive barriers.

3. a. Describe the process of mitosis. Mitosis is a type of cell division that results in the production of genetically identical daughter cells, ensuring that each new cell has the same genetic information as the parent cell.

b. Explain the role of mitosis in the life cycle of an organism. Mitosis plays a critical role in growth, development, repair, and asexual reproduction in many organisms, ensuring the production of new cells as needed.

4. a. Explain the process of meiosis. Meiosis is a specialized cell division that results in the production of sex cells (gametes) with half the number of chromosomes as the parent cell, allowing for genetic diversity through recombination.

b. Describe how meiosis contributes to sexual reproduction. Meiosis allows for the production of gametes that carry unique combinations of genetic material, facilitating the formation of offspring with a mixture of traits from both parents.

Question 2

1. a. Define the term "ecosystem." An ecosystem is a community of living organisms (biotic factors) and their physical environment (abiotic factors) that interact in a specific locale.

b. Explain how energy flows through an ecosystem. Energy enters an ecosystem through photosynthesis, where Primary producers (plants) convert light energy into chemical energy, which is then transferred through the food chain as herbivores consume producers, and carnivores consume herbivores.

2. a. State one example of an interdependent relationship in an ecosystem. Mutualism, where two different species benefit from their interaction, such as the relationship between bees and flowers, is an example.

b. Explain the importance of biodiversity in an ecosystem. Biodiversity increases the resilience and productivity of ecosystems by providing a variety of ecological roles and services, which can help maintain ecological balance and support human well-being.

3. a. Define the term "food web." A food web is a diagram that shows the feeding relationships among all the organisms in an ecosystem, illustrating the complex interactions and energy flow through different trophic levels.

b. Explain how food webs contribute to ecosystem stability. Food webs provide a dynamic structure that allows for the transfer of energy and nutrients, promoting stability and regulating populations by natural checks and balances.

4. a. Define the term "adaptation." Adaptation refers to the evolutionary process where organisms become better suited to their environment over time through natural selection.

b. Explain how adaptation can lead to the evolution of new species. Adaptation under environmental pressure can lead to speciation, where new species form as populations become isolated and evolve independently, accumulating genetic differences.

5. a. Define the term "extinction." Extinction refers to the disappearance of an entire species, either completely or as a result of population decline to the point of no recovery.

b. Explain the factors that can lead to extinction. Factors include habitat loss, overexploitation, climate change, disease, invasive species, and pollution, all of which can reduce species diversity and negatively impact ecosystems.

Question 3

1. a. Explain the process of egg formation in females. The process of egg formation begins with meiosis in the ovaries, followed by ovulation, where mature eggs are released into the oviducts for fertilization.

b. Describe the role of the oviducts in the process of egg formation. The oviducts transport the eggs to the uterus, where they implant and develop further, facilitating fertilization and embryonic development.

2. a. Explain the process of sperm production in males. The process of sperm production begins with spermatogenesis in the testes, followed by ejaculation, where sperm are released into the female reproductive tract for fertilization.

b. Describe the role of the reproductive tract in the process of sperm formation. The reproductive tract includes the testes, epididymis, vas deferens, seminal vesicles, and prostate, which collectively play a role in sperm production, storage, and delivery for effective fertilization.

3. a. Explain the process of fertilization. Fertilization occurs when a mature egg is joined by a sperm, combining the genetic material of the male and female, leading to the formation of a single cell known as a zygote.

b. Describe the role of fertilization in the process of egg formation. Fertilization is the union of two gametes, which is essential for the development of a new individual and the propagation of species.

4. a. Explain the process of embryonic development. Embryonic development is a series of stages where the zygote undergoes cell division and differentiation, resulting in a rapidly growing organism that eventually develops into a fully formed adult.

b. Describe the role of embryonic development in the process of egg formation. Embryonic development is a critical stage in the life cycle of an organism, following fertilization, as it sets the stage for the differentiation and specialization of tissues and organs necessary for survival.

Question 4

1. a. Define the term "ecological succession." Ecological succession is the process by which a new community replaces an existing community over time, often following disturbance or change in the environment.

b. Describe the stages of an ecological succession. Ecological succession typically involves pioneer species, followed by early successional, late successional, and climax communities, each representing different stages of community development.

2. a. Explain the role of human activities in ecological succession. Human activities can significantly affect ecological succession by altering habitats, introducing invasive species, and disturbing natural ecosystems, potentially delaying or altering the natural sequence of succession.

b. Describe the importance of preserving natural ecosystems. Preserving natural ecosystems is crucial for maintaining biodiversity, regulating ecological processes, and providing ecological services essential for human well-being.

3. a. Explain the role of evolutionary processes in ecological succession. Evolutionary processes, such as natural selection, genetic variation, and speciation, can influence ecological succession by shaping the traits and genetic composition of species involved in community development.

b. Describe the importance of understanding evolutionary processes in ecological succession. Understanding evolutionary processes is essential for predicting future changes in ecosystems, managing biodiversity, and conserving species, as these processes underpin the adaptive capacity of species to changing environmental conditions.

Question 5

1. a. Explain the role of reproduction in maintaining biodiversity. Reproduction is crucial for maintaining biodiversity by ensuring the persistence of species and the genetic variation necessary for evolutionary change, promoting the survival of species in changing environments.

b. Describe the importance of understanding reproduction in maintaining biodiversity. Understanding reproduction is vital for managing species populations, conserving genetic resources, and ensuring the long-term survival of species, particularly in the face of threats such as habitat loss and climate change.

2. a. Explain the role of mutation in evolutionary processes. Mutation is a type of genetic variation that can occur spontaneously or be induced by external factors, providing a raw material for natural selection and driving evolutionary change over time.

b. Describe the importance of understanding mutation in evolutionary processes. Understanding mutation is essential for predicting evolutionary outcomes, developing strategies for genetic conservation, and addressing the challenges posed by genetic disorders and diseases.

3. a. Explain the role of genetic drift in evolutionary processes. Genetic drift is a stochastic process that can cause changes in allele frequencies within a population, affecting the genetic makeup of a species and potentially leading to the fixation or loss of alleles.

b. Describe the importance of understanding genetic drift in evolutionary processes. Understanding genetic drift is crucial for grasping the role of chance in shaping genetic diversity and for developing strategies to conserve genetic variation, particularly in small populations at risk of genetic drift.

4. a. Explain the role of natural selection in evolutionary processes. Natural selection is the process by which traits that enhance survival and reproductive success are more likely to be passed on to the next generation, leading to the evolution of species.

b. Describe the importance of understanding natural selection in evolutionary processes. Understanding natural selection is fundamental for understanding how species adapt to their environment, evolve over time, and maintain genetic variation among populations, which is key to conservation genetics and the management of species populations.

Question 6

1. a. Define the term "population." A population is a group of individuals of the same species that live in the same area and interact with each other.

b. Describe the importance of understanding population dynamics. Understanding population dynamics is crucial for managing species populations, conserving genetic resources, and addressing issues such as overpopulation and decline in biodiversity.

2. a. Explain the role of limits to population growth. Limits to population growth, such as resource availability and environmental constraints, can limit the growth of populations and influence their distribution and abundance.

b. Describe the importance of understanding limits to population growth. Understanding limits to population growth is vital for predicting population trends, managing species populations, and conserving genetic diversity, as these factors can affect the persistence and evolution of species.

3. a. Explain the role of competition in population dynamics. Competition occurs when two or more species use the same resources, leading to a struggle for limited resources and influencing survival and reproduction rates among species.

b. Describe the importance of understanding competition in population dynamics. Understanding competition is essential for grasping the interdependencies among species and the role of resource sharing in shaping species distributions and abundance, which is critical for conservation efforts.

4. a. Explain the role of predation in population dynamics. Predation occurs when one species (the predator) preys on another (the prey), influencing the population dynamics of both species, with predation often acting as a strong selective pressure.

b. Describe the importance of understanding predation in population dynamics. Understanding predation is crucial for predicting species interactions, conserving prey species, and addressing issues related to the control of pest populations, which can impact human welfare and ecosystem services.

5. a. Explain the role of herbivory in population dynamics. Herbivory occurs when one species (the herbivore) feeds on another (the plant), influencing plant growth and reproductive success, which can have cascading effects on ecosystem functioning and diversity.

b. Describe the importance of understanding herbivory in population dynamics. Understanding herbivory is essential for grasping the role of grazing in maintaining vegetation structures, conserving plant species, and addressing ecosystem resilience in the face of disturbances.

6. a. Explain the role of parasitism in population dynamics. Parasitism occurs when one species (the parasite) benefits at the expense of another (the host), influencing the survival and reproduction of the host, which can lead to population declines.

b. Describe the importance of understanding parasitism in population dynamics. Understanding parasitism is crucial for managing species populations, conserving genetic resources, and addressing issues such as disease spread and host population declines, which can affect ecosystem health and human well-being.

Question 7

1. a. Define the term "ecological niches." Ecological niches refer to the role that a species plays in an ecosystem and the specific resources it requires to survive and reproduce.

b. Describe the importance of understanding ecological niches. Understanding ecological niches is essential for grasping species interactions, conserving genetic resources, and addressing issues related to species invasions and habitat fragmentation, which can affect biodiversity and ecosystem functioning.

2. a. Explain the role of competition in shaping species distributions. Competition can limit the distribution of species by reducing resource availability, leading to spatial segregation and niche partitioning, which can influence species coexistence.

b. Describe the importance of understanding competition in shaping species distributions. Understanding competition is crucial for predicting species interactions, conserving genetic resources, and addressing issues related to species invasions and habitat fragmentation, which can affect biodiversity and ecosystem functioning.

3. a. Explain the role of predation in shaping species distributions. Predation can shape species distributions by influencing population dynamics and community structure, leading to changes in species interactions and community composition.

b. Describe the importance of understanding predation in shaping species distributions. Understanding predation is essential for grasping the role of top-down control in ecosystem dynamics, conserving prey species, and addressing issues related to the control of pest populations, which can impact human welfare and ecosystem services.

4. a. Explain the role of herbivory in shaping species distributions. Herbivory can influence plant community structure and ecosystem processes, affecting species distributions and community composition through resource availability and plant community interactions.

b. Describe the importance of understanding herbivory in shaping species distributions. Understanding herbivory is crucial for grasping the role of grazing in maintaining vegetation structures, conserving plant species, and addressing issues related to biodiversity and ecosystem resilience in the face of disturbances.

5. a. Explain the role of parasitism in shaping species distributions. Parasitism can influence host population dynamics and community structure, affecting species distributions and community composition through resource availability and host-parasite interactions.

b. Describe the importance of understanding parasitism in shaping species distributions. Understanding parasitism is essential for grasping the role of diseases in community dynamics, conserving host species, and addressing issues related to the control of pest populations, which can impact human welfare and ecosystem services.
<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
</table>
| **Question**: What are the advantages of living in the city?  
- Easy access to medical facilities  
- Access to various entertainment options  
- Diverse cultural experiences  
- Job opportunities |
| **Answer**: 
- Easy access to medical facilities  
- Access to various entertainment options  
- Diverse cultural experiences  
- Job opportunities |
<table>
<thead>
<tr>
<th>Pos</th>
<th>Function</th>
<th>Type of macromolecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lipid</td>
<td>Membrane</td>
</tr>
<tr>
<td>2</td>
<td>Protein</td>
<td>Membrane</td>
</tr>
<tr>
<td>3</td>
<td>Carbohydrate</td>
<td>Membrane</td>
</tr>
<tr>
<td>4</td>
<td>Nucleic acid</td>
<td>Membrane</td>
</tr>
</tbody>
</table>

**Question:** What is the likely identity of the cell and appropriate reason for the given diagram?

**Answer:** The cell in the micrograph below shows part of a cell. Given the appearance of the cell, it is likely a **plant cell**. The reasons include: **A** cell wall, **B** large vacuole, and **C** chloroplasts.
4. The diagram below shows a specialized cell. Which of the labelled structures carry out the following functions below?

A
B
C
D

<table>
<thead>
<tr>
<th>Storage of nutrients and inorganic ions</th>
<th>Site of most cellular activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>D</td>
<td>A</td>
</tr>
</tbody>
</table>

5. The table below shows the ratios of initial mass to final mass of three fresh potato cylinders which have been immersed in sucrose solutions of three different concentrations for 30 minutes:

<table>
<thead>
<tr>
<th>Ratio of initial mass to final mass</th>
<th>Solution P</th>
<th>Solution Q</th>
<th>Solution R</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>1.4</td>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

Which of the following can be deduced from the results?

1. The water potential of the potato cylinders is higher than that of solution P.
2. There is a net movement of water from the potato cylinders to solution Q.
3. Solution Q has a higher sucrose concentration than solution R.

A
B
C
D

6. The graph below shows the energy changes that occur in the reaction in which molecule X breaks down into molecules Y and Z in the presence of an enzyme.

The activation energy for this reaction is equal to

A
B
C
D

7. The following graphs show the way four enzymes, W, X, Y and Z, change their activity in different pH and temperature situations.

Which one of the following statements about the activity of the four enzymes is true?

A. At pH 7, enzyme Y is denatured at temperatures below 20 °C.
B. Enzyme Z could be an intracellular human enzyme.
C. At pH 3 and a temperature of 37 °C, the active site of enzyme W binds well with its substrate.
D. At pH 3 and a temperature of 37 °C, enzyme X functions at its optimum.
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12. The diagram below shows a transverse section of a leaf.

Which layer(s) of cells would turn blue-black in an iodine test after several hours of sunlight?

A. 1 only
B. 2 and 3 only
C. 2, 3 and 4 only
D. all of the above

13. The graph shows pressure changes in the left side of the heart, during a single heartbeat.

At which points will the 'lub' and 'dub' sounds be produced?

A. W and X
B. W and Y
C. X and Y
D. all of the above

14. When the legs are not moved for an extended period of time, the rate of blood flow through the veins is reduced. Which of the following statements best explains this?

A. The muscular wall of the veins have to be contracted together with the muscles of the leg to aid in the movement of blood.
B. The semi-lunar valves that prevent the backflow of blood are opened by the contraction of leg muscles.
C. The thin muscular walls of the veins are unable to withstand high blood pressure and the leg muscles help to prevent them from bursting.
D. The veins are located between muscles and the contraction of muscles helps to push blood along.

15. The diagram below illustrates a simple flowchart showing the mechanism of blood clotting in humans.

Name P, Q, R and S.

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Thrombin</td>
<td>Platelet</td>
<td>Thrombokinase</td>
<td>Fibrinogen</td>
</tr>
<tr>
<td>B</td>
<td>Platelet</td>
<td>Thrombokinase</td>
<td>Thrombin</td>
<td>Fibrinogen</td>
</tr>
<tr>
<td>C</td>
<td>Thrombin</td>
<td>Thrombokinase</td>
<td>Fibrinogen</td>
<td>Platelet</td>
</tr>
<tr>
<td>D</td>
<td>Thrombokinase</td>
<td>Fibrinogen</td>
<td>Thrombin</td>
<td>Platelet</td>
</tr>
</tbody>
</table>

16. Which of the following statements about lactic acid is incorrect?

A. After exercise, lactic acid is removed from the muscles and brought to the liver.
B. Anaerobic respiration always produces lactic acid.
C. An oxygen debt is incurred when lactic acid accumulates in the muscles.
D. The build-up of lactic acid in the muscles causes fatigue.
The diagram shows a human female reproductive system and the cells of a rowan.

### Question 20
Which of the following statements about the diagram are true?

- A. Ovary
- B. Uterus
- C. Cervix
- D. Vagina

### Question 19
The table shows the results of an experiment on the growth of a certain type of grass. Which of the following conclusions is correct?

<table>
<thead>
<tr>
<th>Part Removed</th>
<th>Initial Length (cm)</th>
<th>Final Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No part removed</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Part 1 removed</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Part 2 removed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Both parts removed</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

### Question 18
A student decides to study the impact of removing certain organs on the growth of plants. Which of the following results is expected?

- A. Increase
- B. Decrease
- C. No change
- D. Unknown

### Question 17
The following graph shows the pressure in the lungs during a complete breathing cycle.

- A. Inspiration
- B. Expiration
- C. Inspiration and expiration
- D. Neither inspiration nor expiration

### Question 16
The table shows the results of an experiment on the growth of a certain type of grass. Which of the following conclusions is correct?

<table>
<thead>
<tr>
<th>Part Removed</th>
<th>Initial Length (cm)</th>
<th>Final Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>12</td>
</tr>
<tr>
<td>Part 1 removed</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Part 2 removed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Both parts removed</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

### Question 15
The diagram shows a human male reproductive system. Which of the following statements is correct?

- A. Testis
- B. Semen
- C. Prostate gland
- D. Penis

### Question 14
The table shows the results of an experiment on the growth of a certain type of grass. Which of the following conclusions is correct?

<table>
<thead>
<tr>
<th>Part Removed</th>
<th>Initial Length (cm)</th>
<th>Final Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No part removed</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Part 1 removed</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Part 2 removed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Both parts removed</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

### Question 13
The diagram shows a human male reproductive system. Which of the following statements is correct?

- A. Testis
- B. Semen
- C. Prostate gland
- D. Penis

### Question 12
The table shows the results of an experiment on the growth of a certain type of grass. Which of the following conclusions is correct?

<table>
<thead>
<tr>
<th>Part Removed</th>
<th>Initial Length (cm)</th>
<th>Final Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No part removed</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Part 1 removed</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Part 2 removed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Both parts removed</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>
22. The table shows the results of some tests on body fluids P, Q and R.

<table>
<thead>
<tr>
<th>Body fluid</th>
<th>Chloride</th>
<th>Reducing Sugar</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Q</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>R</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Where are P, Q and R taken from?

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Glomerulus</td>
<td>Collecting duct</td>
</tr>
<tr>
<td>B</td>
<td>Bowman's capsule</td>
<td>Collecting duct</td>
</tr>
<tr>
<td>C</td>
<td>Glomerulus</td>
<td>Bowman's capsule</td>
</tr>
<tr>
<td>D</td>
<td>Loop of Henle</td>
<td>Distal convoluted tubule</td>
</tr>
</tbody>
</table>

24. The diagram shows a section of a human eye focused on a near object.

Which part(s) will change such that light falls onto the fovea sharply when the person looks at a distant object?

A. Z only  
B. V, Y and Z  
C. X, and Y  
D. X, Y and Z

25. Adrenaline is sometimes given to patients. In which of the following conditions would the administration of adrenaline be useful?

1. low heart rate  
2. low blood sugar  
3. low water potential  

A. 2 only  
B. 1 and 2 only  
C. 2 and 3 only  
D. All of the above
30 The ABO blood group system of humans is an autosomal trait that has three alleles as follows.

$I^A$ : protein A on red blood cells
$I^B$ : protein B on red blood cells
$I^O$ : no protein on red blood cells

In this system, four different blood groups exist. They are groups A, B, AB and O. In a family of four children, each child has a different blood group with respect to this gene. The phenotypes of the parents must be:

A  A and B.
B  AB and O.
C  B and AB.
D  O and B.

31 Flamingos are birds that live by lakes. The feather colour of flamingos may vary from white to pink to red. To investigate the inheritance of feather colour, a scientist performed the following crosses and recorded the feather colour of all the offspring when one year old. The diet of the offspring was also recorded.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Feather colour of parents</th>
<th>Feather colour of all one-year-old offspring</th>
<th>Diet of offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>white × white</td>
<td>white</td>
<td>aquatic plans</td>
</tr>
<tr>
<td>2</td>
<td>red × white</td>
<td>white</td>
<td>aquatic plans</td>
</tr>
<tr>
<td>3</td>
<td>white × white</td>
<td>pink</td>
<td>algae and crayceans</td>
</tr>
<tr>
<td>4</td>
<td>red × white</td>
<td>pink</td>
<td>algae and crayceans</td>
</tr>
</tbody>
</table>

Based on this information, a correct conclusion would be that

A  white feather colour is recessive to red feather colour.
B  both the parents in cross 1 must be homozygous for white feather colour.
C  the feather colour of flamingos is influenced by their environment.
D  two parents, both with pink feather colour, would produce one-year-old offspring with only pink feather colour.

Questions 32 and 33 relate to the following information.

Fur length in rabbits is controlled by a single autosomal gene, where a dominant allele causes short fur and a recessive allele causes long fur. Pedigree 1 below shows the inheritance of fur length in a family of rabbits.

32 What is the probability that individual II-4 is a heterozygote for short fur?
A  0
B  0.50
C  0.75
D  1

33 Which one of the following individuals could be used to conduct a test cross with individual III-5?
A  II-2
B  II-7
C  III-1
D  III-6
37. Which of the following are possible advantages to using bacteria to degrade waste?

- Option A: Inactivation of harmful chemicals.
- Option B: Production of useful products like biodegradable materials.
- Option C: Recycling of nutrients back into the environment.
- Option D: Reduction in greenhouse gas emissions.

The base sequence L U C can be transcribed into mRNA, which codes for the protein that catalyzes the reaction.

35. Which parts have been generally modified to contain a gene which encodes a toxin?

- Option A: Cell walls
- Option B: Cytoplasm
- Option C: Plasma membrane
- Option D: Nucleus

34. Refer to the following diagram, which shows a segment of DNA.
The diagram shows a food web in a marine ecosystem. The arrows represent the flow of energy. Use the diagram to answer questions 38 and 39.

![Food Web Diagram](attachment:food_web.png)

38 Which one of the following statements is **Incorrect**?
A. Crabs belong only to the third trophic level.
B. Lobsters belong to both the third and fourth trophic levels.
C. Limpets and zooplankton belong to the same trophic level.
D. Whelks and gulls both belong to one trophic level.

The diagram shows four ecological pyramids.

![Ecological Pyramids](attachment:pyramids.png)

Which is the pyramid of biomass and which is the pyramid of numbers in this food chain: phytoplankton → zooplankton → mussels → whelks?

<table>
<thead>
<tr>
<th></th>
<th>Pyramid of biomass</th>
<th>Pyramid of numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>
BIOLOGY

Paper 2

1 hour 45 minutes

Question and Answer Booklet
Additional Material: Nil

READ THESE INSTRUCTIONS FIRST

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

You are required to submit this booklet at the end of the examination.

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.

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

For Examiner’s Use

<table>
<thead>
<tr>
<th>Section</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

This document consists of 19 printed pages.
1 A student carried out an investigation on the effect of soaking time on the cleaning ability of a biological detergent.

(a) Which of the following would be part of his procedure for this investigation? [1]

Tick (✓) the correct boxes.

- He used different types of cloths.
- He used a range of different temperatures.
- He used a biological detergent only.
- He used a non-biological detergent only.
- He used a range of soaking times.
- He used same type of stains.
- He used different volumes of stain.

(b) Fig. 1 shows the results of an investigation into the effectiveness of a detergent at different temperatures.

![Graph showing stain removal percentage vs temperature](image)

Fig. 1

(i) Describe the effect of temperature on stain removal when using this detergent. [2]

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(ii) The washing machine has four temperature settings:

10°C  20°C  30°C  40°C

Circle the setting which would produce the best results using this detergent. Explain your answer.  [1]

(iii) With reference to Fig. 1, determine how many more times was this detergent more effective when the temperature was increased from 10°C to 30°C? [Show your working]  [1]

[Total: 5 marks]

2 Fig. 2.1 shows the blood pressure measured at different points of one blood vessel.

(a) (i) Name the type of blood vessel.  [1]

(ii) Explain the difference in blood pressure between points X and Y.  [2]

... ...

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Fig. 2.2 shows the external view of a human heart.

(b) Using the numbers labelled in Fig. 2.2, outline the route taken by a red blood cell to travel from chamber X to blood vessel 3.

Include the heart chambers and major organs that the red blood cell has to pass through. [1]

(c) Explain the possible effect of the blood clot in blood vessel 3 on the heart. [2]

(d) Explain why a person who has lost a lot of blood in a car accident may suffer from kidney failure. [2]

[Total: 8 marks]
In an investigation of the transport of organic nutrients in plants, one leaf on each of two similar plants was supplied with a jar containing radioactive carbon dioxide, $^{14}$CO$_2$.

Fig. 3.1 shows the set up. The stem of plant B was ringed below the treated leaf by removing the bark while stem of plant A was not ringed. The plants were allowed to carry out photosynthesis in sunlight for 2 hours.

Table 3.2 shows the radioactivity in the treated leaf and in the roots of the two plants after 2 hours in sunlight.

<table>
<thead>
<tr>
<th>Radioactivity (ppm)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Leaf</td>
<td>Root</td>
</tr>
<tr>
<td>A</td>
<td>0.15</td>
<td>0.12</td>
</tr>
<tr>
<td>B</td>
<td>0.15</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Table 3.2

(a) Explain why the plants were allowed to photosynthesise for 2 hours.  

(b) Name the major compound transported in the plants that contains the radioactive carbon.
(c) Explain why there is no radioactivity in the roots of plant B. [2]

(d) Draw a labelled diagram showing the transverse section of the stem of plant B (above the ringed section). Shade the areas that carry radioactive compounds. [2]

[Total: 7 marks]
Fig. 4.1 shows some of the amniotic fluid surrounding a fetus being withdrawn using a syringe.

Fig. 4.1

(a) Name structures B and C.

B: ...........................................  C: ...........................................

(b) With reference to the direction of the arrow in Fig. 4.1,

(i) state a substance which is carried by the blood in the umbilical cord.

substance: ...........................................  [1]

(ii) name the blood vessel which carries the substance mentioned in (b)(i).

blood vessel: ...........................................  [1]

(c) Explain why the blood vessels between the fetus and the mother are not in direct contact in part labelled A.  [2]
Fetal cells collected from the amniotic fluid may be analyzed to determine if the fetus suffers from any genetic diseases. Fig. 4.2 shows the karyotype – a photomicrograph of the entire collection of chromosomes - obtained from one of these cells.

Fig. 4.2

(d) It was diagnosed that the fetus has inherited a genetic disorder.

State the condition and explain how this condition arose. [3]

[Total: 8 marks]
Fig. 5.1 shows the longitudinal section of an insect-pollinated flower and Fig. 5.2 shows the transverse section of the flower bud of the same species of insect-pollinated flower.

(a) Suggest two possible methods that may be used by this flower to avoid self-pollination.

(b) State and explain one disadvantage of self-pollination.

(c) With reference to Fig. 5.1 only, state one feature that shows the flower is pollinated by insects.

(d) Identify the labelled parts in Fig. 5.2, which are equivalent to parts A, B and C in the Fig. 5.1 respectively.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Equivalent Parts from Fig. 5.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
6 (a) Two students, Daniel and Laura are revising the topic on DNA and Genetic Engineering. Laura argued that, “DNA and genes are the same.”, however, Daniel disagreed.

Who would you agree with? Explain your answer.

(b) Genetically modified organisms (GMO) are organisms whose genetic materials have been altered by human. The most commonly used technology is recombinant DNA technology. The foods produced from genetically modified organisms are called genetically modified foods (GM foods).

Golden rice is one of the GM foods. Betacarotene biosynthesis (BB) genes were inserted into rice genome using recombinant DNA technology. After modification, golden rice can naturally produce beta-carotene, which can be converted into vitamin A later on.

Fig. 6.1 shows the stages involved in the insertion of a BB gene into a bacterium.
11

(i) Identify molecules R and S.

R: .........................................  S: .........................................  [2]

(ii) Explain why the same molecule R is be used to obtain the Betacarotene biosynthesis gene.  [2]

.................................................................................................................................

.................................................................................................................................

(iii) Give two disadvantages of developing golden rice.  [2]

.................................................................................................................................

.................................................................................................................................

.................................................................................................................................

[Total: 8 marks]

7  Read the passage below and answer the questions that follow:

Albinism is a genetic disorder, which can affect all vertebrates, including humans. Affected individuals will appear white since they cannot produce enough melanin pigments in their skin. Albinism occurs when there is a mutation and thus result in the passing down of recessive mutated gene to their offsprings. Albinism can also be found in animals such as birds and reptiles. The survival rate of the animals with albinism is usually very low in nature.

(a) Define the term Mutation.  [1]

.................................................................................................................................

(b) Suggest why is the survival rate of animals with albinism is usually very low in nature.  [1]

.................................................................................................................................

.................................................................................................................................

.................................................................................................................................

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(c) (i) With the help of a genetic diagram, explain how parents who are normal are able to produce an albino child. [4]

(ii) What is the probability of the parents having a first child who is normal and a second child affected by Albinism? [1]

...........................................................................................................................................

[Total: 7 marks]
SECTION B (30 MARKS)

Answer THREE questions in this section.
Question 10 is in the format of an EITHER / OR question. Only one part should be answered.

8. Two athletes, R and S, carried out a six-month training programme in preparation for the 2015 SEA games. The fitness of the two athletes was tested on the first day of each month by measuring their rate of oxygen absorption. An increase in fitness is shown by an increase in the rate of oxygen absorption.

The rate of oxygen absorption was measured for each athlete during exercise. Table 8.1 shows the results of these fitness tests.

<table>
<thead>
<tr>
<th>Month of training programme</th>
<th>Rate of oxygen absorption (cm³ per kg per min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Athlete R</td>
</tr>
<tr>
<td>1</td>
<td>39.0</td>
</tr>
<tr>
<td>2</td>
<td>45.0</td>
</tr>
<tr>
<td>3</td>
<td>50.0</td>
</tr>
<tr>
<td>4</td>
<td>53.0</td>
</tr>
<tr>
<td>5</td>
<td>53.0</td>
</tr>
<tr>
<td>6</td>
<td>53.0</td>
</tr>
</tbody>
</table>

Table 8.1

(a) State which athlete has benefitted most from the training programme. Justify your answer. [1]

(b) Calculate the volume of oxygen absorbed per minute by athlete R when tested in the 6th month. Athlete R had a mass of 60 kg. [Show your working] [2]

Volume of oxygen absorbed per minute: ..............................................
(c) Construct a line graph to show the results for athlete R. [3]

(d) From the results, it was concluded that fitness levels improve in the first months of training and then remain constant. Suggest one way in which the reliability of this conclusion could be improved. [1]

(e) Runners who smoke are advised to quit smoking when they train for marathons. Explain the impact of smoking on running. [3]

[Total: 10 marks]

Need a home tutor? Visit smiletutor.sg
The picture shows a modern swordfish.

Ancestors of swordfish had short swords. Modern swordfish have long swords. Swordfish use their swords to injure prey. The injured prey is easier to catch.

The information below shows one theory of how the length of the sword of swordfish changed.

The sword grew longer as each swordfish used its sword more and more. Swordfish reproduced, the longer sword was passed on to its offspring.

Many generations

(a) Darwin suggested that evolution is a result of natural selection. Describe how natural selection could result in modern swordfish with long swords developing from ancestors with short swords. [4]
(b) Predatory ocean fish such as tuna and swordfish are common examples of mercury bioaccumulation.

With reference to the food chain shown below,

Phytoplankton → Krill → Pollock → Tuna → Shark

explain how bioaccumulation arises and why it is detrimental to the organisms on the higher trophic level and its environment. \[3\]

(c) Explain why the ocean gives out less carbon than it takes. \[3\]

[Total: 10 marks]
10 EITHER

(a) Explain why blood must always be screened for blood types before transfusions. [3]

(b) With reference to the skin, blood and epithelial cells of the body, outline how the body is protected from invasion by foreign particles. [7]

[Total: 10 marks]
10 OR

(a) Explain why it is important to drink water daily. [3]

(b) Blood is an important part of the body's internal environment.

Outline the homeostatic mechanisms that regulate blood in terms of its glucose level and water potential. [7]
TEMASEK SECONDARY SCHOOL
Preliminary Examinations 2015
Secondary 4 Express Biology

Paper 1 Answers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
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<td>C</td>
<td>32</td>
<td>D</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>D</td>
<td>15</td>
<td>B</td>
<td>25</td>
<td>B</td>
<td>35</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>18</td>
<td>B</td>
<td>26</td>
<td>A</td>
<td>36</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
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<td>7</td>
<td>C</td>
<td>17</td>
<td>C</td>
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<td>B</td>
<td>37</td>
<td>C</td>
<td></td>
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<td>8</td>
<td>D</td>
<td>18</td>
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<td>B</td>
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<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>C</td>
<td>19</td>
<td>C</td>
<td>29</td>
<td>D</td>
<td>39</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>10</td>
<td>A</td>
<td>20</td>
<td>B</td>
<td>30</td>
<td>A</td>
<td>40</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

Paper 2 Section A (50 marks)

<table>
<thead>
<tr>
<th>Qn</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>1 (1 or 0)</td>
</tr>
<tr>
<td>1(b)(i)</td>
<td>As temperature rises from 10 °C to 35 °C, % of stained removed increases. 35 °C is the optimal temperature for stain removal. As temperature increases further, less stain gets removed. 1</td>
</tr>
<tr>
<td>1(b)(ii)</td>
<td>40 °C The % of stain removed is highest at 40 °C 1</td>
</tr>
<tr>
<td>1(b)(iii)</td>
<td>((60 - 16) = 16 = 4x) 1</td>
</tr>
<tr>
<td>2(a)(i)</td>
<td>artery 1</td>
</tr>
<tr>
<td>2(a)(ii)</td>
<td>Blood pressure is higher at point X due to the forceful contractions of the heart muscles which send blood out into the artery at high pressure. Whereas at point Y, blood pressure is lower due to stretching of the arterial walls by the elastic fibres when blood passes through. 1</td>
</tr>
<tr>
<td>2(b)</td>
<td>Reduced blood flow to heart muscles will send less oxygen and glucose to the heart muscles to provide energy for muscular contractions resulting in heart failure. 1</td>
</tr>
<tr>
<td>2(c)</td>
<td>1</td>
</tr>
<tr>
<td>2(d)</td>
<td>Kidney requires a constant flow of blood to maintain a constant blood pressure to enable ultrafiltration. When there is an excessive loss of blood, this may result in a drop in pressure, thus affecting the removal of waste products/secretory function of kidneys. 1</td>
</tr>
<tr>
<td>3(a)</td>
<td>To allow plants time to absorb ( 6^\text{th} ) CO(_2) into the leaves to form glucose via photosynthesis and to spread/transport the radioactive compounds throughout the plant. 2</td>
</tr>
<tr>
<td>3(b)</td>
<td>Sucrose 1</td>
</tr>
<tr>
<td>3(c)</td>
<td>Radioactive compounds are transported along phloem tissues, which is blocked by the ringed section. 1</td>
</tr>
</tbody>
</table>
A non-continuous synonym with reduce the chance of local solutions to the problem is needed. The problem also suggests that different blood pressures are needed to maintain different blood vessels in the body. So that the blood pressure of different blood vessels is maintained within certain limits.

6. (a) A. The blood vessels are narrower than those in other areas. 
   B. They have walls that are thicker than those in other areas. 
   C. They are wider than those in other areas. 
   D. They have walls that are thinner than those in other areas.

7. (b) A. The blood vessels are narrower than those in other areas. 
   B. They have walls that are thicker than those in other areas. 
   C. They are wider than those in other areas. 
   D. They have walls that are thinner than those in other areas.

8. (c) A. They are wider than those in other areas. 
   B. They have walls that are thinner than those in other areas. 
   C. They are narrower than those in other areas. 
   D. They have walls that are thicker than those in other areas.
Cost of seeds
Engineered crop plants produce seeds that cannot germinate. Farmers have to buy special seeds every year. This poses a serious problem to poorer societies, where farmers are struggling to make a living.

Reject answers that states bioethics concerns/social classes (e.g. golden rice will be sold at a very high price).

7(a) Mutation is the spontaneous/sudden change in gene structure/chromosome or chromosome number.

7(b) Animals with albinism may lose their protective camouflage in the wild/nature and are therefore unable to hide from their predators/prey.

7(c) Let A be allele for normal, a be allele for albinism

<table>
<thead>
<tr>
<th>Parents Phenotype</th>
<th>Normal x Normal</th>
<th>Gameles</th>
<th>Aa x Aa</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 Genotype</td>
<td>AA, Aa, aa, aa</td>
<td>F1 Phenotype</td>
<td>normal, normal, normal, albino</td>
</tr>
<tr>
<td>Phenotypic ratio</td>
<td>3 normal : 1 albino</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7(d) Probability of 1st child normal and 2nd child albino is \( \frac{1}{2} \times \frac{1}{4} = \frac{3}{16} = 18.75\% \) or 0.1875

8(a) Increases airway resistance
- Tar coats the lungs, reducing the elasticity of the air sacs and resulting in the absorption of less oxygen into the bloodstream.
- This lowers lung capacity and results in shallow breathing.
- Smoking also causes chronic swelling of the mucous membranes of the airways.
- Less oxygen is taken into the lungs, which increases airways resistance; reduces maximum oxygen uptake capacity.
- Carbon monoxide competes with oxygen/Lowers absorption of oxygen/reduced physical endurance
  - Carbon monoxide in smoke competes with oxygen to bind irreversibly with Haemoglobin, this reduces the oxygen carried to the body cells, which is needed for aerobic respiration.
  - This may then reduce the maximal oxygen uptake capability.
| 10(b) | When blood glucose level is low, glucagon is secreted from islets of Langerhans in pancreas, stimulates liver to convert stored glycogen to glucose. More glucose is made available to tissues. When blood glucose level is high, this stimulates the islets of Langerhans in pancreas to secrete insulin, which increases permeability of cells to absorb glucose. Liver then converts excess glucose to glycogen and stored it. Thus restores the blood glucose level.  
When water potential is low in blood plasma, it stimulates the hypothalamus, which in turn stimulates the pituitary gland to secrete more ADH into blood stream, allows more reabsorption of water at the kidney tubules (collecting duct). This allows water potential in blood plasma to be restored back to normal.  
When water potential in blood plasma is high (due to a cold day, less water is lost through sweating), this stimulates the hypothalamus, which then stimulates the pituitary gland to secrete less ADH, less water is reabsorbed at the kidney tubules, allowing more urine to be produced and release from the body. This helps to restore the water potential in blood plasma. |
(d) Calculate the energy in the meat that is available to humans as a percentage of the energy in the animal feed. Show your working.

(3) Table 1 shows how much energy the body can recover from the animal food.

<table>
<thead>
<tr>
<th>Energy in kg of animal feed</th>
<th>Energy in kg of animal feed</th>
<th>Area of energy intake from the animal feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>150,000</td>
<td>125,000</td>
<td>50</td>
</tr>
<tr>
<td>25</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1 shows the results of the investigation.

The student found that an area of 150% of the animal feed is required to recover the energy from the animal feed. The student thought that the energy from the animal feed is more efficient for humans.

(b) Explain why the first topic brings out the second.
Suggest a reason why mean measurements were used.

(c) The measurements of the rate of photosynthesis (x) at the points when the 

and

(d) Which two crop plants show the greatest difference between Rate x and

Suggest why these measurements may give different results.

- Calculating the rate per unit mass of the leaf
- Calculating the rate per unit area of the leaf
- The rate of photosynthesis can be measured by

Suggest two factors that were changed when the plants were grown in

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Section A (2 marks)

Give a brief answer to each question.

1. (a) Write down the correct answer to each question.

2. (a) State the possible genotype of the parent bee used in the cross.

3. (b) A bee breeder is keen to use artificial selection in the leaf cutter bee line to improve the plant seeds. What selection criteria could he use?

4. (c) Write down the process given in the game group that is analogous to the mutation process that gives rise to genetic variation.

END OF SECTION A
Sec 4 Bio T.SCHOOL

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Fig. 6.1: Sperm and egg production in honey bees and worker bees.

(a) Calculate the number of chromosomes in the male and female bees.

(b) Describe the reason why honey bees have fewer chromosomes than worker bees.

(c) Explain what is meant by the term 'haploid'.

(d) Compare the number of chromosomes in the male and female bees.

(e) Find the correct answer to question (b).

(f) Identify the type of response made by John when he moves his arm.

(g) Add arrows to Fig. 6.1 to show the pathway from nerve impulses to muscles.

(h) Sketch the stimulus used to bring about John's response.

(i) Explain your answer to (b).

(j) Identify the nerve H.

(k) Describe the pathway of nerve impulses, including reference to F and G.

(l) State the type of response made by John when he moves his arm.

(m) Explain the role of neurotransmitters in the pathway from nerve impulses to muscles.
4. Fig. 4.1 shows the kidney and some associated structures.

(a) The man who is a smoker noticed that he has been feeling breathless. His doctor also warned him against smoking and cautions him on smoking. Explain how a renal component in tobacco smoke may cause these symptoms.

(b) The kidney is involved in excretion. Explain how excretion is different from elimination.

(i) Glucose molecules

(ii) Protein molecules

Use information in Fig. 4.2 and your own knowledge of how the kidney works to explain why the following molecules are not normally present.

Fig. 4.2 shows part of the processes in the kidney.

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3. Fig. 3.1 shows the oxygen consumption of a man during a 40-minute period of vigorous exercise. Complete the graph in Fig. 3.1 to show the rate of oxygen consumption during rest.

(i) Describe and explain the resulting appearance of the leaves and stem of the school plant.

(ii) The water in apparatus A is replaced by seawater and leaf C is floated. Describe the appearance of the leaf in apparatus A after 24 hours.

(iii) Deduce your answer from the graph.

(iv) Arrange the experiment with apparatus B.
Fig 2.2

The results obtained from the microscope are shown in Fig 2.2.

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Fig 2.1

Fig 2.1 shows an experimental setup which measures the rate of water loss from a leaf. The rate of water loss was recorded in the dark and at full light.

The apparatus was left for 15 minutes before any measurements were taken. Different light intensities at hourly intervals at each light intensity were used. The results obtained from the microscope are shown in Fig 2.2.
Fig. 1.1

Name the blood vessel A.

Fig. 1.2

Humans. The arrows indicate the direction of blood flow.

Answer ALL questions in the spaces provided.

SECTION A (50 marks)
(d) 

Identity and isolate the toxin-producing gene on the DNA of the

[2/1]

and multiple in region with similar disease [2/1]

better [1/2]

By mutagenic selection, they are the ones who could survive

[2/1]

the selection criterion. They are the ones who could survive

[2/1]

they are the likely candidates to move to disease [2/1]

because of rare one, the selection criteria (m) are said to be

[2/1]

individual [2/1]

and the candidates would result in the ability to detect such

[2/1]

by the introduction of potential that cell growth [2/1]

above (m) are selected from the candidate because [2/1]

individuals who are homozygous recessive for the mutant

mTOR [2/1]

concept of normal allele's in mutated to recessive (m)

and their cells are no longer able to produce [2/1]

both concepts in the transport of oxygen

[2/1]

causes cell death to become sickle cells [2/1]

[2/1]

cancer in DNA of single gene [2/1]

[2/1]

structural
Which curve represents the number of primary consumers?

Line of the year

- Intensity of light
- Quantity of nutrients
- Number of primary consumers
- Number of predators

The graph shows the annual changes in a lake of the following factors:

- Energy flow
- Nutrient levels
- Population dynamics
- Predation patterns

The diagram shows a sewage treatment plant.

<table>
<thead>
<tr>
<th>3' end</th>
<th>5' end</th>
</tr>
</thead>
<tbody>
<tr>
<td>d CCA CAA</td>
<td>c CGA CTT</td>
</tr>
<tr>
<td>c GGA CTT</td>
<td>g GTA AAT</td>
</tr>
<tr>
<td>A GCC GAA</td>
<td>a CTA CAC</td>
</tr>
</tbody>
</table>

The table shows some amino acids and their corresponding mRNA codons.
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Which substances are present at X in higher concentrations than at Y?

A. Carbon dioxide and glucose
B. Carbon dioxide and urea
C. Glucose and oxgen
D. Glucose and urea

Blood in the placenta:
The diagram shows how the blood of a human embryo flows close to the mother's

<table>
<thead>
<tr>
<th>Nourishment</th>
<th>Oxygen</th>
<th>Progesterone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>I</td>
</tr>
<tr>
<td>B</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>C</td>
<td>II</td>
<td>I</td>
</tr>
</tbody>
</table>

Which of the following represents cestagen and progesterone?

The diagram below shows the structure of a flower:

- Attaching
- Stigma
- Anther

- Which statement correctly describes advantages of disadvantages of self-pollination?
D. It needs two plants of the same species but there is little variation in the
C. It needs a lot of pollen but this can happen even on its own
B. It needs no agent to transfer pollen but pollination is unlikely
A. It needs little pollen but there is a high chance of pollination

The graph below plots the rise and fall of primary and ovary hormones during

3. Which tierm correctly describes advantages of disadvantages of self-pollination?
28. How does meiosis contribute to each of the following processes listed below?

- Genetic variation
- Replacement of damaged cells
- Increase in cell number

Key:
- X = contributes to process
- □ = does not contribute to process

29. When do the following measurements of the curve represent?

- Distance between the centromeres and the poles of the spindle
- Distance between the centromeres and the distance between the telophase I of meiosis and the origin of the spindle

The graph shows three measurements obtained following meiosis of maize.
Sec 4 Bio T-SCHOOL

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22. Which of the following statements about voluntary muscles and their actions is INCORRECT?

- a) More exercise results in less ADH production.
- b) More exercise results in more ADH production.
- c) More exercise results in a decrease in blood pressure.
- d) More exercise results in an increase in blood pressure.

23. What is the function of the urinary system? Choose the correct option.

- a) Production of urine
- b) Regulation of water balance
- c) Regulation of blood pressure
- d) Regulation of blood glucose levels

24. The graph shows the change in arterial blood pressure during diastole. Which of the following best describes the graph?

- a) The pressure decreases linearly during diastole.
- b) The pressure increases linearly during diastole.
- c) The pressure decreases and then increases again during diastole.
- d) The pressure remains constant during diastole.

25. When all statements correctly describe a condition of regulation of blood pressure, choose the correct option.

- a) Blood pressure is high, causing contractions of the blood vessels.
- b) Blood pressure is high, causing relaxation of the blood vessels.
- c) Blood pressure is low, causing contractions of the blood vessels.
- d) Blood pressure is low, causing relaxation of the blood vessels.
14. The following five events occur during one cardiac cycle in humans:

- Event I: Blood is forced into the heart from the pulmonary veins.
- Event II: Blood is expelled from the heart to the lungs via the pulmonary arteries.
- Event III: Blood flows through the atria.
- Event IV: Blood is expelled from the heart to the body via the aorta.
- Event V: Blood is forced back into the heart from the systemic veins.

What is the correct sequence of these events?

A. I → II → III → IV → V
B. I → III → II → IV → V
C. V → I → II → III → IV
D. III → I → II → IV → V

15. The diagram below shows part of a section through a stem. What are the results expected from the test?

Key:
- + = positive result
- - = negative result

- Cell X
- Cell Y

16. The diagram shows two shoots at the start of an experiment on transpiration.

What is the reason for this?

A. Transpiration occurs only by diffusion.
B. Stomata may close in the leaf of shoot X.
C. Stomata in the leaf of shoot X cannot release water vapor.
D. Companion cells no longer produce sufficient energy.
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Which of the following characteristics of an enzyme is the diagram above trying to illustrate?

D. Only one of the reactions is enzymatically catalyzed.
E. Only two of the reactions are reversible.
F. All of the reactions are irreversible.

For question 6, the graph shows the relationship between concentration of enzyme and time. Given the graph, which of the following statements is not true about the region between points A and B?

A. Enzyme concentration is the limiting factor.
B. pH of the solution is the limiting factor.
C. Temperature is the limiting factor.

The table below shows the effect of the solutions on the reaction time. Which of the following solutions were used with a standard bacteria solution? The table below shows the results of the experiment.

<table>
<thead>
<tr>
<th>Solution</th>
<th>Time (min)</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution 1</td>
<td>3</td>
<td>Yellow</td>
</tr>
<tr>
<td>Solution 2</td>
<td>2</td>
<td>Blue</td>
</tr>
<tr>
<td>Solution 3</td>
<td>1</td>
<td>Green</td>
</tr>
<tr>
<td>Solution 4</td>
<td>4</td>
<td>Red</td>
</tr>
</tbody>
</table>

Four sugar solutions were used in the experiment:

- A: 0.05% reducing sugar
- B: 0.5% reducing sugar
- C: 1% reducing sugar
- D: 10% reducing sugar

What is the best representation of the results?

- A. The reaction time increases as the concentration of sugar decreases.
- B. The reaction time decreases as the concentration of sugar decreases.
- C. The reaction time is independent of the concentration of sugar.
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<table>
<thead>
<tr>
<th>Type of Sugar</th>
<th>Reaction</th>
<th>Reaction</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose + Water</td>
<td>Glucose + Water</td>
<td>Glucose + Water</td>
<td></td>
</tr>
</tbody>
</table>

The figure shows the themes of reactions in the human body involved in different processes.

<table>
<thead>
<tr>
<th>Concentration of Glucose (g/dl)</th>
<th>Reaction of A</th>
<th>Reaction of B</th>
<th>Reaction of C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.05</td>
<td>A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.10</td>
<td>A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.15</td>
<td>A</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Which is the correct concentration of Solution A and Z respectively?

- Solution A: 0.05 g/dl
- Solution Z: 0.10 g/dl

A few leaves of simple palisade were placed in a beaker of water for 15 minutes.

A few leaves of simple epidermis were placed in a beaker of water for 15 minutes.

A few leaves of simple palisade were placed in a beaker of 1.00 M NaCl solution.

A few leaves of simple epidermis were placed in a beaker of 1.00 M NaCl solution.

Stomata are open in the guard cells.

Stomata are closed in the guard cells.

Which of the following correctly identifies substances A and B and the respective processes?

- Substance A: Water
- Substance B: Water
The diagram is a photomicrograph which shows some human blood cells. Which of the following can be observed in these cells?

A. 1, 3, and 5
B. 3 and 4
C. 2 and 5
D. 2 and 4

The following question is about the surface area to volume ratio of cells. Which of the following factors contributes to an increase in this ratio?

A. The cells become smaller in size
B. The cells become larger in size
C. The cells increase in number in the bone marrow
D. The cells increase in number in the bone marrow and decrease in surface area to volume ratio.

The diagram shows a plant cell. Which of the following is an adaptation of these cells?

- Photosynthesis
- Respiration
- Transpiration
- All of the above

**Information for Candidates:**

**Sheet**

Each question is worth 1 mark. Marks will not be deducted for wrong answers.

**Instructions to Candidates:**

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

- Level: Secondary 4 Express
- Subject: Biology (5195)
- Paper I
- Date: 28 Aug 2015

**ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATIONS 2015**