



2016
Higher School Certificate
Trial Examination

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your student number and/or name at the top of every page

Total marks – 100

Section I

75 marks

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21–32
- Allow about 1 hour and 40 minutes for this part

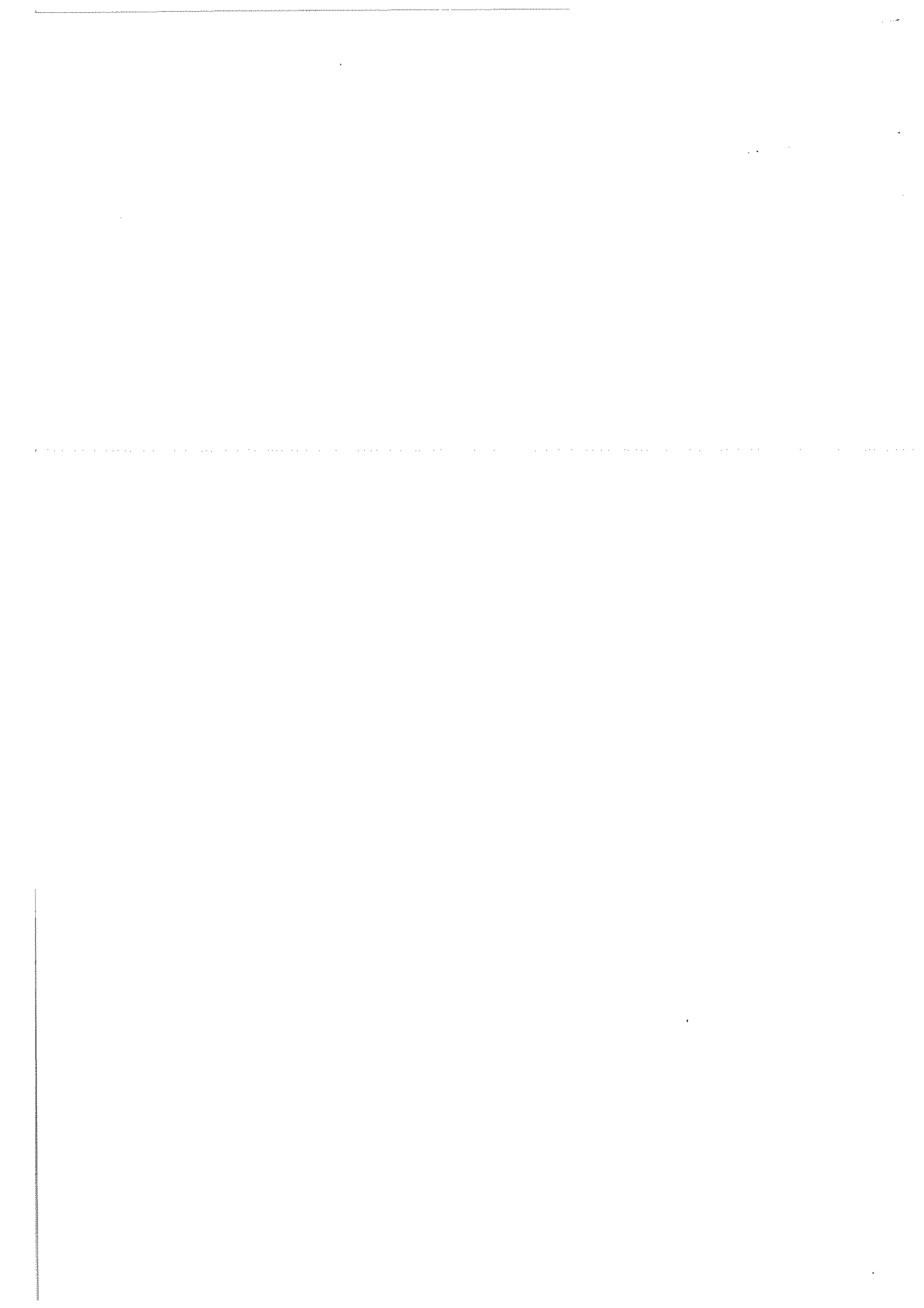
Section II

25 marks

- Attempt ONE question from Questions 33–37
- Allow about 45 minutes for this section

This paper MUST NOT be removed from the examination room

STUDENT NUMBER/NAME:



STUDENT NUMBER/NAME:

Section I

20 marks

Attempt Questions 1–20

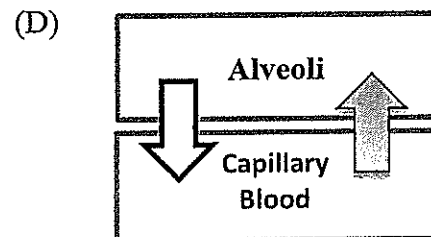
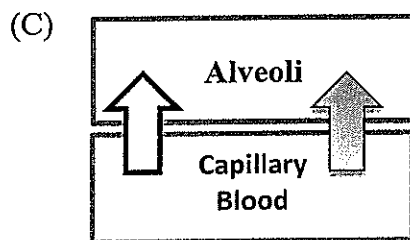
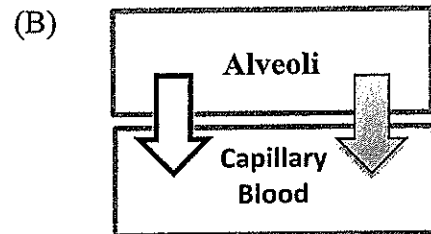
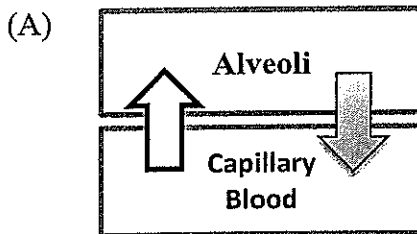
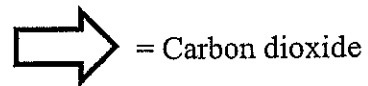
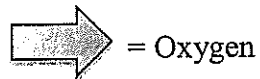
Allow about 35 minutes for this section



- 1 Which of the following correctly matches a product extracted from donated blood with its use in treating patients?

	<i>Blood product</i>	<i>Clinical use</i>
(A)	Human albumen	Chemotherapy
(B)	Red cells	Help boost blood volume
(C)	Granulocytes (white cells)	To prevent Rhesus disease in newborns
(D)	Erythrocytes	Transport oxygen

- 2 Which diagram represents the exchange of gases in capillary blood as it passes by the alveoli?



- 3 Which of the following correctly compares the responses of an Australian endotherm and ectotherm to *changes* in ambient temperature?

	<i>Australian endotherm</i>	<i>Response</i>	<i>Australian ectotherm</i>	<i>Response</i>
(A)	<i>Central netted dragon</i>	Alters body position to expose either its pale front or its dark back to the sun to increase or decrease heat absorption	Bent-wing bat	Hibernates during cold periods
(B)	<i>Kangaroo</i>	Licks forearms in hot weather. The evaporating saliva cools blood in the vessels just under the skin	King brown snake	Basks in the sun to increase body temperature
(C)	<i>Fairy penguin</i>	Lifts feathers away from the skin to create an insulating layer	Saltwater crocodile	Has thick, scaly skin
(D)	<i>Death adder</i>	Hibernates during the colder months	Bogong moth	Hibernates in cool caves during hot weather

- 4 *Lactase* is an enzyme that catalyses the breakdown of *lactose*, a sugar found in milk. Lactase does **not** catalyse the breakdown of *sucrose*, another sugar found in a range of foods.

Which is the best explanation for why lactase does **not** have the same effect on sucrose?

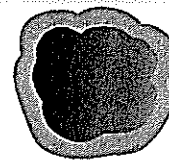
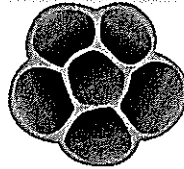
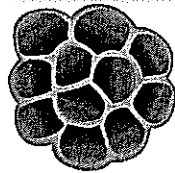
- (A) The pH of milk is different to the pH of foods that contain sucrose.
 (B) Lactase only functions at colder temperatures.
 (C) The lactase is denatured by the sucrose.
 (D) Enzymes only function with specific substrates.

- 5 As part of your study you were required to perform a *first-hand investigation* to test the effect of changes in pH on the activity of a named enzyme.

Which response below correctly lists **only** factors to be controlled in such an experiment?

- (A) pH, size of test tube, time allowed for reaction
- (B) Size of test tube, pH, substrate concentration
- (C) Amount of enzyme, temperature of experiment, substrate concentration
- (D) Amount of enzyme, time allowed for reaction, amount of enzyme activity

- 6 Examine the diagrams below which show three different human *alveoli*.



A: Normal alveoli

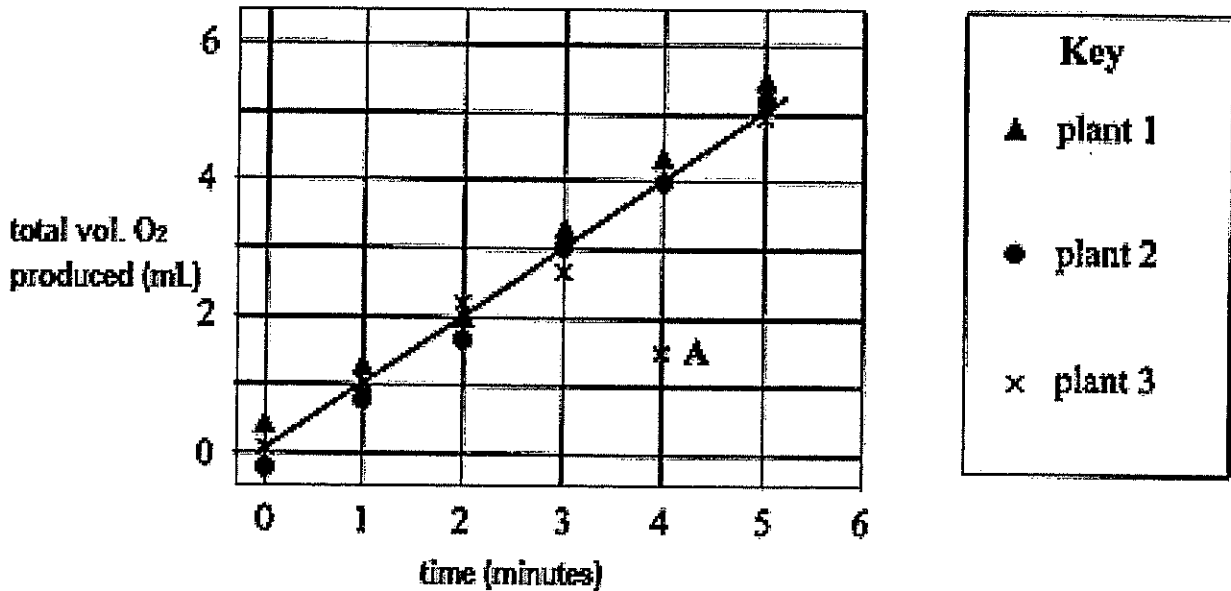
B: Enlarged alveoli

C: Collapsed alveoli

Which of the following statements is correct of these three diagrams?

- (A) The efficiency of exchange of gases in A, B and C is the same.
- (B) The efficiency of exchange of gases across the walls of the alveoli in A will be greater than in B, because in A each alveolus has a larger surface area per volume.
- (C) The efficiency of exchange of gases in B will be greater than in A, because the total volume of all the alveoli in B is greater than in A.
- (D) The efficiency of exchange of gases in C will be greater than in A or B because C has the largest volume per alveolus.

- 7 Refer to the graph, which shows the total volume of oxygen produced by three plants during an investigation.



The measurements for all three plants were taken at the same time of day during the investigation.

Point A, shown on the graph, is most likely the result of which of the following?

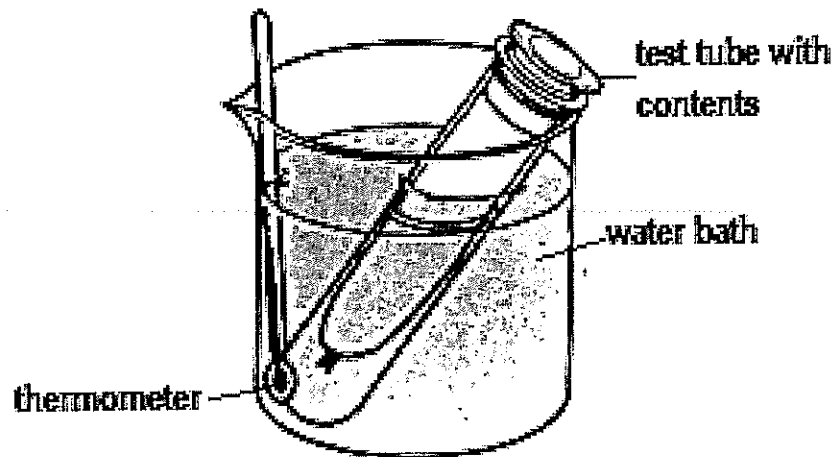
- (A) A random error when measuring the independent variable
 - (B) A systematic error when measuring the independent variable
 - (C) A systematic error when measuring the dependent variable
 - (D) A random error when measuring the dependent variable
- 8 A student was asked to determine if a sample of sausage meat contained any bacteria. A 10 % sample was removed from a large sausage, ground up and carefully spread over different nutrient agar plates ready for incubating. After analysis, the agar plates were boiled and discarded.

Which of the following statements is correct concerning this test?

- (A) It is destructive because a sample was removed and discarded.
- (B) It is non-destructive because the amount of sample tested was very small.
- (C) It is non-destructive because the sample removed was not living.
- (D) It is destructive because the sausage was found to be contaminated and discarded.

- 9 A student set up an experiment to test the effect of pH on the action of the enzyme pepsin. Pepsin is an enzyme that is found in the human stomach. Pepsin catalyses the breakdown of protein (e.g. in egg white) into amino acids, as shown by *coagulation* (forming a thickened mass). The apparatus the student used to test solutions is shown below. Various combinations of egg white, pepsin and acid were placed in a test tube in five different beakers. Temperature was set (0°C and 30°C) with a water bath and thermometer.

Data collected was placed in the table shown below.



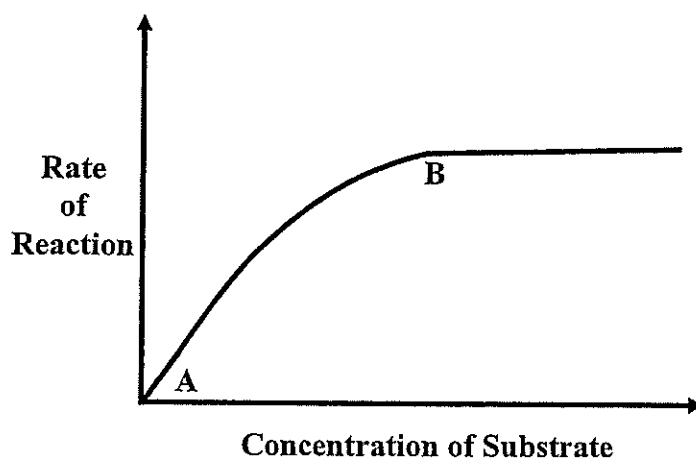
Apparatus	Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
Egg white	5 mL	5 mL	5 mL	5 mL	1 mL
Pepsin	5 drops	5 drops	No pepsin	5 drops	5 drops
Acid (HCl)	4 drops	4 drops	4 drops	No acid	No acid
Water bath temperature	30°C	0°C	30°C	30°C	30°C

Resulting *coagulation* only occurred in the test tube in beaker 1.

Which two beakers support the hypothesis that the *acid* caused the egg white to coagulate?

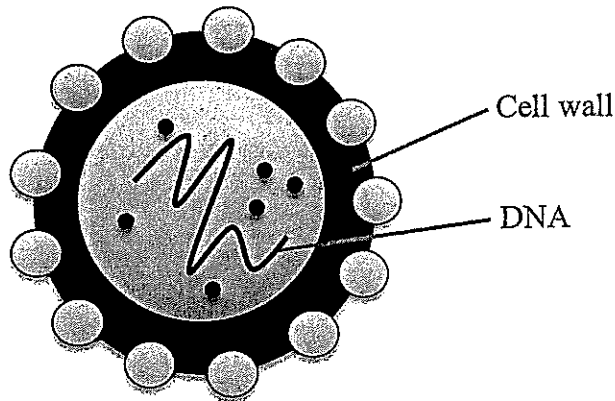
- (A) Beaker 1 and Beaker 4
- (B) Beaker 2 and Beaker 4
- (C) Beaker 1 and Beaker 2
- (D) Beaker 1 and Beaker 5

- 10 Examine the graph of rate of reaction, due to a substrate and enzyme.



- Which is the best explanation for the trend after Point B on the graph?
- (A) All the substrate has been used in the reaction.
 - (B) The greater the substrate concentration, the faster the rate of reaction.
 - (C) All the enzyme available is being used in the reaction.
 - (D) The reaction cannot go any faster unless substrate concentration is increased.
- 11 Which scientist conducted a notable experiment with a “swan-necked flask” to hypothesise that microbes were the cause of food spoilage and some diseases?
- (A) Walter Sutton
 - (B) Howard Florey
 - (C) Frank Macfarlane Burnet
 - (D) Louis Pasteur
- 12 Which of the following is a *chemical* defence barrier, to prevent the entry of pathogens into humans?
- (A) White blood cells
 - (B) Mucous membranes
 - (C) pH of skin
 - (D) Cilia of the trachea

- 13 A diagram of a potential pathogen found in the blood is shown.

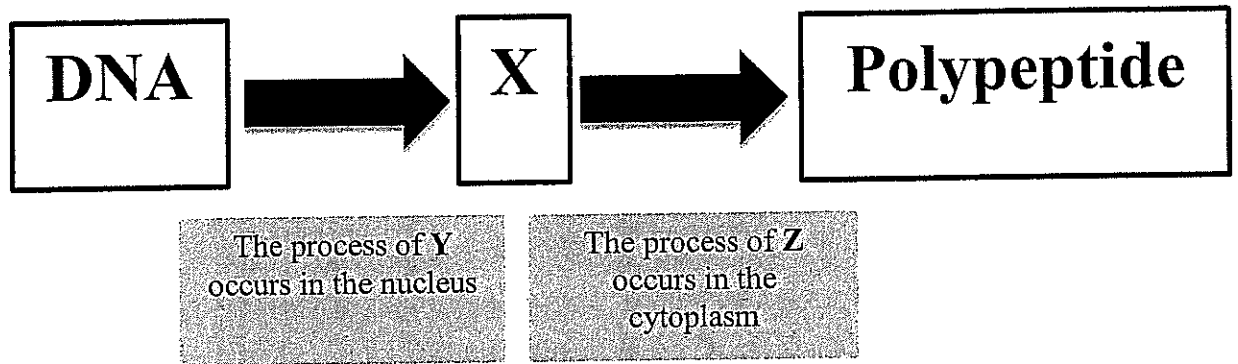


Based on the information in the diagram, the potential pathogen is most likely which of the following?

- (A) Virus
 - (B) Bacterium
 - (C) Protozoan
 - (D) Fungus
- 14 Which method would be the most efficient way of treating a large volume of drinking water, to reduce the risk of infection from pathogens?
- (A) Chemically treating the water with chlorine
 - (B) Chemically treating the water with fluorine
 - (C) Filtering the water and adding a small amount of salt
 - (D) Heating the water beyond 100° C
- 15 Which statement best describes the *inflammation* response in humans?
- (A) Excess production of mucous at a site of infection in the respiratory tract.
 - (B) Vasoconstriction to reduce blood flow to a site of infection.
 - (C) Cell death to seal off pathogens at a site of infection.
 - (D) Swelling and increased temperature at a site of infection.

- 16 Mendel's experiments on inheritance were thought to be successful, because of which of the following factors?
- (A) Mendel was known in scientific circles.
 - (B) Mendel chose characteristics on different chromosomes.
 - (C) Mendel published in a well-known journal.
 - (D) Mendel used artificial fertilisation to control the breeding of plants.
- 17 Which of these scientists' experiments best shows the *mutagenic* nature of radiation?
- (A) Walter Sutton
 - (B) Theodor Boveri
 - (C) George Beadle
 - (D) Alfred Wallace
- 18 What is a section of DNA responsible for coding for a particular characteristic known as?
- (A) Allele
 - (B) Gene
 - (C) Chromosome
 - (D) Base pair

- 19 The diagram below shows a summary of polypeptide synthesis:



Which option below correctly labels X, Y and Z?

	X	Y	Z
(A)	tRNA	Translation	Transcription
(B)	mRNA	Translation	Transcription
(C)	tRNA	Transcription	Translation
(D)	mRNA	Transcription	Translation

- 20 In a species of bird, homozygous individuals have either grey or black feathers. However, when a heterozygous offspring is produced, their feathers are 'speckled', with both black and grey feathers present.

Which is the inheritance of feather colour in this species of bird an example of?

- (A) Dominant-recessive inheritance
- (B) Incomplete dominance
- (C) Co-dominance
- (D) Sex-linked inheritance

Section I (continued)

Part B – 55 marks

Attempt Questions 21–32

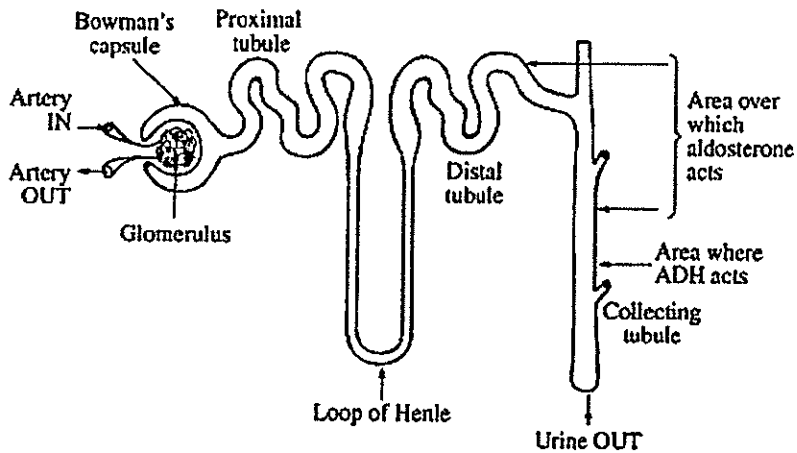
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided.

Question 21 (6 marks)

Marks

The nephron is the functional unit of the kidney and helps mammals to excrete waste products and maintain appropriate concentrations of dissolved ions.



- (a) Using examples, explain why BOTH *active* and *passive* processes are needed in the nephron.

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Question 21 continues on the next page



Question 21 (continued)

Marks

- (b) Explain why *removal of wastes* is needed for continued metabolic activity. 2

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Question 22 (3 marks)

As part of your course, you were required to perform a *first-hand investigation* to draw transverse AND longitudinal sections of xylem AND phloem tissue.

- (a) Outline ONE safety precaution you took during this investigation. 1

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- (b) DRAW and LABEL a diagram of a *transverse* section of xylem AND phloem tissue. 2

Question 23 (5 marks)

Marks

- (a) As part of your study, you analysed second-hand data on a non-infectious disease. Identify the non-infectious disease you studied. **1**

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- (b) In a table, outline the occurrence, symptoms, cause, treatment/management of your stated non-infectious disease. **4**

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Question 24 (3 marks)

Marks

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The chromosomal determination of sex is the same in fruit flies as it is in humans.

Wild fruit flies have red eyes, but a white eyed variation exists which occurs almost exclusively in males. The allele for white eyes is recessive and is carried on the X chromosome.

Explain, with the aid of appropriate diagrams, how it would be possible for a female fruit fly with white eyes to arise.

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Question 25 (2 marks)

Marks

2

Predict the phenotypes of the offspring of a cross between this female and a red-eyes male.

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Question 26 (6 marks)

Marks

During the 'Blueprint of Life' module you learnt that Francis Crick, Rosalind Franklin, James Watson and Maurice Wilkins were involved in finding the structure of the DNA molecule.

- (a) Outline the nature of each scientist's work AND its relative importance in the discovery of the structure of DNA.

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- (b) *It is an often held belief that the quality of communication and collaboration between these scientists impacted their scientific research.*

Justify this belief, focusing on the contributions by Rosalind Franklin.

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Question 27 (5 marks)

Marks

- (a) In HIV (AIDS) infection the helper T cells cease to function.

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Describe how this will affect the immune response.

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Question 28 (5 marks)

Marks

The table shows results of the analysis of urine samples of four native Australian animals.

<i>Organism</i>	<i>Bogong Moth</i>	<i>Bilby</i>	<i>Golden Perch (freshwater fish)</i>	<i>Bass Groper (saltwater fish)</i>
Urine Concentration	High	High	Low	High
Type of nitrogenous waste produced	Uric acid	Urea	Ammonia	Ammonia

Using the information in the table, explain the differences in the type of nitrogenous waste AND the concentration of urine produced by each animal.

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Question 29 (5 marks)

Marks

In order for a species to survive in a changing environment, the gametes produced should show variation.

- (a) Identify the TWO ways that variation is introduced into gametes during *meiosis*.

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- (b) In the space below, DRAW a series of labelled diagrams to demonstrate how ONE of the above ways introduces variation.

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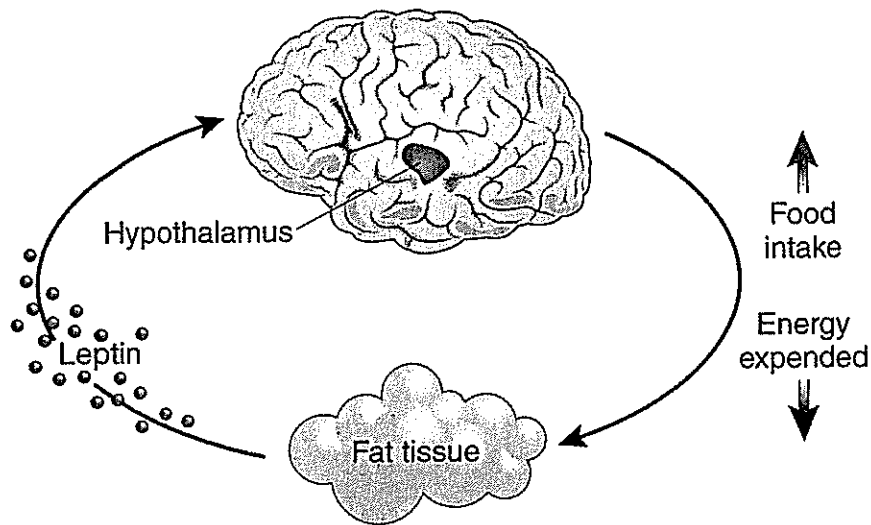
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Question 30 (4 marks)

Marks

Scientists have discovered two hormones in the body (leptin and ghrelin) that regulate appetite to achieve *homeostasis*. Leptin decreases hunger and ghrelin increases hunger.

Leptin is the signal in a negative feedback loop that maintains homeostatic control of fat tissue.



(a) Explain what is meant by a *negative feedback* system.

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(b) Justify the use of *models*, such as the one shown above, to explain biological activities in the human body.

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Question 32 (5 marks)

Marks

Use the Darwin/Wallace Theory of 'natural selection' to explain the increasing numbers of antibiotic-resistant bacteria AND how this knowledge can be used to reverse this resistance trend.

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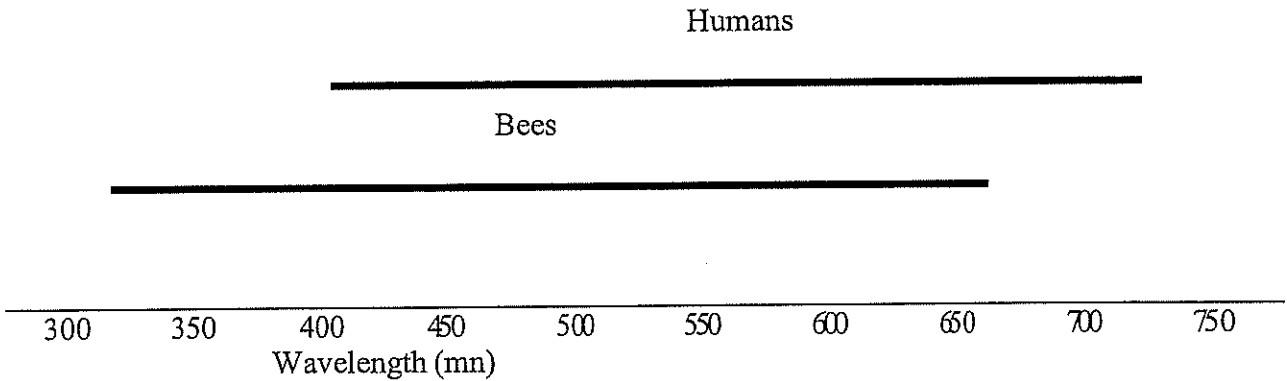


Section II**25 marks****Attempt ONE question from Questions 33–37****Allow about 45 minutes for this section**

Answer parts (a) – (f) of one of the questions in the Section II writing Booklet. Extra writing booklets are available.

	Pages
Question 33 Communication	24 - 25
Question 34 Biotechnology	26
Question 35 Genetics: The Code Broken?	27 – 29
Question 36 The Human Story	30 – 32
Question 37 Biochemistry	33 - 34

(a) Below is a diagram showing the ranges of electromagnetic radiation detected by both humans and bees.



Distinguish between the frequency of light detected by humans to that detected by bees. 2

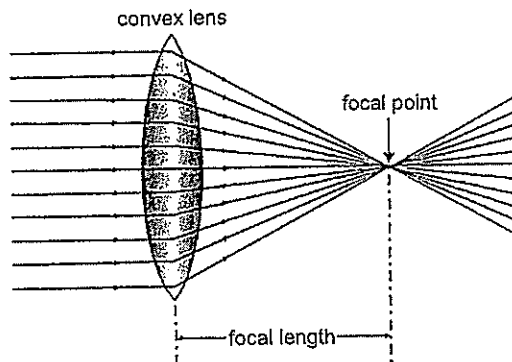
(b) Construct a flow diagram using the following: 2

- messenger,
- stimulus,
- effector,
- receptor,
- response.

(c) Identify the meaning of the term *accommodation* and describe how it is achieved in visual communication. 5

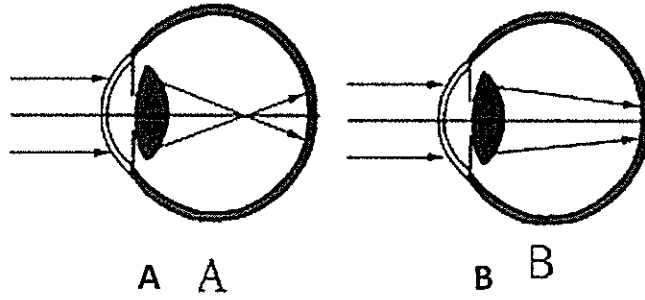
(d) Explain the cause of colour blindness in humans. 2

(e) During your study you were required to conduct a *first-hand investigation* using convex lenses of different focal lengths, to model the process of accommodation in the mammalian eye.



Assess the value of this investigation in providing a model of accommodation in the eye. 3

- (f) Observe the following images representing the passage of light as it enters the human eye. In both instances the person's vision will be blurred.



Analyse the diagrams and explain how both conditions affect vision. In your answer discuss how technology can be used to correct a **named condition** of the eye

7

- (g) (i) Outline the function of FOUR named *structures* of the human eye. 4

End of question 33

Question 34 – Biotechnology (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) Outline the function of RNA. 3
- (b) Using a named example, outline how greater knowledge of science has led to a change in traditional methods of fermentation. 4
- (c) (i) Outline the steps in the extraction process of DNA from a named source. 2
- (ii) How could the final product be identified as DNA? 1
- (iii) Describe how a specific gene from extracted DNA could be amplified. 2

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) Analyse the contribution that ONE of the following applications has made to medicine. 6
- tissue engineering
 - gene delivery by nasal sprays
 - production of a synthetic hormone
- (e) The domestication of seeds produced the most cultural change in human history, transforming most human societies from hunter gatherers to permanent settlements anchored by agriculture.
- (i) Outline how the collection of seeds could be seen as an early example of biotechnology. 1
- (ii) Using your knowledge of the domestication of one plant or animal species, evaluate relevant ethical issues raised by the use of current biotechnology. 6

Question 35 – Genetics: The Code Broken?

(25 marks)

Marks

(a) Distinguish between *gametic* and *somatic* cells. 2

(b) In the early 1900s, Bateson and Punnett studied inheritance in the sweet pea plant. They studied the inheritance of two genes:

- flower colour (*P*, purple, and *p*, red)
- shape of pollen grain (*L*, long, and *l*, round).

They crossed pure lines *PPLL* (purple, long) × *ppll* (red, round). In the F1 generation all offspring had purple flowers and long pollen grains. These offspring were then crossed with the expectation that the Mendelian ratios would occur.

- (i) Construct a Punnett square to show the phenotypic ratios that would have been obtained if these genes showed typical Mendelian dihybrid inheritance. 2
- (ii) The table shows the actual results that Bateson and Punnett obtained.

<i>Phenotype</i>	<i>Number of offspring</i>
Purple, long	4831
Purple, round	390
Red, long	393
Red, round	1338
Total number of offspring	6952

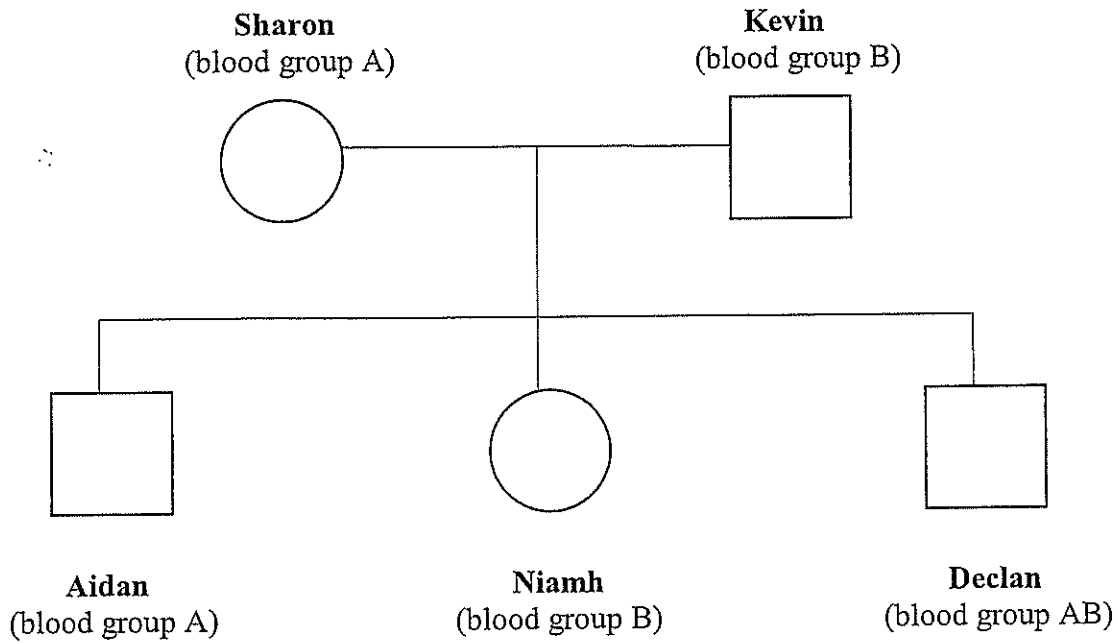
Explain how the results of cross-breeding experiments could be used to identify the relative positions of genes. 3

(c) Explain what is meant by gene linkage. 2

(d) The following are the 3 different alleles for ABO blood group antigens, and a list of possible genotypes for each blood group.

<i>Allele</i>	<i>Antigen</i>	<i>Phenotype</i> <i>(blood group)</i>	<i>Genotype</i>
I^A	Antigen A	A	$I^A I^A$ or $I^A i$
I^B	Antigen B	B	$I^B I^B$ or $I^B i$
$I^A I^B$	Antigen A and B	AB	$I^A I^B$
<i>i</i>	No antigen	O	<i>ii</i>

The pedigree below shows the blood groups of a typical family.

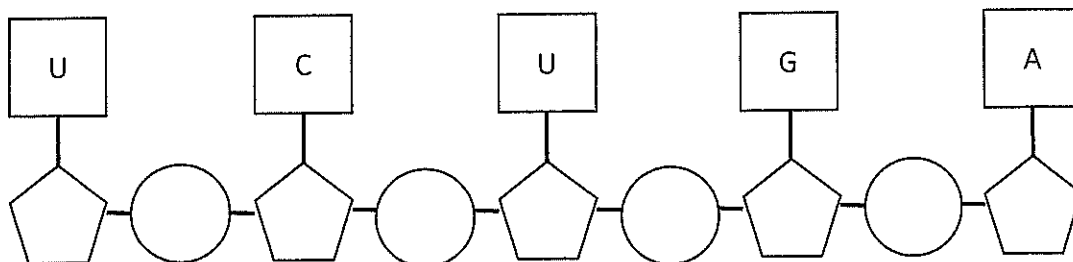


(i) Draw a Punnett square, or another appropriate technique, to explain this pattern of inheritance AND give the genotype of each parent and child. Copy the table below into the writing booklet. 4

Sharon:	Aidan:
Kevin:	Niamh:
	Declan:

(ii) What is the probability that Sharon and Kevin could have another child with blood group O? 1

(e) The diagram below shows a section of messenger RNA molecule.



- (i) Give the sequence of bases on the template strand of DNA from which this mRNA molecule was transcribed. 1
- (ii) During your study of Genetics: The Code Broken you have constructed a model of DNA. Assess the value of this model. 3
- (f) Using named examples, analyse the process of selective breeding AND whole organism cloning. In your answer, discuss the effectiveness of BOTH process. 7

Question 36 – The Human Story (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) Outline the features used to identify humans as the species *Homo sapiens*. 3

(b) ^{14}C can be used for dating fossils. Its half life is approximately 5750 years. 4

Compare this method for dating with another dating technique.

(c) This table outlines human population growth.

<i>Human Population</i> (billions)	<i>Year</i>	<i>Time Span</i> (years)
1	1830	50 000
2	1930	100
3	1960	30
4	1975	15
5	1989	14
6	1999	10
7	2011	12
8 (predicted)	2025	14
9 (predicted)	2045	20

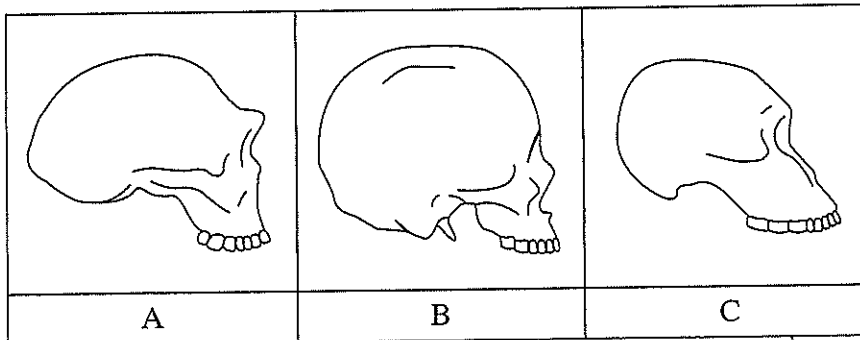
- (i) What trends in human population growth do the data illustrate? **2**
- (ii) Outline specific examples of technology that could explain the growth rate of the human population before and after 1999. **3**

Question 34 continues on page 29

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) Analyse the impact of cultural development on human evolution. 6

(e) Different hominid skulls are illustrated.



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Hominin Evolution.
Nature Education
Knowledge 3(10):8,
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(i) Place the hominid skulls in order from the oldest to the youngest. 1

(ii) Explain how molecular analysis has 'changed scientists' opinions about primate classification. In your answer, include specific examples. 6

End of Question 34

12
7

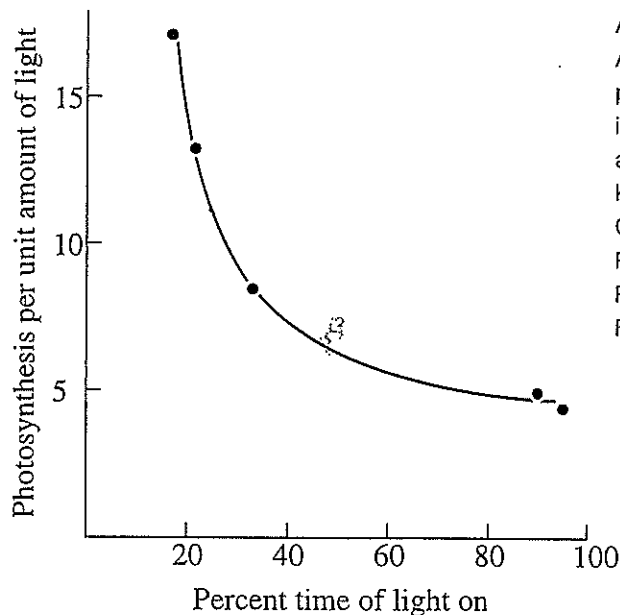
Question 37 – Biochemistry. (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) Outline the roles of the coenzymes in the light reactions. 3
- (b) Describe an experiment to identify the pigments in leaves. 4
- (c) Emerson and Arnold (1932) measured the amount of photosynthesis caused by a flashing light rather than by a continuous light. They kept the temperature constant, the levels of CO₂ high, and the intensity of the flashing light constant.

They measured the effect on photosynthesis if they changed the percentage of time for each light flash but still kept the light flashing at 50 times per second.

The curve shows the relationship between percent time of illumination and yield of photosynthesis per unit amount of light.



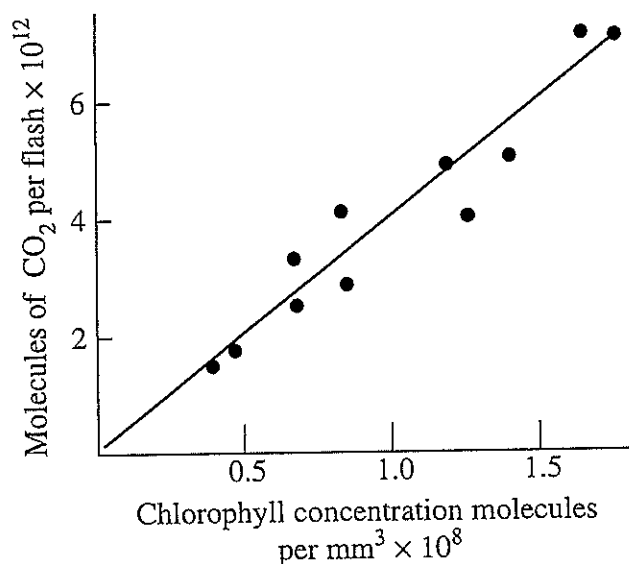
Acknowledgement :
A separation of the reactions in photosynthesis by means of intermittent light by Robert Emerson and William Arnold. From the Kerckhoff Laboratories of Biology, California Institute of Technology, Pasadena, The Journal of General Physiology, March 14, 1931, Figure 2, page 195

- (i) What would you predict would happen to photosynthesis per unit of light if continuous light rather than flashing light were used in this experiment? 1

Question 35 continues on page 31

(ii) The following data were obtained by Emerson and Arnold.

4



Acknowledgement :
A separation of the reactions in photosynthesis by means of intermittent light by Robert Emerson and William Arnold, From the Kerckhoff Laboratories of Biology, California Institute of Technology, Pasadena, The Journal of General Physiology, March 14, 1931, Figure 2, page 195

The figure shows the concentrations of chlorophyll in molecules per mm³ of cells plotted against molecules of carbon dioxide used per flash of light at saturation, at 25°C.

Outline how the experiments of Emerson and Arnold led to Gaffron and Wohl concluding the presence of a photosynthetic unit.

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) Analyse how the use of isotopes has contributed to tracing biochemical pathways. 6
- (e) (i) Identify the products of photosynthesis. 1
- (ii) Explain how photosynthesis could be used to help solve THREE named environmental issues. 6

End of paper

Biology

Section I Part A - Multiple Choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
 A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

A B C D
 correct

Start Here →

1 A B C D

2 A B C D

3 A B C D

4 A B C D

5 A B C D

6 A B C D

7 A B C D

8 A B C D

9 A B C D

10 A B C D

11 A B C D

12 A B C D

13 A B C D

14 A B C D

15 A B C D

16 A B C D

17 A B C D

18 A B C D

19 A B C D

20 A B C D

