



The Victorian  
Institute of  
Learning

# VCE Unit 3 & 4 Biology

Trial Examination 2019

Question and Answer Booklet

Student Name: \_\_\_\_\_

Teacher Name: \_\_\_\_\_

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

Section	Number of Questions	Number of Marks
A	40	/40
B	10	/80
Total		/120

**Students are permitted** to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

**Instructions**

Write your name and your teacher's name in the space provided above on this page.

Unless otherwise indicated, the diagrams in this booklet are not drawn to scale.

All written responses must be in English.

You may keep the data booklet.

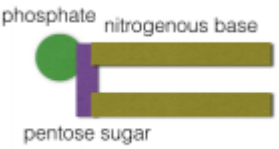
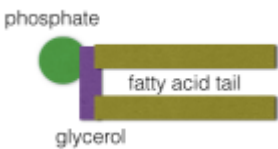
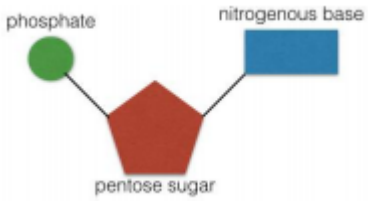
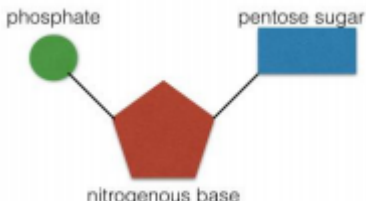
Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

Students are reminded that this is a trial examination only and can not guarantee the content or format of the 2018 VCAA Examination

## Section A: Multiple choice Questions

### Question 1

Which of the following best represents the structure of a nucleotide?

- a) 
- b) 
- c) 
- d) 

### Question 2

Which of the following couldn't be dated using radiocarbon dating?

- a) A tyrannosaurus rex bone
- b) A tree estimated by other means to be around 30,000 years old
- c) An Egyptian mummy
- d) A stone tool suspected of being used by early humans

### Question 3

Which of the following correctly matches the type of membrane protein with its function?

- |    |                        |  |
|----|------------------------|--|
| a) | Transmembrane proteins | Link cells together into three dimensional structures          |
| b) | Receptor proteins      | Regulate movement of substances across the membrane            |
| c) | Adhesion proteins      | Detect hormones  |
| d) | Recognition proteins   | Markers that enable to the body to identify the cell as 'self' |

#### Question 4

Arsenic in the form of arsenate is highly toxic to humans, its molecular structure is very similar to phosphate. The arsenate molecules are competitive inhibitors, which of the following is incorrect about competitive inhibitors?

- a) They can permanently exclude the intended substrate from the active site
- b) They alter the shape of the active site
- c) They take the place of the intended substrate
- d) They stop enzymes from performing their regular functions

#### Question 5

Jane wants to investigate the idea of utilizing the ethylene produced by ripening fruit to get unripe fruit to ripen quicker. Which of the following variables needs to be controlled for her experiment to produce reliable data?

- a) The size of the fruit
- b) The number of fruit present in the bowl
- c) The type of fruit being used
- d) The temperature at which the fruit is stored

#### Question 6

*Australopithecus afarensis* is a species of hominid which is thought to have lived from around 3-2.1 million years ago. In comparison to modern humans, *A. afarensis* have:

- a) A smaller brain
- b) Larger brow ridges
- c) Larger Canines
- d) Flatter faces

#### Question 7

Which of the following adaptations does not distinguish homo sapiens from other primates?

- a) Parabolic arrangement of teeth
- b) The loss of opposable toe
- c) Forward Facing eyes
- d) Position of foramen magnum at the base, rather than back, of the skull

**Question 8**

Which of the following enzymes is used in transcription?

- a) DNA Polymerase
- b) RNA Polymerase
- c) taq polymerase
- d) Pepsin

**Question 9**

Somewhere between 69,000 and 70,000 years ago, one of the largest volcanoes eruptions in Earth's history occurred in Sumatra, Indonesia. According to Toba catastrophe theory, this plunges earth into a winter of several years in length, killing off the vast majority of humans and so reducing the size of human population to just 15,000 individuals.

This reduction in size of population is an example of:

- a) Natural Selection
- b) The Founder Effect
- c) The Bottleneck Effect
- d) Allopatric speciation

**Question 10**

Which of the following processes enables the formation of multiple distinct polypeptides from a single gene sequence?

- a) Alternative splicing
- b) Capping
- c) Polyadenylation
- d) Transcription

**Question 11**

The molecule responsible for allergic reactions is:

- a) Histidine
- b) Histones
- c) Histamine
- d) Helicase

**Question 12**

Following an infection that stimulates the body's specific immune response, a memory is kept of the event for future defense. Where is the information kept?

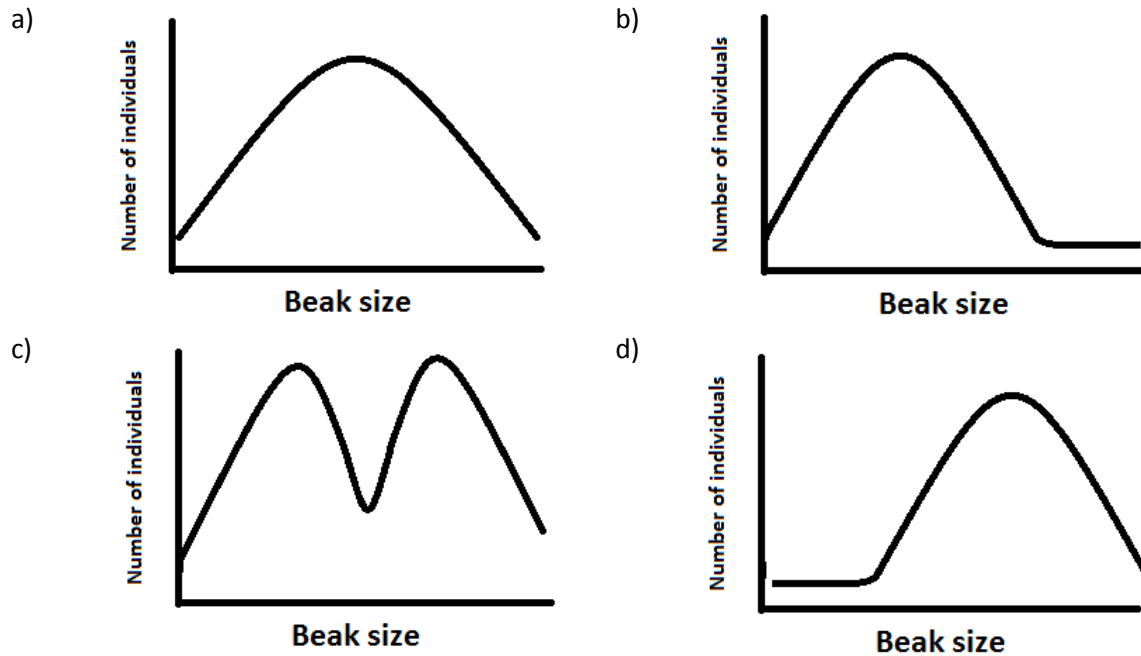
- a) In the Plasma B lymphocytes in the bone marrow
- b) In the memory B lymphocytes in the plasma membrane
- c) In the memory B lymphocytes in the bone marrow
- d) In the plasma B lymphocytes in the plasma membrane

*Use the following information to answer question 13 and 14*

On a small island in the Pacific there is a species of sparrow that all feed off of three different species of flowering bush. The size of the sparrow's beak varies greatly in this species and the size of the sparrows' beak is directly related to the size of flower they are able to feed off of. A disease was introduced to the island that affected only the species of bush with medium sized flowers.

**Question 13**

Which of the following graphs would represent the expected change in sparrow population?



**Question 14**

This type of selection can be described as

- a) Disruptive
- b) Directional
- c) Divergent
- d) Destructive

**Question 15**

Which of the following alterations to chromosome structure usually results in the least adverse effects?

- a) Duplications
- b) Translocations
- c) Deletions
- d) Inversions

**Question 16**

Which of the following is an example of a homologous structure?

- a) Carpal bones present in the wrist of a cat and a whale
- b) The eye of an invertebrate and the eye of a vertebrate
- c) Both sparrows and bats have wings
- d) Both crocodiles and alligators have long snouts

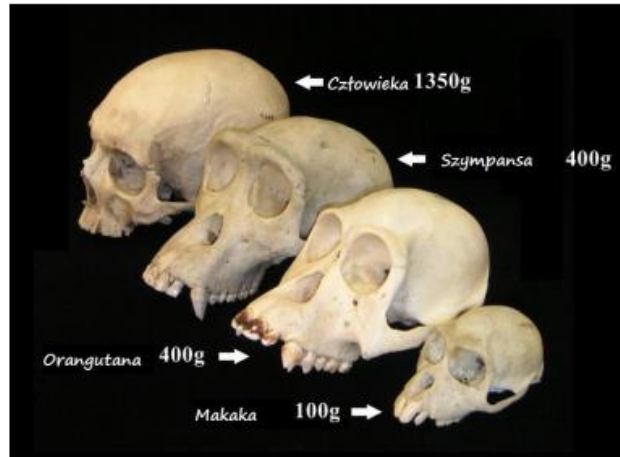
**Question 17**

There are approximately 10,000 pug dogs in Britain, however their gene pool only equates to that of about 50 individuals. This lack of genetic variation is due to:

- a) Natural selection
- b) Mutation
- c) Bottleneck Effect
- d) Artificial selection

### Question 18

Based on the image below, which of the following is not evidence of structural change that occurred during Hominid evolution?



Source: Wikimedia Commons

- a) Shorter and broader pelvis
- b) Flattening on face
- c) Enlargement of the frontal lobe proportional to the rest of the brain and an increase in the size of the cranial cavity
- d) Decreased prominence of the brow ridges

### Question 19

Which of the following is incorrect about the light dependent stage of photosynthesis?

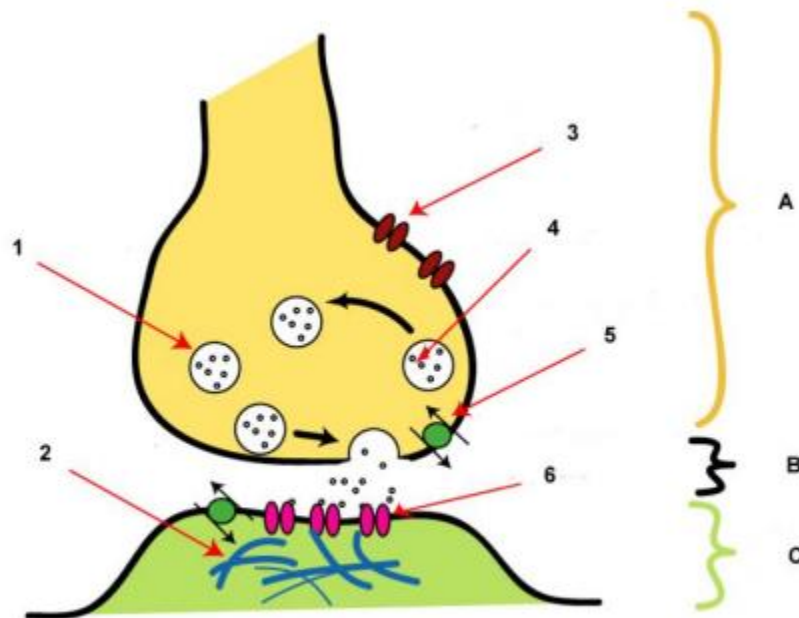
- a) Light and NADP are inputs
- b) Occurs in the stroma
- c) Oxygen is an output
- d) Water molecule are split

### Question 20

Which of the following best describes the order and location of the steps in aerobic respiration?

- a) Glycolysis in the cristae producing 2 ATP, Krebs cycle in the matrix producing 2 ATP and the electron transport chain in the cytosol producing 32 ATP
- b) Glycolysis in the matrix producing 2 ATP, Krebs cycle in the cytosol producing 2 ATP and the electron transport chain in the cristae producing 32 ATP
- c) Glycolysis in the cytosol producing 32 ATP, Krebs cycle in the matrix producing 2 ATP and the electron transport chain in the cristae producing 2 ATP
- d) Glycolysis in the cytosol producing 2 ATP, Krebs cycle in the matrix producing 2 ATP and the electron transport chain in the cristae producing 32 ATP

*Refer to the diagram below for questions 21-23*



Source: Wikimedia Commons

### Question 21

The region across which neurotransmitters diffuse is marked:

- a) 6
- b) B
- c) 1
- d) C



**Question 22**

Which of the following would occur if structure 3 was damaged and couldn't function?

- a) The neurotransmitters wouldn't be released from the vesicles
- b) The neurotransmitters wouldn't be able to cross the synapse
- c) The action potential would increase
- d) The neurotransmitter wouldn't bind to the receptor

**Question 23**

Fill in the gaps, enough of (A) \_\_\_\_\_ must bind to (B) \_\_\_\_\_ in order to be activated and for the message to continue electrically along the neuron.

- a) A:2, B:6, C:4
- b) A:4, B:2, C:4
- c) A:4, B:6, C:5
- d) A:4, B:6, C:2

**Question 24**

The section of chloroplast in which the light independent phase of the photosynthesis occurs is

- a) Granum
- b) Thylakoid membrane
- c) Stroma
- d) Chlorophyll

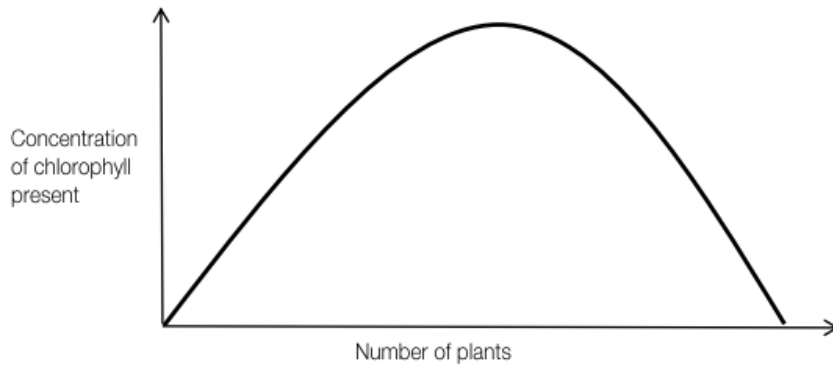
**Question 25**

If an onion skin cell was left in distilled water for 24 hours, the cell would?

- a) Become turgid
- b) Lyse
- c) Crenate
- d) Plasmolyze

**Question 26**

The graph below depicts the variation in chlorophyll levels of plant samples from a forest

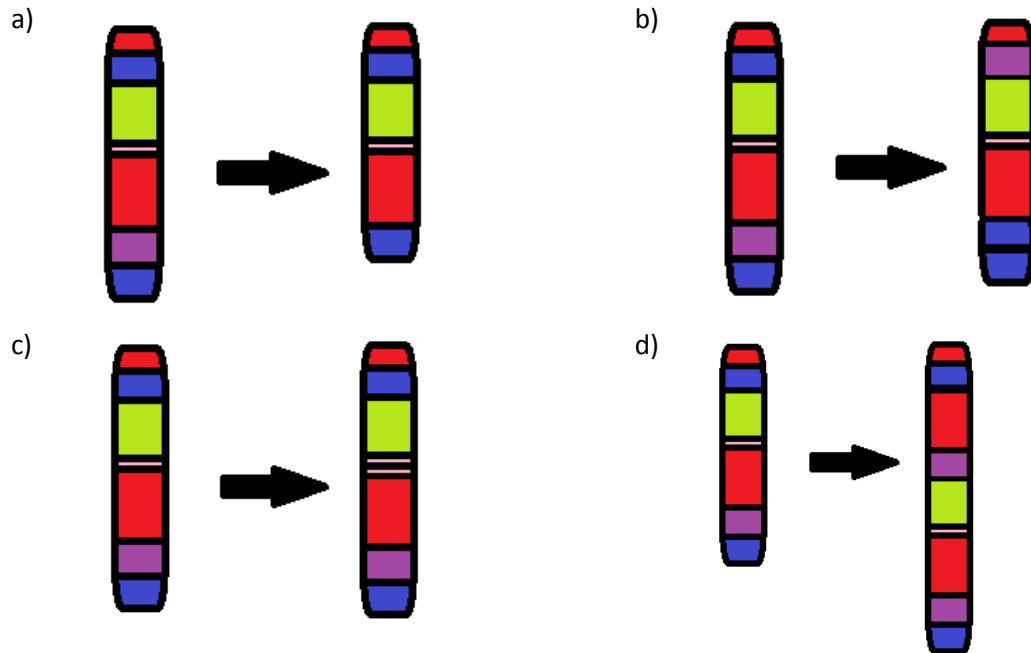


From the above information its concluded that concentration of chlorophyll in individual plants:

- a) Display continuous inheritance
- b) Display discontinuous inheritance
- c) is under control of one gene
- d) is under control of more than two alleles

**Question 27**

Which of the following images shows a translocation block mutation?



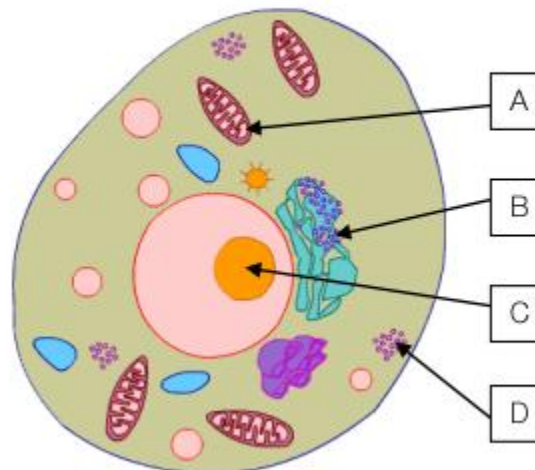
**Question 28**

Where do B Lymphocytes mature?

- a) thymus
- b) Liver
- c) Bone Marrow
- d) Blood stream

**Question 29**

The conversion of three carbon sugar molecules to ATP occurs in which organelle of the animal cell shown below:



- a) Organelle A
- b) Organelle B
- c) Organelle C
- d) Organelle D

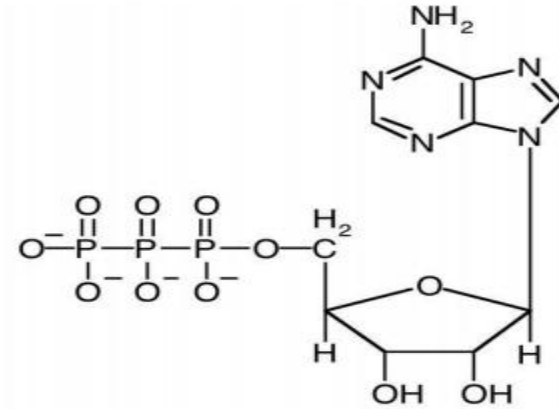
**Question 30**

A red blood cell was left in a concentrated salt solution for 24 hours. The cell would:

- a) become turgid
- b) Lyse
- c) Crenate
- d) Plasmolise

### Question 31

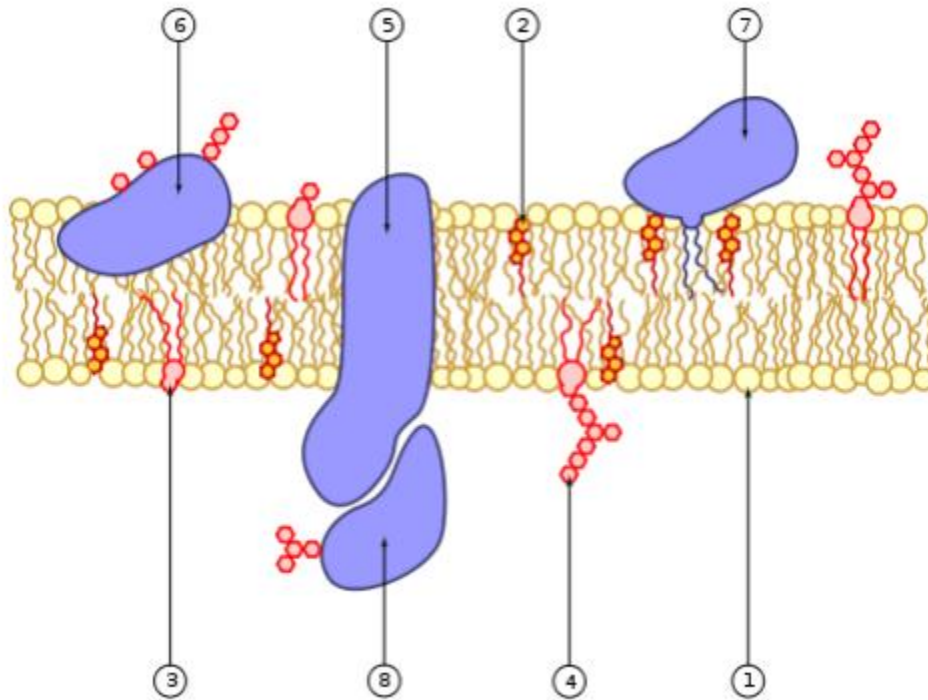
The image shown below is of an ATP molecule, When ATP is converted to ADP, energy is released , this is an example of ?



Source: Wikimedia Commons

- a) Catabolic reaction
- b) Anabolic reaction
- c) Condensation reaction
- d) Mutation

Refer the figure below to answer questions 32 and 33



Source: Wikimedia Commons

**Question 32**

An example of glycopospholipid is:

- a) 5
- b) 6
- c) 2
- d) 4

**Question 33**

Movement of small, steroid hormones created by a cell with this fluid mosaic model into the extracellular space could occur via:

- a) 5
- b) 7
- c) 1
- d) 4

**Question 34**

The smooth endoplasmic reticulum is responsible for:

- a) Synthesis of proteins
- b) packaging of proteins for export from the cell
- c) synthesis of lipids
- d) packaging of lipids for export from the cell

**Question 35**

The electron transport chain produces how many electrons?

- a) 32 or 34
- b) 36
- c) 36 or 38
- d) 32-34

**Question 36**

What are the products of anaerobic fermentation in a plant cell?

- a) Ethanol and lactic acid
- b) Lactic acid and carbon dioxide
- c) Carbon dioxide and ethanol
- d) Ethanol

**Question 37**

What is the name of the molecule that enters the mitochondrion to initiate the cellular transpiration?

- a) Glucose
- b) Pyruvate
- c) Pyruvic Fluid
- d) Glycogen

**Question 38**

Simple diffusion in plants is sufficient to account for

- a) absorption of water by root hairs.
- b) transport of potassium ions through protein channels in the cell membrane.
- c) the secretion of cellulose to form the cell wall.
- d) exchange of oxygen and carbon dioxide within the leaves.

**Question 39**

Which of the following cells of the immune system are primarily involved with the production of chemicals that destroy virus-infected cells?

- a) mast cells
- b) natural killer cells
- c) dendritic cells
- d) macrophages

**Question 40**

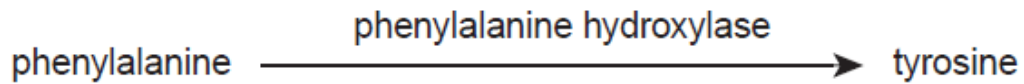
Fran is investigating the effect of surface on reaction rate of a particular enzyme, she will measure the reaction rate by collecting the gaseous products in balloons and then measuring their volume. What is the dependent variable in Fran's experiment?

- a) Reaction rate
- b) Surface area
- c) Volume of reactant
- d) Volume of gas produced

## Section B - Short Answer

### Question 1

Phenylketonuria (PKU) is an autosomal recessive disorder affecting 1 in 10 000 humans. If this condition is detected early in life it can be treated with diet modification to reduce the symptoms of the disorder. The intracellular biochemical reaction of the conversion of phenylalanine to tyrosine is shown below.



In sufferers of PKU, the enzyme phenylalanine hydroxylase (PAH) no longer functions due to a mutation in the gene coding for its synthesis. This leads to a build-up of phenylalanine which subsequently leads to the genetic disorder PKU.

- a) Where within a cell would PAH be synthesised?

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1 Mark

- b) Describe the steps involved in the transcription of the PAH gene.

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2 Marks



There are many different kinds of mutations that lead to variations in PAH. Each variation will lead to the symptoms of PKU. Generally, the greater the degree of difference between the normal PAH and the version formed from the mutated gene, the more severe the symptoms. The following DNA base sequence is from a template strand within the normal PAH gene.

**3' TTGATGCAC5'**

- c) Using the DNA strand above and the table of mRNA codons below, show how a single base substitution could lead to a different version of PAH.

2 Marks

		second base				
		U	C	A	G	
first base	U	UUU } phe UUC } UUA } leu UUG }	UCU } UCC } ser UCA } UCG }	UAU } tyr UAC } UAA } stop UAG }	UGU } cys UGC } UGA } stop UGG } trp	U C A G
	C	CUU } leu CUC } CUA } CUG }	CCU } CCC } pro CCA } CCG }	CAU } his CAC } CAA } gln CAG }	CGU } arg CGC } CGA } CGG }	U C A G
	A	AUU } ile AUC } AUA } AUG } met	ACU } ACC } thr ACA } ACG }	AAU } asn AAC } AAA } lys AAG }	AGU } ser AGC } AGA } arg AGG }	U C A G
	G	GUU } val GUC } GUA } GUG }	GCU } GCC } ala GCA } GCG }	GAU } asp GAC } GAA } glu GAG }	GGU } gly GGC } GGA } GGG }	U C A G

mutations that can cause a change in the normal form of PAH include

- single base substitution
- a single base deletion that codes for a stop signal.

d) Using the nine base sequence from the normal PAH gene as a starting point, give a DNA sequence that would illustrate a single base deletion coding for a stop signal.

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1 Mark

e) If the DNA base sequence from part c. was near the start of the template strand from the PAH gene, which type of mutation would be more likely to lead to more severe symptoms of PKU? Choose either a single base substitution or a single base deletion that codes for a stop signal. Explain your answer.

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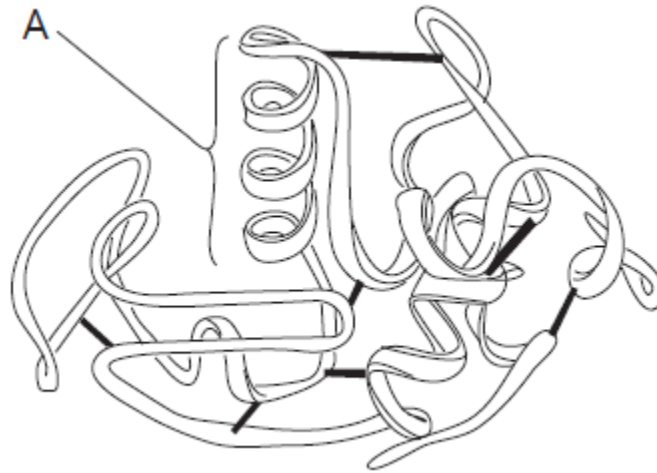
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2 Marks

## Question 2

Lipase is an enzyme that catalyses the hydrolysis of triglycerides. It is a soluble globular protein. The function of an enzyme depends upon the precise nature of its tertiary structure. The diagram below represents the structure of an enzyme. The black strips represent the disulfide bonds that help to stabilise its tertiary structure.



Region A in the above diagram is a secondary structure.

- a) What is this secondary structure called?

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1 Mark

- b) Explain why the function of an enzyme depends upon the precise nature of its tertiary structure.

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2 Marks

c) Describe the effect of breaking the bonds between the R groups of the amino acids of the protein on lipase function.

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2 Marks

### Question 3

Apple farmers often use artificial environments to ensure their apples are available to consumers all year round. One such method is to accelerate fruit ripening by exposing large quantities of apples to a specific set of conditions.

An experiment was carried out to test the effect of varying the levels of a plant hormone ethylene on apple ripening when exposed to different temperatures. Testing was conducted in aluminium containers that had 100 equally sized unripe apples placed in them. The internal environment of the aluminium containers could be altered by adding or removing factors in the air by an inlet and outlet valve.

The apples were considered ripe when two apples could be consecutively removed and deemed ripe by tasting them for sweetness as well as looking at their colour. Results of such an experiment are outlined in the table below.

<b>Ethylene concentration (ppm)</b>	<b>Temperature (°C)</b>	<b>Time taken for apples to ripen (hours)</b>
0	20	200
1	20	150
2	20	100
50	20	75
150	20	30
500	20	30
500	5	100

- a) List one strength in the experimental design.

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1 Mark

b) List one weakness in the experimental design.

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1 Mark

c) Use the experimental results to describe the optimal conditions you would recommend to apple farmers for fast fruit ripening.

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2 Mark

d) Describe the accuracy and precision of the data collected

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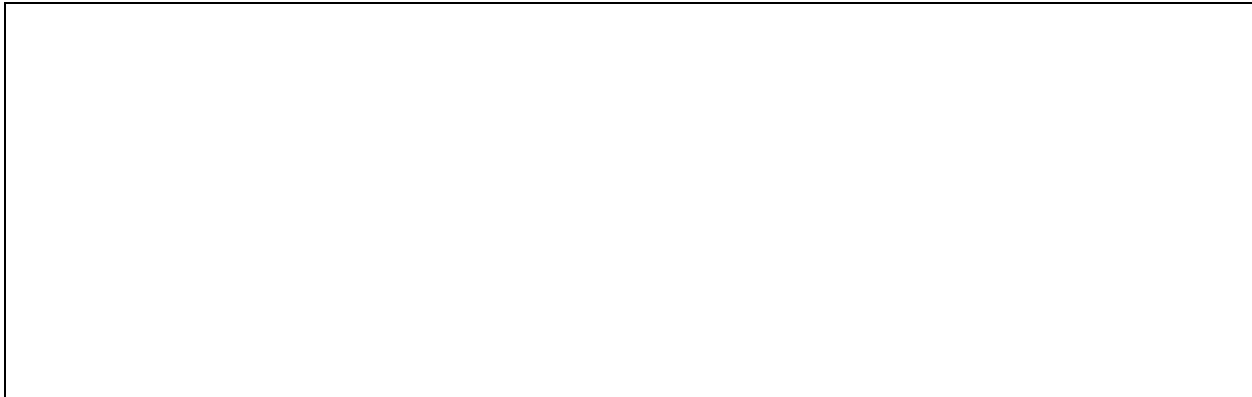
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3 Mark

**Question 4**

There have been major concerns about the avian influenza virus (bird flu) infecting humans and possibly causing a worldwide pandemic. The bird flu is one of many different subtypes of type A influenza viruses. These subtypes differ because of changes in certain antigenic proteins on the surface of the influenza A virus. The proteins are symbolized with the letters H (hemagglutinin) and N (neuroaminidase). H1N1, H1N2 and H1N3 are the strains of the influenza A virus currently affecting the human population. However, they are usually only suffered for a week and the victims generally survive. On the other hand, the bird flu is the variant form H5N1 and humans have rarely been exposed to this strain. When contracted by humans, this form of the flu is generally very severe. The symptoms can range from high temperatures to brain swelling and death. The H5N1 strain is usually contracted from infected birds and it is rare for humans to pass this strain of flu onto other humans.

- a) Draw a labelled diagram of a typical virus.



3 Marks

- b) The viral DNA in the H1N3 and H5N1 strains is different. Explain why this leads to different antigenic proteins on their surfaces.

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2 Marks

The table below illustrates the number of confirmed cases from the World Health Organisation of humans who have contracted the bird flu in the recent past.

<b>Year of onset</b>	<b>Total Cases reported</b>	<b>Number of Deaths</b>
2009	4	3
2010	49	33
2011	86	35

c) What has happened to the percentage of mortality over the three years?

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1 Mark

Research was conducted at a frenzied pace in an effort to develop a vaccine for the bird flu so that a possible pandemic could be thwarted.

d) What does a vaccine contain?

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1 Mark

e) If, after being vaccinated, a person was infected with the bird flu, how would you expect this person's immune system to respond?

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3 Mark



**Question 5**

There are several factors that are taken into account when determining the compatibility of a potential organ donor. These are outlined below in order of importance:

- **ABO Blood types.** Blood types of the donor and recipient should be the same. There are four blood types: A, B, AB and O.
- **Rhesus factor.** This can either be negative or positive which should match with the recipient and the donor.
- **Tissue matching.** The cells of the recipient and the donor should be as similar as possible with respect to a group of six antigens (called HLA proteins) located on the surface of all body cells.

a) Define the term antigen in the context of this question.

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1 Mark

A certain individual who is blood type B positive is in need of a kidney transplant and luckily two potential donors are available at the same time. Their compatibility, with respect to the factors above, follows:

- Person 1: Blood type B negative and five of the antigens are a perfect match.
- Person 2: Blood type B positive and three of the antigens are a perfect match.

b) Based on the information provided, explain which person (1 or 2) would be the best donor.

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1 Mark

c) Using the information provided as well as your understanding of the immune system, explain why the risk of rejection of the transplanted organ still exists even if all the factors outlined above are a perfect match.

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2 Marks

d) Describe a measure that could be taken which could reduce the risk of rejection of the transplanted organ.

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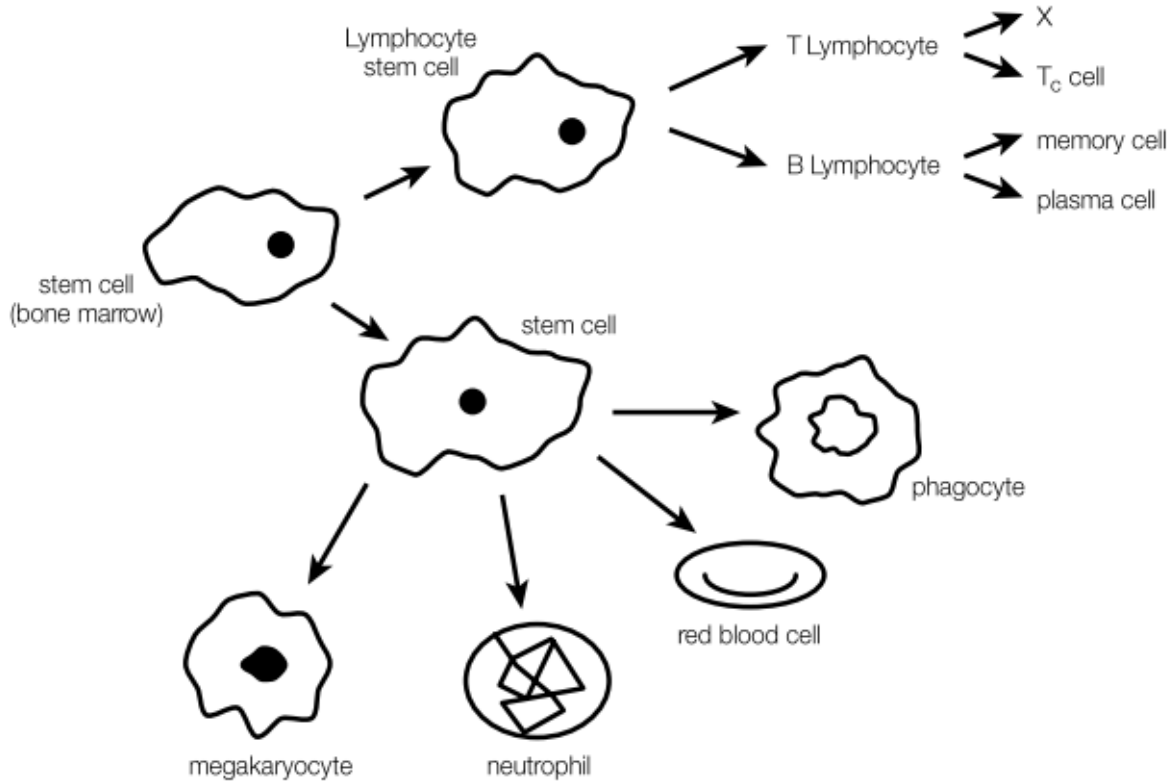
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1 Mark

**Question 6**

Stem cells from the bone marrow can differentiate into a number of specialized cells, some of which are involved in the immune response.



a)

- a. From the diagram above, select a cell involved in the specific immune response and outline its function.

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ii. From the diagram above, select a cell involved in the non-specific immune response and outline its function.

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2 Marks

iii. Name another type of T cell, represented by X on the diagram above.

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1 Mark

b) Recently there has been lot of research on the possible treatments of diseases caused by autoimmune attacks on cells.

i. What is meant by autoimmune disease?

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1 Mark

ii. What chemicals are present in the blood of a person with an autoimmune disease that are not present in the blood of someone without the disease?

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1 Mark

iii. On the following diagram of an antibody, circle the antigen -binding sites



1 Mark

c)

i. Explain the key difference between active and passive immunity.

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1 Mark

ii. For the examples listed below, indicate whether they are active or passive immunity?

A person is given a dose of anti-venom found in blood of a horse following a dangerous snake-bite.

Active / Passive

After contracting Chickenpox you never contract it again

Active / Passive

A baby is automatically resistant to German measles after drinking the breast milk of its mother, who has immunity.

Active / Passive

3 Marks

**Question 7**

Below is the depiction of a genetic code

Codon – Base Position			Amino Acid
1	2	3	
A	A	A or G	Lysine
A	A	C or U	Asparagines
A	C	A C G U	Threonine
A	G	A or G	Arginine
A	G	C or U	Serine
A	U	A C or U	Isoleucine
A	U	G	Methionine
C	A	A or G	Glutamine
C	A	C or U	Histidine
C	C	A C G U	Proline
C	G	A C G U	Arginine
C	U	A C G U	Leucine
G	A	A or G	Glutamic acid
G	A	C or U	Aspartic acid
G	C	A C G U	Alanine
G	G	A C G U	Glycine
G	U	A C G U	Valine
U	A	A or G	NONSENSE – STOP
U	A	C or U	Tyrosine
U	C	A C G U	Serine
U	G	A	NONSENSE – STOP
U	G	C or U	Cysteine
U	G	G	Tryptophan
U	U	A or G	Leucine
U	U	C or U	Phenylalanine

a) The genetic code is often described as reductant. What is meant by this term?

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1 Mark

b) What is RNA Polymerase and what does it do?

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2 Mark

c) Describe the process in which an mRNA molecule synthesized in the nucleus, and name this process

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3 Marks



d) Describe a process in which a polypeptide is formed at the ribosome, and name its process

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3 Marks

e) Are the codes represented in the table for DNA or RNA? Explain

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2 Marks

A healthy polypeptide has the following series of codons:

AUGCCUAGGGAAUGA

The following are two mutated form of messenger RNA molecule that code for the polypeptide above.

AUGCGUAGGGAAUGA (mutation a)  
AUGCCCUAGGGAAUGA (mutation b)

f) What type of mutation are a and b respectively?

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2 Marks

g) Is an individual with mutation a, or an individual with mutation b. more likely to suffer serious consequences? Explain your choice.

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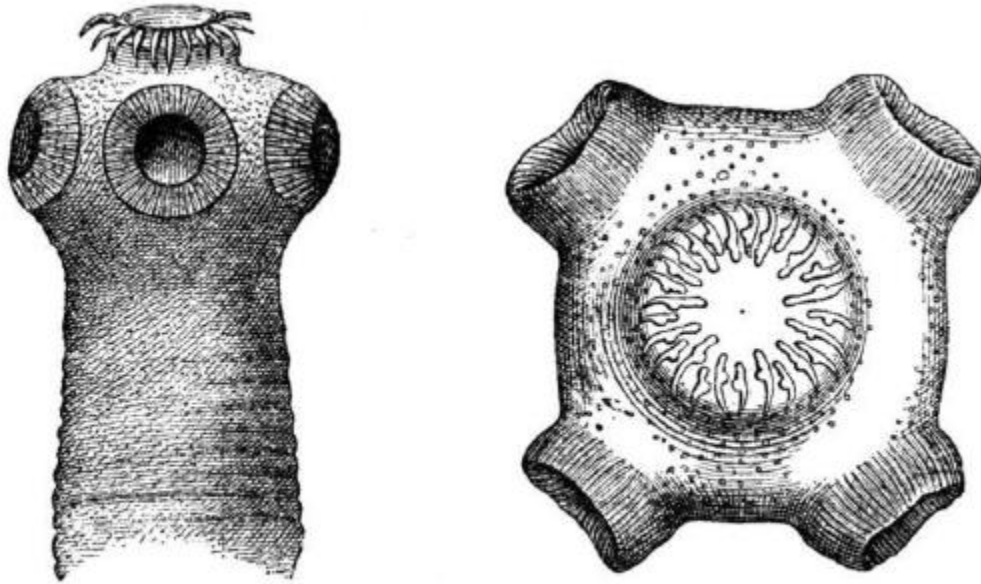
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2 Marks

**Question 8**

The diagram below is of Pork tapeworm, *Taenia Solium*, which is eukaryotic parasite that lives in the digestive tracks of the pigs.



Source: Wikimedia Commons

a) What are the two benefits living in digestive tracks of pigs for *Taenia Solium*?

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2 Marks

b) What is one of the physical features of pork tapeworm that enables it to live in the intestines of a pig? How does it help the tapeworm survive?

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2 Marks

c) Explain using Darwin theory of natural selection, how the feature you described in part b. could have evolved in *Taenia Solium*.

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3 Marks

**Question 9**

Peter has always been interested in the mating calls of frogs and decided to set up an experiment to investigate the effect of pitch on how effective the mating calls were.

- a) What is the independent variable in this experiment?

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1 mark

Peter hopes to conduct his experiment by the side of the creek behind his house. He plans on putting model frogs with a speaker inside and playing mating calls of different pitches through the speaker. He will then record the number of frogs he sees or hears responding to the calls.

- b) Identify and outline how Peter could control 2 variables that could impact his experiment

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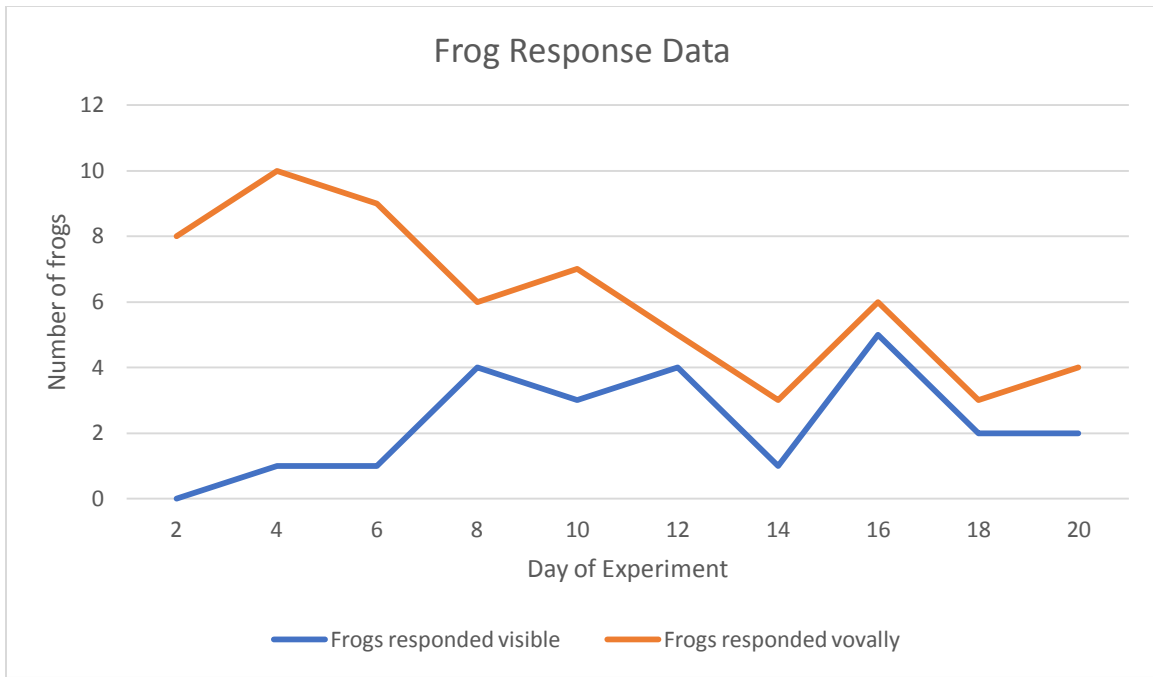
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4 marks

Peter conducted his experiment every second night for 20 days, the data he collected is shown below



c) Discuss 2 observations from the data Peter collected

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4 marks

d) Suggest 1 improvement Peter could make to his experiment

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1 mark