



## THE SCHOOL FOR EXCELLENCE (TSFX)

### VCE BIOLOGY UNITS 3 & 4

### WRITTEN EXAMINATION 2018

Reading Time: 15 minutes  
Writing Time: 2 hours 30 minutes

### QUESTION AND ANSWER BOOK

Student  
Number:









Letter

#### Structure of Book

Section	Number of questions	Number of questions to be answered	Number of marks
A	40	40	40
B	9	9	80
			<b>Total 120</b>

- 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.
- No calculator is allowed in this examination.

#### Materials Supplied

- Question and answer book of 30 pages.
- Answer sheet for multiple choice questions.

#### Instructions

- Write your **student number** in the space provided above on this page.
- All written responses must be in English.

#### At the End of the Examination

Place the answer sheet for multiple-choice questions inside the front cover of this book.

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

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## SECTION A – Multiple Choice Questions

### Instructions for Section A

Answer all questions in pencil on the answer sheet provided for multiple choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

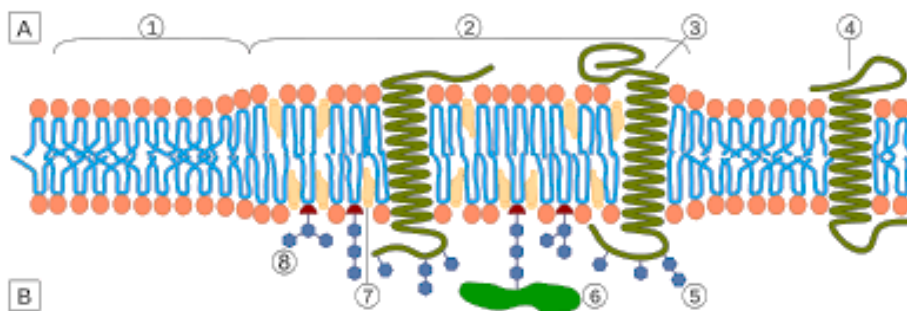
Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

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

*Use the following information to answer Questions 1 and 2.*

Consider the following diagram of the plasma membrane.



#### QUESTION 1

Region A represents the extra cellular environment and region B represents the intra cellular environment. A signal transduction pathway involving a hydrophobic molecule would commence at

- A. Regions 1, 3 and 4
- B. Region 6
- C. Regions 2, 3 and 7
- D. Regions 4

#### QUESTION 2

A molecule containing many amino acids will likely pass through a plasma membrane

- A. by dissolving through the phospholipid heads from region A to region B.
- B. in the spaces between the phospholipid tails.
- C. through structures 3 or 4.
- D. using a lipid raft at structure 6.

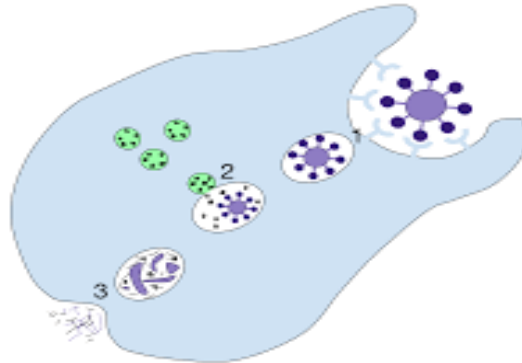
### QUESTION 3

The correct order in which the parts of a cell play a role in exocytosis of a protein is

- A. vesicle, rough endoplasmic reticulum, nucleus, ribosome.
- B. rough endoplasmic reticulum, nucleus, vesicle, golgi apparatus.
- C. nucleus, rough endoplasmic reticulum, Golgi apparatus, vesicle.
- D. golgi apparatus, vesicle, rough endoplasmic reticulum, nucleus.

### QUESTION 4

Consider the following diagram of a particle being ingested after antigens are recognised by the cell.



This process of ingestion is an example of

- A. exocytosis
- B. phagocytosis
- C. pinocytosis
- D. apoptosis

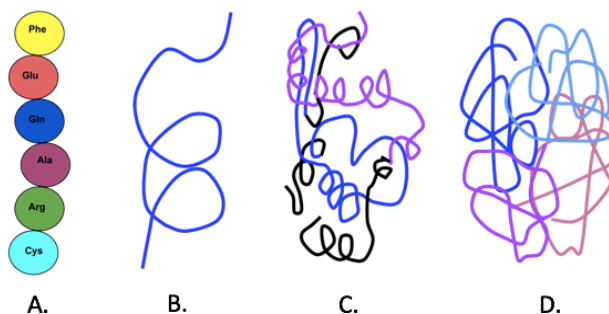
### QUESTION 5

The term used to indicate all proteins expressed by a cell is

- A. proteomics
- B. proteome
- C. genome
- D. genomics

### QUESTION 6

The primary structure of a protein is represented by



### QUESTION 7

The process of protein synthesis involves

- A. translation followed by transcription
- B. tRNA molecules transferring codons to an anticodon
- C. introns carrying information to a mRNA molecule
- D. RNA processing in Eukaryotes

### QUESTION 8

The following is a sequence of amino acids found in a protein: -cys-arg-leu-pro-val-

		1st base					
		U	C	A	G		
2nd base U	U	UUU Phenylalanine	UCU Serine	UAU Tyrosine	UGU Cysteine	3rd base U	
	U	UUC Phenylalanine	UCC Serine	UAC Tyrosine	UGC Cysteine		C
	U	UUA Leucine	UCA Serine	UAA Stop	UGA Stop		A
	U	UUG Leucine	UCG Serine	UAG Stop	UGG Tryptophan		G
2nd base C	C	CUU Leucine	CCU Proline	CAU Histidine	CGU Arginine	3rd base U	
	C	CUC Leucine	CCC Proline	CAC Histidine	CGC Arginine		C
	C	CUA Leucine	CCA Proline	CAA Glutamine	CGA Arginine		A
	C	CUG Leucine	CCG Proline	CAG Glutamine	CGG Arginine		G
2nd base A	A	AUU Isoleucine	ACU Threonine	AAU Asparagine	AGU Serine	3rd base U	
	A	AUC Isoleucine	ACC Threonine	AAC Asparagine	AGC Serine		C
	A	AUA Isoleucine	ACA Threonine	AAA Lysine	AGA Arginine		A
	A	AUG Methionine (Start)	ACG Threonine	AAG Lysine	AGG Arginine		G
2nd base G	G	GUU Valine	GCU Alanine	GAU Aspartic Acid	GGU Glycine	3rd base U	
	G	GUC Valine	GCC Alanine	GAC Aspartic Acid	GGC Glycine		C
	G	GUA Valine	GCA Alanine	GAA Glutamic Acid	GGA Glycine		A
	G	GUG Valine	GCG Alanine	GAG Glutamic Acid	GGG Glycine		G

Using the table provided, the DNA sequence that could code for this sequence is

- A. ACG-ACT-TAC-AGC-CAT
- B. ACG-GCT-GAT-GGA-CAT
- C. ACG- GCC-TAC-AGC-CAT
- D. ACG-CGC-ACG-AGC-CAT

### QUESTION 9

A molecule that takes part in many biochemical reactions is NAD<sup>+</sup>  
Which of the following is correct for this molecule?

- A. NAD<sup>+</sup> supplies energy to the Calvin Cycle.
- B. NAD<sup>+</sup> supplies energy when protons and electrons are added to it.
- C. NAD<sup>+</sup> has a higher energy level when it is unloaded.
- D. NAD<sup>+</sup> is converted into the coenzyme NADPH.

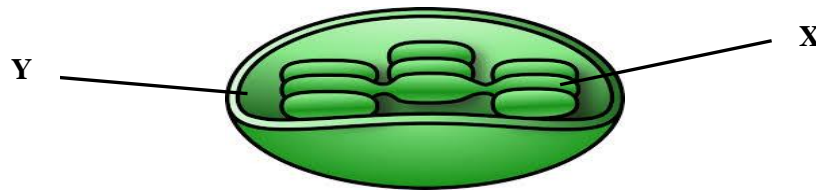
**QUESTION 10**

Evidence for the bacterial origin of the mitochondria include the observation that

- A. mitochondria divide by mitosis
- B. mitochondria contain many plasmids
- C. mitochondria contain both circular and linear DNA
- D. mitochondria contain its own genome

*Use the following information to answer Questions 11 and 12.*

The following is a three-dimensional diagram of an organelle found in eukaryotic cells



**QUESTION 11**

The region labelled Y is called the

- A. stoma
- B. matrix
- C. stroma
- D. granum

**QUESTION 12**

The structure labelled X is where

- A. ATP is produced.
- B. the light independent stage occurs.
- C. NAD is an input.
- D. carbon dioxide is an output.

**QUESTION 13**

Which of the following correctly matches a signalling molecule with its mode of transmission?

	<b>Molecule</b>	<b>Role</b>
A.	Cytokine	Travels to a nearby cell via extracellular fluid
B.	Pheromone	Travels by blood to extra cellular receptors
C.	Neurotransmitter	Travels in blood to an intracellular receptor in a target cell
D.	Plant hormone	Travels across a synapse by diffusion

### QUESTION 14

The extrinsic pathway of apoptosis removes

- A. cells with damaged DNA.
- B. developing nerve cells that fail to make profitable connections.
- C. irradiated cells.
- D. cancer cells

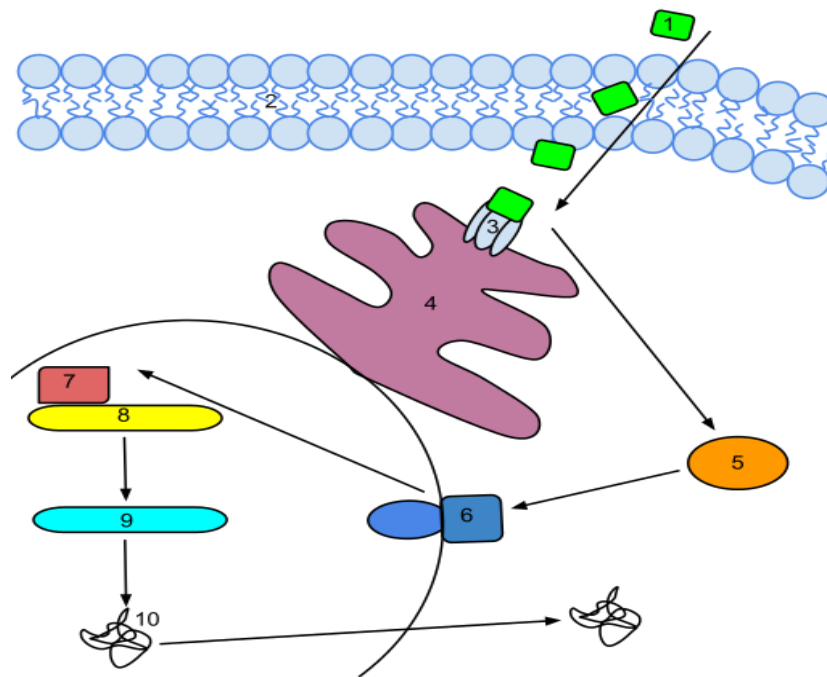
### QUESTION 15

When cells respond to an extracellular signal, the message is converted into a response. This process is called signal

- A. Transformation
- B. Cascade
- C. Amplification
- D. Transduction

### QUESTION 16

Molecule 1 is a hydrophobic signalling molecule. A likely consequence of this molecule binding to its receptor 3 is



- A. translation in area 7 will cease.
- B. many molecules of a required protein may be expressed.
- C. transcription may begin in the ribosome of that cell.
- D. gene expression in all areas of all the cell's DNA will occur.

**QUESTION 17**

Cellular agents capable of causing infection of body cells include

- A. prions
- B. bacteria
- C. Retro Viruses
- D. pollen

**QUESTION 18**

Which of the following is directly involved in the inflammatory response?

- A. The adaptive immune response
- B. T and B lymphocytes
- C. Interferon
- D. Histamine

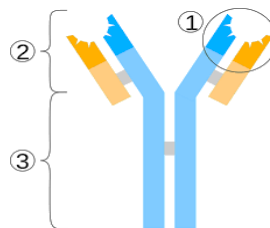
**QUESTION 19**

In the lymphatic system

- A. phagocytes mature into T cells.
- B. mast cells are produced.
- C. plasma B cells are produced.
- D. lymph is pumped by the heart.

**QUESTION 20**

The numbers 1, 2 and 3 correspond respectively to which parts of the antibody shown below?



- A. Variable region, constant region and antigen binding site
- B. Antigen binding site, variable region and constant region
- C. Antigen binding site, light chain, heavy chain
- D. Epitope, constant region, variable region

**QUESTION 21**

During an allergic response to pollen

- A. blood vessels constrict.
- B. T cells release histamine.
- C. macrophages destroy T cells.
- D. IgE antibodies attach to mast cells.



### QUESTION 22

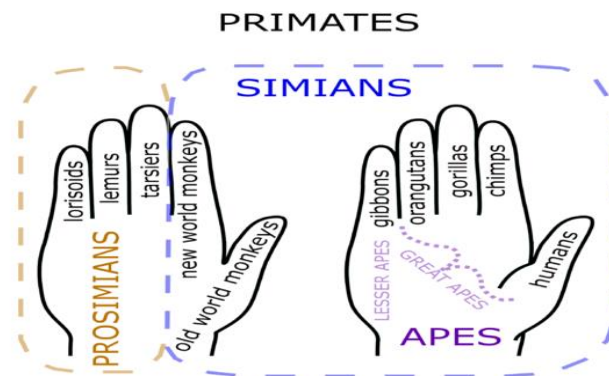
One of the consequences of Mass Extinctions is

- A. adaptive radiation of new species.
- B. mutations resulting in new favourable characteristics.
- C. reduction in divergent evolution of new species.
- D. widespread genetic abnormalities.

*Use the following information to answer Questions 23 and 24.*

A VCE Biology teacher used this hand mnemonic to help her students learn the categorisation of primates.

The hand on the right correlates to the apes, including the great apes and lesser apes, with humans being represented as a distinct group using the thumb.



### QUESTION 23

According to this system of classification, it is reasonable to assume that

- A. primates represented on the hand on the left share a more recent common ancestor with humans than the primates represented on the right hand.
- B. lorisoids, lemurs are in the same family as orangutans and gorillas.
- C. humans share more primate characteristics with chimps than lemurs.
- D. all promisiams and simians would have an opposable thumb.

### QUESTION 24

A limitation of using this model as a basis for phylogeny could be that

- A. humans and chimps share a low percentage of genetic commonality.
- B. it is improper to classify humans with the great apes.
- C. the ten hand digits do not show accurate branching geometry.
- D. the primates on the left hand do not share any characteristics with the primates on the right hand.

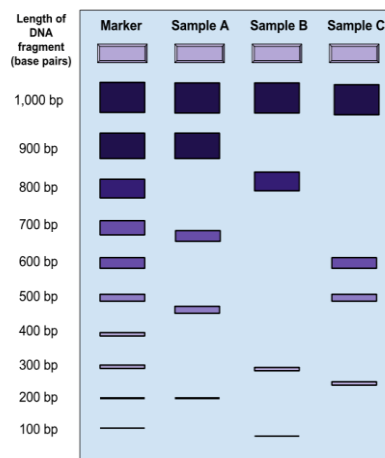
### QUESTION 25

Mitochondrial DNA

- A. is found in all cells.
- B. contains uracil.
- C. is always linear.
- D. is inherited only from the female parent.

### QUESTION 26

The diagram below shows gels of a shared restriction fragment length polymorphism (RFLP) allele at a particular RFLP locus from three different hominin fossils species discovered from three separate locations.



These results show evidence of

- A. gene flow between the three species.
- B. genetic drift between Samples A and B.
- C. random mutations within the three different species.
- D. in breeding between the three species.

### QUESTION 27

The three main steps in PCR include in order

- A. extension, annealing and cooling
- B. cooling, denaturation and extension
- C. heating, annealing, extension
- D. denaturation, extension and annealing

### QUESTION 28

Genetic modification always involves

- A. a change to an organism's DNA.
- B. gel electrophoresis.
- C. a plasmid vector.
- D. a new gene inserted into an organism.

**QUESTION 29**

In the process of genetic transformation, a reason for growing potential transformed bacteria on a culture containing an antibiotic could be for

- A. showing that the bacteria was infected with a pathogen.
- B. showing the presence of viable transformed bacteria.
- C. showing the effectiveness of an antibiotic in killing untreated bacteria.
- D. to provide a food source for the bacteria.

**QUESTION 30**

The antiviral drug developed in Australia called Relenza has been rationally designed to

- A. inhibit the activity of a specific enzyme.
- B. immunise patients against a viral infection.
- C. be the same molecular shape as the influenza virus.
- D. be the same molecular shape as a viral enzyme.

**QUESTION 31**

The most effective and practical way to reduce the likelihood of an influenza epidemic in Australia would be

- A. to vaccinate all Australians against all strains of the influenza virus.
- B. to make antibiotics freely available to all Australians.
- C. isolate all infected patients from the rest of the population until symptoms have passed.
- D. vaccinate at risk groups with the new version of the vaccine each year.

**QUESTION 32**

Since the first cases of acquired immunodeficiency syndrome (**AIDS**) were reported in 1981, infection with human immunodeficiency virus (**HIV**) rapidly increased to become considered

- A. a global epidemic
- B. a pandemic
- C. an epidemic
- D. a controlled outbreak

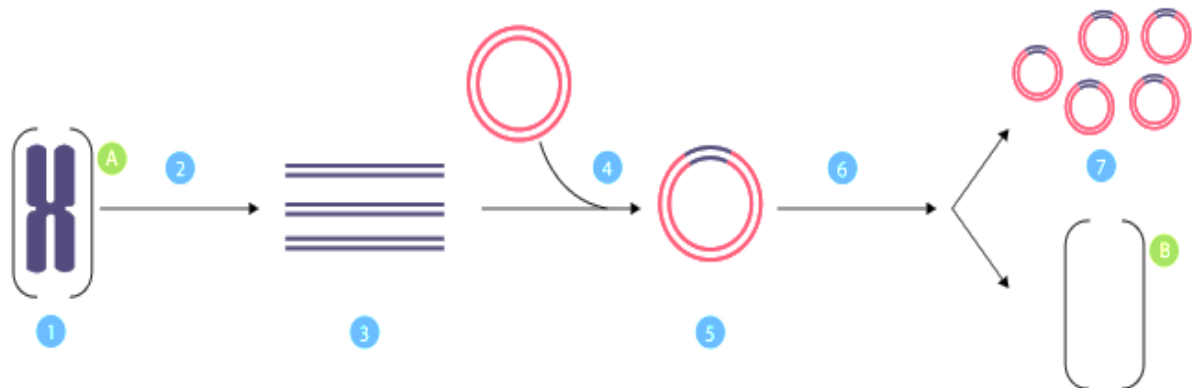
**QUESTION 33**

A consequence of the overuse of antibiotics by humans is

- A. viruses becoming resistant to antibiotics.
- B. no effective treatments available for influenza outbreaks.
- C. a rise in inherited diseases.
- D. some treatments becoming ineffective.

### QUESTION 34

Bacteria can be transformed with a human insulin gene and cultured to make this insulin in commercial quantities.



The correct terms corresponding with the numbers in the diagram below are

- A. 1 is PCR; 3 is Isolation of gene from human cell; 6 is Insertion of Plasmid into Human cell
- B. 1 is Isolation of gene from human cell; 3 is PCR; 7 is Multiple expression of insulin gene in Bacterial cell
- C. 2 is Insertion of gene into the plasmid; 5 is PCR; 6 is Insertion of plasmid into Human cell
- D. 2 is Insertion of gene into the plasmid; 5 is PCR; 7 is Multiple expression of insulin gene in Bacterial cell

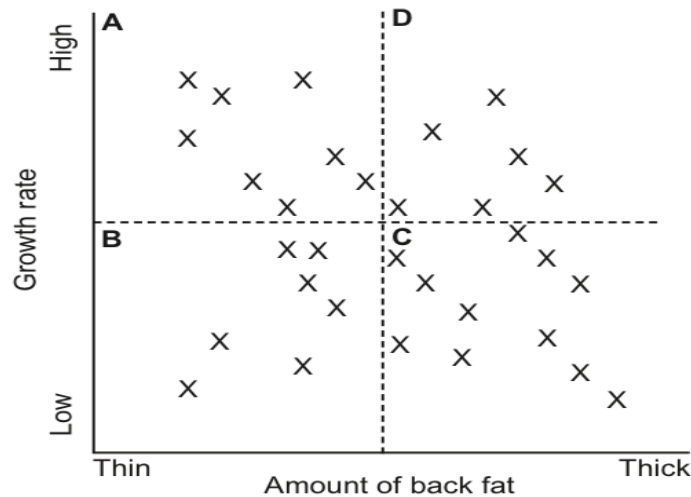
### QUESTION 35

An ethical issue raised by the genetic modification of organisms could be

- A. concern over long term health effects to the genetically modified organism.
- B. concern that a genetically modified species could result in longer life spans.
- C. the risk of disease and infection to other organisms that are in contact with the genetically modified organism.
- D. an uncontrolled increase in genetic diversity amongst a genetically modified group of organisms.

**QUESTION 36**

A beef farmer interested in selective breeding to produce leaner meat for commercial use measured the growth rate and the thickness of back fat in four different groups of his cows. The results are shown in the diagram, where each 'X' represents one cow. The farmer divided the cows into four groups (A, B, C and D) according to their growth rate and thickness of back fat, as shown in the diagram.



The best cows to selectively breed to produce calves with a high growth rate and thin back fat would be those from

- A. group A
- B. group B
- C. group C
- D. group D

**QUESTION 37**

The following is a list of the main steps in the life cycle of the HIV virus in no particular order.

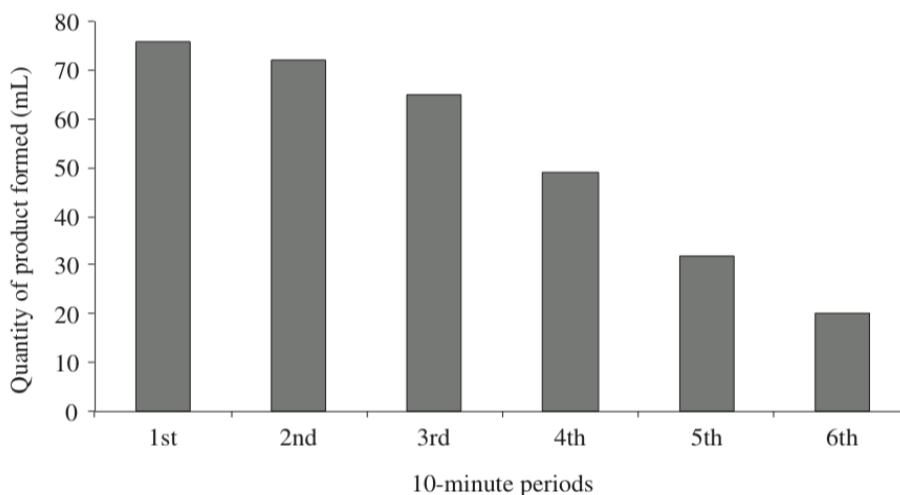
<b>Step A</b>	Viral proteins and nucleic acids are assembled in the host cell.
<b>Step B</b>	The HIV virus binds to the T helper cell
<b>Step C</b>	The HIV virus injects its RNA into the T helper cell
<b>Step D</b>	The T helper cell releases viral particles
<b>Step E</b>	The T helper cell produces viral nucleic acids and proteins.

The correct sequence of steps in the order they occur is

- A. Step B, Step C, Step E, Step A, Step D
- B. Step B, Step E, Step C, Step D, Step B
- C. Step B, Step B, Step A, Step D, Step E
- D. Step B, Step C, Step E, Step B, Step A

Use the following information to answer Questions 38 – 40.

A student performed an enzyme-substrate experiment. At the end of each 10-minute period, the quantity of the product formed was collected and measured. The graph shows the results of this experiment.



Source: <http://educationstandards.nsw.edu.au>

### QUESTION 38

Which of the following would explain the trend shown in the graph?

- A. The rate of enzyme activity is decreasing.
- B. The concentration of the product is decreasing.
- C. The concentration of the enzyme is decreasing.
- D. The concentration of the substrate is decreasing.

### QUESTION 39

If the method used to measure the amount of gas collected was by observing the height of bubbles in a test tube, which type of error could result?

- A. systematic
- B. non directional
- C. precision
- D. directional

### QUESTION 40

This type of error could be corrected by

- A. repeating the experiment a number of times.
- B. using more accurate equipment to measure the quantity of product.
- C. including more levels of the independent variable.
- D. including a control set up.

**END OF SECTION A**

## SECTION B – Short Answer Questions

### Instructions for Section B

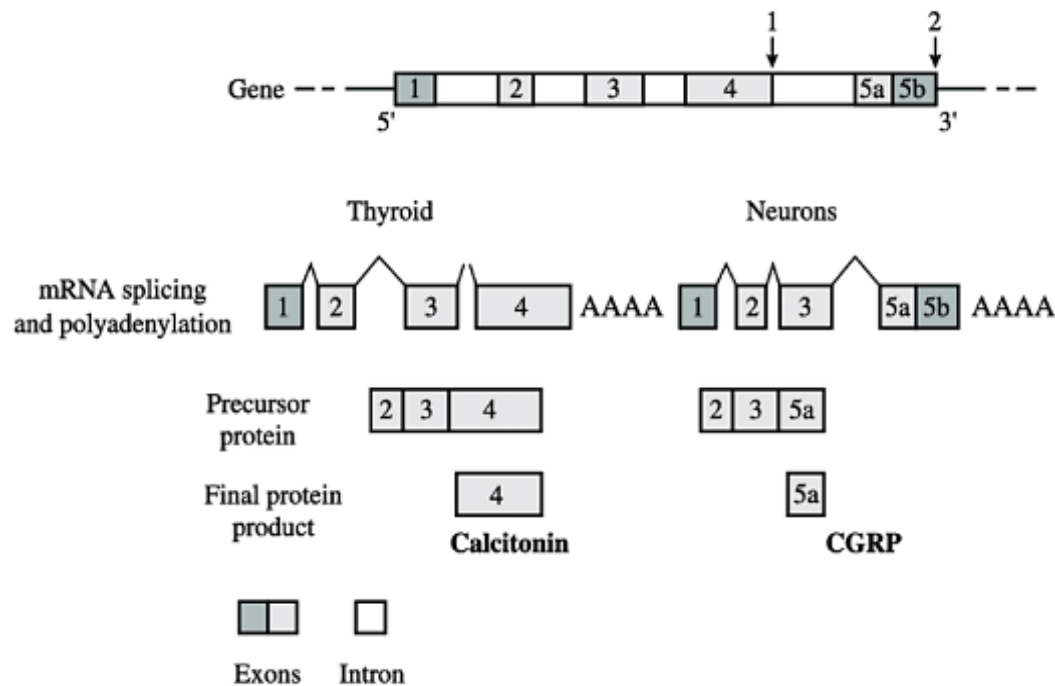
Answer **all** questions in the spaces provided. Write using blue or black pen.

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

### QUESTION 1 (6 marks)

The gene illustrated below contains 2 different signals, as illustrated by arrows 1 and 2 and six exons (1,2,3,4,5a and 5b).

In the thyroid, the signal (arrow 1) is recognised, and this results in the production of a pre mRNA molecule containing exons 1, 2, 3 and 4. These four exons are spliced together to form a precursor protein containing exons 2, 3 and 4 and eventually a protein called calcitonin that contains information from only exon 4. In neurons, the signal (arrow 2) is recognised to form a pre mRNA molecule containing exons 1, 2, 3, 4, 5a and 5b, and a similar process occurs resulting in a different protein called CGRP (calcitonin gene-related peptide). Both proteins are eventually secreted by the process of exocytosis.



- a. What is the term used to describe the expression of different genes in different cells?

1 mark

**b.** State one difference between exons and introns.

1 mark

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**c.** Name the organelle within a cell where both the calcitonin and the CGRP are synthesised.

1 mark

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**d.** Explain how the expression of this same gene can lead to the production of these two different proteins in the different cells.

3 marks

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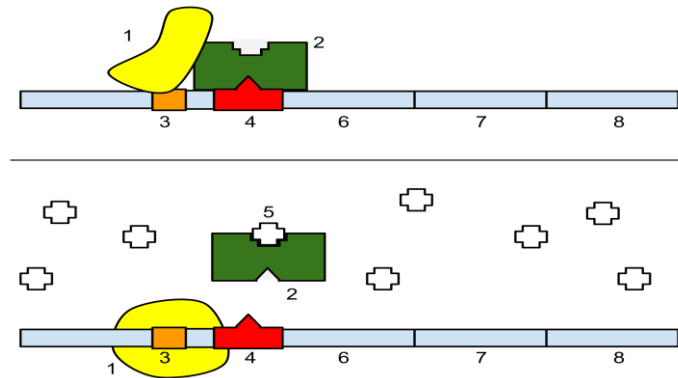
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**QUESTION 2** (8 marks)

Below is a diagram that shows the *lac* operon. It has three structural genes numbered below as 6, 7 and 8. In the top diagram these three genes are essentially 'switched off'. When lactose (structure 5) is introduced into the cell the genes are transcribed.



Complete the table below by identifying structures 1 to 4 and state their role in the *lac* operon.

8 marks

Name of Structure	Role in the <i>lac</i> Operon
1.	
2.	
3.	
4.	

**QUESTION 3** (11 marks)

The protein hormone tumour necrosis factor alpha ( $TNF\alpha$ ) is thought to be an important molecule in the process of apoptosis. When this hormone binds to a cell surface death receptor it activates a cascade of events that results in cell death.

a. What is apoptosis and what is the role of caspases in this process?

3 marks

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b. Suggest what is meant by 'a cascade of events' in this context.

2 marks

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c. Is this an example of an intrinsic or extrinsic pathway of apoptosis? Justify your answer.

2 marks

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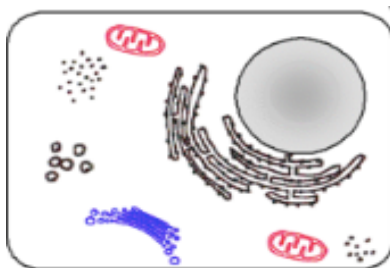
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d. In the space below draw a picture of how the cell will appear during phagocytosis following apoptosis.

4 marks

**Before**

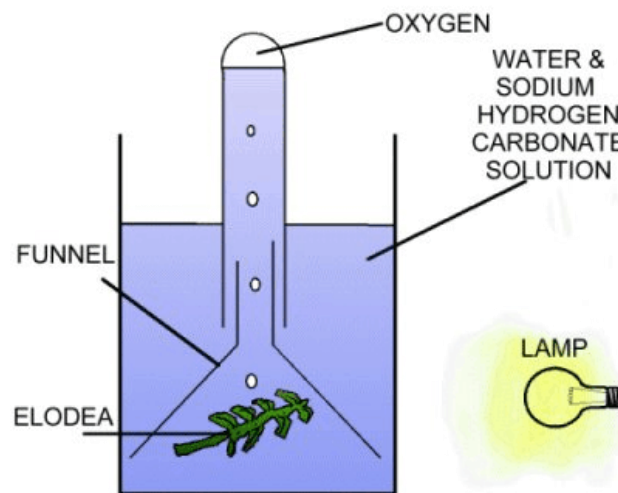
**After**



**QUESTION 4** (9 marks)

For their VCE Biology practical investigation, Emily and Luca decided to investigate the effect of carbon dioxide concentration on the rate of photosynthesis. They used the following method.

- Step 1:** Six pieces of *Elodea* (an aquatic plant) each measuring 15 cm were cut from the same plant.
- Step 2:** Solutions of differing concentrations of carbon dioxide, 0.2%, 0.4%, 0.6%, 0.8%, and 1.0%, were all prepared using water and sodium hydrogen carbonate, and each solution was spread equally among five beakers. A sixth beaker contained only water.
- Step 3:** A piece of *Elodea* was placed in each beaker and covered with a funnel and inverted test tube.
- Step 4:** A dissolved oxygen sensor was used to take initial measurements in the test tube.
- Step 5:** The beakers were placed 10 cm from a lamp for 30 minutes after which the dissolved oxygen sensor was again used to take final measurements in the test tube.
- Step 6:** The percentage change in dissolved oxygen was then calculated from the initial and final measurements.
- Step 7:** Steps 1-5 were repeated three times for each solution and an average was calculated.



- a. Write a balanced equation for the photosynthesis reaction.

1 mark

- b. What was the dependent variable? Justify why this was used in their investigation. 2 marks

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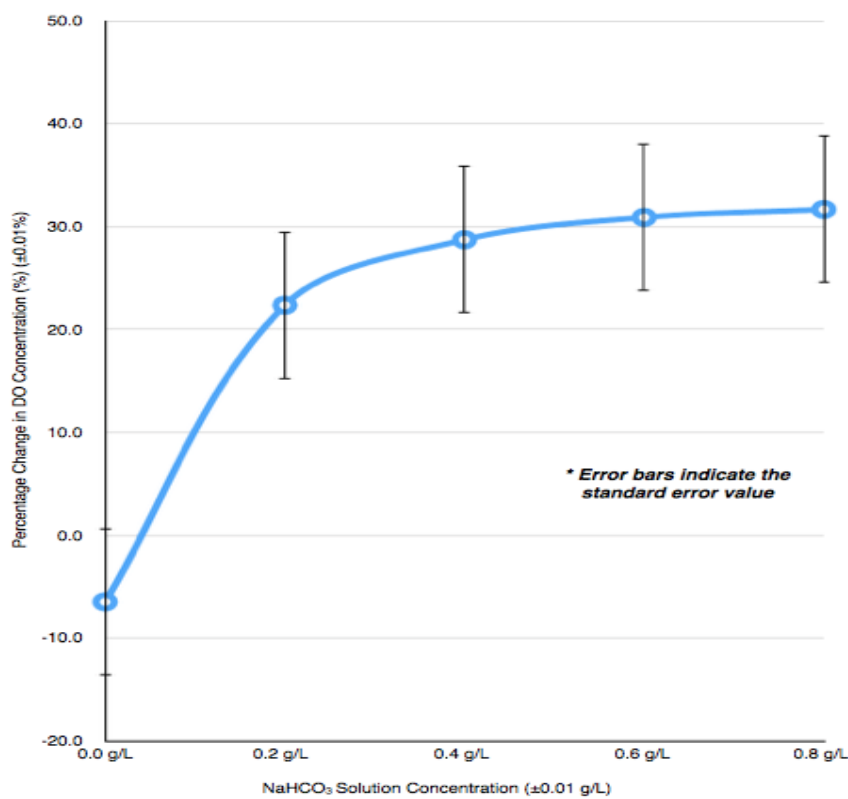
- c. What was the purpose of the beaker containing water? 1 mark

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- d. Emily and Luca prepared the graph below from their results. The error bars on the graph indicate the uncertainty in their measurements and illustrate how precise their data is.



Based on this graph and their procedure, were their results valid? Justify your answer.

2 marks

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e. What conclusion do you think Emily and Luca can draw from their investigation?

3 marks

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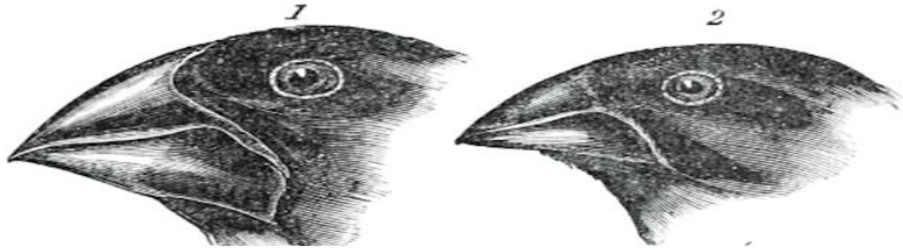
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**QUESTION 5** (9 marks)

The diagram below illustrates two of Darwin's Finches. Finch number one is *Geospiza magnirostris* (large ground finch) and Finch number 2 is *Geospiza fortis* (medium ground finch). Darwin's observations of these and other Finches contributed to his proposed theory of evolution.



- a. How would Charles Darwin account for difference in beak size between these two Finches?

1 mark

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In 2004 scientists found that manipulating a master gene BMP4 produced large variations in beaks that matched Darwin's observations.

- b. How do master genes such as BMP4 differ from structural genes?

2 marks

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Darwin proposed that all the Finches likely came from a common ancestor but had become different enough to be classified as separate species. Today, a molecular technique known as DNA hybridisation can be used to determine the evolutionary relationships between the many different species of Finches found on the Galapagos Island.

**c.** Outline the steps involved in this technique.

4 marks

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**d.** How does this technique enable scientists to determine the evolutionary relationship between species?

2 marks

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**QUESTION 6** (12 marks)

Hepatitis B (HB) is one of the most common infectious diseases with the World Health Organisation estimating that there are as many as 285 million chronic carriers of this virus worldwide.

- a. Explain how a traditional vaccine could provide long term immunity to Hepatitis B.

4 marks

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Different vaccination schedules are recommended for different age groups/settings. For example, infants have three doses at 2, 4 and 6 months of age. There is also an accelerated vaccination schedule available for travellers when there isn't enough time for completion of the vaccination course before departure to region with a high risk of contracting Hepatitis B.

- b. Explain why an additional 4th dose needs to be administered to these people 12 months after receiving the first dose.

2 marks

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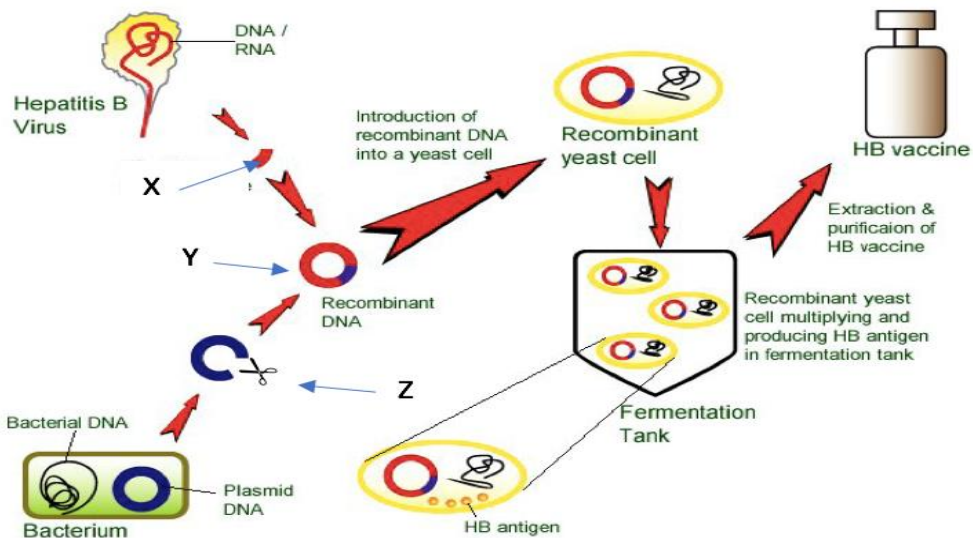
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Recombivax HB was approved as a hepatitis B prevention vaccine in July 1986. Using recombinant DNA technology, Recombivax HB uses the surface antigen of the virus that stimulates the production of protective antibodies which combat the HB virus.

The diagram below represents the process of recombinant DNA technology used to produce Recombivax HB.



c. Describe the role of the following in the production of Recombivax HB.

3 marks

Structure	Role in Recombinant Process
Hepatitis B Gene (X)	
Plasmid (Y)	
Restriction Enzyme (Z)	

d. Name one benefit associated with recombinant DNA technology to prepare this vaccine over traditional vaccine preparations.

1 mark

e. Describe how herd immunity could prevent a Hepatitis B epidemic.

2 marks

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**QUESTION 7** (9 marks)

In July 2018 it was announced that an Australian-led team of scientists had successfully sequenced the entire Koala genome comprising more than 26 000 genes and 3.5 billion base pairs. The project, which took five years to complete, is based on samples taken from three koalas: Pacific Chocolate and Bilbo, two female koalas who succumbed to chlamydia (a bacterial disease); and a male called Birke, who was mauled by a dog.

- a. Why is it important to sequence multiple samples from the same species?

1 mark

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- b. State one ethical consideration that would be relevant in the sequencing of the koala genome.

1 mark

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Koalas are highly specialist feeders, surviving on eucalypt leaves that would be toxic to other animals. They also almost exclusively rely on the leaves for water, seeking out leaves with at least 50 per cent water content. Analysis of the genome shows that Koalas have lots of bitter taste receptors as well as a 'water taste' gene.

- c. Suggest how these genes would account for the Koalas' preference for eating specific eucalypt leaves.

1 mark

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The same proteins appear to metabolise antibiotics given to treat chlamydia at a much faster rate. This therefore requires much higher doses to treat the disease.

- d. (i) How do antibiotics perform their function?

1 mark

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**(ii)** Suggest why it may be a disadvantage to the Joey to have higher doses of antibiotics.

2 marks

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Joeys gain some protection from the disease from their mother's milk. The scientists discovered a number of genes involved in the fine tuning of milk, including proteins that may have antimicrobial properties.

**e.** Why would these proteins be of particular interest to scientists in terms of fighting human bacterial diseases?

1 mark

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**f.** Name another type of protein that would have been present in the mother's milk and explain how this would have provided a beneficial form of immunity to the joey.

2 marks

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**QUESTION 8** (10 marks)

**Tasmanian Devils are evolving rapidly to fight their deadly cancer**

For the past 20 years, an infectious cancer has been killing wild Tasmanian devils, creating a massive challenge for conservationists. But new research, published today in Nature Communications, suggests that devils are evolving rapidly in response to their highly lethal transmissible cancer and that they could ultimately save themselves.

Andrew Storfer at Washington State University and Paul Hohenlohe at the University of Idaho compared the frequency of genes in devils in regions before DFTD arrived to devils 8-16 years after DFTD arrived.

We identified significant changes in two small regions in the DNA samples of devils from regions with DFTD. Five of seven genes in the two regions were related to cancer or immune function in other mammals, suggesting that Tasmanian devils are indeed evolving resistance to DFTD. Evolution is often thought of as a slow process, but these changes have occurred in as few as 4–8 generations of devils since disease outbreak. Devils are surviving at our long-term sites, despite models that predicted extinction. Previously, studies have shown that devils with lower rates of DFTD showed specific changes in their immune response.

New infectious diseases put strong pressure on their hosts to evolve, leading to rapid changes in resistance or tolerance. Rapid evolution requires pre-existing genetic variation. Our results are surprising because Tasmanian devils have low levels of genetic diversity.

Source: extract adapted from M.E. Jones (University of Tasmania), A.Storfer (Washington State University), H. McCallum (Griffith University), P.Hohenlohe ( University of Idaho), R. Hamede (University of Tasmania), 'Tasmanian Devils are evolving rapidly to fight their deadly cancer', **The Conversation Website**, 31 August 2016, <<https://theconversation.com/au>>

- a. Identify two pieces of evidence in the text that supports the theory that the Tasmanian Devils are evolving resistance to the disease. Justify how each piece of evidence can be used to support the rapid evolution theory.

4 marks

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The **Tasmanian devil** was once native to mainland Australia and is now found in the wild only on the island state of Tasmania. Its genome was sequenced in 2010 and found to have very low genetic diversity consistent with **genetic drift** and possibly a **founder effect**.

- b.** Explain the meaning of each of these terms with reference to allele frequencies of the Tasmanian Devils

2 marks

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- c.** Explain how the combination of low genetic diversity and new infectious diseases in the population of Devils impacts the survival of the species.

2 marks

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At Lake Nitchie in western New South Wales in 1970, a male human skeleton wearing a necklace of 178 teeth from 49 different devils was found. The skeleton is estimated to be 7000 years old, and the necklace is believed to be much older than the skeleton.

- d.** How would the scientists accurately determine the different ages of the skeleton and the necklace?

2 marks

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**QUESTION 9** (6 marks)

Both the sequencing of the Neanderthal genome and genetic evidence (both mitochondrial DNA and nuclear DNA) from the Denisova Cave in Siberia, have brought in new evidence that raises further questions with regards to hypotheses of human dispersal. Recent scientific information suggests that:

1. Neanderthals diverged from modern humans between 270 000 and 440 000 years ago.
  2. Neanderthals are more closely related to non-Africans than to Africans and were distributed East- West across central Europe to Asia.
  3. Denisovans share a common ancestor with Neanderthals and diverged from them around 640 000 years ago and were distributed North-South from Siberia to South-East Asia.
  4. Denisovans are more closely related to modern Melanesians (from, for example, Papua New Guinea, Australia, Solomon Islands, Vanuatu, and Fiji), which carry an additional 5% of Denisovan DNA.
  5. Modern non-African humans have inherited about 2.5% of their DNA from Neanderthals.
  6. Evidence of Neanderthal, Denisovan, and modern human occupation can be found in the Denisova cave, though this may be inconclusive.
- a. Suggest one reason why it is possible to study Denisovan DNA even though they lived around 41000 years ago?

1 mark

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- b. Suggest why there is greater genetic diversity between African populations than between modern non-African populations.

2 marks

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- c. State two shared characteristics of the Neanderthals, Denisovans and modern humans that would classify them as hominins.

2 marks

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- d. Suggest one advantage to the modern human populations from the inbreeding with the Neanderthals and Denisovans.

1 mark

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**END OF QUESTION AND ANSWER BOOK**