

2020 VCE Biology Trial Examination



Kilbaha Education

Quality educational content

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VICTORIAN CERTIFICATE OF EDUCATION

Year 2020

STUDENT NUMBER

Letter

Figures								
Words								

BIOLOGY

Trial Written Examination

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	40	40	40
B	11	11	80
			Total 120

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied

- Question and answer book of 29 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- 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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VCE BIOLOGY 2020

Trial Written Examination

MULTIPLE-CHOICE ANSWER SHEET

Student Name _____

Student Number _____

Signature _____

If your name or number on this sheet is incorrect, notify the Supervisor.
Use a **PENCIL** for **ALL** entries. For each question, shade the box that indicates your answer.
All answers must be completed like **THIS** example.

A	☒	C	D
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Marks will **NOT** be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer. **DO NOT** cross it out.

ONE ANSWER PER LINE

ONE ANSWER PER LINE

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
21.	A	B	C	D
22.	A	B	C	D
23.	A	B	C	D
24.	A	B	C	D
25.	A	B	C	D
26.	A	B	C	D
27.	A	B	C	D
28.	A	B	C	D
29.	A	B	C	D
30.	A	B	C	D
31.	A	B	C	D
32.	A	B	C	D
33.	A	B	C	D
34.	A	B	C	D
35.	A	B	C	D
36.	A	B	C	D
37.	A	B	C	D
38.	A	B	C	D
39.	A	B	C	D
40.	A	B	C	D

SECTION A – Multiple-choice questions

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

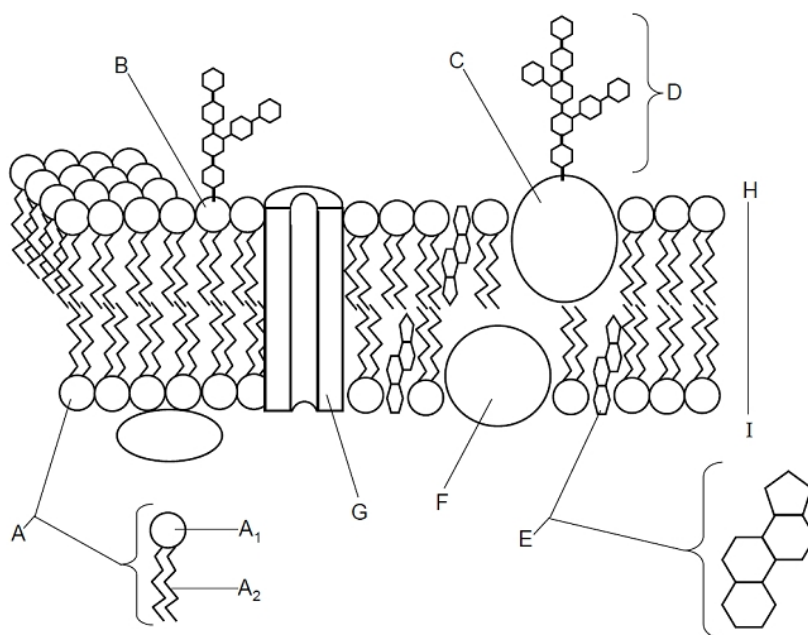
Choose the response that is **correct** for the question.

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.

The next 3 questions refer to the following diagram of a plasma membrane.



<http://6.ivory.das-knie.de/cell-wall-diagram-unlabeled.html>

Question 1

It would be appropriate to say that

- A. structure G is a peripheral protein.
- B. structure E assists with structural stability of the membrane.
- C. structure B is a glycoprotein.
- D. structure A1 is a nitrogenous base.

Question 2

With regard to structure spanning H-I,

- A. the hydrophobic heads face both the intracellular and extracellular environment.
- B. the lipophilic amino acids from structure C that face the inside of the membrane in the region between H and I, enable the structure to be stable in that configuration.
- C. the hydrophilic tails allow the passage of water across the plasma membrane.
- D. strong chemical bonds hold the structures spanning H to I in that arrangement.

Question 3

This type of plasma membrane could be expected to be found

- A. around the perimeter of a virus.
- B. around the outside of a ribosome.
- C. as part of a granum in a chloroplast.
- D. on the surface of a Helper T cell.

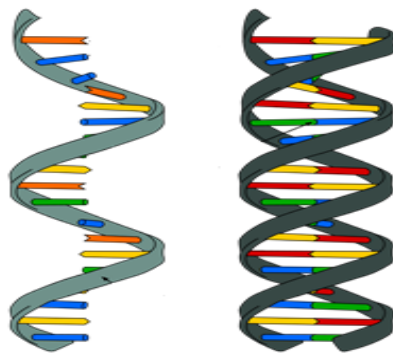
Question 4

When comparing the genome of a eukaryotic cell to the proteome of the same eukaryotic cell, it would be reasonable to state that the

- A. genome and the proteome are the same.
- B. genome would be the same for the life of the cell.
- C. proteome would be the same for the life of the cell.
- D. proteome provides the blueprint for the genome of the cell.

Question 5

The following diagrams are examples of cellular biomolecules



https://en.wikipedia.org/wiki/Nucleic_acid#/media/File:Difference_DNA_RNA-EN.svg

It is reasonable to conclude that

- A. both molecules contain weak hydrogen bonds holding complementary bases together.
- B. both molecules contain deoxyribose carbohydrates.
- C. both molecules are formed by condensation polymerisation.
- D. only one of the molecules contains guanine nitrogenous bases.

Question 6

The number of water molecules that would be required to hydrolyse a polypeptide comprised of 20 amino acids would be

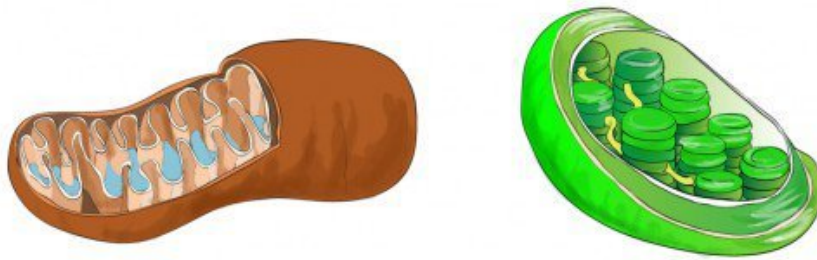
- A. 19
- B. 20
- C. 21
- D. 40

Question 7

The following molecule that could best be defined as a catalyst would be

- A. Adenosine triphosphate
- B. Cellulose
- C. Chlorophyll
- D. Caspase

The next 3 questions refer to the following diagrams of a mitochondrion and a chloroplast



<http://www.thecliffsidegroup.com/blog-in-focus/compare-and-contrast-chloroplasts-and-mitochondria>

Question 8

Both organelles contain

- A. Ribosomes and circular DNA
- B. NADPH and ATP
- C. Cristae and Grana
- D. Matrix and cytosol

Question 9

Both organelles were isolated from cells and added together into a buffer solution that was isotonic to both organelles. All the chemicals and conditions required to sustain them were provided. If the light intensity was increased to a very high level

- A. the level of carbon dioxide in the solution would remain constant.
- B. the level of carbon dioxide and oxygen would remain constant.
- C. the rate of respiration and the rate of photosynthesis would decrease.
- D. the level of oxygen in the solution would increase.

Question 10

Both organelles express proteins. To carry out this task, it is reasonable to assume they would both contain

- A. DNA, tRNA and ribosomes
- B. Membranes, DNA and mRNA
- C. Cristae, grana and circular DNA
- D. mRNA, tRNA but not rRNA

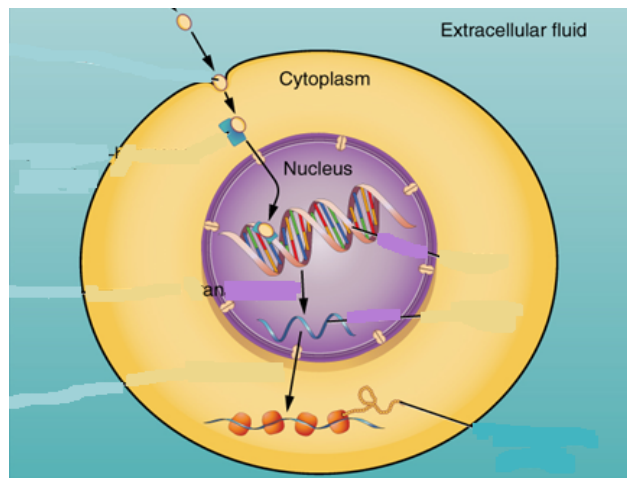
Question 11

The products of glycolysis include

- A. Carbon dioxide
- B. Acetyl CoA
- C. Glucose
- D. Pyruvic acid (pyruvate)

Question 12

The following diagram shows the action of a signalling molecule with a target cell after it has been transported through the bloodstream



Modified from: <https://opentextbc.ca/anatomyandphysiology/chapter/17-2-hormones/>

The information in the diagram is consistent with a

- A. hydrophobic hormone.
- B. hydrophilic protein.
- C. neurotransmitter.
- D. cytokine.

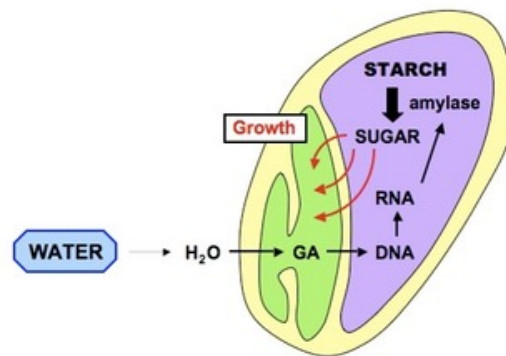
Question 13

Pheromones are signalling molecules that usually

- A. bind to receptors within the same individual that secretes them.
- B. move through air or water between members of the same species.
- C. dissolve in water prior to their action.
- D. signal danger between members of different species.

Question 14

The following diagram shows the interaction of a plant hormone (GA) within a germinating seed



<http://www.vce.bioninja.com.au/aos-2-detecting-and-respond/coordination--regulation/plant-hormones.html>

The GA activates a section of DNA that leads to a growth response. The correct order of this process is

- A. response, transduction and reception.
- B. transduction, expression and response.
- C. activation, expression and reception.
- D. reception, transduction and response.

Question 15

During apoptosis the action of caspase is to

- A. endocytose apoptotic bodies.
- B. cleave cytoskeletal proteins.
- C. activate cytochrome C in the mitochondria.
- D. direct the external signal to stimulate the internal apoptotic pathway.

Question 16

If the rate of cell replacement is greater than the rate of apoptosis in a fully grown individual, then

- A. cancer could develop.
- B. degenerative disorders such as Alzheimer's could develop.
- C. necrosis could impact on the health status of the individual.
- D. normal development would continue indefinitely.

Question 17

A pathogen was causing disease in a cow. The pathogen was isolated from the cow and analysed in a laboratory so it could be categorised. Microscopically it had a nucleus and a distinct cell wall. Based on this information it is likely to be

- A. the bacteria *E. coli* causing mastitis.
- B. the infectious bovine rhinotracheitis virus, a type 1 bovine herpesvirus (BHV1).
- C. fungal endometriositis in bovines, which causes persistent infection in the uterus when certain predisposing factors occur, like prolonged use of antibiotics.
- D. the protist Babesiosis causing the malaria-like infection called Texas cattle fever.

Question 18

Pineapple contains an enzyme called bromelain that when consumed, digests any protein it comes in contact with. Pineapple farmers have very little trouble with crop destruction due to opportunistic insects feeding on the fruit. However, when insects do attempt to feed on pineapple fruit the bromelain acts as a

- A. physical defence barrier.
- B. chemical defensive barrier.
- C. mechanical defensive barrier.
- D. combination of physical, mechanical and chemical defence.

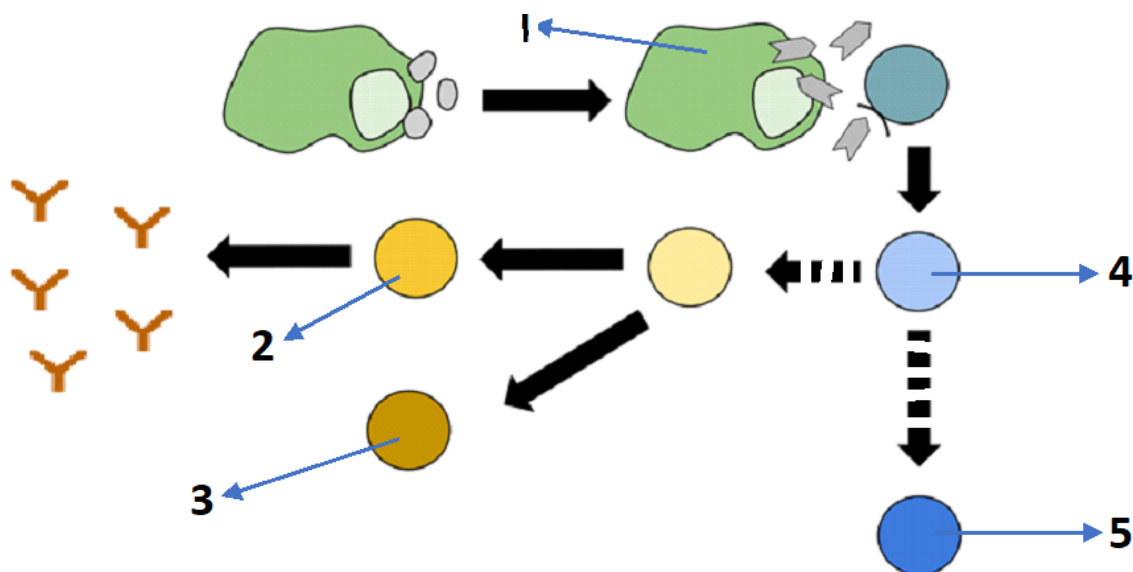
Question 19

When the human body is first exposed to a pathogen in the bloodstream the innate immune response acts first against the pathogen. It is reasonable to assume that this initial response would involve

- A. Lymphocytes.
- B. Antibodies.
- C. Plasma cells.
- D. Neutrophils.

Question 20

There are many cells involved in active immunity against pathogens and they have a bewildering number of names. These names include Antigen Presenting Cells (APC), Helper T cells, Plasma cells, Cytotoxic T cells and Memory B cells. The numbers in the diagram represent those cells



Modified from: https://en.wikipedia.org/wiki/Immune_response#/media/File:Immune_Response.svg

Cells 1-5 would be called

	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5
A.	APC	Cytotoxic cell	Memory cell	Plasma cell	Helper cell
B.	Memory cell	APC	Cytotoxic cell	Helper cell	Plasma cell
C.	Killer cell	Helper cell	Plasma cell	Memory cell	APC
D.	APC	Plasma cell	Memory cell	Helper cell	Cytotoxic cell

Question 21

Yoshi accidentally ate a peanut which triggered an allergic reaction that required emergency treatment before he completely recovered. As Yoshi was going through an allergic reaction against the allergen in the peanut, it would be expected that

- A. antigens bound to mast cells would activate the endocytosis of histamine into tissue fluid in areas surrounding the airways.
- B. histamines will be released from mast cells that stimulate vasoconstriction of blood vessels that directs more blood to the airways, causing inflammation in that area.
- C. antibodies bound to mast cells to form cross links with the allergen, which stimulates the mast cell to release histamine by exocytosis.
- D. mast cells to release interferon to alert localised cells of the allergic reaction.

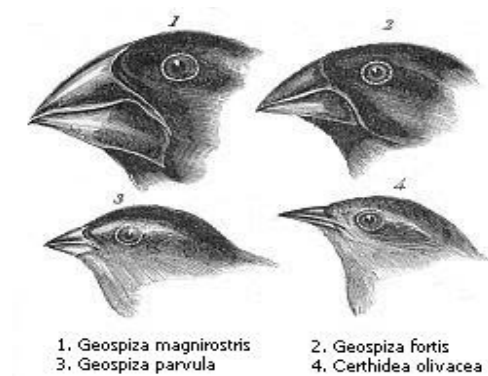
Question 22

The anopheles' mosquitoes are the vector of the malarial plasmodium that, in humans, causes malaria. DDT has been used, since the 1950s, as an insecticide to eradicate the mosquitoes, however the mosquitoes are now virtually resistant to the effect of DDT. It would be appropriate to conclude that

- A. the frequency of resistant alleles in the mosquito population increased during the 1950s.
- B. resistant alleles would have appeared in the mosquito population during the 1950s.
- C. non-resistant mosquito phenotypes were at a selective advantage after the 1950s.
- D. the malarial plasmodium has become more resistant against DDT.

The next 2 questions refer to the following information

The following diagram illustrates 4 species (1 - 4) of the many Darwinian finches that are located on some of the Galapagos islands in the Pacific Ocean a few hundred km from the South American mainland. They are the descendants of an original species from the South American mainland that left the mainland about 2 million years ago



<http://frizzledthoughts.blogspot.com/2009/10/four-finches-on-my-shoulder.html>

Question 23

The process that led to species 2 and 3 could be described as

- A. allopatric speciation.
- B. artificial selection.
- C. gene flow.
- D. the founder effect.

Question 24

When comparing species 1 and 4 it would be reasonable to conclude that

- A. they could breed to produce species 2.
- B. that species 4 mutated to develop a thicker beak and so evolved into species 1.
- C. they would be unable to produce viable offspring.
- D. that in an environment of small insect species 1 changed into species 4.

Question 25

The Black Robin population in New Zealand is still recovering from its low point in 1980, when cats and rats depleted the population to a mere five individuals. One of those was called Old Blue and every specimen of the Black Robin is a descendant of Old Blue. This is an example of

- A. gene flow.
- B. the founder effect.
- C. a population bottleneck.
- D. speciation.

Question 26

Over the past few million years, blind forms of the Mexican tetra (*Astyanax mexicanus*) have evolved in caves; however, their ancestors did not live in caves and were able to see. The blind forms do retain an eye groove that is smaller and doesn't detect light in the same fashion as Mexican tetras that can see. Maintaining eyes and the visual parts of the brain uses lots of energy, so the loss of eyes is a big advantage for animals living in the dark. Instead the cavefish "see" by sucking. The presence of a smaller eye groove is an example of

- A. an analogous structure.
- B. a vestigial structure.
- C. an evolutionary dead-end.
- D. adaptive radiation.

Question 27

The following diagram shows a spider fossil found in China in sedimentary rock, which was dated to be about 165 million years old



<https://www.wired.com/2010/10/best-fossils/>

Based on this information it would be reasonable to conclude that

- A. stratigraphic layers higher in the ground would be ancestral to this spider fossil.
- B. the half-life of radioisotopes located in volcanic layers closer to the surface than those closer to the spider would illustrate an older layer in comparison.
- C. the spider died in a watery environment that was cold and with low oxygen levels.
- D. the spider would be a transitional fossil between insects and centipedes.

Question 28

The best description of a primate is they are

- A. also a hominin.
- B. always bipedal.
- C. a tailless mammal.
- D. an organism with an opposable 5th digit as well as stereoscopic vision.

Question 29

Some *Homo sapiens* share 3-4% of their genomes with *Homo neanderthalensis* because

- A. Neanderthals and Humans belong to the same species.
- B. Neanderthals and Humans cross bred before leaving Africa.
- C. after leaving Africa, Humans located in the same area as Neanderthals bred with each other.
- D. Humans and Neanderthals once had a common ancestor and the 3-4% of shared DNA is a molecular homology.

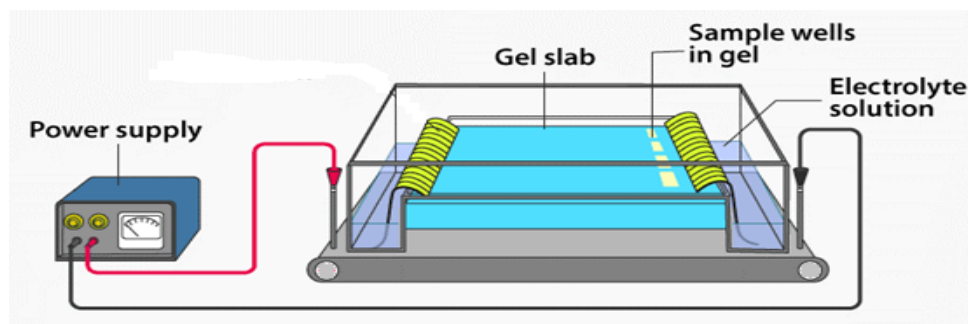
Question 30

The most reliable method that could be used to determine the absolute age of a lump of organic and cellular material found at an archaeological dig would be to

- A. determine the amino acid sequence of the proteins and compare this to the known sequences of modern day cells.
- B. compare a sequence DNA nucleotide from the cellular material to homologous sequences of modern day cells.
- C. compare the location of the cellular material to other similar lumps of cellular material found in the same area.
- D. use potassium rubidium dating to determine the age of the material.

The next 2 question refers to the following diagram.

The diagram below is a profile of a gel electrophoresis tank with various parts labelled



Modified from: <https://byjus.com/chemistry/types-of-electrophoresis/>

Question 31

The correct sequence of steps required to successfully complete a gel electrophoresis cycle would be

	Step 1	Step 2	Step 3	Step 4	Step 5
A.	Turn on the power for 20 minutes	Add the electrolyte solution	Place the gel slab in the tank	Place the DNA into the sample wells	Turn off the power
B.	Add the electrolyte solution	Place the gel slab in the tank	Place the DNA into the sample wells	Turn on the power for 20 minutes	Turn off the power
C.	Place the gel slab in the tank	Turn on the power for 20 minutes	Turn off the power	Add the electrolyte solution	Place the DNA into the sample wells
D.	Add the electrolyte solution	Turn on the power for 20 minutes	Place the DNA into the sample wells	Turn off the power	Place the gel slab in the tank

Question 32

The terminals on the gel tank are not labelled. The most accurate scenario based on the movement of DNA in the gel as well as the charges on the terminals would be

- A. the DNA added to the gel in the sample wells would move to the right and get pushed into the electrolyte solution if the terminal near the power supply was positive.
- B. the DNA added to the sample wells would move to the left and spread out in the gel slab if the terminal furthest from the power supply was negative.
- C. the DNA added to the sample wells in the gel will move across the top surface of the gel slab towards the negative terminal due to the attractive forces of the electrolyte.
- D. if the power supply is turned off the DNA will continue to move towards the negative terminal indefinitely.

Questions 33 and 34 refer to the following information.

Sickle cell anaemia (SCA) is a life-threatening genetic disorder and relates to the production a fully functional haemoglobin protein coded for by the HBB gene. There are 2 alleles that exist for this genetic disorder, a normal form of about 500 nucleotides and a sickle form also of 500 nucleotides. There is a point mutation on the sickle allele that does not have the same endonuclease recognition site (*mstII*) as that found on the normal allele. The point mutation is located at about the 200th nucleotide along the allele. Individuals can have 2 copies of the normal allele (NN) and not suffer SCA. Individuals can have 1 normal copy and 1 sickle copy of the allele (Nn) making them a carrier of SCA. Individuals can have 2 copies of the sickle allele (nn) making them a sufferer of SCA. This enables genetic profiles of individuals to be constructed using gel electrophoresis.

Question 33

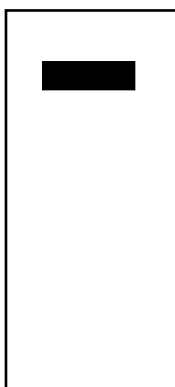
A point mutation in the case of sickle cell anaemia would be caused by

- A. a change in a single nucleotide within the HBB gene.
- B. the addition of a single nucleotide within the HBB gene.
- C. the deletion of a single nucleotide within the HBB gene.
- D. a change in a single amino acid in the haemoglobin protein.

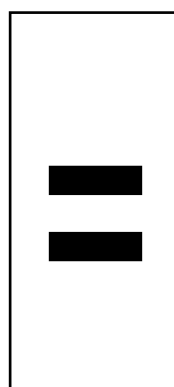
Question 34

If DNA samples were added to the gel at the top, the appropriate profile for a sickle cell sufferer (nn) would be

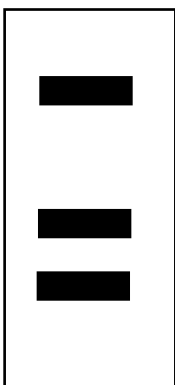
A.



B.



C.



D.



Question 35

The factors (materials) that should be added to an Eppendorf tube prior to applying PCR to it would be

- A. DNA sample, Primers, Nucleotides, DNA ligase.
- B. DNA sample, DNA polymerase, Nucleotides, DNA ligase.
- C. *Taq* polymerase, Primers, Nucleotides, DNA polymerase.
- D. Primers, Nucleotides, *Taq* polymerase, DNA sample.

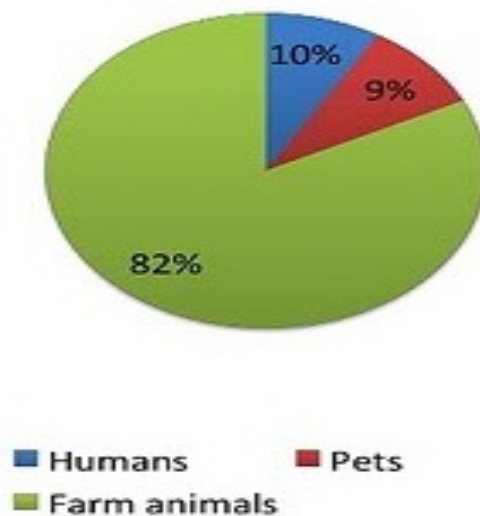
Question 36

Influenza can be a life-threatening viral disease. All Australians were encouraged to get the 2020 Fluvax (vaccination) as a preventative measure not just against 4 strains of influenza, but also against COVID-19. An appropriate reason for this would be

- A. being immune to influenza means individuals are also immune to COVID-19.
- B. immunity to influenza means there will be less strain on hospitals when outbreaks of COVID-19 sporadically happen.
- C. when 85% of Australians are vaccinated against influenza, herd immunity is achieved.
- D. the symptoms of influenza and COVID-19 are the same.

Question 37

The following pie chart demonstrates the proportion of antibiotic use distribution in Australia



If less antibiotics were used with farm animals, it would be expected that

- A. a greater proportion of antibiotic resistant bacteria would appear in the human population.
- B. weaker antibiotics could be prescribed to humans.
- C. the sales of farm animals would increase.
- D. less antibiotic resistant bacteria would be present in the human population.

Question 38

Bacteriophage virus (virus that target bacteria) is a promising alternative to administering antibiotics. If the use of bacteriophage therapy gets to clinical trials, then there would be 2 groups of humans all with a bacterial infection exposed to either the bacteriophage or a placebo. Factors to be considered when generating data would be

- A. all the subjects should all be the same age.
- B. the placebo and experimental groups should know which group they are in.
- C. the of concentration bacteriophage provided should be the same for everyone in the experimental group.
- D. all the subjects should be the same ethnicity.

Question 39

Consider the following hypothesis:

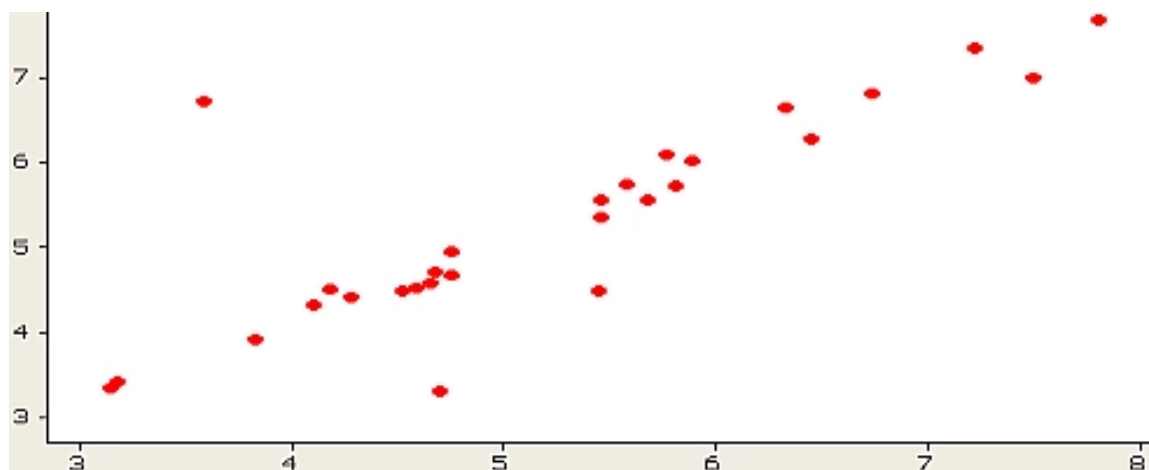
“If the level of ultra violet light is increased from 0 to 10 mW/cm² the risk of skin cancer will increase with an increase in USEPA (probability of developing cancer over a lifetime)”

There are several factors that must be included to make it a valid hypothesis such as

- A. the IV (USEPA), the DV (mW/cm²) and a prediction.
- B. the IV (mW/cm²) and the DV (USEPA).
- C. a prediction.
- D. the IV (mW/cm²), the DV (USEPA) and a prediction.

Question 40

The following graph



- A. has several outliers that do not change the obvious trend.
- B. is not properly scaled.
- C. is appropriately labelled.
- D. would support the hypothesis it was intended to test.

END OF SECTION A

SECTION B – Short answer questions**Question 1 (Total 6 marks)**

Different organelles have different roles to play in the manufacture and secretion of a protein product. The function of these organelles involved in this overall process are listed below but are completely jumbled up.

- A. Proteins enclosed in a small membrane are starting to fuse with the plasma membrane.
- B. A stack of membranous sacs that pinch off in small packages containing a modified protein product.
- C. A transcription factor is stimulating the activation of a specific gene.
- D. 2 subunits combine to allow polypeptides to be manufactured.
- E. A network of tubes enabling the efficient transport of proteins within the cell.

- a) (i) Name the organelles.

Function	Organelle Name
A.	
B.	
C.	
D.	
E.	

(2 marks)

- (ii) List the functions (A to E) collectively together in sequential order in the manufacture and secretion of a protein.

(1 mark)

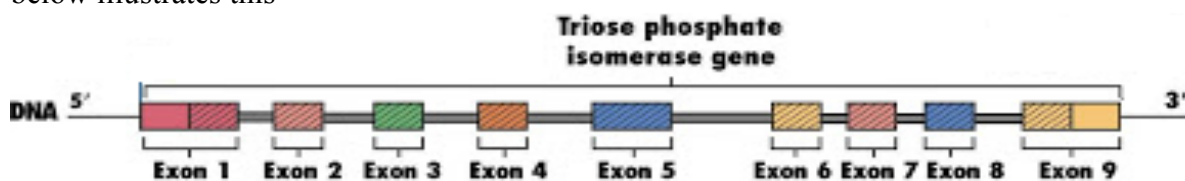
Some organelles within eukaryotic cells have a well-researched history relating to their origins. When a large amount of evidence abounds, theories begin to be developed. One such theory related to endosymbiosis.

- b) In the space below, draw a labelled diagram of a chloroplast that shows evidence of the endosymbiotic theory. Illustrate in your diagram how the labelled structure is demonstrative of this evidence.

(3 marks)

Question 2 (Total 7 marks)

The triose phosphate isomerase (TPI) gene from maize is composed of 9 exons and 8 introns. (Triose phosphate isomerase is one of the enzymes in the glycolysis/gluconeogenesis pathway). The diagram below illustrates this



From: <https://sandwalk.blogspot.com/2007/06/rna-splicing-introns-and-exons.html>

- a) (i) What binds upstream from exon 1 to initiate transcription?

(1 mark)

- (ii) Discuss evidence from the diagram that shows that the proteome has many more polypeptides than the genome has genes.

(2 marks)

The table below shows the coding strand of exon 3.

Coding	G	A	G	T	T	A	C	G	T	A	G	A
Template												

- b) Complete the sequence of the template strand in the table above.

(1 mark)

The following table gives anticodons and their corresponding amino acids.

Amino acid	Anticodon
Aspartic acid (asp)	CUG CUC
Arginine (arg)	UCU UCC GCU GCA GCC GCG
Leucine (leu)	AAC AAU GAC GAG GAA GAU
Glutamic acid (glu)	GAA GAG
Asparagine (asn)	UUA UUG
Methionine (met)	AUG

- c) (i) How many possible anticodons exist in total?

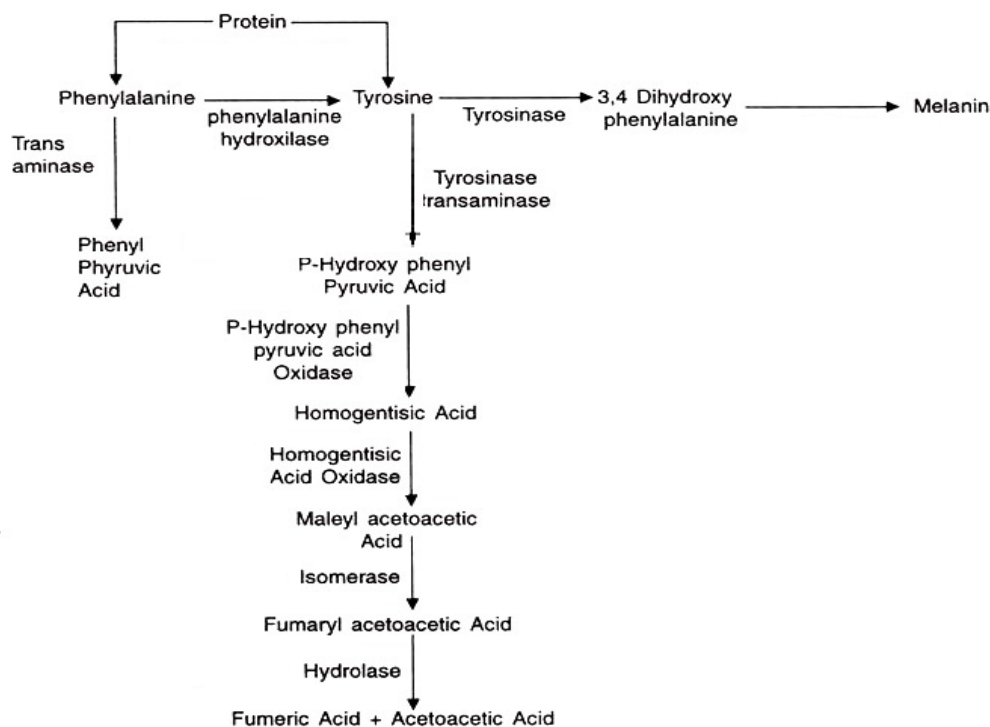
(1 mark)

- (ii) What is the amino acid sequence of exon 3? (use the space below for working out)

Amino acid sequence: _____ (2 marks)

Question 3 (Total 10 marks)

The metabolism of phenylalanine within human cells is illustrated in the biochemical pathway below. The protein at the top of the diagram is obtained through the diet and provides the amino acids phenylalanine and tyrosine.



- a) (i) How many enzymes are included in the diagram?

(1 mark)

- (ii) Describe 2 properties of Hydrolase and explain how each property relates specifically to the function of hydrolase.

(4 marks)

Question 3 (continued)

Phenylketonuria (PKU) is a genetic disorder that leads to a very low concentration of phenylalanine hydroxylase within human cells.

- b)** Describe the main imbalance in the biochemical pathway of PKU sufferers.

(1 mark)

Albinism is another genetic disorder that is caused by a low level of tyrosinase. Albinism is caused due to a lack of melanin in skin.

- c)** Explain why sufferers of albinism are not necessarily PKU sufferers as well considering both conditions are derived from the same biochemical pathway.

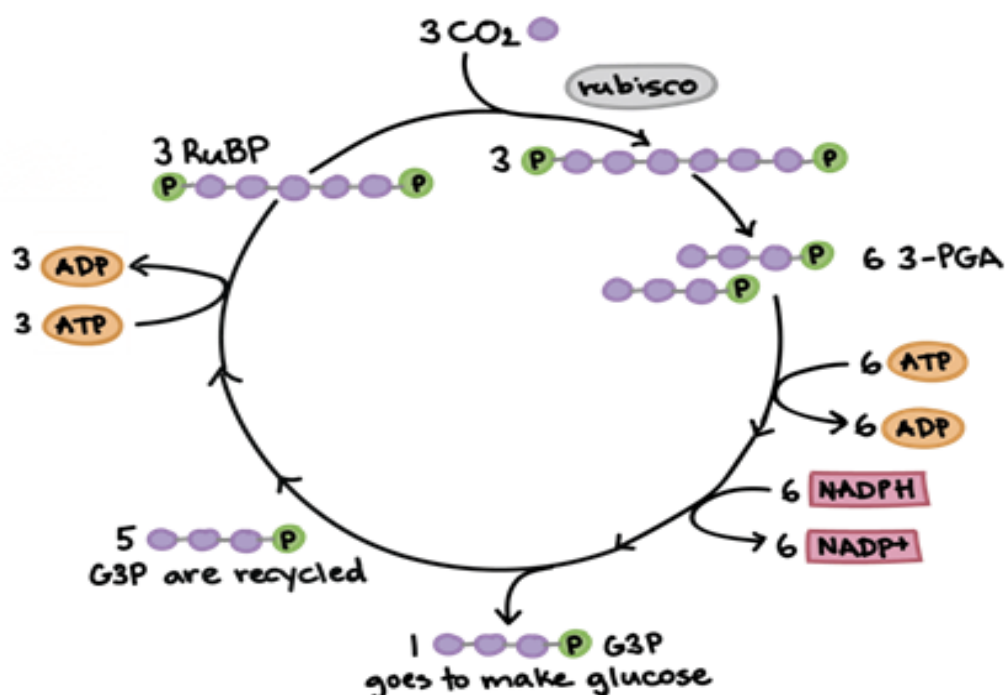
(2 marks)

- d)** How can this biochemical pathway occur in the cytosol, the same location as glycolysis?

(2 marks)

Question 4 (Total 5 marks)

The biochemical diagram below represents the light independent reaction (Calvin Cycle) occurring inside a photosynthesising eukaryotic cell.



Modified from: <https://www.biologyjunction.com/calvin-cycle-definition>

- a) State the specific cellular location of this reaction within a eukaryotic cell.

(1 mark)

- b) Explain the importance of both ATP and NADPH in the conversion of 3-PGA into G3P.

(2 marks)

- c) Why is the light independent reaction above also called a cycle (Calvin Cycle)?

(2 marks)

Question 5 (Total 7 marks)

The following diagram shows the hormone bonding sites on 3 similar cells of the body.



<http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/basics/hormones.html>

- a) Describe how hormone A could stimulate a response in the cell that is the target cell only for hormone A.

(1 mark)

- b) Explain how hormone A and B could cause the different overall responses in the cells illustrated above.

(2 marks)

- c) Use the diagram to explain the chemical nature of hormone A and B.

(1 mark)

There are many kinds of signalling molecules other than hormones, which include pheromones, neurotransmitters and cytokines.

- d) Describe a similarity that all of these different types of signalling molecules have that enables them to elicit a response.

(1 mark)

Question 5 (continued)

A competitive inhibitor of hormone B can be used in the body as a form of therapy when there is an excess of hormone B.

- e) Draw in the space below how a competitive inhibitor could lower the response caused by an excess of hormone B.



(2 marks)

Question 6 (Total 8 marks)

The novel coronavirus (COVID-19) has proven to be a very tricky disease to contain. As of the 19th June 2020 there were 8,785,293 cases and 462,898 deaths making it a disease requiring containment. When researching the transmission of diseases such as the coronavirus, various factors need to be considered. Some of these factors are listed below.

- Transmission rate of 3-4
- Incubation period of 2-14 days

a) Explain how these factors listed above would be calculated.

(2 marks)

b) Describe the general structure of a virus such as the coronavirus.

(1 marks)

There are currently 4,682,487 individuals that have fully recovered.

c) Outline the role of the humoral and the cell mediated immune response in those recovered individuals.

(2 marks)

COVID-19 is referred to as a novel coronavirus because humans have not been exposed to the viral antigens before (due to it jumping from animals to humans) and therefore the world's immunity is very low. However, our immunity against other coronavirus such as influenza is stronger because, even though there are new mutations, humans have been previously exposed to the virus or had a vaccination and therefore have greater immunity.

d) (i) State the main content(s) present in a vaccine against coronavirus such as influenza.

(1 mark)

(ii) Using an understanding of the immune system, explain why the human immune system is less equipped to fight against COVID-19 than it is against influenza.

(2 marks)

Question 7 (Total 6 marks)**160 years of Charles Darwin's ideas**

The theory of evolution by natural selection, first formulated in Darwin's book "On the Origin of Species" in 1859, is the process by which organisms change over time as a result of changes in heritable physical or behavioural traits, which allow an organism to better adapt to its environment will help it survive and have more offspring.

Evolution by natural selection is one of the best substantiated theories in the history of science, supported by evidence from a wide variety of scientific disciplines, including palaeontology, geology, genetics and developmental biology. In his book, Charles Darwin speculated about how natural selection could cause a land mammal to turn into a whale, but he used North American black bears instead of cows and hippopotamuses, which is the current acceptable model. The story of the origin of whales is one of evolution's most fascinating tales and one of the best examples scientists have of natural selection.

The evolution of the blowhole, for example, might have happened in the following way: Random genetic changes resulted in at least one ancestor to the whale having its nostrils placed farther back on its head. Those animals with this adaptation would have been better suited to a marine lifestyle, since they would not have had to completely surface to breathe. Such animals would have been more successful and had more offspring. In later generations, more genetic changes occurred, moving the nose farther back on the head.

From: <https://www.livescience.com/474-controversy-evolution-works.html>

- a) Discuss 2 inaccuracies within the first paragraph of the article.

(2 marks)

- b) How does 'genetics' provide evidence in support of Evolution by natural selection?

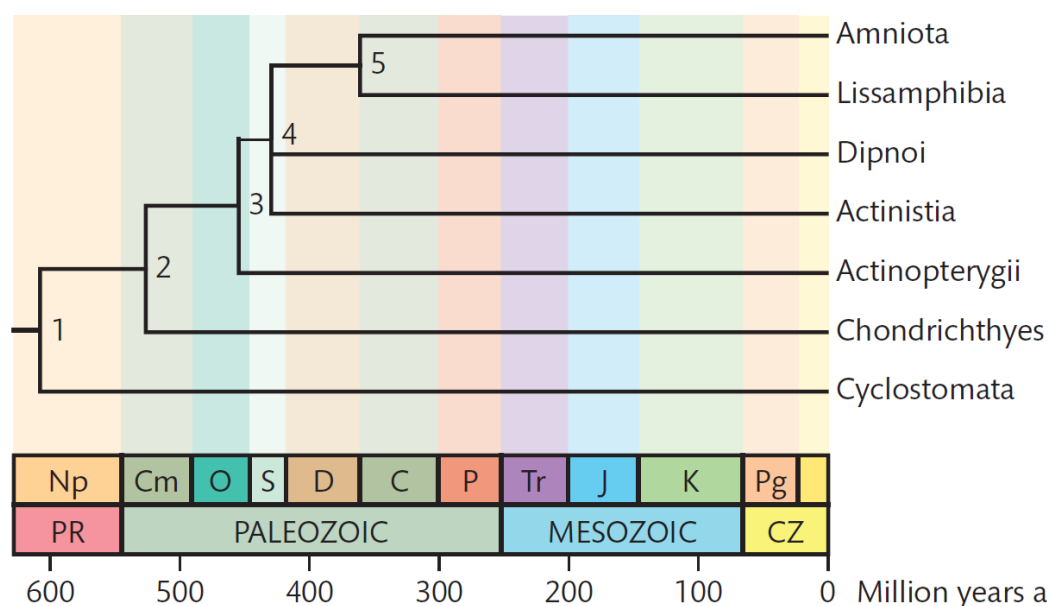
(2 marks)

- c) When comparing a modern whale with the land mammal ancestor, how would evidence in the disciplines of developmental biology and geology support this scenario?

(2 marks)

Question 8 (Total 5 marks)

The following phylogenetic tree illustrates the evolution of vertebrates over the last 600 million years. Branches 1-5 are significant moments in the diversification of the vertebrates.



From: <https://en.wikipedia.org/wiki/Timetree>

- a) (i) List the 2 most closely related vertebrates from the phylogenetic tree above.

(1 mark)

- (ii) How long ago did the Actinopterygii (a subclass of bony fish) group diverge from the other vertebrates?

(1 mark)

- (iii) Branch 4 was a significant event that led to 3 branches in the phylogenetic tree. It was due to a geographic barrier separating the common ancestor into 3 groups which, over time, evolved into 3 new species. The name of this process is

(1 mark)

The fossilised remains of the ancestor to all vertebrates was absolutely dated to be 600 million years old. This was done by dating volcanic rock using Uranium 235 (with a half-life of 700 million years) in very close proximity to the fossil.

- b) Describe how volcanic rock could be dated to be 600 million years old using Uranium 235.

(2 marks)

Question 9 (Total 7 marks)

DNA can be used as a molecular clock to determine evolutionary relationships between hominins and some hominoids.

- a)** What is the difference between a hominin and a hominoid?

(2 marks)

DNA has an average mutation rate of about 1 nucleotide substitution every 10,000 years.

- b)** Why is this described as the ‘average’ mutation rate?

(2 marks)

A sequence of 100 DNA nucleotides from a particular loci was analysed between 4 hominins of unknown age. Each hominin was compared to the same loci from a modern African. The data gained is illustrated in the table below.

Individual	Number of nucleotide differences
1	20
2	6
3	16
4	55

- c)** According to this data, how long ago did individual 1 diverge from the modern African they were compared to?

(1 mark)

There is much more variability in the data gained when measuring the age of older hominins compared to more recent ones. This is partly due to the saturation phenomenon, where individual sites experience multiple mutations.

- d) (i)** How could multiple mutations in a single site lead to inaccurate conclusions of the age of a hominin?

(1 mark)

- (ii)** Based on this information, is individual 4 likely to have existed more or less recently than the average data indicates?

(1 mark)

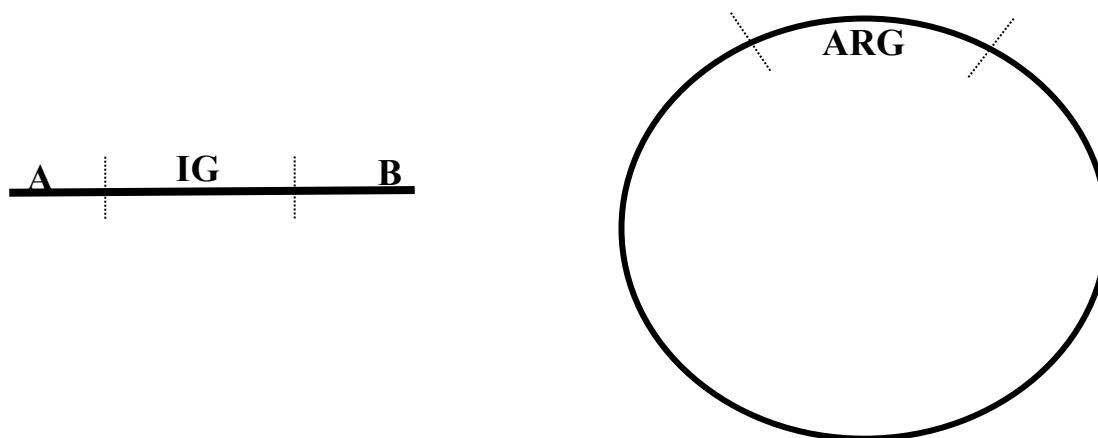
Question 10 (Total 9 marks)

The construction of transgenic organisms is a thriving business in areas such as medicine and agriculture. One example is transgenic *E. coli* with the human insulin gene embedded in the bacterial genome so the bacteria can express the insulin protein. This is extremely useful in the daily management of type 1 diabetes. The methods used to transfer the gene from a human cell to a bacterial cell has a variety of steps. To successfully produce the transgenic *E. coli*, PCR, restriction enzymes, plasmids, non-transgenic *E. coli* and DNA ligase are all used.

a) What does PCR stand for?

_____ (1 mark)

The diagram below shows a section of human DNA showing the location of the insulin gene (IG) as well regions on each side (A and B) and a plasmid showing the location of an ampicillin resistant gene (ARG).



b) Describe the method used to get the IG into the plasmid. In your answer include the type of restriction enzyme(s) used, the location(s) along the genome(s) of the binding site(s) and when DNA ligase would be used in the process.

_____ (4 marks)

Question 10 (continued)

- c) The technique of transforming the bacteria is hit and miss. In other words, most of the bacteria exposed to the genetically modified plasmid do not take up the plasmid. Outline the method used to ensure that the transformed bacteria can be identified.

(2 marks)

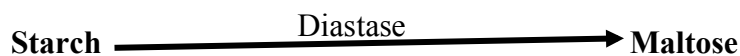
- d) Identify one social and one economic reason as to why this specific type of technology is beneficial to society

Issue	Reason
Social	
Economic	

(2 marks)

Question 11 (Total 10 marks)

Diastase is an enzyme involved in the hydrolysis of starch as shown in the diagram below.



A VCE Biology student was conducting her EPI experiment to investigate the effect of temperature on the activity of diastase. The following method was included on the final poster.

- Two 5ml test tubes of starch were made up
- Both test tubes were incubated at different temperatures
- 5ml of 0.5% diastase was added to each test tube
- After 5 minutes a drop of iodine was added to each solution
- A colorimeter was used to measure the darkness of the solution (more darkness = more starch)

The results of this experiment are shown below

Temperature (°C)	Darkness of solution (arbitrary units)
30	22
50	85

- a) State the hypothesis being tested.

(1 mark)

- b) State 2 problems with the experimental method written above and explain how these flaws could lead to unreliable results.

(2 marks)

- c) (i) Describe how this experiment could have been made more precise.

(1 mark)

- (ii) What would be a control in an experiment such as this one?

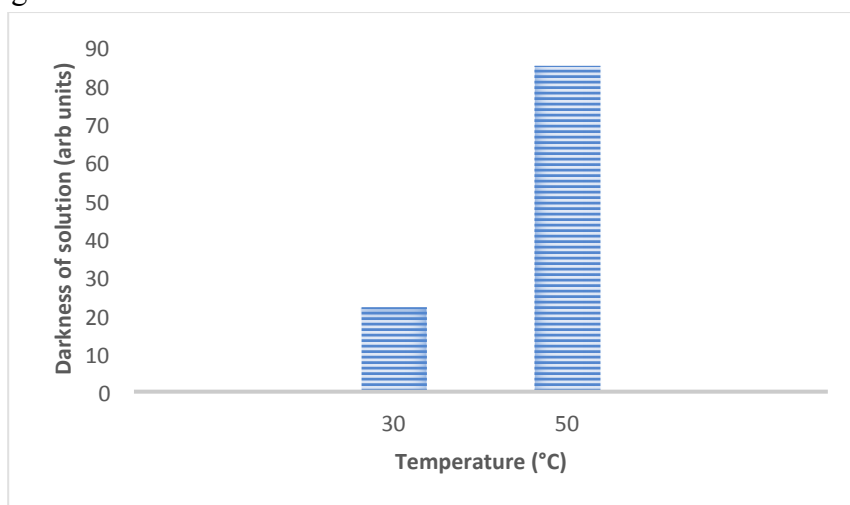
(1 mark)

Question 11 (continued)

- d) List 3 factors /conditions that would need to be considered to ensure the experiment was more valid.

(2 marks)

The following graph was presented on the poster that displayed the results in the table on the previous page.



- e) One of the comments from the teacher was that the graph was the incorrect type. Explain why you agree or disagree with the teacher's comment.

(1 mark)

- f) Use the data to explain the trend demonstrated in this experiment.

(2 marks)

End of questions for the 2020 Kilbaha VCE Biology Trial Examination Units 3 and 4

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