

2018 VCE Biology Trial Examination



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VICTORIAN CERTIFICATE OF EDUCATION

Year 2018

STUDENT NUMBER

Letter

Figures		
Words		

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BIOLOGY

Trial Written Examination

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
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 38 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.

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VCE BIOLOGY 2018

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	21.	A	B	C	D
2.	A	B	C	D	22.	A	B	C	D
3.	A	B	C	D	23.	A	B	C	D
4.	A	B	C	D	24.	A	B	C	D
5.	A	B	C	D	25.	A	B	C	D
6.	A	B	C	D	26.	A	B	C	D
7.	A	B	C	D	27.	A	B	C	D
8.	A	B	C	D	28.	A	B	C	D
9.	A	B	C	D	29.	A	B	C	D
10.	A	B	C	D	30.	A	B	C	D
11.	A	B	C	D	31.	A	B	C	D
12.	A	B	C	D	32.	A	B	C	D
13.	A	B	C	D	33.	A	B	C	D
14.	A	B	C	D	34.	A	B	C	D
15.	A	B	C	D	35.	A	B	C	D
16.	A	B	C	D	36.	A	B	C	D
17.	A	B	C	D	37.	A	B	C	D
18.	A	B	C	D	38.	A	B	C	D
19.	A	B	C	D	39.	A	B	C	D
20.	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.

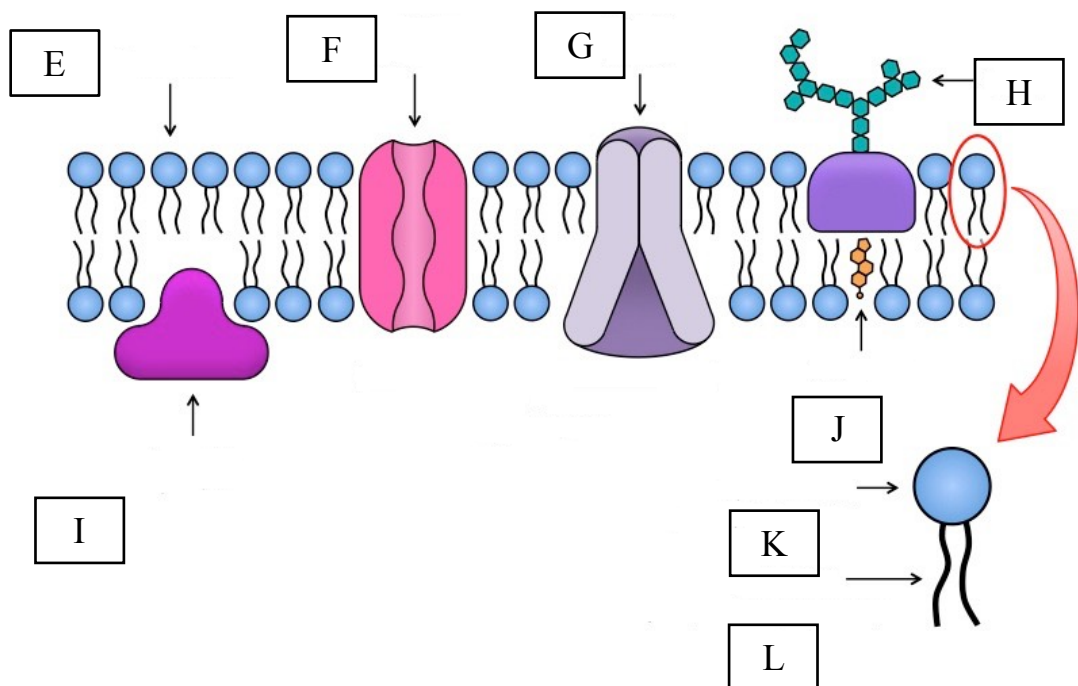
A correct answer scores 1, an incorrect answer scores 0.

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 2 questions refer to the following information and diagram

The diagram below is a representation of a cell membrane. Structures E to L are important components that assist the functioning of the membrane.



Modified from: <https://bit.ly/2Mc74da>

Question 1

Phospholipid is represented by

- A. E
- B. H
- C. K
- D. L

Question 2

The structure that allows the membrane to maintain fluidity in cold temperatures is

- A. F
- B. G
- C. I
- D. J

Question 3

Which type of biomolecule is most likely to move through a protein channel embedded within the plasma membrane of a neuron at the site of an electrical stimulus

- A. Large non polar biomolecules
- B. Small lipophilic biomolecules
- C. Large hydrophobic biomolecules
- D. Small polar biomolecules

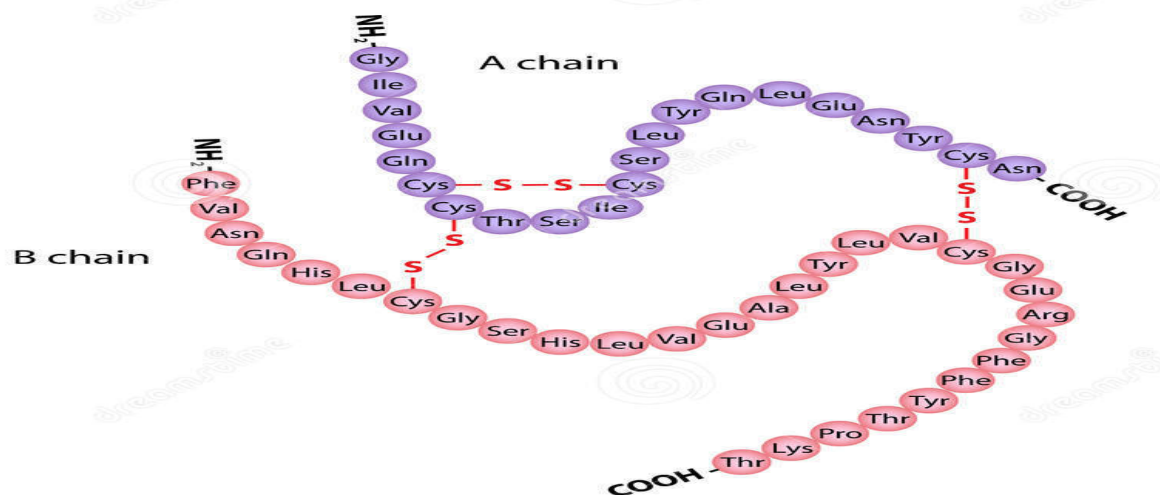
Question 4

The central dogma of biology explains the flow of genetic information within a cell. It explains that nucleic acids provide a blueprint for protein, but proteins do not provide a blueprint for nucleic acids. In other words

- A. The product of translation cannot be converted into the product of transcription
- B. Polypeptides are the blueprint for nucleic acids
- C. The product of translation can be converted into the initial reactant for transcription
- D. The product of transcription cannot be converted into the product of translation

Question 5

The diagram below represents a functional insulin molecule, which is comprised of 2 polypeptide chains (A and B) connected by disulphide bonds



<https://bit.ly/2OUxKO4>

The insulin protein is functional at the

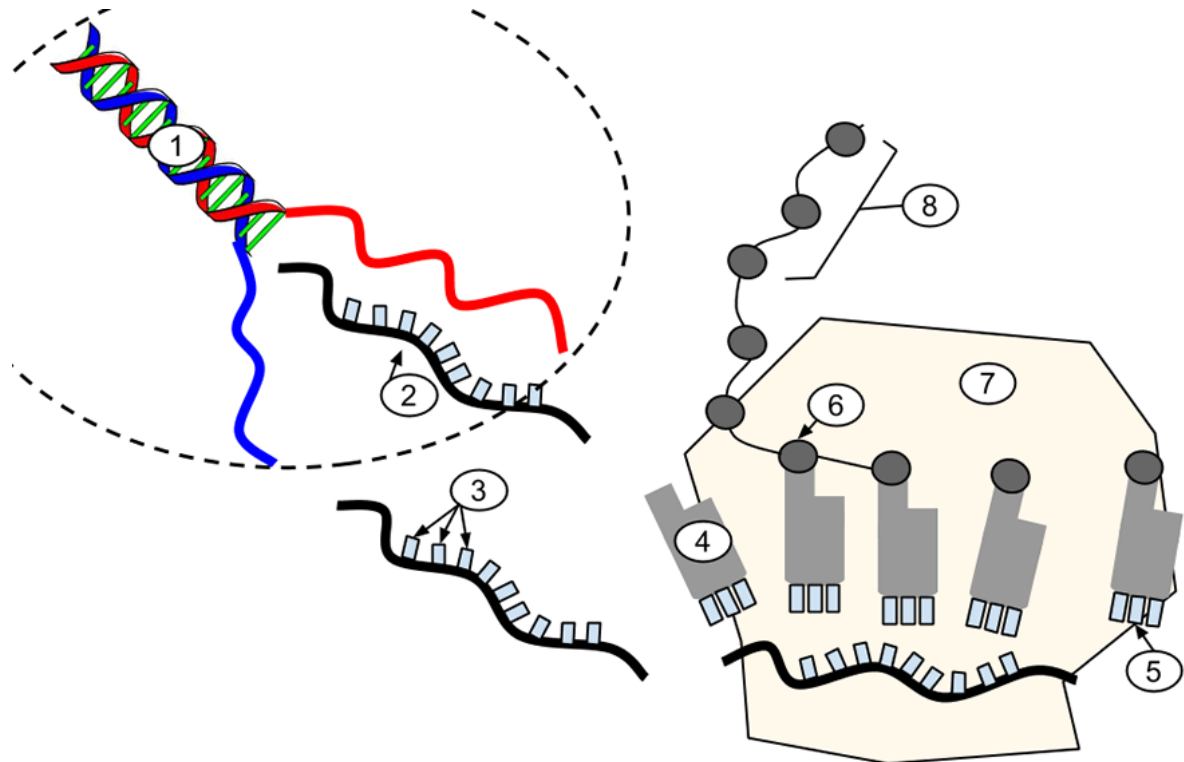
- A. Primary level
- B. Secondary level
- C. Tertiary level
- D. Quaternary level

Question 6

A condensation reaction includes

- A. The joining of two nucleotides together
- B. The conversion of ATP into ADP
- C. The digestion of a polypeptide
- D. All of the steps during glycolysis

The next 2 questions refer to the following diagram of a process occurring in most cells



<https://bit.ly/2Mcq4Id>

Question 7

An antiparallel pair of polynucleotide strands is represented by

- A. 1
- B. 2
- C. 3
- D. 4

Question 8

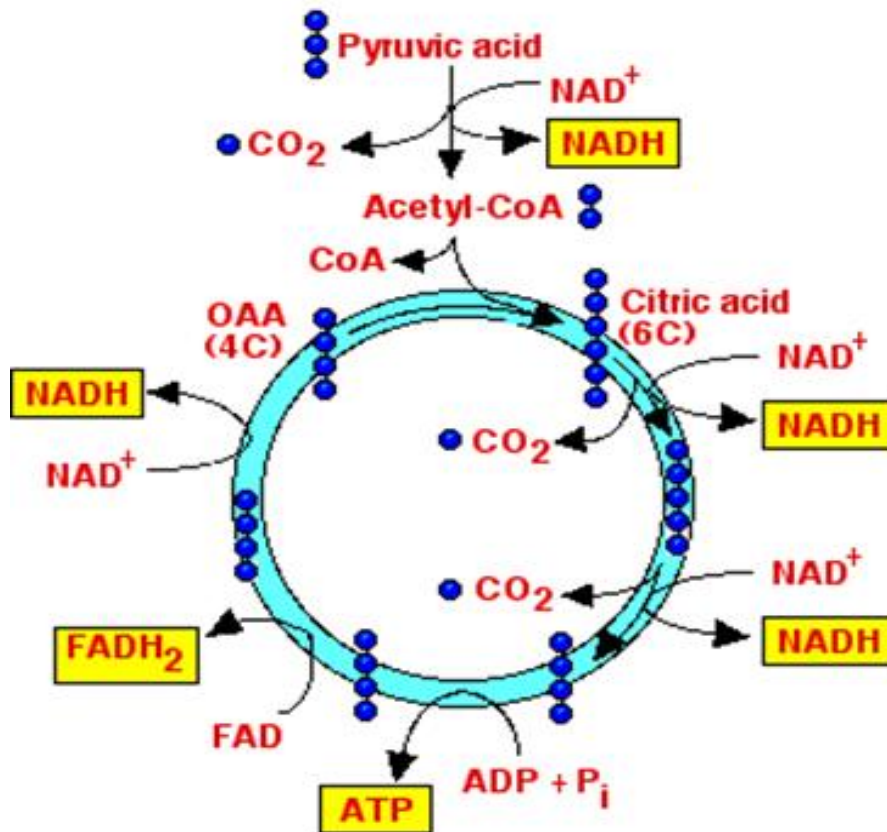
The product of translation is

- A. 5
- B. 6
- C. 7
- D. 8

Question 9

For lactose to be digested by *Escherichia coli*, the following conditions need to be met

- A. The activation of the lactose digesting enzyme β -galactosidase
- B. The expression of the β -galactosidase gene only
- C. The production of β -galactosidase, permease and transacetylase
- D. The binding of RNA polymerase to the operator region of the lac operon gene

Question 10

<https://bit.ly/2vwnAuR>

The chemical reaction illustrated in the diagram above

- A. Occurs in the stroma of the mitochondria
- B. Occurs in the matrix of the mitochondria
- C. Is an endergonic reaction
- D. Is an important step in the synthesis of carbohydrates

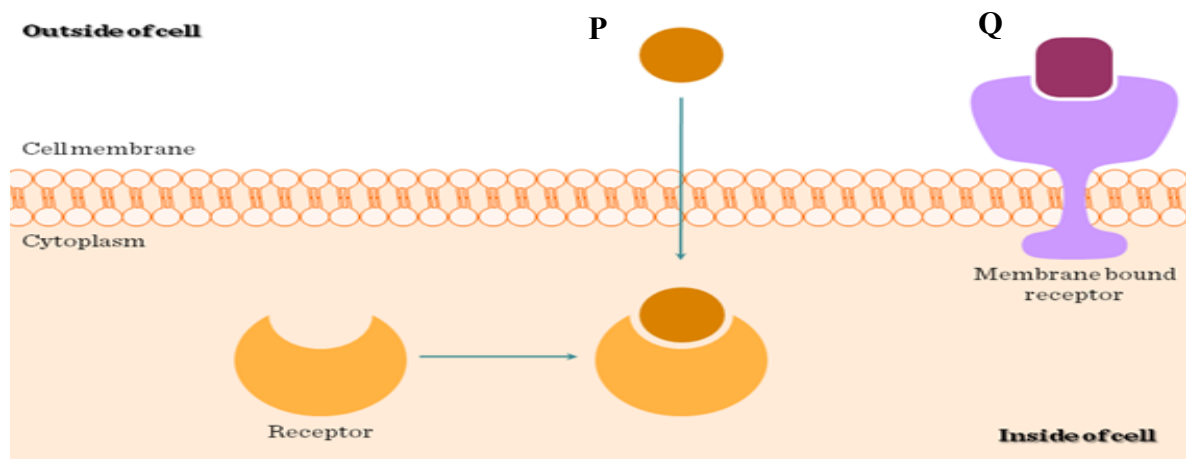
Question 11

When comparing anaerobic with aerobic cellular respiration it is reasonable to state that

- A. Aerobic respiration occurs only in the cytosol and anaerobic respiration occurs in the cytoplasm
- B. Aerobic respiration has many more metabolic steps than anaerobic respiration
- C. Aerobic respiration uses the substrate oxygen but anaerobic respiration uses the substrate carbon dioxide
- D. Aerobic respiration uses NADH as a hydrogen carrier but anaerobic respiration uses NADPH as a hydrogen carrier

Question 12

The following diagram represents how signaling molecules (P and Q) interact with cells



<https://bit.ly/2nmHuE8>

It would be true to state that

- A. Molecule Q is a steroid
- B. Molecule P is a protein
- C. Molecule P is a steroid
- D. Molecule Q has a shape that could bind to any membrane bound receptor

Question 13

Signalling molecules released from a lymphocyte to stimulate the destruction of a viral infected cell are called

- A. Cytokines
- B. Hormones
- C. Pheromones
- D. Neurotransmitters

The next 2 questions refer to the following diagram and information

Insulin is a signalling molecule involved in the regulation of blood glucose. Labels 2 to 6 refer to a variety of cellular actions as a result of the signalling molecule binding to a receptor (1)

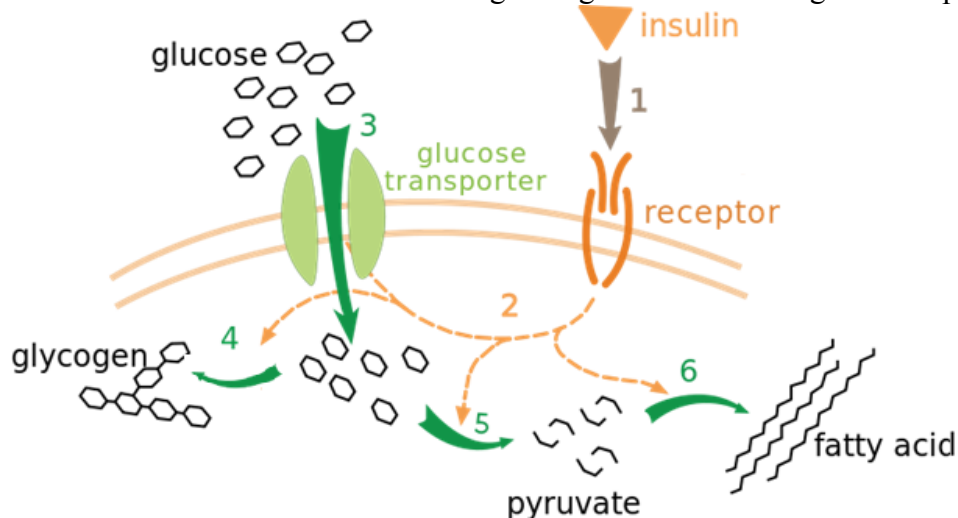


Diagram modified from: <https://bit.ly/2MwCoQG>

Question 14

Signal transduction is referred to by

- A. 2 and 6
- B. 4 and 5
- C. 3 and 4
- D. 2

Question 15

Step 4 in the diagram would be

- A. The activation of glycogen synthase
- B. The activation of glycolytic enzymes
- C. The facilitated diffusion of glucose into the cell
- D. The production of lipids for energy storage

Question 16

Bacteria, viruses and prions can all be pathogenic. An appropriate way of describing these pathogens would be

	Bacteria	Virus	Prion
A.	Cellular	Cellular	Non cellular
B.	Cellular	Non cellular	Cellular
C.	Cellular	Non cellular	Non cellular
D.	Non cellular	Cellular	Cellular

Question 17

As intracellular parasites, plant viruses depend on the host cellular machinery to cause disease in their hosts. Natural barriers such as the waxy cuticle and cell walls reduce the incidence of viruses causing disease in plants but sometimes this is breached; however, the plant will be less likely to develop symptoms of the viral disease if

- A. The plant is vaccinated against the viral pathogen so their immune system can be boosted
- B. A vector such as an insect feeds on the plant removing the food to consume it in a different location
- C. Chemical barriers such as the antiviral chemical protocatechuic acid are within the plant
- D. The virus is a RNA virus rather than a DNA virus

Question 18

The following correctly links a name, diagram and function of the innate immune response to an antigen

	Name	Diagram	Function
A.	B Cell		Detects that foreign material is present in the body and directs the immune system to activate
B.	Complement		A series of soluble proteins that combine on cellular surfaces to assist phagocytosis
C.	Antigen presenting cells		One cell carries many antigens on their surface so that the immune system can activate
D.	Neutrophil		First cells to migrate to the site on a microbial infection. Here they start phagocytosing the invading microbe

Diagrams from: <https://bit.ly/2M5d347>

Question 19

About 11,000 people in Australia have had a functional kidney transplanted into them. The survival rate for each of the recipients is over 95%; however, immunosuppressant medication is needed to be taken every day for life by the recipient. This type of medication targets the T cell response rather than the B cell response because

- A. The B cell response is a cell mediated response that produces antibodies which coat the transplanted cells prior to their destruction.
- B. Both the B and T cellular response need to work in conjunction with each other and so suppressing a T cell response stops both responses activating.
- C. The T cell response is a cell mediated response so the immunosuppressant medication stops specific cytotoxic cellular action.
- D. The T cell response is a humoral response that produces helper T cells that coordinate all aspect immunity thus suppressing it.

Question 20

The new Gardasil 9 vaccine offered through government funded school immunization programs to all 12 to 13 year-old children in Australia will all but eradicate the disease within the next few years. Data in 2018 suggests HPV infection rates have plummeted from 25% to just 1% in young women in the last decade. This

- A. Will confer herd immunity only when there are 0% infection rates
- B. Means that there will be no need to vaccinate against HPV by 2020
- C. Form of artificial passive immunity is effective
- D. Means there will be a very low proportion of HPV viruses within the population thus reducing the chance of it spreading to those who are unvaccinated

Question 21

The following nucleotide sequence exists within a cell prior to transcription

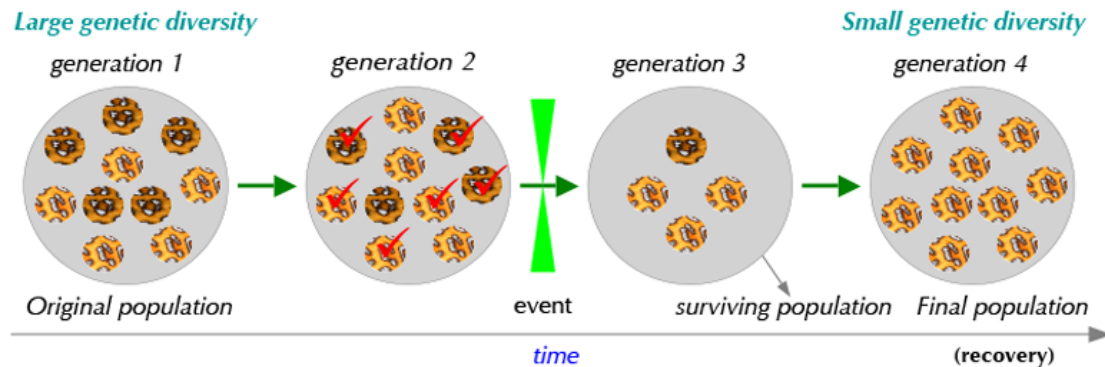
3' GTTAAGCAGTAGTAC5'

The following nucleotide sequence that would represent an inversion mutation at the same loci in another cell would be

- A. 3' GTTAAGGAGTAGTAC5'
- B. 3' GTTAAGCAGTAC5'
- C. 3' GTTGAACAGTAGTAC5'
- D. 3' GTTAAGCCCCAGTAGTAC5'

Question 22

An event occurred in a population of cheetahs that led to the change depicted in the diagram below



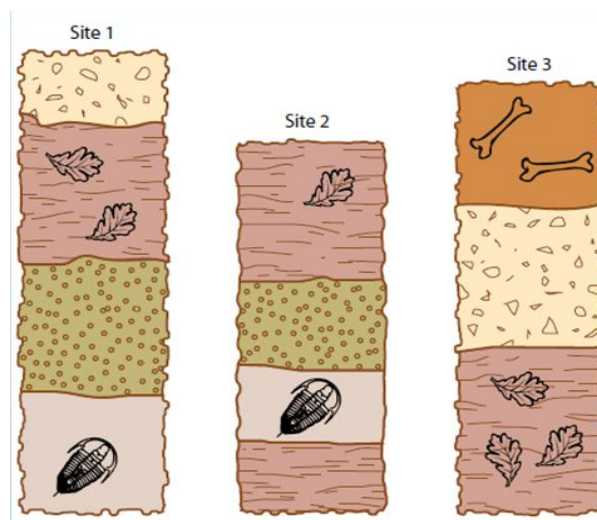
From: <https://bit.ly/2inXMI4>

The mechanism that has led to the phenotypic change illustrated above would best be called

- A. Genetic drift
- B. The bottleneck effect
- C. The founder effect
- D. Gene flow

Question 23

Three sites containing fossils in various strata levels were compared to each other in an effort to determine which site contained the youngest layer



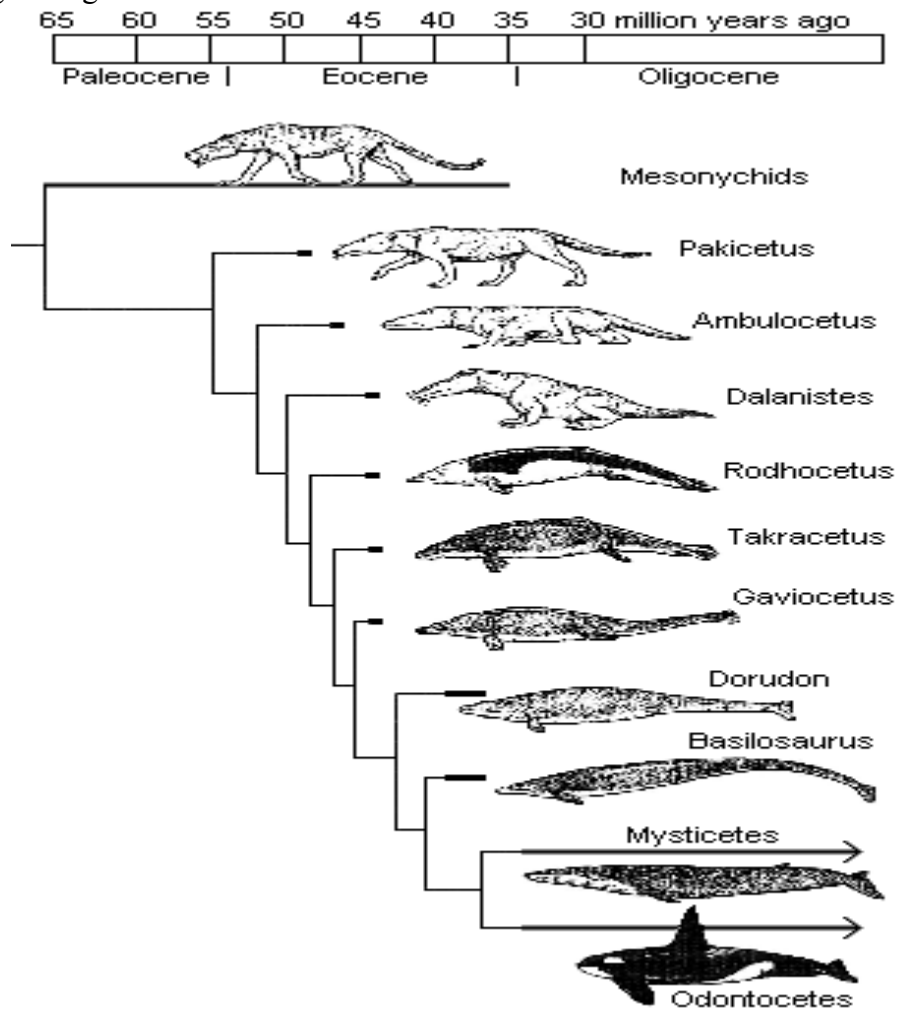
<https://bit.ly/2AUfUb0>

The youngest strata layer is located

- A. Site 1
- B. Site 2
- C. Site 3
- D. Both site 1 and site 2

The next 2 questions refer to the following information

The following cladogram illustrates the evolution of whales from their terrestrial ancestors



<https://bit.ly/2vL8FMG>

Question 24

The closest relative to Dalanistes is

- A. Mesonychids
- B. Rodhocetus
- C. Gaviocetus
- D. Basilosaurus

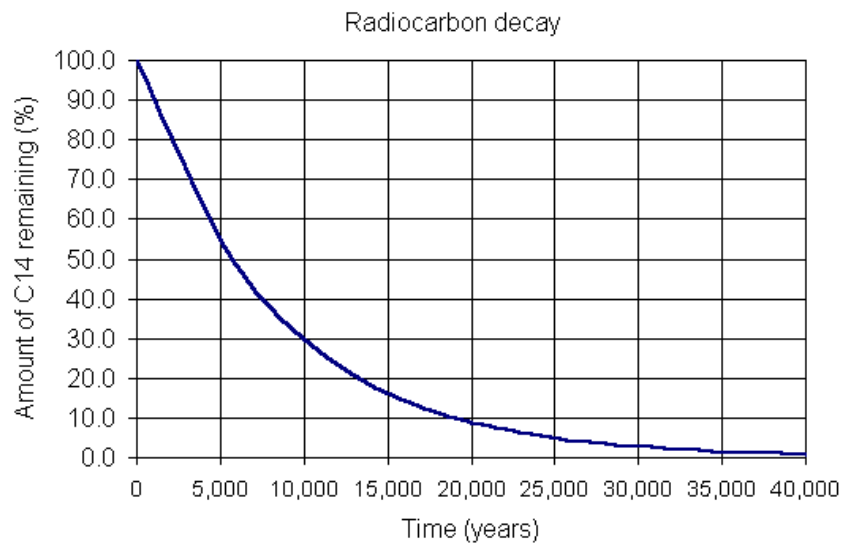
Question 25

Mysticetes and Odontocetes diverged

- A. 35 million years ago
- B. 36 million years ago
- C. 37 million years ago
- D. 38 million years ago

Question 26

The graph below is used to determine the age of fossils containing organic material.



From: <https://bit.ly/2KGCcwn>

A piece of fossilised organic material was found to be about 24,000 years old. The number of half-lives that has elapsed to generate a fossil of this age is approximately

- A. 2
- B. 3
- C. 4
- D. 5

Question 27

The BMP4 gene is a master regulator gene in both cichlid fish and Darwinian finches (as well as many other organisms). It can activate a large number of structural genes as well as other regulator genes. In a given population of Darwinian finches with small sharp beaks it would be expected that

- A. The variation of BMP4 alleles as well as alleles this gene controls would show more variation compared to a population of larger beaked Darwinian finches
- B. The variation of BMP4 alleles as well as alleles this gene controls would show less variation compared to a population of larger beaked Darwinian finches
- C. The BMP4 gene or genes controlled by the BMP4 gene would be active for a shorter time during beak development compared to a population of larger beaked Darwinian finches.
- D. During the evolutionary path toward small beaks the BMP4 gene or the genes controlled by the BMP4 gene mutated so smaller beaks appeared.

Question 28

The first hominin accredited with the prolific use of tools was

- A. *Australopithecus africanus*
- B. *Homo habilis*
- C. *Homo erectus*
- D. *Homo neanderthalensis*

Question 29

In developing evolutionary relationships, DNA hybridisation studies are sometimes conducted. The results below illustrate results of studies comparing certain gene loci of aardvarks, pandas and polar bears.

NOTE: the initial melting temperature for all original DNA strands was 85°C

Organisms the hybridised strands were from	The melting temperature (°C) of the hybridised strand
Aardvark and panda	70
Aardvark and polar bear	81
Panda and polar bear	69

Based on this hybridisation data

- A. Along the gene loci investigated the panda and polar bear have the most nucleotides in common.
- B. The aardvark and polar bear have a more distant ancestor as they have less nucleotides in common along the gene loci investigated.
- C. All three animals compared radiated from a single ancestor because their melting temperatures were similar to each other.
- D. The smaller the difference in temperature between the initial melting temperature and the melting temperature of the hybridised strand, the more closely related the organisms are.

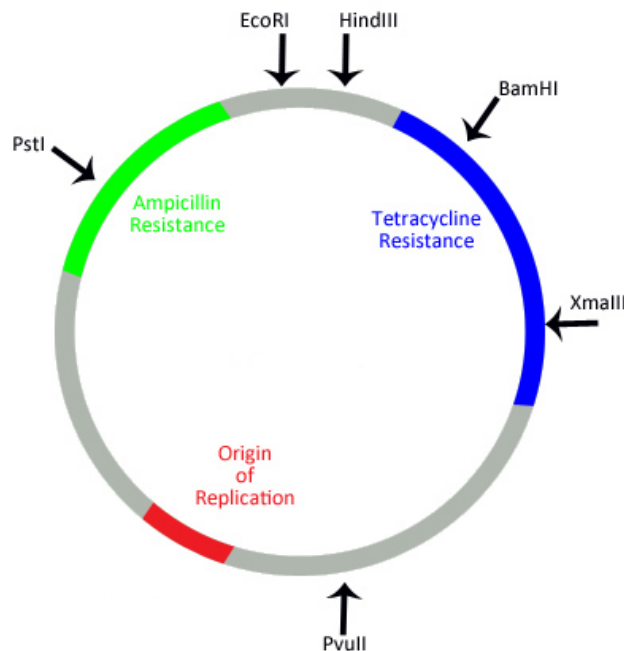
Question 30

The polymerase chain reaction (PCR) amplifies specific sections of DNA. The process is a multi-stepped involving denaturation, annealing and replication. Repetitive cycles of these steps leads to enough DNA for a variety of tests. The reason specific sections of DNA are able to be targeted in PCR is due to

- A. Primers
- B. *Taq* Polymerase
- C. Nucleotides
- D. Linear DNA being used

Question 31

The diagram below is of a plasmid from *S. aureus* showing 2 genes conferring antibiotic resistance and 6 restriction enzyme cutting sites



Modified from: <https://bit.ly/2MbCbFx>

The following conclusion can be made about the information provided

- A. If HindIII and PvuII were mixed with this plasmid, 3 strands of DNA would be formed
- B. A *S. aureus* bacterium containing this plasmid would not be destroyed in the presence of tetracycline and/or ampicillin.
- C. An effective method of forming a recombinant plasmid would be to use both HindIII and EcoRI so the foreign DNA could be inserted between these cuts
- D. If a gene of interest was added to the plasmid it would move further in a gel that underwent electrophoresis

Question 32

Type I diabetics have benefited from the bacterium *Escherichia coli* having had the human insulin gene inserted into it. This eventually led to the mass production of insulin and could be regarded as an example of

- A. Genetic modification but not a transgenic organism
- B. A transgenic organism that is not genetically modified
- C. An unethical use of genetic manipulation
- D. A transgenic organism that has been genetically modified

Question 33

In a disputed paternity case, 3 gene loci were tested and run through a gel. The results of the test are shown in the diagram below.

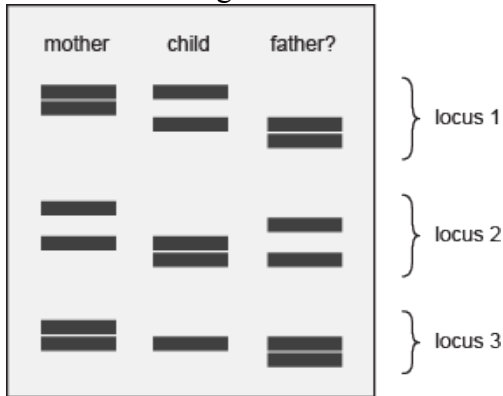


Diagram from: <https://bit.ly/2nkFdtc>

What conclusion could be made about the paternity case.

- A. The male tested is not the father
- B. The male tested is the father
- C. The male tested could be the father but more gene loci would need to be tested
- D. The child only has 1 copy of gene locus 3

Question 34

The number of influenza cases in Australia in 2017 reached almost 250,000, which was a dramatic increase from the previous year's 85,000. Medical authorities are prepared for even more cases of influenza in 2018. Appropriate and realistic measures taken would be

- A. Have a stockpile of vaccines available only to be given to those at risk of contracting influenza.
- B. Ensure all people in areas where there are outbreaks are quarantined
- C. Provide free prescriptions of antibiotics to those displaying flu-like symptoms.
- D. Have a stockpile of Relenza available to be available to unaffected individuals who have had recent contact with a known influenza sufferer.

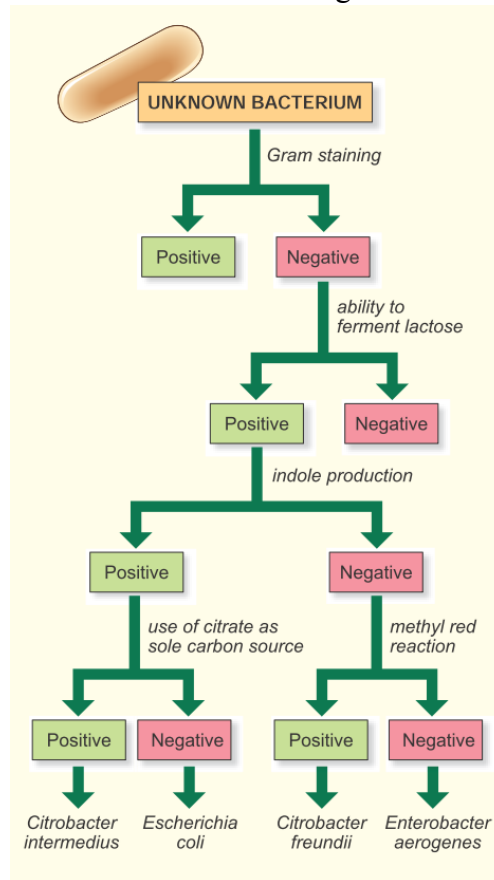
Question 35

The Zika virus achieved notorious fame at the 2016 Rio Olympics with images of young children with microcephaly (small brains). This caused worldwide concern because of people movement in and out of Rio, thus potentially spreading the disease. The spread of a disease in this manner would be

- A. A pandemic turning into an epidemic
- B. An epidemic turning into a pandemic
- C. Extremely slow as people would take appropriate precautions to not contract the disease
- D. Not a concern as the number of people in Rio is very low compared to the world's population

Question 36

The identification of an unknown bacterial pathogen was undertaken. The following key of tests with positive or negative results can be used for a diagnosis



For an *Citrobacter freundii* infection, the following test result would be required

A.	Gram positive	Unable to ferment lactose	Unable to produce indole	Negative reaction to methyl red
B.	Gram negative	Able to ferment lactose	unable to produce indole	Positive reaction to methyl red
C.	Gram negative	Able to ferment lactose	Able to produce indole	Negative to using citrate
D.	Gram positive	Able to ferment lactose	Unable to produce indole	Positive to using citrate

The next 4 questions refer to the following information

An experiment was conducted investigating the level of an externally applied signaling molecule called gibberellic acid (GA) that was required to promote seed germination in sweet corn (*Zea mays*). Five seeds were exposed to varying levels of GA and the growth of the seedlings were measured after seven days. This was repeated several times in batches. The data obtained is set out in the data table below.

	Length of seedlings (mm)					
Level of GA (mg/L)	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6
0	12	11	13	18	14	13
1	13	12	14	16	13	17
5	15	18	25	19	16	19
10	25	23	32	28	34	24
20	24	24	35	38	35	40

Question 37

Controlled conditions would **not** include

- A. The length of seedlings
- B. Temperature
- C. The atmospheric concentration of oxygen
- D. The light intensity

Question 38

This experiment demonstrates that

- A. Qualitative observations are easier to record than quantitative observations
- B. Hypotheses should be constructed after an experiment is conducted because the results may be different to what was expected.
- C. When working with plants there are no safety or ethical guidelines that need to be followed.
- D. Initially, there may be some internal GA within the seeds prior to germination.

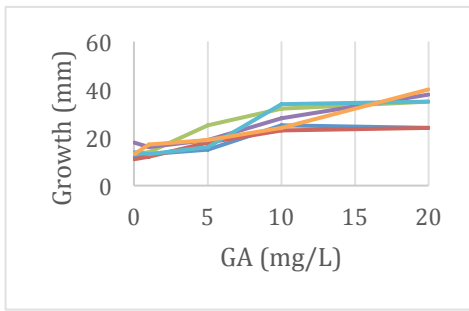
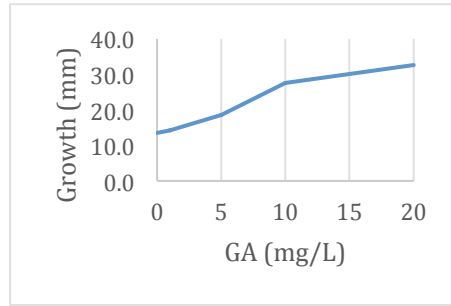
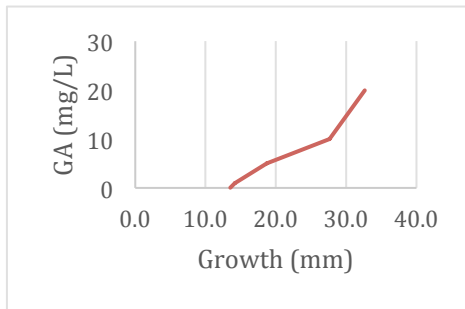
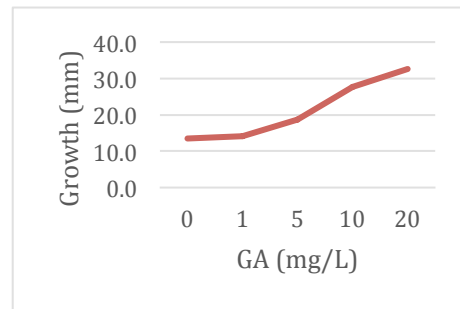
Question 39

When analyzing the data, it can be concluded that

- A. Batch 3 demonstrates the highest level of precision
- B. 10 mg/L of GA is the optimum amount required to be externally applied for sweet corn germination
- C. The accuracy of the data will be very high
- D. The level of repeatability was appropriate

Question 40

A line graph was drawn demonstrating the trends apparent. The following graph that would be the most appropriate is

A.**B.****C.****D.**

Short Answer Questions**Question 1**

Proteins at the plasma membrane (PM) allow cells to communicate with each other and with the extracellular environment and are critical for initiating signal cascades, vesicle trafficking and ion transport. Proteomic approaches to the study of PM proteins are complicated because there is such a low abundance of PM proteins, hydrophobicity, and problems associated with the separation of PM proteins from those of other organelles.

- a)** Define the proteome

(1 mark)

Once isolated, these PM proteins can be further investigated.

- b)** Discuss how proteins such as surface MHC (self) markers can be a functional component of a plasma membrane when the properties within the membrane and the areas on either side of the membrane are so different.

(2 marks)

The components of membranes, including proteins fit the fluid mosaic model.

- c)** Describe and justify 2 pieces of evidence that support the fluid mosaic model

(2 marks)

Question 1 (continued)

d) Complete the table below in terms of the PM protein function

Protein type	Protein function example	How protein structure suits its function
Signal cascade initiators		
Ion transport		

(2 marks)

Total 7 marks

Question 2

The diagram below represents the process of transcription within a typical eukaryotic cell

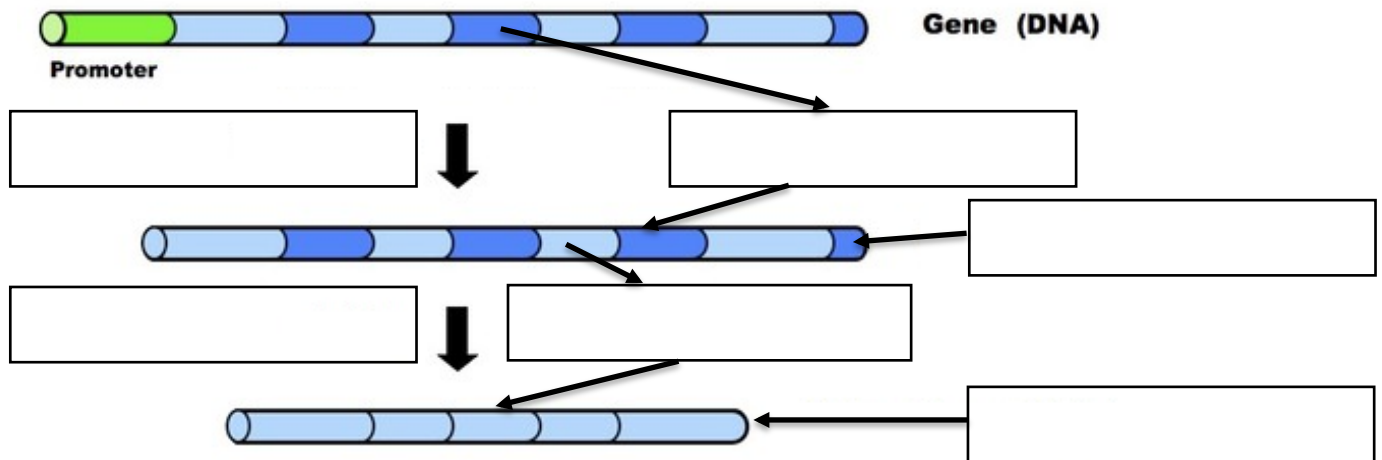


Diagram modified from: <https://bit.ly/2M9yqAu>

a) On the diagram above, fill in the blank spaces from the following words

- Transcription
- Pre mRNA
- Mature RNA
- RNA processing
- Introns
- Exons

(3 marks)

A portion of a strand of template DNA that codes for amino acids has the following sequence

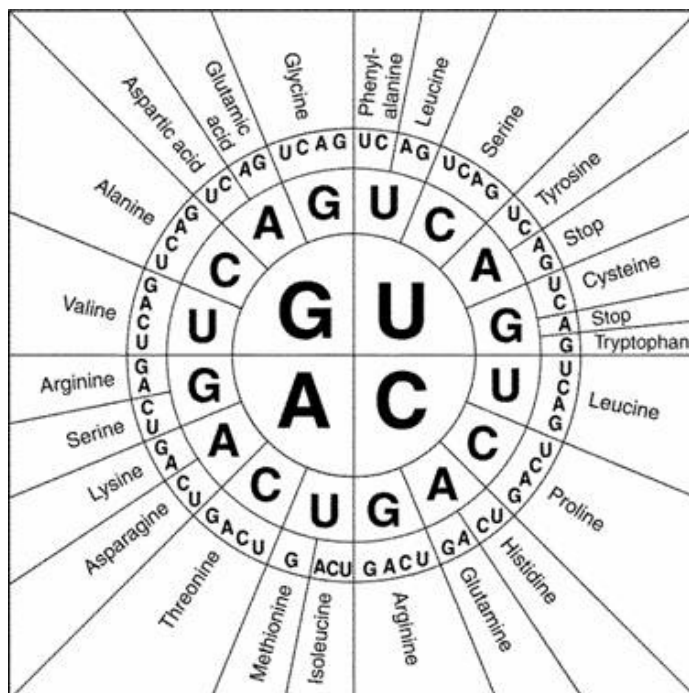
3' GGATTGCGATGA 5'

b) Describe why this particular sequence codes for 4 amino acids rather than 12.

(2 marks)

Question 2 (continued)

The following table gives a list of codons and their respective amino acids. The inner circle gives the first letter of the codon



- c) State the amino acid sequence of the polypeptide coded for by the DNA template on the previous page.

mRNA sequence: _____

polypeptide sequence: _____

(2 marks)

The original DNA strand from the previous page also contained a region called the promoter region which is located upstream from the portion given.

- d) State the function of the promoter region and the role it plays in protein synthesis.

(1 mark)

Total 8 marks

Question 3

Invertase is an enzyme that converts sucrose (a disaccharide) into glucose and fructose (both monosaccharides) according to the following equation.



- a) Name the cellular location where invertase is synthesised

_____ (1 mark)

Bees use invertase to make honey. The process begins when worker honey bees gather nectar (containing sucrose) from flowers. The nectar is passed into a honey sac in their digestive system, which contains a set concentration of invertase, a pH of 7 and an optimum working temperature of 25°C. This is where the process of converting nectar into honey (a mixture of glucose and fructose), begins. Changing environmental conditions impact on honey production and, hence, the profits honey farmers may make.

- b) Complete the following table

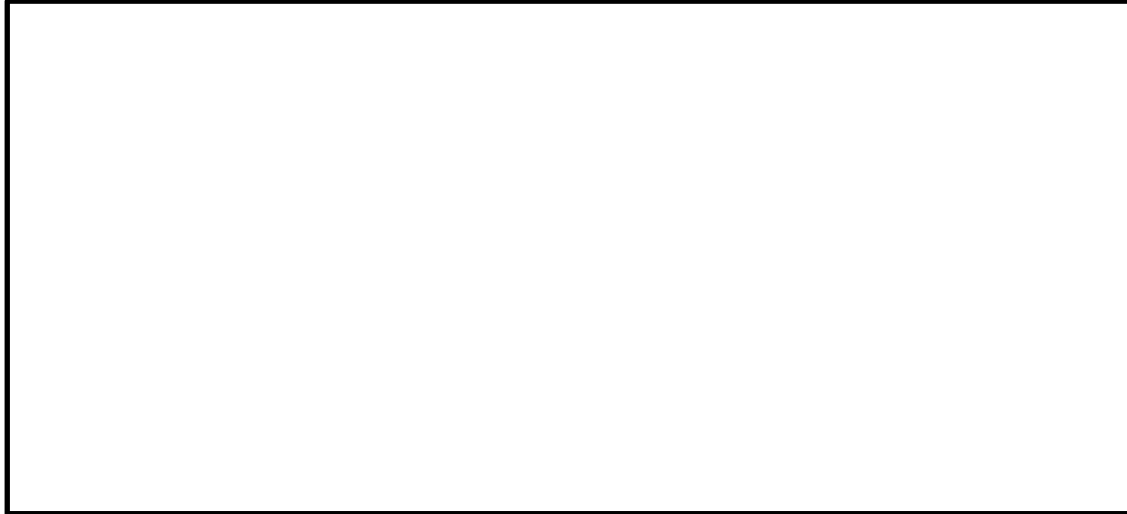
Condition	How the condition effects the rate of honey production. Choose from: (higher/lower/same)	In terms of enzyme chemistry why does the condition effect honey production?
A long period of cold (average of 10°) is followed by a month of warmer temperature (average of 20°C)		
Very little nectar is available on a particular day		

(4 marks)

Question 3 (continued)

Some herbicide sprays, which are used to improve crop productivity, act as a competitive inhibitor to invertase. This leads to a reduction in the capacity for bees to produce honey because sprayed crops can be adjacent to nectar producing trees that are conducive to honey production. This practice can be an annoyance to honey farmers.

- c) (i) In the space below draw a labelled diagram(s) illustrating the action of the competitive inhibitor on invertase.



(2 marks)

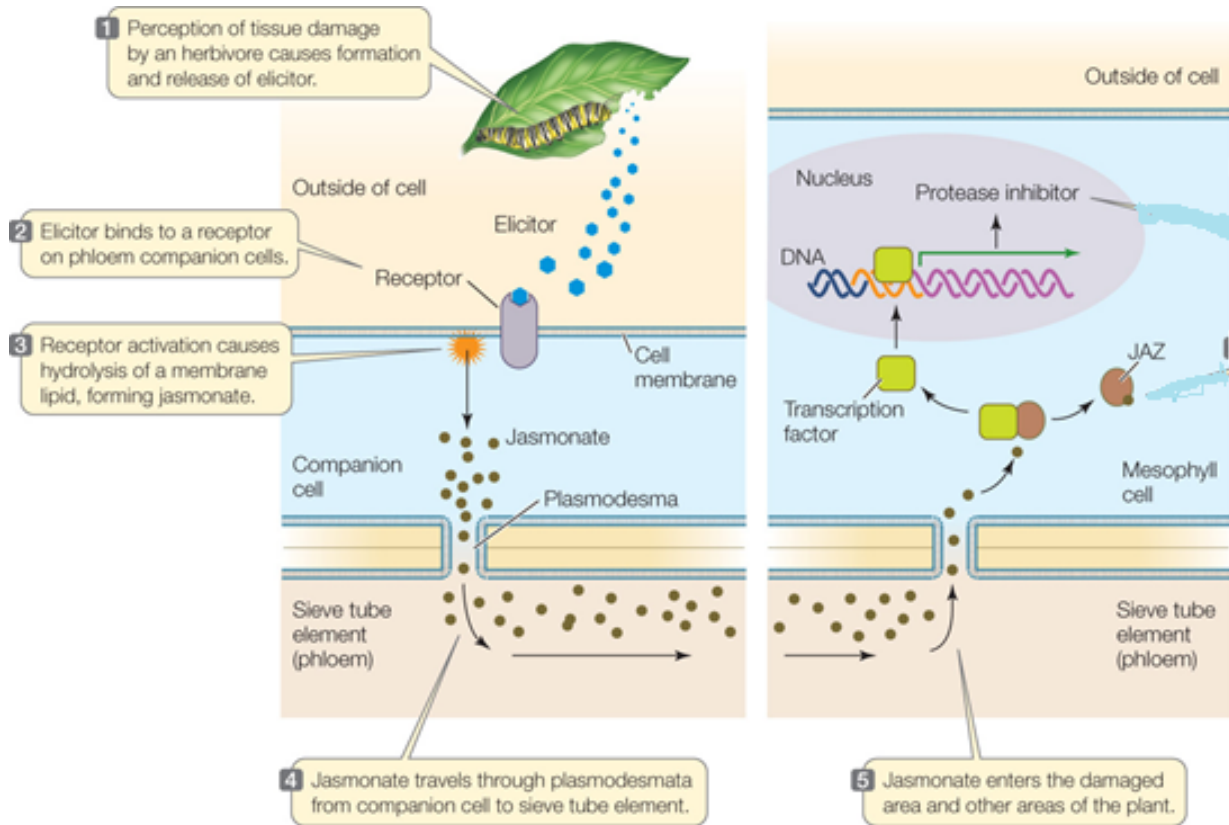
- (ii) Describe and justify a realistic strategy a bee farmer could implement to ensure his honey production was maintained at a constant level during the 'honey' season in areas that are sprayed with herbicide sprays.

(2 marks)

Total 9 marks

Question 4

Some plants resort to chemical warfare to stop herbivores eating them. Some plants stimulate a signal transduction pathway involving a hormone called jasmonate that can lead to the secretion of protease inhibitors. If these inhibitors are consumed by an insect, they can die. The diagram below illustrates this signal transduction process.



<https://bit.ly/2vUvP3s>

- a) (i) By referring to the diagram, discuss why jasmonate is regarded as a plant growth regulator (hormone)

(1 mark)

- (ii) Explain, using the diagram, how jasmonate binding to JAZ contributes to the formation of the protease inhibitor.

(2 marks)

Question 4 (continued)

Kenny was interested in how far away from the initial damaged leaf the jasmonate could travel in the phloem and still be effective as a defense against further damage. He planned an experiment to carry out.

- b)** Write a suitable hypothesis for the experiment Kenny was conducting

(1 mark)

- c) (i)** Kenny constructed a suitable method to follow to test his hypothesis. What factors should he take into account to ensure high...

Validity: _____

Precision: _____

(2 marks)

- (ii)** State the results Kenny would need to get in support of his hypothesis.

(1 mark)

Total 7 marks

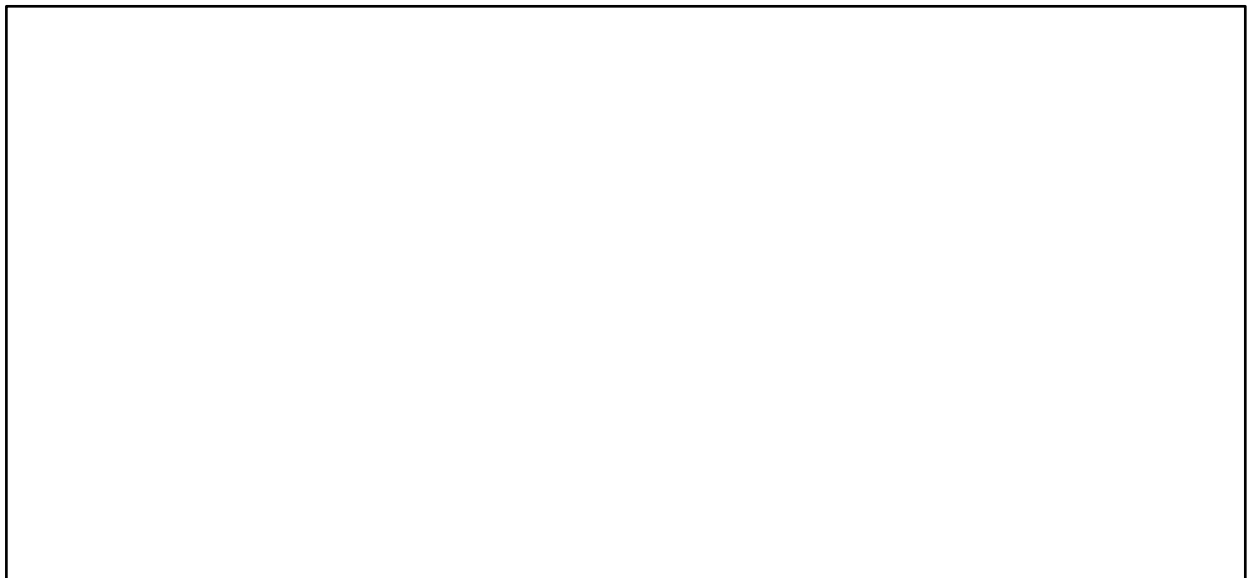
Question 5

Extremes of temperature, exposure to toxins, and mechanical damage can lead to cellular stress, which in turn can lead to mitochondrial stress. The inner membrane of the mitochondria contains an electron transport protein called cytochrome C, which when released into the cytosol of a cell, is an internal signal that promotes apoptosis.

- a) Explain the process of apoptosis in a cell such as this after the cytochrome C signal has been detected.

(3 marks)

- b) Draw a labelled diagram in the space below of how the products of apoptosis are removed after the event described in part a.



(2 marks)

Question 5 (continued)

Cancer is when the balance between the rate cellular replacement (mitosis) and the rate of cell death (apoptosis) is incorrect.

- c) Describe the relationship between mitosis and apoptosis in a small tumor (cancer) developing in an individual.

(1 mark)

Cancer cells are usually removed by apoptosis stimulated by an external death signal released from a killer T cell (a type of cytotoxic cell). For the killer T cell to recognize the cancer cell, there needs to be unique antigens on the surface of the cancer cell that are different to the normal cells.

Monoclonal antibody research could be used as a potential therapy specifically against cancer cells.

- d) Describe how monoclonal antibodies could be formed and used as a potential treatment against cancer

(3 marks)

Total 9 marks

Question 6

When a Rhesus negative mother gives birth to a rhesus positive baby the blood of the baby may mix with the blood of the mother. If this occurs in the mother's body, an immune response can be stimulated against the rhesus positive antigens found on the surface of red blood cells. This is not harmful to the baby that has been born; however, subsequent pregnancies can be problematic.

- a) Describe how the humoral immune response in the mother would act against the rhesus positive antigens from the baby

(2 marks)

If the next child is rhesus positive there is a high chance of the child contracting haemolytic disease (destruction of red blood cells) both during pregnancy as well as during the birthing process. This is where the products of the humoral response within the mother after the first pregnancy can enter the child's bloodstream and cause the disease.

- b) Describe how the products of the humoral response can act within the child to cause haemolytic disease.

(1 mark)

To reduce the incidence of haemolytic disease, a form of artificial passive immunity is administered to the rhesus negative mother within 72 hours of giving birth to the first child.

- c) Describe how artificial passive immunity can reduce the incidence of haemolytic disease.

(2 marks)

Total 5 marks

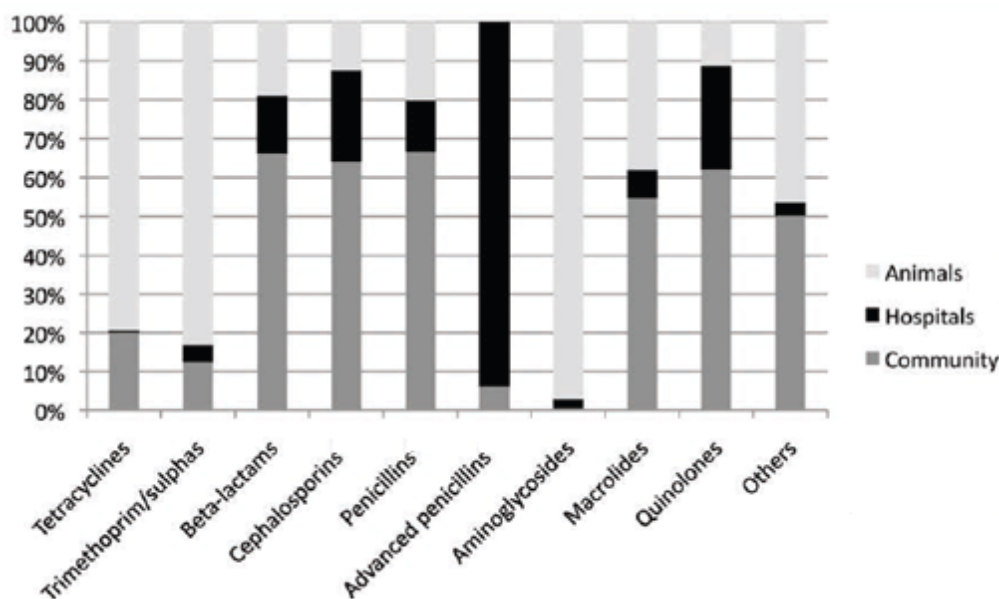
Question 7

MRSA (methicillin resistant *staphylococcus aureus*) is an antibiotic resistant form of bacteria that naturally inhabits the skin, nose and throat. The resistant form of these usually harmless bacteria has developed over the last 20-30 years as a result of the over use of antibiotics to treat other bacterial infections and as a result MRSA increase in numbers.

- a) Show an understanding of natural selection, using words such as selective agent and selective advantage to discuss how MRSA can increase in numbers.

(3 marks)

The following graph illustrates the use of different anti-microbial agents in the agricultural industry, the human community as well as hospitals



- b) (i) What proportion of quinolone is used within the community?

(1 mark)

(ii) If methocillin is a type of advanced penicillin, which industry is the likely main contributor to MRSA?

(1 mark)

Question 7 (continued)

- c) Apart from developing more potent antibiotics, state 2 strategies that could be put in place to reduce the incidence of bacterial antibiotic resistance. Use evidence for the graph on the previous page to answer the question.

(2 marks)

Total 7 marks

Question 8

The diagram below shows that speciation of a common ancestor into 5 species (p,q,r s and t) occurring by gradualism (diagram A) or punctuated equilibrium (diagram B).

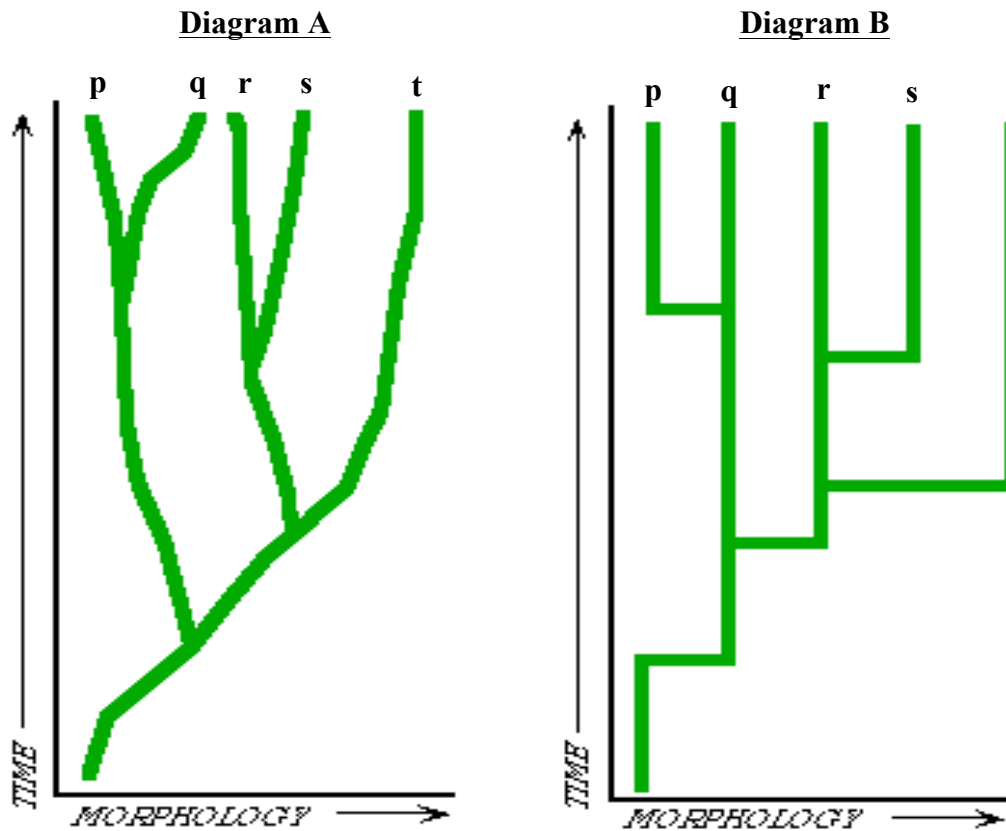


Diagram: <https://bit.ly/2KD2CPP>

- a) State two pieces of fossil evidence that would support the gradualism or punctuated equilibrium model as a form of speciation and explain how it supports that model

Form of speciation supported	Fossil evidence	Explanation how the evidence supports the model

(2 marks)

Question 8 (continued)

- b) Describe how the process of allopatric speciation may have led to the emergence of species r and s in diagram B.

(3 marks)

Total 5 marks

Question 9

Using molecular homologies is regarded as a more accurate way of predicting evolutionary patterns rather than using structural homologies.

- a) Define the term molecular homology

(1 mark)

- b) Complete the table below showing the advantages and disadvantages of using molecular homologies compared to using structural homologies when determining evolutionary relationships.

	Structural homology	Molecular homology
Advantage		
Disadvantage		

(4 marks)

Amino acid comparisons were made between 5 mammals and used as a means of determining relatedness. The comparisons are illustrated in the table below

Species	Sequence of Amino Acids in the Same Part of the Hemoglobin Molecules
Human	Lys–Glu–His–Iso
Horse	Arg–Lys–His–Lys
Gorilla	Lys–Glu–His–Lys
Chimpanzee	Lys–Glu–His–Iso
Zebra	Arg–Lys–His–Arg

From: <https://bit.ly/2M2Muwq>

- c) Describe if it is true to say that the gorilla is more closely related to the horse than the zebra is related to the chimpanzee?

(1 mark)

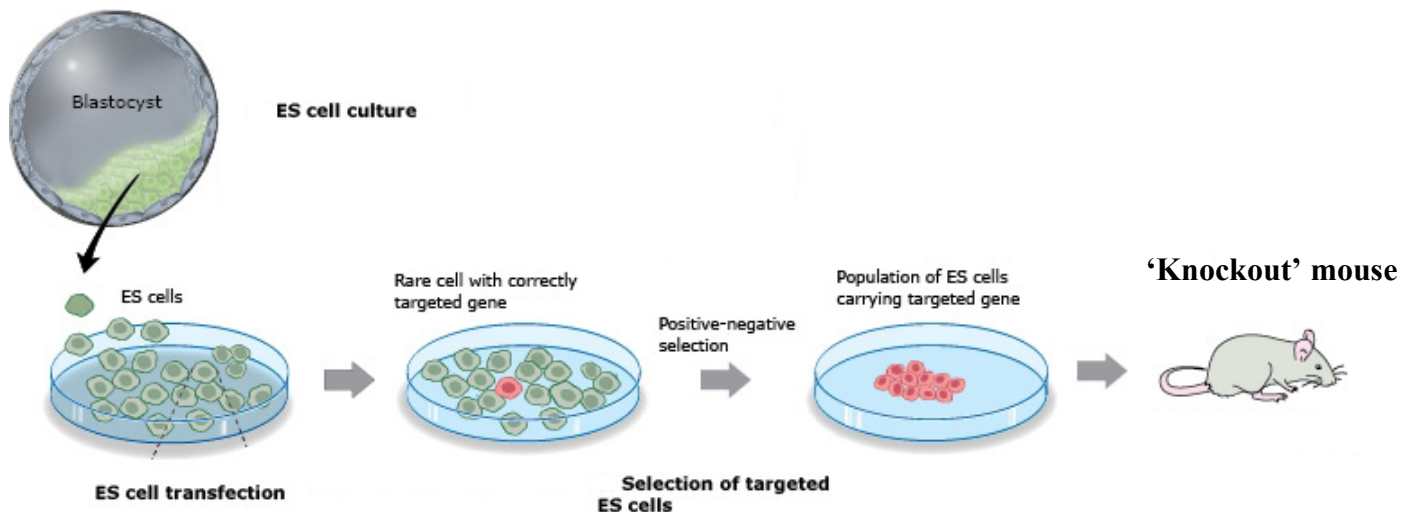
Question 10

A knockout mouse is a genetically modified mouse where specific genes are inactivated in an effort to understand the roles of already sequenced genes, but the function has not been determined. The steps used to achieve this process is outline below

- Embryonic stem cells (ES) are generated from a mouse and cultured in a petri dish.
- The ES cells are then mixed (transfected) with the gene of interest in the hope the gene will be inserted into the mouse's genome.
- The ES cells that have been successfully transfected are selected and implanted into a surrogate mouse
- Breeding the offspring can generate many knockout mice with the same modification

A diagram is illustrated below

The gene of interest has previously been sequenced and modified with virus DNA to enable positive selection. The modified mouse gene is then inserted into a plasmid that acts as a vector for transfection.



- a) How would restriction and ligase enzymes be used in the process of inserting a modified gene into a plasmid

(2 marks)

Question 10

The modified mouse gene has sections on either end that are complementary to the same sections on either end of the genes within the ES cells. During cell division, the modified genes have a chance of successfully being transfected.

- b) Would it be true to say that the complementary sections act like primers do in the process of PCR? Explain your answer

(2 marks)

After transfection, all the ES cells are exposed to a chemical that enables the modified ES cells to be selected. The process of transfection has a 20% success rate.

- c) Many people regard this poor success rate as one clear example as to why technologies such as these is an unethical use of time and resources. Explain whether you agree or disagree with this logic.

(1 mark)

Total 5 marks

Question 11

Chlorella is a single celled algae and can be used as an excellent model of cellular metabolism. Samples of chlorella were mixed with alga, solidified and formed into equally sized cubes to be used for experimentation. A scale of aqueous carbon dioxide levels in solution was set up by using pH changes in solution containing an indicator as well as all the requirements for chlorella (called testing buffer) to survive in. The scale is illustrated below

pH	Colour	Carbon dioxide levels
6.7	Yellow-red	Very high
7.0	Yellow	high
7.3	Yellow-orange	equal
7.6	Orange	low
7.9	Purple	Very low

- a) In terms of cellular metabolism for chlorella, what are the pH changes measuring?

(2 marks)

Chlorella cubes were placed into test tubes with set volumes of testing buffer added. Each test tube was placed different distances from the same light source and left for 24 hours. The results of this experiment are shown below.

Distance from light source (cm)	Initial buffer solution colour	Final buffer solution colour	Change in pH (more acidic, less acidic, nil)
10	Yellow-orange	Purple	
20	Yellow-orange	Orange	
30	Yellow-orange	Yellow-orange	
40	Yellow-orange	Yellow	
50	Yellow-orange	Yellow-red	

- b) (i) Why was the initial buffer solution the same colour for each sample

(1 mark)

- (ii) Complete the final column of the data table

(1 mark)

Question 11 (continued)

- c) State and explain one way the experiment could be modified to reduce the impact of error in the experiment.

(2 marks)

- d) Explain the results in detail

(3 marks)

Total 9 marks

End of questions for the 2018 Kilbaha VCE Biology Trial Examination Units 3 and 4

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