



VCE BIOLOGY 2017

YEAR 12 TRIAL EXAM

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Units 3/4

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

<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	10	10	80
			Total 120

An Answer Sheet is provided for Section A
Answer all questions in Section B in the space provided

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STUDENT NUMBER

Figures

Words

Letter

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Student Name.....**VCE Biology 2017 Year 12 Trial Exam Units 3/4**

There are **40 Multiple Choice Questions** to be answered by circling the correct letter in the table below. Use only a 2B pencil. If you make a mistake, erase it and enter the correct answer. Marks will not be deducted for incorrect answers.

Question 1 A B C D

Question 2 A B C D

Question 3 A B C D

Question 4 A B C D

Question 5 A B C D

Question 6 A B C D

Question 7 A B C D

Question 8 A B C D

Question 9 A B C D

Question 10 A B C D

Question 11 A B C D

Question 12 A B C D

Question 13 A B C D

Question 14 A B C D

Question 15 A B C D

Question 16 A B C D

Question 17 A B C D

Question 18 A B C D

Question 19 A B C D

Question 20 A B C D

Question 21 A B C D

Question 22 A B C D

Question 23 A B C D

Question 24 A B C D

Question 25 A B C D

Question 26 A B C D

Question 27 A B C D

Question 28 A B C D

Question 29 A B C D

Question 30 A B C D

Question 31 A B C D

Question 32 A B C D

Question 33 A B C D

Question 34 A B C D

Question 35 A B C D

Question 36 A B C D

Question 37 A B C D

Question 38 A B C D

Question 39 A B C D

Question 40 A B C D

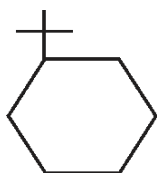
VCE Biology 2017 Year 12 Trial Exam Units 3/4

SECTION A – Multiple Choice Questions

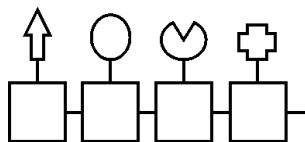
(40 marks)

Questions 1 and 2 refer to information in **Figure 1**.

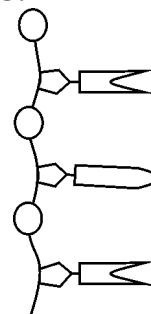
A.



B.



C.



D.

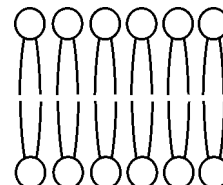


Figure 1

Question 1

Which of the above diagrams in **Figure 1** best represents a monomer?

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

Question 2

In **Figure 1** above, structure D would possess the elements

- A. carbon, hydrogen and oxygen.
- B. carbon, hydrogen, oxygen and nitrogen.
- C. carbon, hydrogen, oxygen and sulphur.
- D. carbon, hydrogen, oxygen and phosphorus.

Question 3

A human chromosome is made up of

- A. deoxyribonucleic acid only.
- B. deoxyribonucleic acid and proteins.
- C. ribonucleic acid only.
- D. ribonucleic acid and proteins.

Question 4

Which of the following organelles would **not** contain ribosomes?

- A. Chloroplasts.
- B. Mitochondria.
- C. Smooth endoplasmic reticulum.
- D. Rough endoplasmic reticulum.

Question 5

Plasmolysis occurs when a/an

- A. plant cell is placed in a hypertonic solution.
- B. plant cell is placed in a hypotonic solution.
- C. animal cell is placed in a hypertonic solution.
- D. animal cell is placed in a hypotonic solution.

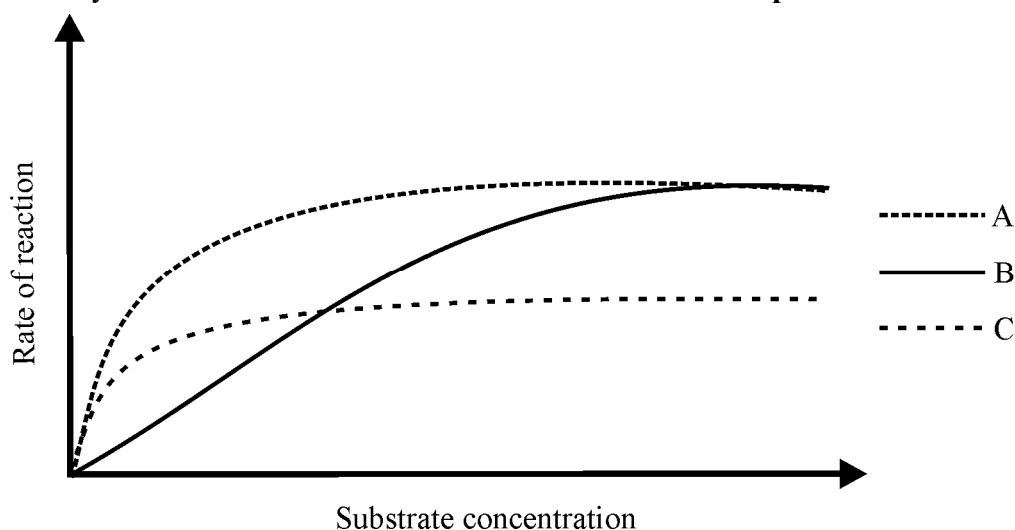
Question 6

A regulator gene codes for a protein that

- A. blocks the active site of a specific enzyme.
- B. binds to a specific enzyme and enables it to function.
- C. blocks the gene that codes for it.
- D. inhibits the activity of a different gene.

Use the information provided below to answer Questions 7 and 8.

An experiment was carried out to show the effects of various inhibitors on the functioning of an enzyme-catalysed reaction. The results obtained are shown in **Graph 1** below.



Graph 1

Question 7

In **Graph 1** above, the letters **A**, **B** and **C** represent the effect of increasing substrate concentration on the rate of an enzyme-catalysed reaction in the presence of

	---- A ----	— B —	-- C --
A.	No inhibitor	A non-competitive inhibitor	A competitive inhibitor
B.	No inhibitor	A competitive inhibitor	A non-competitive inhibitor
C.	A non-competitive inhibitor	No inhibitor	A competitive inhibitor
D.	A competitive inhibitor	A non-competitive inhibitor	No inhibitor

Question 8

In **Graph 1** above, the rate of all the enzyme-catalysed reactions levelled off despite increasing levels of substrate. This is due to

- A.** all the substrate being used up in the reaction.
- B.** high levels of product stopping the enzyme from binding to the substrate.
- C.** all of the available active sites forming enzyme substrate complexes.
- D.** the enzyme not functioning at optimal temperature.

Question 9

There are a number of molecules that cycle between the stages of aerobic respiration and are referred to as carrier molecules. Which of the following molecules is used in respiration and considered to be in an 'unloaded' state?

- A.** ATP.
- B.** NADP.
- C.** NADH.
- D.** FAD.

Question 10

The three stages of aerobic cellular respiration include

- A. plasmolysis, Krebs cycle and the electron transfer chain.
- B. glycolysis, Krebs cycle and the electron transport chain.
- C. plasmolysis, Calvin cycle and the electron transfer chain.
- D. glycolysis, Calvin cycle and the electron transport chain.

Question 11

The protein that plays a role in the formation of adenosine triphosphate (ATP) is known as ATP synthase. This protein can be found in

- A. the grana of chloroplasts.
- B. the matrix of mitochondria.
- C. both A and B.
- D. neither A nor B.

Question 12

Which of the following signalling molecules would be least likely to stimulate the release of a secondary messenger molecule like cAMP?

- A. A steroid hormone.
- B. A protein hormone.
- C. A peptide hormone.
- D. An amino acid derivative.

Question 13

What is meant by the term *incubation period* when referring to a pathogen? The time

- A. it takes for observable colonies to grow on a petri dish.
- B. taken from exposure to a person displaying symptoms of a disease.
- C. it takes to spread from one person to a new person.
- D. required in warm conditions to survive.

Question 14

Which of the following diseases is caused by an infectious agent?

- A. Scurvy caused by vitamin C deficiency.
- B. Lung cancer caused by smoking.
- C. Downs Syndrome.
- D. AIDS.

Question 15

A naked virus consists of

- A. nucleic acid only.
- B. nucleic acid surrounded by a glycoprotein envelope.
- C. nucleic acid surrounded by a protein capsid.
- D. a protein capsid surrounded by a glycoprotein envelope.

Question 16

Figure 2 below is a diagram of a white blood cell.

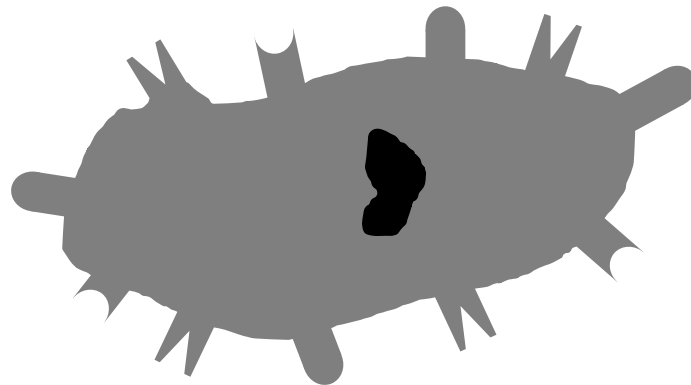


Figure 2

The shape of the bacterial antigen that this white blood cell would be most effective against is

- A.  B.  C.  D. 

Question 17

Which of the following would be ineffective in lysing bacteria?

- A. Bacteriophages.
- B. Antibodies.
- C. White blood cells.
- D. Complement proteins.

Question 18

Natural killer cells destroy virally infected body cells in response to

- A. histamine.
- B. complement proteins.
- C. interferon.
- D. cytokinins.

Question 19

Tetanus, or lockjaw, is an extremely serious disease caused by the pathogen *Clostridium tetani*. This bacterium is commonly found in soils and produces an exotoxin that blocks inhibitory neurotransmitters in the nervous system, thereby producing spasms and uncontrollable tightening of the muscles. The vaccine against tetanus is administered at birth and booster shots are recommended every ten years due to the virulence of the exotoxin. The vaccine against tetanus is likely to contain

- A. the actual bacterium *Clostridium tetani*.
- B. antibodies complementary to the exotoxin.
- C. a small amount of the exotoxin.
- D. a treated and harmless form of the exotoxin.

Question 20

Which of the following cells involved in the immune system mature in the thymus?

- A. Plasma Cells.
- B. Helper T cells.
- C. Antigen presenting cells.
- D. Mast cells.

Question 21

An original sequence of DNA has the coding **-TTCGACCTA-** while a mutated form of the sequence was found to have the code **-TTCACCTA-**

This mutation is an example of a

- A. block mutation.
- B. point addition.
- C. point substitution.
- D. point deletion.

Question 22

Potassium - Argon dating could be used to accurately date the age of

- A. a Viking longship.
- B. stone tools used by *Homo habilis*.
- C. a fossilised *Tyrannosaurus rex* bone.
- D. ash from a Neanderthal camp fire.

Question 23

An example of a trace fossil would be

- A. a trilobite shell.
- B. footprints left in sediment by velociraptors.
- C. an insect trapped in amber.
- D. hair from a woolly mammoth preserved in ice.

Question 24

Which of the following is **not** beneficial to the survival of a species?

- A. New mutations.
- B. A small gene pool.
- C. Frequent, random mating.
- D. Large numbers of offspring.

Question 25

Living organisms

- A. contain no carbon-14.
- B. have all their carbon in the form of carbon-14.
- C. have a small amount of their carbon in the form of carbon-14.
- D. have equal amounts of carbon-14 and nitrogen-14.

Question 26

Analogous structures would most likely form as a result of

- A. divergent evolution.
- B. convergent evolution.
- C. adaptive radiation.
- D. phyletic evolution.

Question 27

DNA hybridization between species is likely to be higher between organisms

- A. of the same genus.
- B. of the same size.
- C. with the same number of chromosomes.
- D. with the same number of genes.

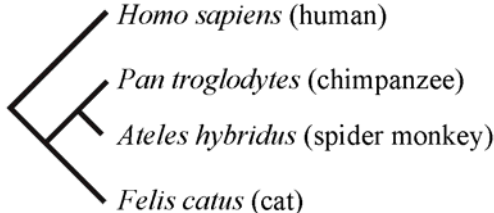
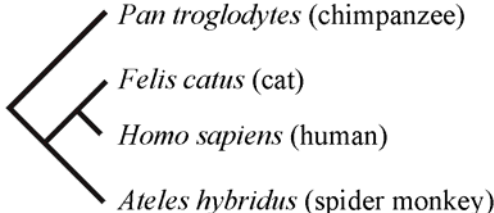
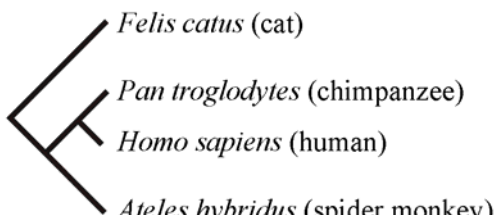
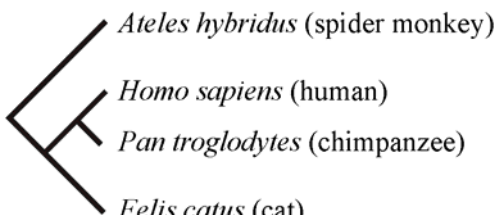
Question 28

Phylogenetic trees differs to cladograms in that

- A. phylogenetic trees are only based on differing characteristics between organisms.
- B. cladograms have short lines for extinct species while phylogenetic trees don't.
- C. cladograms are based on the number of differences in the DNA sequence between the species whilst phylogenetic trees are less specific.
- D. only phylogenetic trees use a geological time scale to show the evolutionary relationships of organisms.

Question 29

Which of the following cladograms is accurate in terms of human evolution?

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

Question 30

Opposable thumbs on the hands and feet would not be beneficial for

- A. power grip.
- B. precision grip.
- C. brachiating.
- D. bipedalism.

Question 31

As hominins evolved into modern humans the general trend seen in skull characteristics included a

- A. more centrally located foramen magnum and a more sloping face.
- B. more centrally located foramen magnum and a less sloping face.
- C. less centrally located foramen magnum and a more sloping face.
- D. less centrally located foramen magnum and a less sloping face.

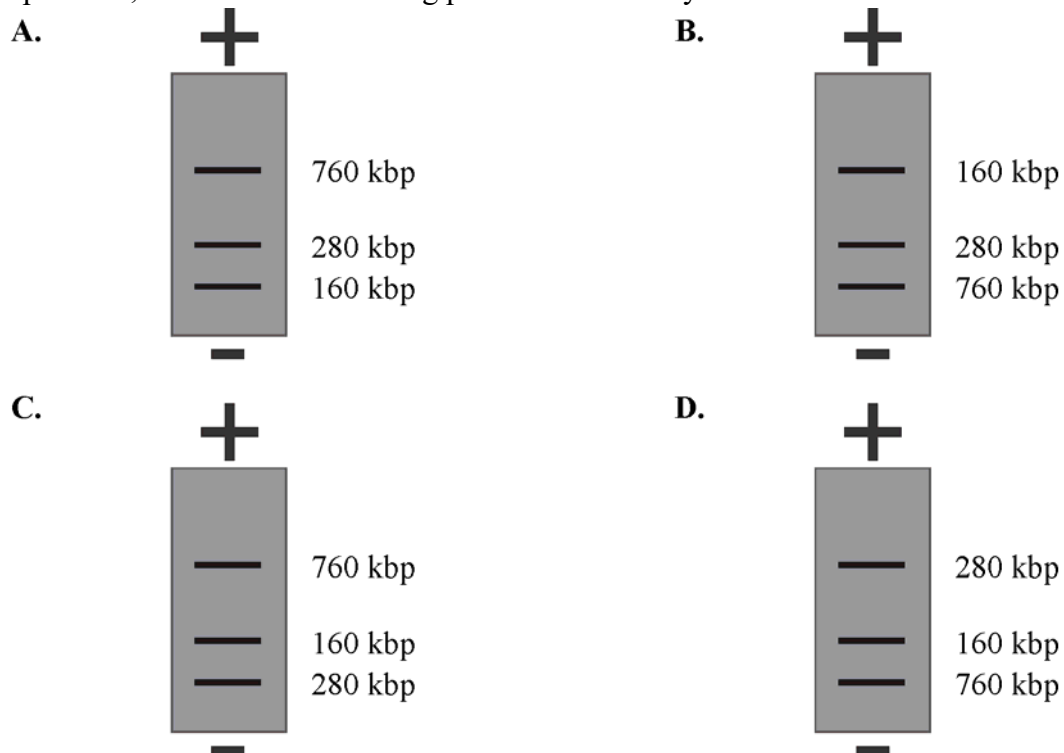
Question 32

A bacterial plasmid was cut using the restriction enzyme Alu I. This resulted in the production of three DNA fragments of 760 kbp, 280 kbp and 160 kbp length respectively. This indicates that the original plasmid was a double stranded length of DNA

- A. 1200 kbp long with three Alu I restriction sites.
- B. 1200 kbp long with four Alu I restriction sites.
- C. 600 kbp long with three Alu I restriction sites.
- D. 600 kbp long with four Alu I restriction sites.

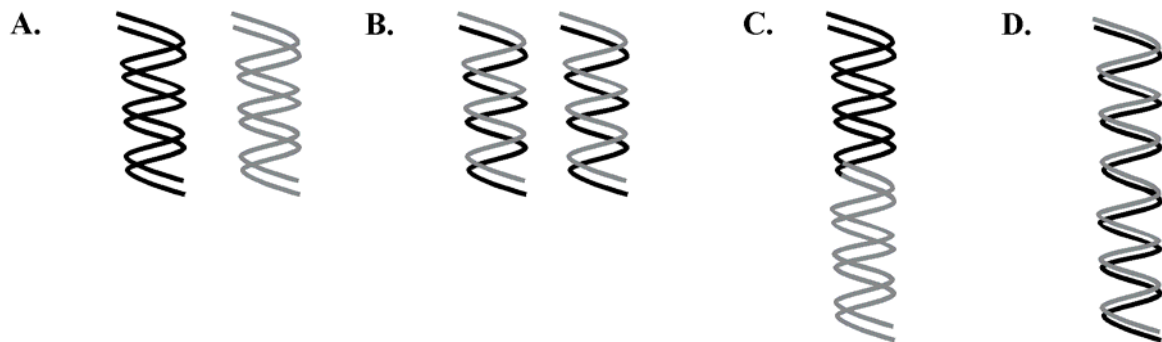
Question 33

If the generated DNA fragments described in **Question 32** were run through a gel electrophoresis, which of the following patterns would they show?



Question 34

If a section of DNA was replicated in a PCR machine using radioactive DNA nucleotides, which of the following results would you expect to see after one full cycle?



Questions 35 and 36 refer to information presented in **Figure 3**.

Figure 3 shows a pedigree for a genetically inherited disease whose symptoms develop during puberty.

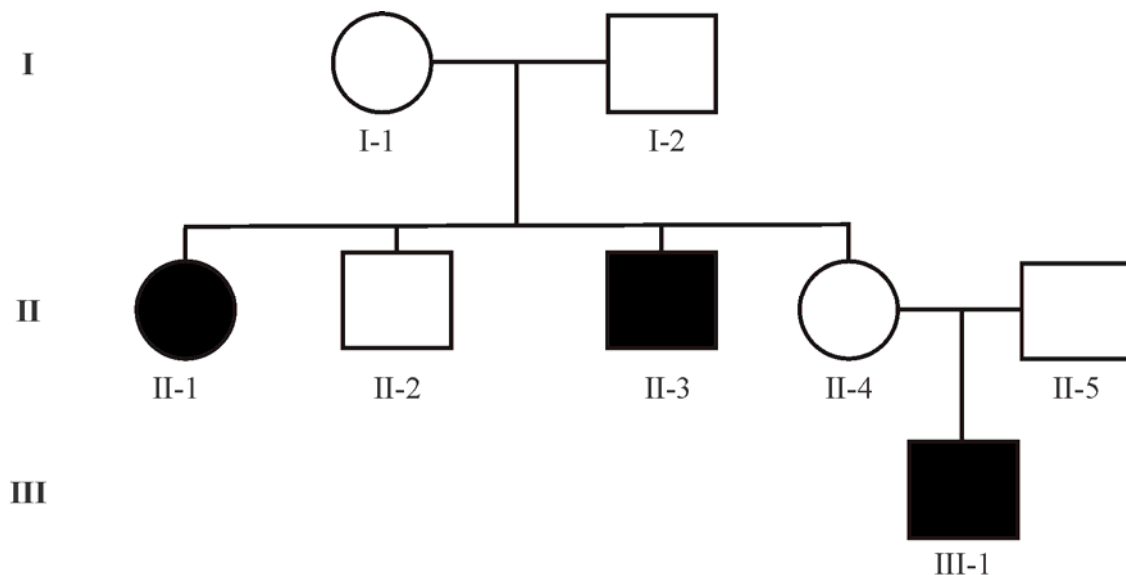


Figure 3

Question 35

Carrier testing would be recommended for individual

- A. I-1
- B. II-1
- C. II-2
- D. III-1

Question 36

Individual II-4 is pregnant and soon to have another child. Which of the following tests would be of most benefit in determining whether her next child will also inherit the disorder?

- A. Carrier testing.
- B. Adult screening.
- C. Predictive testing.
- D. Prenatal screening.

Use the information provided in **Table 8+1** to answer Questions 37 and 38.

Table 1 below outlines the DNA profiles of two adults and two children with respect to three STR loci.

	Mother	Alleged father	Child 1	Child 2
STR locus 1	12,17	15,17	12,17	17,17
STR locus 2	32,40	35,36	32,40	36,40
STR locus 3	6,11	6,15	6,11	11,15

Table 1

Question 37

In **Table 1** above, Child 2 only has one number for STR locus 1. This is most likely because

- A. non disjunction occurred and he did not receive a full set of chromosomes from each parent.
- B. both chromosomes of the pair have 17 repeats of the STR considered.
- C. Child 2 is a boy and STR locus 1 is carried on the X chromosome.
- D. insufficient DNA was supplied, preventing the test from being performed accurately.

Question 38

According to the above test the alleged father is the father of

- A. child 1 only.
- B. child 2 only.
- C. both child 1 and 2.
- D. neither child 1 nor 2.

Question 39

A possible action of an antibiotic would be

- A. inhibiting the synthesis of the cell wall in the bacteria.
- B. blocking the action of the neuraminidase proteins on a virus.
- C. easing the congestion produced by excess mucus.
- D. limiting the release of histamines from mast cells.

Question 40

Bowerbirds display tails with a wide range of differing lengths. This variation is likely to be seen as

- A. continuous distribution due to a monogenic trait.
- B. continuous distribution due to a polygenic trait.
- C. discontinuous distribution due to a monogenic trait.
- D. discontinuous distribution due to a polygenic trait.

End of Section A

VCE Biology 2017 Year 12 Trial Exam Units 3/4

SECTION B – Short Answer Questions

(80 marks)

Question 1 (8 marks)

Wine is traditionally produced in glass bottles sealed with a cork. When a bottle of wine is opened, the cork is often sniffed to detect whether the wine has ‘gone off’. This is usually caused by the cork not sealing the bottle correctly and air getting in. Wine that has ‘gone off’ will have an unpleasant smell, and will also have little or no alcoholic content.

- a. Name the process that would normally occur within the wine to produce the alcohol. **1 mark**
-
- b. Explain what occurs when the wine has access to air due to the presence of a poor quality cork. **2 marks**
-
-
- c. Write a word equation for the process identified in 1b. **1 mark**
-
- d. Suggest a reason why the normal process of alcohol production is less likely to occur once air has entered the wine bottle. **3 marks**
-
-
-
- e. Wine rarely exceeds 14% alcohol content despite there being an excess of natural sugars available and many years of storage. Suggest what occurs during this process that limits the alcohol content. **1 mark**
-
-

Question 2 (9 marks)

Scrapie is an infectious disease that occurs in sheep. It causes skin irritation and neural damage. Scrapie is similar to bovine spongiform encephalopathy (mad cow disease) and Creutzfeldt–Jakob disease as it is believed to be caused by misshapen cytoplasmic proteins.

Figure 4 shows the normal shape of the cytoplasmic protein involved **(a)** whilst **(b)** shows the form connected with scrapie.

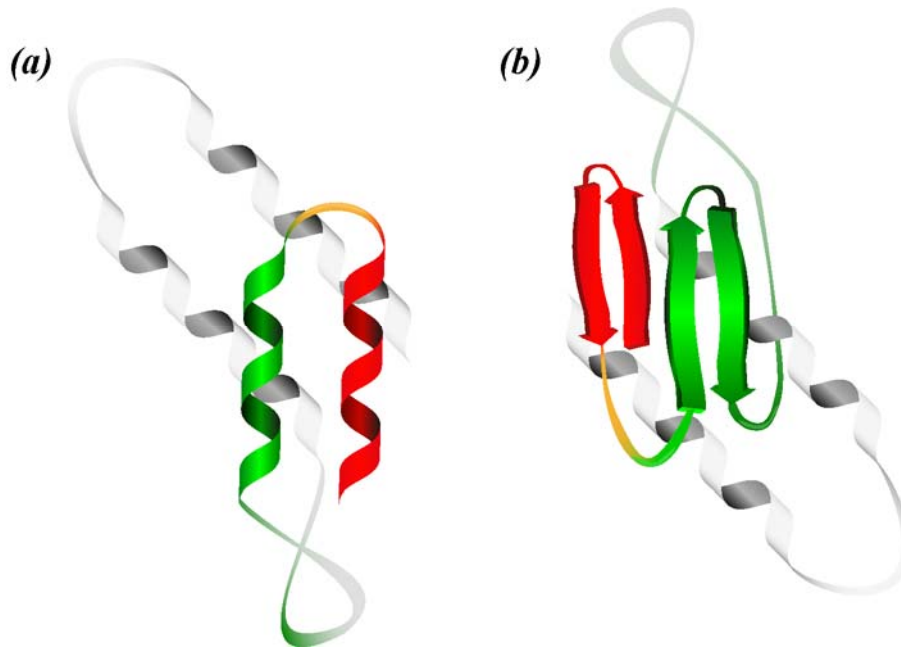


Figure 4

- | | | |
|-----------|---|---------------|
| a. | Diseases like scrapie, bovine spongiform encephalopathy and Creutzfeldt–Jakob disease are known as what kind of disease? | 1 mark |
| <hr/> | | |
| b. | Name the monomers that make up the normal and scrapie forms of the protein. | 1 mark |
| <hr/> | | |
| c. | In Figure 4 , name the structure marked with arrows in the scrapie form of the protein (b) that is not visible in the normal form of the protein (a) . | 1 mark |
| <hr/> | | |
| d. | What level(s) of structural organisation have changed between the normal and scrapie forms of the protein? | 1 mark |
| <hr/> | | |

- e. Explain why bacterial diseases such as botulism are well understood yet less is known about diseases like scrapie and Creutzfeldt–Jakob disease. **2 marks**

The normal form of this protein is found on the plasma membrane of nerve cells whereas the scrapie form is found in vesicles in the cytoplasm.

- f. Name the molecules that the vesicles are made from. **1 mark**

- g. Explain how the difference in location of this protein might lead to neural degeneration. **2 marks**

Question 3 (7 marks)

Vasopressin (also known as Anti Diuretic Hormone or ADH) is released from the hypothalamus and travels through the bloodstream to the kidneys, where its effect is to make the tubules more permeable to water thereby increasing the retention of water in the body. A detailed process of what happens in the tubule cells is shown in **Figure 5**.

Mechanism of action of ADH on kidney tubules

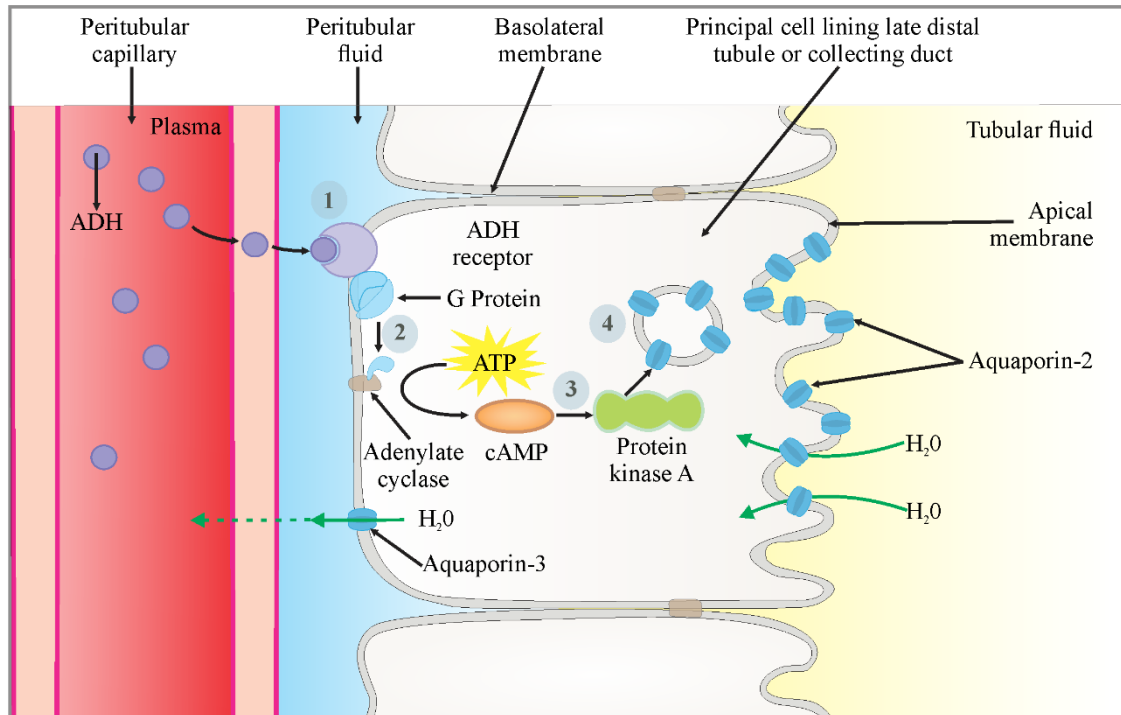


Figure 5

- a. What name is given to molecules like vasopressin (ADH) that affect other cells of the body? 1 mark

- b. Name the three stages of cellular signalling and, using the information in **Figure 5**, state what is occurring at each stage. 6 marks

Stage 1 _____

Stage 2 _____

Stage 3 _____

Question 4 (8 marks)

In 2000, Japanese scientists discovered a single-celled eukaryote that seemed to possess a single huge 'chloroplast'. They named this organism *Hatena arenicola* (hatena in Japanese means 'unusual'). What made *Hatena arenicola* particularly unusual was that the 'chloroplast' present within it was actually the remains of another eukaryote, a photosynthetic algae, *Nephroselmis*. When the *Hatena arenicola* divided into two daughter cells, the *Nephroselmis* stayed in one of the daughter cells. The other *Hatena arenicola* cell then found and engulfed a new *Nephroselmis* algae and the life cycle repeated itself.



Figure 6

- a. What term is given to the theory which accounts for the evolution of organisms like *Hatena arenicola*? **1 mark**
-
- b. What organelle, other than a chloroplast, is believed to have derived from a similar process? **1 mark**
-
- c. Explain the difference between the origins of the 'chloroplast' in *Hatena arenicola* and that of chloroplasts in plant cells. **1 mark**
-
- d. Name three intracellular structures that *Nephroselmis* algae would possess that would not be found in a chloroplast isolated from a plant cell. **3 marks**
-
-

- e. Explain how this arrangement of coexistence may be beneficial to **both** the *Hatena arenicola* and the *Nephroselmis* algae. 2 marks

Question 5 (7 marks)

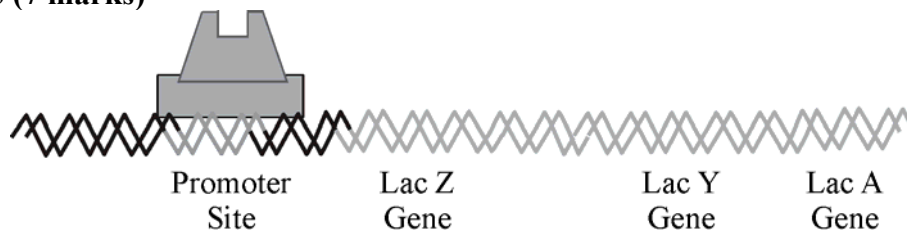


Figure 7

Figure 7 shows the Lac operon genes found in *Escherichia coli* (*E. coli*). These genes are responsible for producing the enzyme lactase. An operon is a group of genes with a common promoter site and operator site. Often the product of a regulator gene can be found attached to the promoter site, as seen in **Figure 7**.

- a. What name is given to a protein that binds to DNA to prevent the expression of a gene? 1 mark
- b. With regard to the Lac operon in *E. coli*, name the molecule that is likely to interact with this protein. 1 mark
- c. Detail what takes place when this interaction occurs. 2 marks
- d. Explain the benefits of having this protein on the DNA. 1 mark

- e. Name the enzyme responsible for the transcription of these genes. **1 mark**

- f. If the sequence of DNA on the template strand was CCGTAGATGGAC, write down the sequence that would be produced by transcription. **1 mark**

Question 6 (8 marks)

In 2013, recreational cavers discovered the remains of at least 15 hominoid skeletons in a cave in the Gauteng province of South Africa. These were unlike any previously discovered hominoid fossils and were given the name *Homo naledi*. Anthropologists initially estimated their age at about two million years old, based on the observed anatomical features. However more precise dating techniques have since placed these fossils' age at approximately 335,000 to 235,000 years old.



Figure 8

- a. Describe **two** features of the *Homo naledi* skull that would have led to scientists initially estimating the age of the skull to approximately two million years old. **2 marks**

- b. Describe an absolute dating technique that could have been used to find the accurate age of the *Homo naledi* skeletons. **2 marks**

- c. Explain what the age of approximately 335,000 to 235,000 years old means in terms of the relationship between *Homo naledi* and *Homo sapiens*. **2 marks**

- d. There are some indications that the deceased individuals of *Homo naledi* may have been placed in the cave at the time of their death. Explain the significance of this event and state the form of evolution that this type of behaviour is an example of. **2 marks**

Question 7 (6 marks)

A section of the gene that produces human insulin was found to have the following DNA nucleotide sequence

5'...CCAAGCCAA...3'

- a. Using **Table 2** below, write down the amino acid sequence that these nine nucleotides would code for. (The sequence starts at the first letter). 1 mark

- b. Write a different DNA sequence that would still produce the same amino acid sequence as that outlined in **Question 7a**. 1 mark

- c. The new sequence of DNA nucleotides listed in **Question 7b** could arise as a consequence of a type of mutation. What term is given to the form of mutation likely to produce variant DNA sequences like that given in **Question 7b**? 1 mark

- d. A version of genetically inherited diabetes was recently found to have been caused by a mutation in the DNA sequence **CCAAGCCAA**. In this mutation, the glycine nucleotide had been replaced with a thymine. Explain what effect this mutation would have on the insulin protein. 3 marks

		Second Base									
		U		C		A		G			
First Base	U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U	Third Base
		UUC		UCC		UAC		UGC		C	
		UUA	Leu	UCA		UAA	Stop	UGA	Stop	A	
		UUG		UCG		UAG	Stop	UGG	Trp	G	
	C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U	
		CUC		CCC		CAC		CGC		C	
		CUA		CCA		CAA	Gln	CGA		A	
		CUG		CCG		CAG		CGG		G	
	A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U	
		AUC		ACC		AAC		AGC		C	
		AUA	Met or Start	ACA		AAA	Lys	AGA	Arg	A	
		AUG		ACG		AAG		AGG		G	
	G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U	
		GUC		GCC		GAC		GGC		C	
		GUA		GCA		GAA	Glu	GGA		A	
		GUG		GCG		GAG		GGG		G	

Table 2 showing mRNA codons for the 20 different amino acids used in protein synthesis.

Question 8 (9 marks)

A hypervariable region of human mtDNA was taken from four individuals and analysed.

A section of the matching intergenic region in four different individuals is listed below.

Individual 1	...CGACTTCGATAGTA...
Individual 2	...CGACTTCGATAATA...
Individual 3	...CAACTCCGATACTA...
Individual 4	...CCACTACGATACTA...

- a. Based on the sequences of mtDNA listed above, draw a tree showing the relative genetic relationship between the four individuals. **2 marks**
- b. A study of the four individuals' ancestry indicates that individuals 2 and 4 were the most closely related. Explain why this result might differ from that provided by the mtDNA sequences above. **2 marks**
-
-
- c. What is meant by the term intergenic? **1 mark**
-
- d. Why would studying mutations within intergenic DNA be more useful than studying the mutations that occur within genes? **2 marks**
-
-
- e. Explain why mitochondrial DNA is more often used to track the ancestry of people rather than nuclear DNA. **2 marks**
-
-

Question 9 (10 marks)

Vitamin A deficiency can lead to blindness, an impaired immune system and can affect brain development. It has been linked to the deaths of approximately 700,000 children worldwide every year, usually in developing countries.

After nearly ten years of development, researchers in Australia have genetically modified a standard Cavendish banana to produce far greater amounts of beta-carotene which the body then converts into Vitamin A. They achieved this by isolating the beta-carotene gene from a different species of banana, known as the 'Karat' which produces small fruit that are high in beta-carotene. They then placed this isolated beta-carotene gene into the DNA of the larger Cavendish banana.



Figure 9

- a. What term is given to describe an organism that contains genetic material from different species?

1 mark

- b. Using some of the concepts of genetic engineering you have studied this year, explain how researchers were able to place the desired beta-carotene gene into the DNA of the Cavendish banana.

3 marks

- c.** Cavendish bananas are triploid organisms. What is meant by the term triploid? **1 mark**
-
- d.** What effect would the feature identified in **Question 9c** have on the ability of farmers to crossbreed the Cavendish and Karat bananas naturally? **2 marks**
-
-
- e.** The new beta-carotene enriched banana is also triploid. What effect is this genetically modified plant likely to have on the wild species of bananas when grown in Africa? **1 mark**
-
-
- f.** Currently the DNA of these genetically modified bananas is identical. State the term that is given to groups of individuals with identical DNA and suggest why this is occurring. **2 marks**
-
-

Question 10 (8 marks)

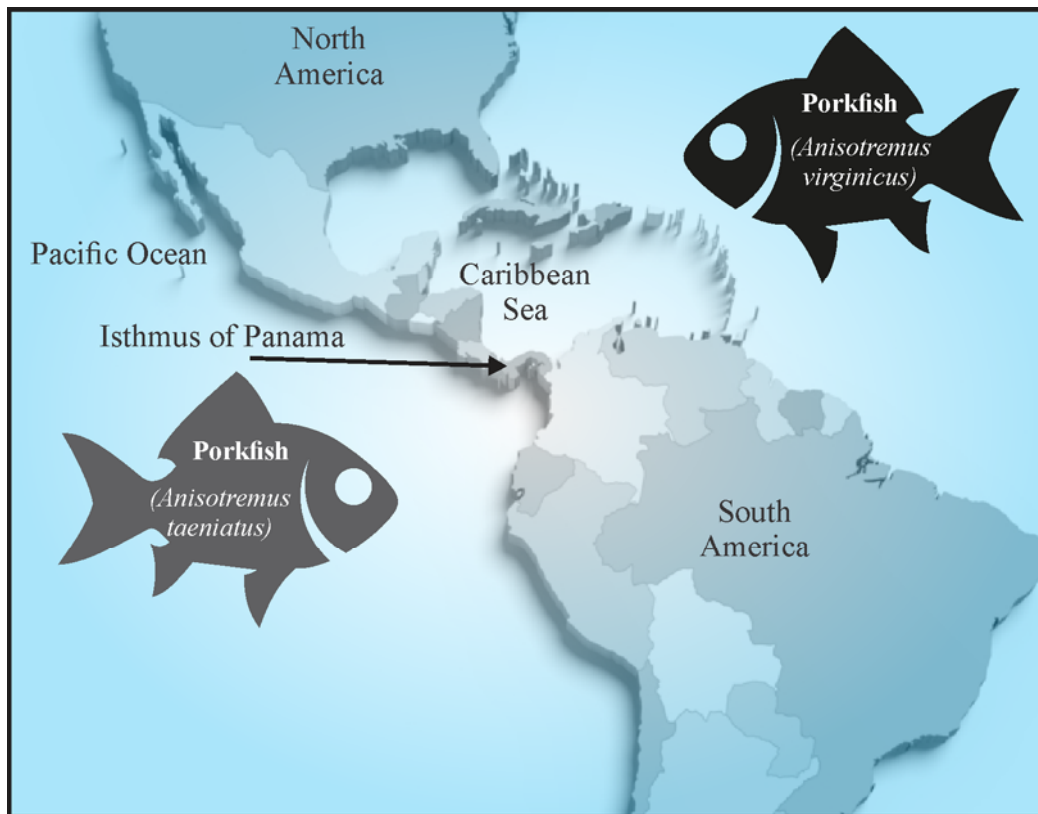


Figure 10

Porkfish are native to the waters around Central America. The *Anisotremus virginicus* is only found in the Caribbean Sea while *Anisotremus taeniatus* is native to the Pacific Ocean. A narrow band of land called the Isthmus of Panama separates these two bodies of water. Researchers have determined that while they are closely related, the two different populations of Porkfish are clearly two different species.

- a.** What would have led researchers to determine that the two different populations of Porkfish were indeed two different species?

1 mark

- b.** Suggest the process by which the Porkfish may have evolved into two distinct species.

5 marks

- c. Give **two** terms which describe this form of speciation.

2 marks

End of Section B

End of Trial Exam

Suggested Answers

VCE Biology 2017 Year 12 Trial Exam Units 3/4

SECTION A – Multiple Choice Answers

(40 marks)

1. A	2. D	3. B	4. C	5. A
6. D	7. B	8. C	9. D	10. B
11. C	12. A	13. B	14. D	15. C
16. D	17. B	18. C	19. D	20. B
21. D	22. C	23. B	24. B	25. C
26. B	27. A	28. D	29. C	30. D
31. B	32. A	33. B	34. B	35. C
36. D	37. B	38. B	39. A	40. B

SECTION B – Short Answer (Answers)

(80 marks)

Question 1 (8 marks)

- a. Fermentation (**1 mark**).
- b. Oxygen enters the wine (**1 mark**) and the yeast present carries out aerobic cellular respiration as a consequence (**1 mark**).
- c. glucose and oxygen → carbon dioxide and water (**1 mark**).
- d. Yeasts are facultative anaerobes and use fermentation when oxygen is absent and aerobic cellular respiration when oxygen is available (**1 mark**). Aerobic cellular respiration produces 36-38 ATPs per molecule of glucose compared to 2 ATPs produced per molecule of glucose by fermentation (**1 mark**). Since aerobic cellular respiration is more productive in terms of ATP production, the yeast will use this option rather than fermentation when oxygen is available (**1 mark**).
- e. High levels of alcohol kill the yeast cells, thereby stopping any further fermentation (**1 mark**).

Question 2 (9 marks)

- a. Prion disease (1 mark).
- b. Amino acids (1 mark).
- c. Beta pleated sheets (1 mark).
- d. Secondary and tertiary structures (1 mark).
- e. Bacteria are larger and are visible under a normal microscope. Consequently, there has been many years' worth of research on them (1 mark). Prions are far smaller and harder to detect, hence less research has been done on them (1 mark).
- f. Phospholipids (1 mark).
- g. The scrapie form of the protein is a different shape and in a different location (1 mark). The movement of ions across the plasma membrane of nerve cells is crucial for their functioning. Without the necessary proteins, the nerve may no longer function correctly (1 mark).

Question 3 (7 marks)

- a. Hormone (1 mark).
- b. Stage 1 - Signal Reception (1 mark). The ADH molecule binds to the ADH receptor embedded in the plasma membrane of the cell (1 mark).
Stage 2 - Signal transduction (1 mark). A second messenger is released within the cell and stimulates the release of cAMP and protein kinase. A cascade of changes occurs within the cell (1 mark).
Stage 3 - Cell response (1 mark). A response to the original stimulus is produced by the cell. In this case, aquaporins move to the plasma membrane of the cell thereby allowing greater movement of water (1 mark).

Question 4 (8 marks)

- a. Endosymbiosis (1 mark).
- b. Mitochondrion (1 mark).
- c. The *Hatena* 'chloroplast' is derived from a eukaryotic cell while chloroplasts located in plant cells are derived from a bacterial cell (1 mark).
- d. Any **three** of the following:
 - nucleus
 - linear chromosomes
 - mitochondria
 - endoplasmic reticulum
 - golgi bodies**or** any other reasonable answer (3 marks).
- e. Carbon dioxide produced by respiration in *Hatena arenicola* is utilised by *Nephroselmis* in photosynthesis which produces oxygen that can be used by the *Hatena arenicola* in respiration (1 mark).
Hatena arenicola would gain a regular food supply and *Nephroselmis* may gain protection or be moved towards stronger light source (1 mark).
(Any other reasonable answer acceptable as long as it explains how *both* organisms benefit.)

Question 5 (7 marks)

- a. Repressor protein (1 mark).
- b. Lactose (1 mark).
- c. Lactose binds to the repressor and changes its shape so that the repressor becomes inactive (1 mark). Transcription and translation then occur to produce the lactase enzyme (1 mark).
- d. The benefit is that the enzyme lactase is only ever produced when there is lactose available for breakdown (1 mark).
- e. RNA polymerase (1 mark).
- f. GCCAUCUACCUG (1 mark).

Question 6 (8 marks)

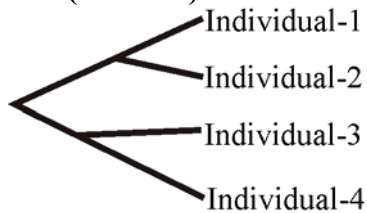
- a. Any two for 2 marks
 - Small brain case
 - Prominent eye ridge
 - Sloping face
 - Large jaw
- b. Potassium - Argon dating (1 mark). The rock surrounding the skull is melted and the amount of argon – 40 released is compared to the amount of potassium – 39 still found in the rock (1 mark)
or
Electron-spin resonance (1 mark). The amount of background radiation absorbed by the skull is measured and age determined on a scale (1 mark).
- c. *Homo naledi* is unlikely to be an ancestor of modern humans (1 mark) since dating techniques place them both in existence at roughly the same time (1 mark).
- d. This is an example of cultural evolution (1 mark) and shows that *Homo naledi* is likely to have had some kind of religion or belief in regards to their dead (1 mark).

Question 7 (6 marks)

- a. Gly. – Ser. – Val (1 mark).
- b. CC**G**AG#C**A**G... Any large glycine can be considered a valid change. # can be A,C,G or T (1 mark).
- c. Point substitution or silent mutation (1 mark).
- d. The codon coding for serine is replaced with a stop codon (1 mark). This means the resulting polypeptide chain would be shorter than normal (1 mark) resulting in a protein that is likely to be non-functional (1 mark).

Question 8 (9 marks)

a.



Cladogram should show that 1 and 2 are the most closely related (1 difference) with 3 and 4 less so (2 differences) **(1 mark)**.

There are also 3 differences between the first and second pair of individuals **(1 mark)**.

b. Only a small section of DNA is being examined, so it's less likely to be accurate than if the study was performed on a larger sample **(1 mark)**.

Multiple mutations may have altered the nucleotides so that they appear unchanged **(1 mark)**.

c. Intergenic refers to sections of DNA on a chromosome that are not part of a specific gene **(1 mark)**.

d. Genes are responsible for inheritable characteristics. Mutations within genes may alter the genes' function and the consequence of this change could become an issue for survival **(1 mark)**. Intergenic DNA can mutate without altering any gene function and therefore be passed on through the generations without any adverse effects **(1 mark)**.

e. Mitochondria in cells originally come from the maternal gamete and therefore can be used to trace maternal ancestry **(1 mark)**, whereas nuclear DNA in cells has originated from both parents, making ancestral studies more difficult to perform **(1 mark)**.

Question 9 (10 marks)

a. Transgenic **(1 mark)**.

b. Using biolistics **(1 mark)**. The desired gene is replicated and placed on small gold particles which are then fired into the cell **(1 mark)**. Cells are cultured to determine whether or not the desired gene has merged with the nuclear DNA **(1 mark)**.

or

Using *Agrobacterium tumefaciens* **(1 mark)**. The desired gene is merged into a plasmid and inserted into *Agrobacterium tumefaciens* **(1 mark)**. Transformed bacteria introduce the plasmid into the plant cells which are then cultured and grown **(1 mark)**.

or

Using CRISPR **(1 mark)**. Cas9 restriction enzyme cuts DNA at the desired site **(1 mark)**. Desired DNA sequence is 'knocked in' at the desired site **(1 mark)**.

c. 3n or 3 copies of every homologous chromosome rather than just a pair in all somatic cells of an organism **(1 mark)**.

d. Meiosis cannot occur to produce pollen or ova with the correct number of chromosomes **(1 mark)**. Farmers would have been unsuccessful in trying to cross these two forms of bananas naturally as their sex cells are not genetically compatible **(1 mark)**.

e. It should not affect the wild banana plants (other than in terms of competition for light and water) since it will not be able to cross breed with them **(1 mark)**.

f. Triploid bananas are clones **(1 mark)** as these beta-carotene enriched bananas are produced by vegetative propagation (i.e. asexually) **(1 mark)**.

Question 10 (8 marks)

- a. If the fish cannot interbreed and produce viable offspring they are considered to be separate species **(1 mark)**.
- b. There was already variation in the species **(1 mark)**.
The two groups of fish became isolated as the Isthmus of Panama formed **(1 mark)**.
There were different selection pressures on each group of fish in the two different geographical locations **(1 mark)**.
Those most suited to each environment survived **(1 mark)**.
They passed these favourable traits onto their offspring and over time became reproductively isolated and developed into distinct species **(1 mark)**.
- c. **(1 mark each for the two answers supplied)**.
- Allopatric speciation.
 - Divergent evolution.
 - Adaptive radiation.

End of Suggested Answers