



Victorian Certificate of Education 2013

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

BIOLOGY

Written examination

Thursday 31 October 2013

Reading time: 9.00 am to 9.15 am (15 minutes)

Writing time: 9.15 am to 11.45 am (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	12	12	70
			Total 110

- 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 41 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.

SECTION A – Multiple-choice questions**Instructions for Section A**

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

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

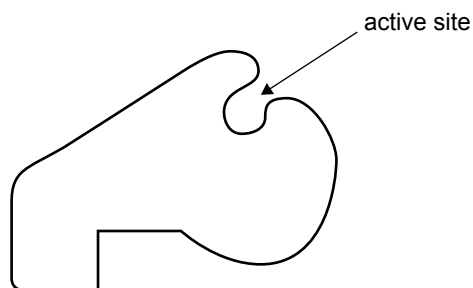
A correct answer scores 1, an incorrect answer scores 0.

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

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

Question 1

A drug molecule has been designed to inhibit the activity of an enzyme. The shape of the enzyme is shown below. The position of the active site is labelled.



What is the most likely shape for the drug molecule that is capable of competitive inhibition of the enzyme?

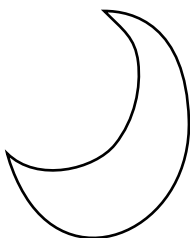
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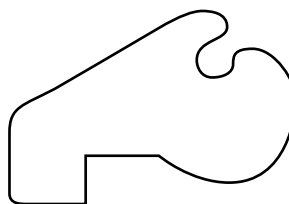
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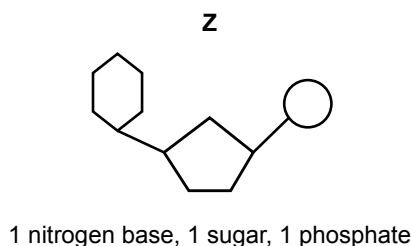
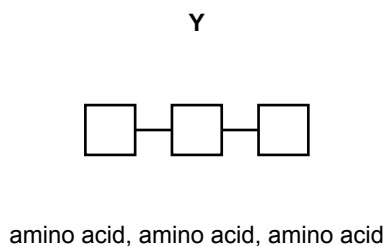
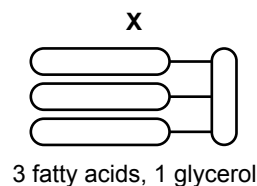
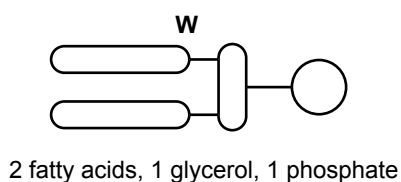
D.



Use the following information to answer Questions 2–4.

Consider the diagrams below showing structural sub-units of four types of biomolecules.

The sub-units are named in the order shown in each diagram.



Question 2

The class of biomolecules called lipids includes

- A. W only.
- B. W and X only.
- C. W, X and Y only.
- D. W, X, Y and Z.

Question 3

In an animal cell, a typical function of biomolecule Z is to

- A. encode genetic information.
- B. transport materials into the cell.
- C. provide long-term energy storage.
- D. help stabilise the plasma membrane.

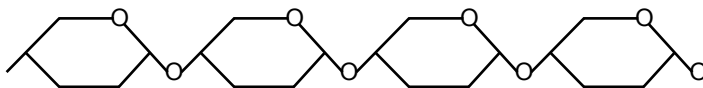
Question 4

When biomolecule X is being formed from its respective sub-units

- A. peptide bonds are formed.
- B. there is a net energy output.
- C. a molecule of water is added.
- D. a condensation reaction occurs.

Question 5

Consider the following molecular structure.



This could be part of a

- A. lipid.
- B. protein.
- C. nucleic acid.
- D. carbohydrate.

Use the following information to answer Questions 6 and 7.

Protein M, made by a particular cell type, is released for use by other cells.

Question 6

The site of synthesis of protein M is the

- A. vesicles.
- B. ribosomes.
- C. plasma membrane.
- D. smooth endoplasmic reticulum.

Question 7

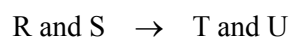
The export of protein M by these cells would involve

- A. centrioles.
- B. lysosomes.
- C. the Golgi apparatus.
- D. chromosomes.

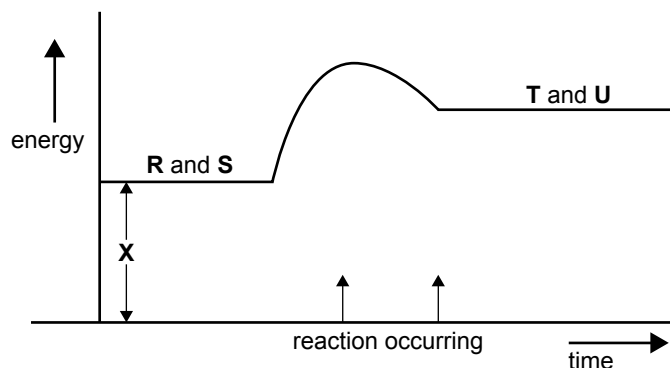
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Question 8

Consider the following reaction in which substrate molecule R and substrate molecule S are converted into product molecule T and product molecule U.



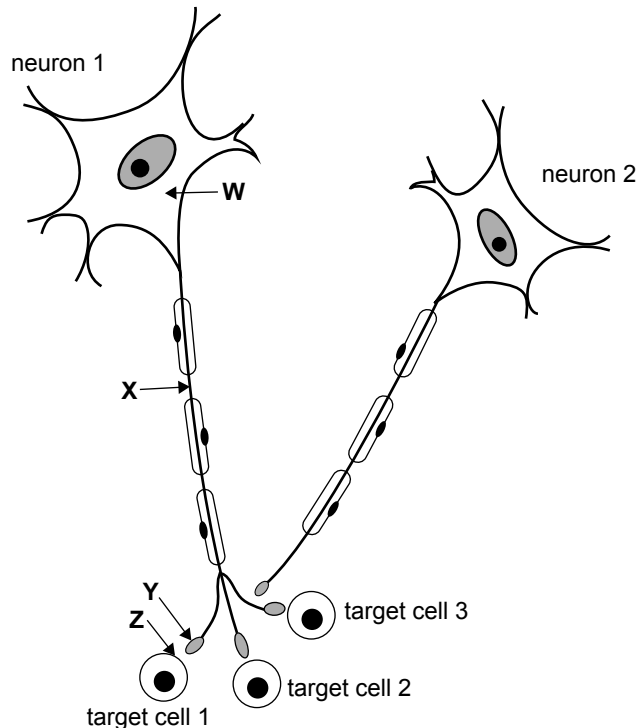
The following graph shows the energy available in the molecules against time.



Based on the information in the graph, a correct conclusion would be that

- A. this is an anabolic reaction.
- B. the reaction would release energy.
- C. the value of the activation energy for the reaction is shown by X.
- D. product molecules T and U have less energy than substrate molecules R and S.

Use the following information to answer Questions 9 and 10.



Question 9

Receptors for neurotransmitters released from neuron 1 would be found at position

- A. W.
- B. X.
- C. Y.
- D. Z.

Question 10

Neuron 1 is an excitatory neuron. Neuron 2 is an inhibitory neuron.

If simultaneous action potentials pass down both neurons, you would expect

- A. a response in target cell 3.
- B. an action potential to be generated at point Z.
- C. diffusion of a neurotransmitter to target cell 2.
- D. release of a neurotransmitter at point X.

Question 11

Facilitated diffusion

- A. requires a cell to expend energy.
- B. requires the presence of a membrane protein.
- C. moves molecules against their concentration gradient.
- D. is the movement of lipid-soluble molecules across a cell membrane.

NO WRITING ALLOWED IN THIS AREA

Question 12

In multicellular organisms, cells have receptors for death-signalling molecules. These death-signalling molecules play a role in apoptosis.

The death-signalling molecules

- A. allow for tumour formation.
- B. act by decreasing the rate of mitosis.
- C. initiate a response causing a cell to swell and burst.
- D. result in destruction of cells that are no longer required.

Question 13

Some responses or reactions seen in individuals are caused by the release of chemicals into the environment by other individuals of the same species.

These chemicals are called

- A. enzymes.
- B. pheromones.
- C. neurohormones.
- D. neurotransmitters.

Question 14

As part of the first line of defence in the human immune system, naturally occurring barriers to invading pathogens include

- A. lysozymes in tears.
- B. the production of antibodies.
- C. the engulfing of pathogens by phagocytes.
- D. inflammation at the site of infection.

Question 15

Defence mechanisms against bacterial pathogens include

- A. the production of interferon.
- B. neutralisation by histamines.
- C. destruction by complement proteins.
- D. agglutination by cytotoxic T cells.

Use the following information to answer Questions 16 and 17.

Ross River fever is caused by a virus that lives in kangaroos and wallabies. When a female mosquito bites an infected animal, it picks up viral particles. When the mosquito bites a human, the virus enters the bloodstream. The virus then reproduces in blood cells, resulting in fever, rashes and joint pain.

Question 16

Using the information given, it can be concluded that

- A. the viral vector is a mosquito.
- B. the virus is a cellular pathogen.
- C. Ross River water transmits the virus.
- D. many kangaroos and wallabies would be killed.

Question 17

The most effective way to reduce the incidence of Ross River fever in Australia would be to

- A. prevent humans from living near the Ross River.
- B. use an attenuated form of the virus to create a human vaccine.
- C. increase spending on anti-inflammatory drugs to treat the symptoms.
- D. isolate kangaroos and wallabies in nature reserves near the Ross River.

Question 18

DiGeorge syndrome is a rare, congenital disease that can disrupt the normal development of the thymus gland.

This disease would result in the

- A. swelling of lymph nodes.
- B. overproduction of B cells.
- C. reduced production of T cells.
- D. release of histamines from mast cells.

Question 19

Cytotoxic T cells are

- A. antibodies.
- B. able to kill virus-infected cells.
- C. part of the humoral response.
- D. part of the second line of the immune defence.

Question 20

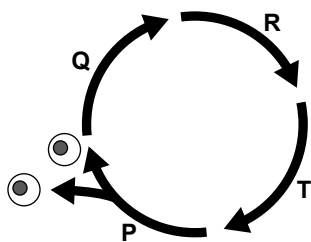
In the lymphatic system

- A. clonal selection occurs.
- B. mast cells are produced.
- C. vessels have thick, muscular walls.
- D. lymph is pumped by the heart.

NO WRITING ALLOWED IN THIS AREA

Question 21

The following diagram represents the cell cycle in cells of a eukaryotic organism. Each letter represents a particular section of the cell cycle.



During this cycle

- A. cytokinesis occurs during T.
- B. mitosis occurs during P.
- C. DNA replicates during Q.
- D. cell growth occurs during R.

Question 22

You have the same mitochondrial DNA as your

- A. paternal grandfather.
- B. paternal grandmother.
- C. maternal grandfather.
- D. maternal grandmother.

Question 23

Cystic fibrosis is an autosomal recessive trait that affects many parts of the body, particularly the lungs and other organs.

Parents who show none of the characteristics of cystic fibrosis have an affected child.

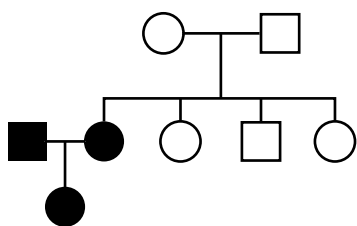
The chance that their next child will be phenotypically normal is

- A. three in four.
- B. one in four.
- C. one in two.
- D. zero.

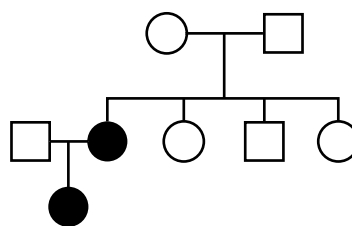
Question 24

Which pedigree represents an X-linked dominant trait?

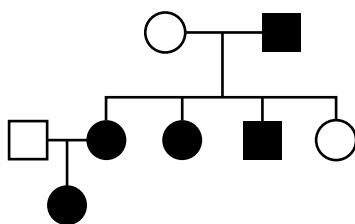
A.



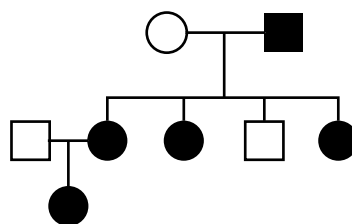
B.



C.



D.

**Question 25**

The ABO blood group system of humans is an autosomal trait that has three alleles as follows.

I^A	:	protein A on red blood cells
I^B	:	protein B on red blood cells
i	:	no protein on red blood cells

In this system, four different blood groups exist. They are groups A, B, AB and O.

In a family of four children, each child has a different blood group with respect to this gene.

The phenotypes of the parents must be

- A. AB and O.
- B. A and B.
- C. B and AB.
- D. O and B.

NO WRITING ALLOWED IN THIS AREA

Question 26

Plant height is a polygenic trait in a particular species. There are three independently segregating genes, each with two alleles, which determine the height of a particular plant. The alleles and their height contributions to the plant are as follows.

Alleles and height contributions						
gene locus 1	M	:	5 cm	M'	:	2 cm
gene locus 2	R	:	5 cm	R'	:	2 cm
gene locus 3	S	:	5 cm	S'	:	2 cm

The following cross was carried out.

$$\text{MM RR SS} \times \text{M'M' R'R' S'S'}$$

The expected heights of the offspring plants would be

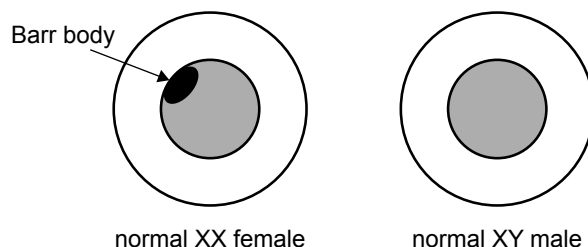
- A. 7 cm.
- B. 15 cm.
- C. 21 cm.
- D. 36 cm.

Question 27

The sex chromosomes in humans are usually females **XX** and males **XY**.

In each of the somatic cells of a normal female, only one of the X chromosomes is active. The other X chromosome is inactive or 'switched off' and becomes condensed close to the nuclear membrane. The inactive chromosome is known as a Barr body.

The following diagrams show normal cells of a female and a male.



The 'switching off' means that each somatic cell in females and males usually has one effective X chromosome. If any person, female or male, has more than the usual number of X chromosomes, the excess X chromosomes are also inactive or 'switched off'.

It is reasonable to assume that an individual with the sex chromosomes

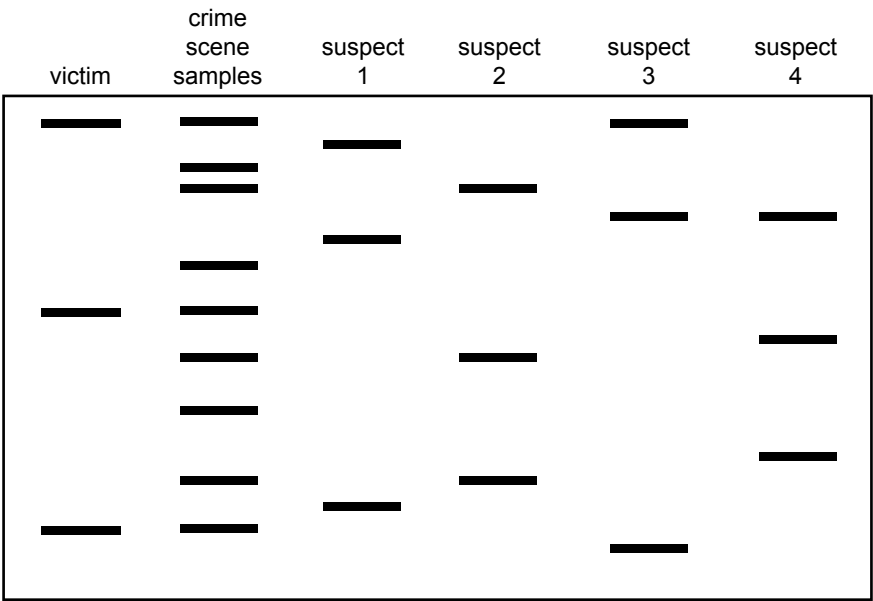
- A. XX would have no Barr bodies in each of their somatic cells.
- B. XXXX would have two Barr bodies in each of their somatic cells.
- C. XYY would have one Barr body in each of their somatic cells.
- D. XXXY would have two Barr bodies in each of their somatic cells.

Question 28

During a fight between a number of people, one was seriously injured. Blood samples were taken from the victim, the crime scene and four suspects.

DNA was extracted from white blood cells in each of the blood samples and electrophoresis of the samples was carried out.

The results are shown in the following diagram.



- The person most likely to have been at the crime scene is suspect
- A. 1.
 - B. 2.
 - C. 3.
 - D. 4.

NO WRITING ALLOWED IN THIS AREA

Use the following information to answer Questions 29 and 30.

Genetic engineers use restriction enzymes to cut DNA into smaller lengths. The recognition sequences of several restriction enzymes are shown in the table below. The symbol * denotes the restriction site (position of the cut).

Restriction enzyme	Recognition sequence (read in 5' to 3' direction)
EcoRI	$\begin{array}{ccccccccc} \text{G}^* & \text{A} & \text{A} & \text{T} & \text{T} & \text{C} \\ \text{C} & \text{T} & \text{T} & \text{A} & \text{A} & \text{G}^* \end{array}$
HindIII	$\begin{array}{ccccccccc} \text{A}^* & \text{A} & \text{G} & \text{C} & \text{T} & \text{T} \\ \text{T} & \text{T} & \text{C} & \text{G} & \text{A} & \text{A}^* \end{array}$
AluI	$\begin{array}{ccccc} \text{A} & \text{G}^* & \text{C} & \text{T} \\ \text{T} & \text{C}^* & \text{G} & \text{A} \end{array}$
HaeIII	$\begin{array}{ccccc} \text{G} & \text{G}^* & \text{C} & \text{C} \\ \text{C} & \text{C}^* & \text{G} & \text{G} \end{array}$

Question 29

Consider a length of double-stranded DNA with the sequence

5' T T A A G G A A T T C A A 3'
 3' A A T T C C T T A A G T T 5'

Adding EcoRI to a solution containing one copy of this double-stranded DNA produces

- A. two fragments of double-stranded DNA, each with a sticky end.
- B. four fragments of single-stranded DNA, each with a sticky end.
- C. two fragments of double-stranded DNA, each with blunt ends.
- D. four fragments of single-stranded DNA, each with blunt ends.

Question 30

Now consider a different length of double-stranded DNA with the sequence

5' C T T A A G C T T C C A A A T T A C C G A 3'
 3' G A A T T C G A A G G T T T A A T G G C T 5'

Which enzyme(s) will cut this piece of DNA?

- A. EcoRI only
- B. HindIII only
- C. AluI and HindIII only
- D. AluI, HindIII and HaeIII only

Question 31

The thylacine (*Thylacinus cynocephalus*) was a large, dog-like marsupial that was declared extinct in 1986. A mummified carcase of a thylacine was found in a cave on the Nullarbor Plain. The carcase was dated about 5000 years old.

The most likely method used to date the mummified carcase would involve

- A. dating the layers of rocks within the cave.
- B. potassium–argon dating of the mummified remains.
- C. measuring the proportion of carbon-14 atoms in the carcase.
- D. comparing the teeth in the mummified carcase to the teeth of other dog-like marsupials.

Question 32

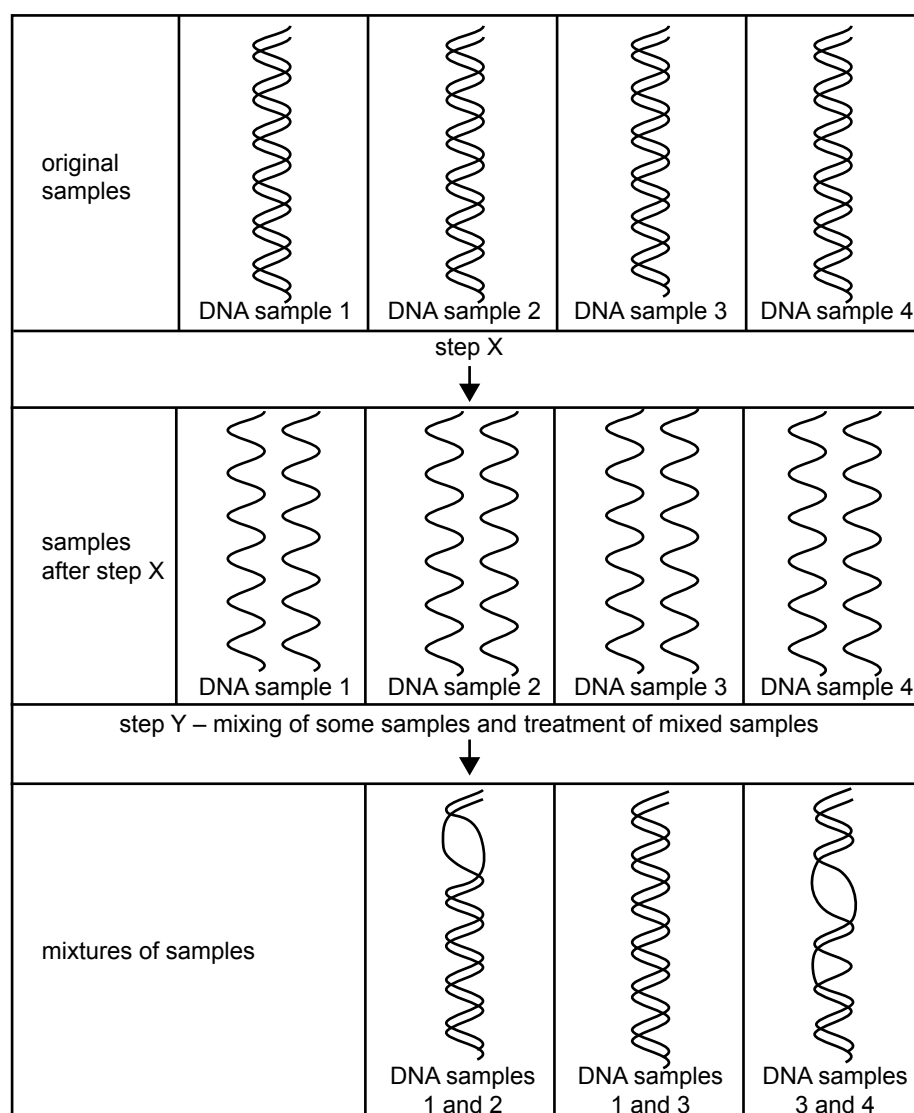
Biogeography is the study of

- A. the distribution of plants and animals in particular areas.
- B. fossil types and their relation to living organisms.
- C. islands and their distances from continents.
- D. mountain ranges and rivers.

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Question 33

Samples of DNA were taken from four individuals. The samples went through a series of steps and the resulting DNA is shown.

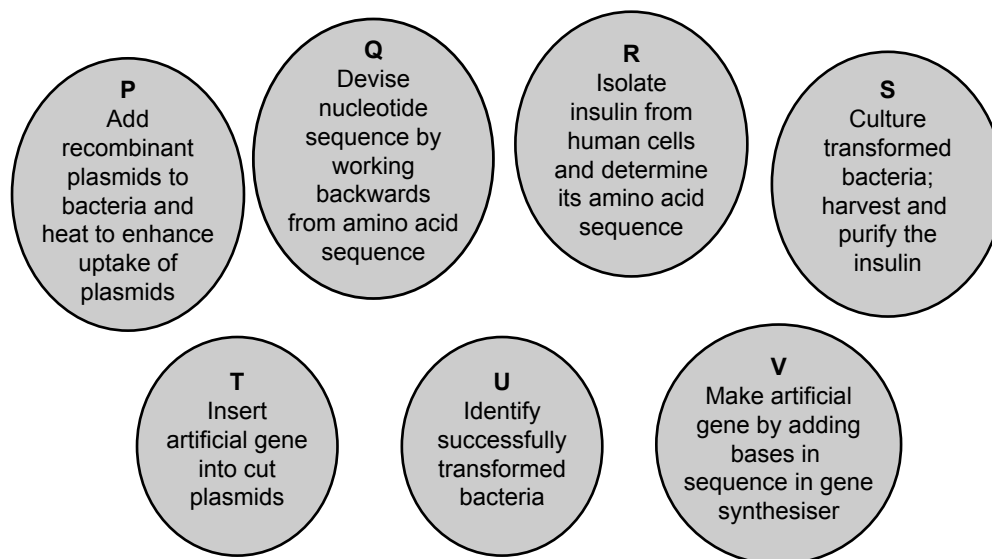


Using information from the diagram, which conclusion could be drawn?

- A. Samples 1 and 2 are from individuals belonging to the same species.
- B. Treatment at step X would have included cooling each of the original samples.
- C. Treatment of mixed samples at step Y would have included the addition of DNA helicase.
- D. Individuals belonging to samples 1 and 3 are more closely related than individuals belonging to samples 3 and 4.

Use the following information to answer Questions 34–36.

Bacteria can be transformed with an artificial insulin gene and cultured to make insulin in commercial quantities. The steps taken to produce genetically engineered insulin are summarised below. The order of the steps has been mixed up.



Question 34

The correct sequence of steps when producing the insulin is

- A. V, P, T, S, U, R, Q.
- B. V, T, P, U, S, Q, R.
- C. R, Q, V, T, P, U, S.
- D. R, V, Q, T, P, S, U.

Question 35

The tool used for joining the artificial gene to plasmid DNA at step T is

- A. a primer.
- B. DNA ligase.
- C. DNA polymerase.
- D. gel electrophoresis.

Question 36

The artificial insulin gene may have a different nucleotide sequence from the human insulin gene.

This is because the DNA code is

- A. redundant.
- B. universal.
- C. mutated by heat shock.
- D. contaminated by bacterial DNA.

NO WRITING ALLOWED IN THIS AREA

Use the following information to answer Questions 37 and 38.

Chimpanzees are the closest living relatives of humans. Less than 1 per cent of our DNA has changed in the 6 million years or so since the human and chimpanzee lineages diverged.

Question 37

The measurement of the rate of accumulation of random genetic changes in the genomes of chimpanzees and humans is called

- A. stratigraphy.
- B. a molecular clock.
- C. radiometric dating.
- D. relative dating.

Question 38

Research has shown that in a number of genes the sequence of nucleotides is unique to humans and is not found in chimpanzees.

Gene with sequence unique to humans	Functional role of gene with sequence unique to humans
HAR1	active in the brain necessary for development of the cerebral cortex
FOXP2	facilitates formation of words by the mouth
AMY1	facilitates digestion of starch
ASPM	controls brain size
LCT	permits digestion of milk sugar in adulthood
HAR2	drives gene activity in the wrist and thumb during development

Using the information in the table, it is reasonable to conclude that humans

- A. can digest milk sugar only in infancy.
- B. have less-opposable thumbs than chimpanzees.
- C. are able to walk on two feet in an upright position.
- D. process and remember more complex information than chimpanzees.

Use the following information to answer Questions 39 and 40.

Health professionals are concerned about the overprescription of antibiotics. Many antibiotics have become ineffective against certain species of bacteria.

Question 39

Any rise in incidence of antibiotic-resistant bacteria is due to

- A. these bacteria having acquired immunity to antibiotics.
- B. the overuse of antibiotics causing mutations in bacteria.
- C. the introduction of selectively bred, antibiotic-resistant bacteria.
- D. antibiotic-resistant phenotypes being favoured through natural selection.

Up to 80 per cent of bacterial diseases are caused by bacteria living in biofilms.

Biofilms are large communities of bacteria encased in extra-cellular coverings that attach to slippery surfaces, such as teeth and contact lenses. Special features of biofilms include the following.

- Some regions of cells form spores for reproduction and dispersal.
- Other regions of cells grow flagella for movement.
- Cells can detect others of their own species through cell-to-cell signalling (so they can sense when sufficient numbers are present to invade new areas successfully).

Question 40

Researchers are trying to develop therapies that avoid the use of antibiotics.

These therapies could include

- A. using drugs that stop spindle fibres forming during mitosis.
- B. providing amino acid supplements to promote flagella development.
- C. preventing biofilm bacteria from detecting others of their own species.
- D. targeting the biofilm's covering to make it more permeable to antibiotics.

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END OF SECTION A

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SECTION B – Short-answer questions**Instructions for Section B**

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

Question 1 (7 marks)

Yeast is a single-celled, microscopic fungus that uses sucrose as a food source. An experiment was carried out to investigate cellular respiration by a particular species of yeast.

Yeast cells were placed in a container and a sucrose solution was added. An airtight lid was placed on the container. The percentages of oxygen and ethanol in the container were recorded over a one-hour period. The experiment was carried out at room temperature. The results are shown in the following table.

	Percentage of oxygen	Percentage of ethanol
at the start of the experiment	21	0
at the end of the experiment	18	4

- a. Explain any changes that have been observed in oxygen and ethanol levels within the airtight container.

2 marks

Levels of carbon dioxide were also monitored during the experiment.

- b.** Predict whether the carbon dioxide concentration inside the airtight container would increase, stay the same or decrease within the time the experiment was carried out. Explain the reasoning behind your prediction.

2 marks

prediction _____

explanation _____

Scientists are looking at ways to increase the efficiency of photosynthesis in plants, including the way in which carbon dioxide is captured.

- c. i.** Name the stage of photosynthesis in which carbon dioxide is captured.

1 mark

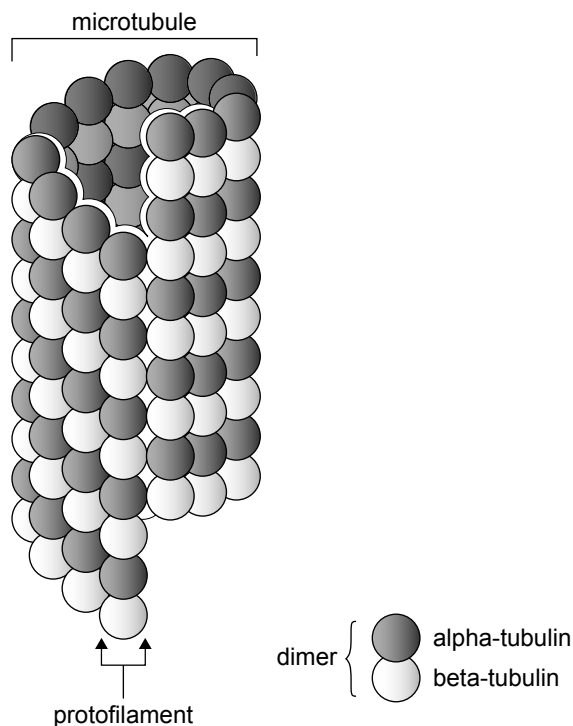
- ii.** The stage of photosynthesis in which carbon dioxide is captured requires other inputs. Name two other inputs and describe the role played by each in this stage of photosynthesis.

2 marks

Name of input	Role

Question 2 (5 marks)

Microtubules are hollow structures composed of a protein, tubulin, which has two forms: alpha-tubulin and beta-tubulin. A tubulin dimer is formed when one alpha-tubulin molecule and one beta-tubulin molecule join. Tubulin dimers polymerise into long chains to form protofilaments. A microtubule can be formed when 13 protofilaments align side by side, as represented in the diagram below.



- a. With respect to the structure of a protofilament, explain what is meant by the term 'polymerise'. 1 mark

- b. Consider an alpha-tubulin molecule.
Explain the difference between its primary structure and secondary structure. 2 marks

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- c. Describe what is meant by tertiary and quaternary protein structures.

2 marks

SECTION B – continued
TURN OVER

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Question 3 (5 marks)

A signalling molecule, epinephrine (adrenaline), is released from the adrenal gland when a human feels threatened. The molecule is transported in the bloodstream and initiates responses in cells in other parts of the human body.

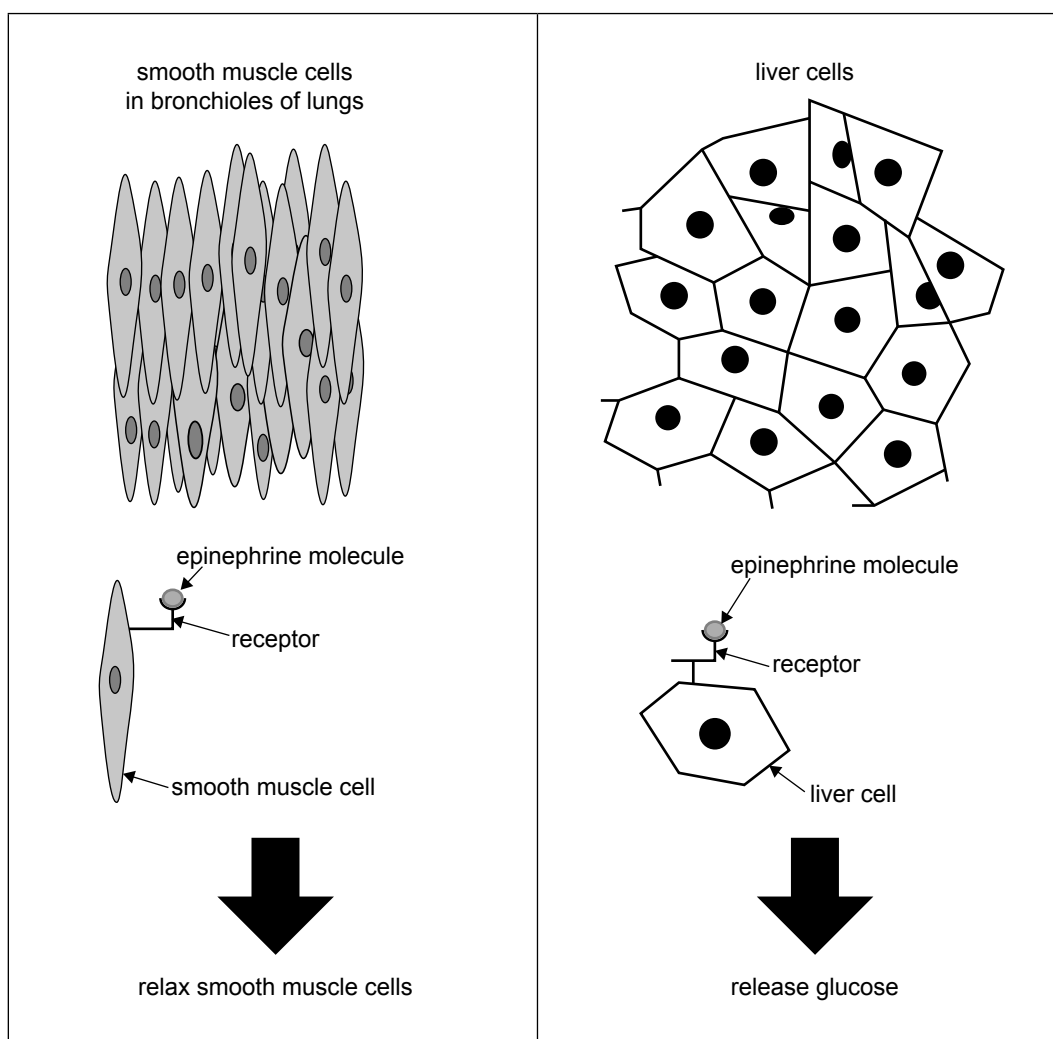
- a. To which group of signalling molecules does epinephrine belong?

1 mark

- b. Receptors for epinephrine are found on the exterior surface of the plasma membrane of cells. What does this suggest about the nature of the epinephrine molecule?

1 mark

Two examples of cells that respond to epinephrine are shown in the diagrams below.



- c. i.** Describe how the attachment of a molecule, such as epinephrine, to a receptor can bring about a response within a cell.

2 marks

- ii.** Suggest how epinephrine can produce the different responses in smooth muscle cells and liver cells.

1 mark

SECTION B – continued
TURN OVER

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Question 4 (7 marks)

In 1995, the Australian Bureau of Statistics released a report showing that only 53 per cent of children aged between three months and six years had completed the immunisation schedule.

- a. Is childhood immunisation an active or passive form of protection against a disease? Justify your answer.

2 marks

After a major advertising campaign by the government, the immunisation rate increased to 92 per cent.

- b. Complete the following flow chart to show the immune response in a person receiving their first vaccination. The following words must appear in your flow chart.

3 marks

plasma cells

memory cells

B cells

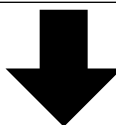
antibodies

cytokines

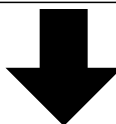
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Step 1

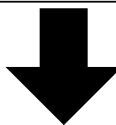
antigens detected by T-helper cells



Step 2



Step 3



Step 4

NO WRITING ALLOWED IN THIS AREA

Many immunisation schedules include regular booster injections.

- c. Explain how these work and why they are necessary.

2 marks

Question 5 (3 marks)

Sufferers of autoimmune diseases produce autoantibodies.

- a. What role do these autoantibodies play in causing the symptoms of an autoimmune disease?

1 mark

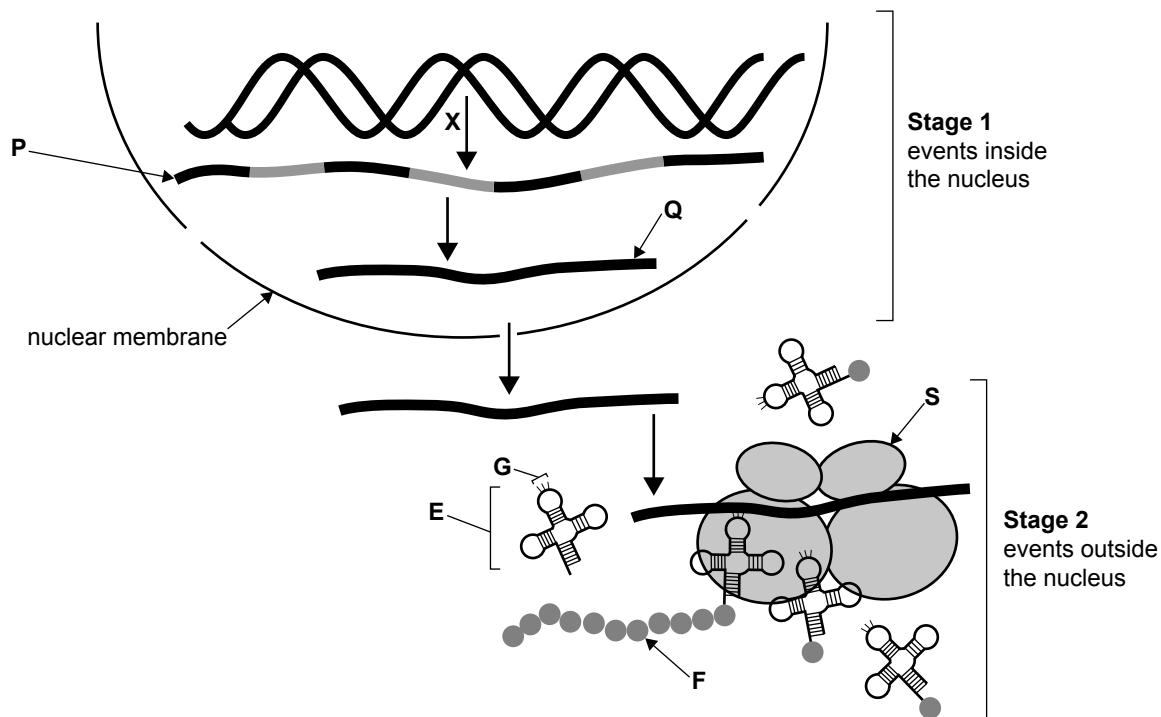
A teenager with a family history of an autoimmune disease underwent a genetic screen for the disease. After receiving a positive result for the genetic screen, she had an additional autoantibody test. The result of this autoantibody test was negative.

- b. Explain why the autoantibody test could be negative even though the genetic screen was positive.

2 marks

Question 6 (8 marks)

The following diagram outlines various events that occur in cells when DNA is activated.



- a. i. Outline events that occur during action X.

2 marks

- ii.** Note that structure P consists of two different kinds of components.

What are these two components called and what happens to each component?

2 marks

- b.** Describe the events occurring in stage 2, including the role of each of the structures S, F, E and G.

4 marks

SECTION B – continued
TURN OVER

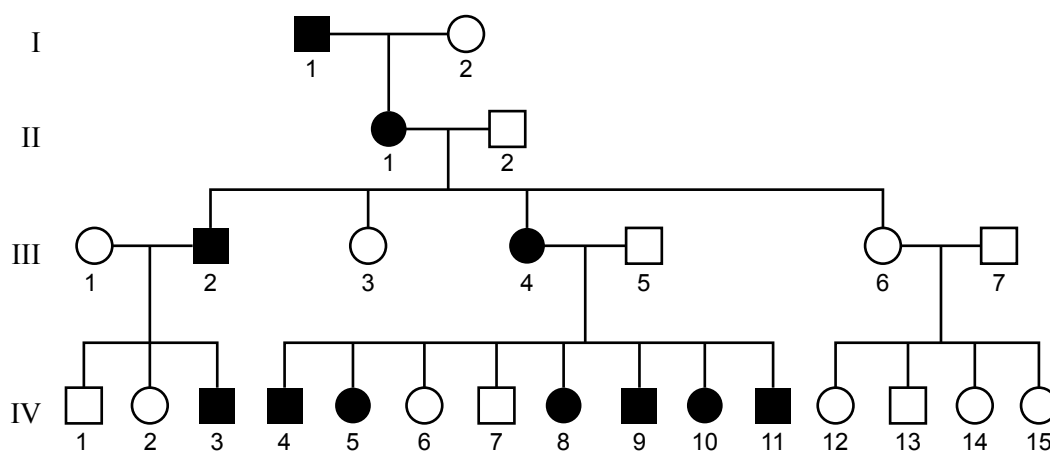
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Question 7 (4 marks)

The following drawing shows an individual with the phenotype 'piebald spotting', a rare autosomal genetic condition.



The following pedigree shows the inheritance of piebald spotting in a Norwegian family. Those individuals with the condition are shaded.



Individual II-1 was the first piebald person in his family. None of his ancestors was piebald.

- a.** What event must have taken place, and where, to account for the presence of the new phenotype? 2 marks

- b.** Is piebald spotting a dominant or recessive trait? Outline the reasons for your answer. 2 marks

SECTION B – continued
TURN OVER

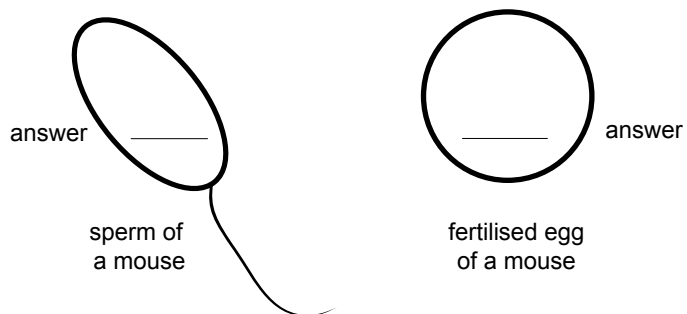
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Question 8 (7 marks)

Mice have a diploid number of 40.

- a. How many chromosomes are there in each of the following cells?

1 mark



- b. Briefly state the biological significance of the process of meiosis.

2 marks

- c. In mice, black hair colour is dominant to white hair colour. Another gene controls the length of the tail; short tails are dominant to long tails. The genes are not linked.

i. What is meant by linked genes?

1 mark

The symbols for the alleles for the two genes are shown below.

B : black hair

S : short tail

b : white hair

s : long tail

- ii. A mouse with black hair and a short tail is crossed with a mouse with white hair and a long tail. The black-haired, short-tailed mouse is heterozygous at both gene loci.

Predict the genotypes and phenotypes of the offspring of these two mice. Show all working.

2 marks

- iii. Explain whether you would expect the same genotypes and phenotypes in the offspring if the two genes had been linked.

1 mark

SECTION B – continued
TURN OVER

NO WRITING ALLOWED IN THIS AREA

Question 9 (7 marks)

The southern brush-tailed rock wallaby (*Petrogale penicillata*) is threatened with extinction in Victoria. Since European settlement, it has suffered from hunting for its fur, clearing of habitat and predation by foxes. Early in 2012, the population of brush-tailed rock wallabies in the Grampians National Park numbered only four individuals.



Source: Richard Lydekker, *A Hand-book to the Marsupialia and Monotremata*,
R Bowdler Sharpe (ed.), WH Allen & Co. Limited, London, 1894

- a. What is meant by extinction?

1 mark

Eighteen brush-tailed rock wallabies were released into the Grampians in late 2012. The wallabies had been bred in captivity in zoos and nature reserves in Victoria, South Australia, New South Wales and the Australian Capital Territory. Care was taken to ensure that the gene pool of the released wallabies was as diverse as possible.

- b. i. What is a gene pool?

1 mark

- ii. Using your knowledge of natural selection, explain why it is an advantage to have a diverse gene pool among the released wallabies.

2 marks

Wildlife officers are hoping that the Grampians population will increase to at least 50 wallabies in five years and that it will be maintained over time.

A small population of wallabies could be affected by genetic drift and, possibly, a genetic bottleneck effect.

- c. Explain the meaning of each of these terms with reference to allele frequencies.

2 marks

Term	Explanation
genetic drift	
bottleneck effect	

The Grampians wallabies will be closely monitored by surveillance cameras and radio collars after their release.

- d. Suggest **one** further measure that wildlife officers should carry out to help maintain the population over time.

1 mark

Question 10 (4 marks)

In humans, severe acute respiratory syndrome (SARS) is a serious form of pneumonia. SARS is caused by a coronavirus that was first identified in 2003.

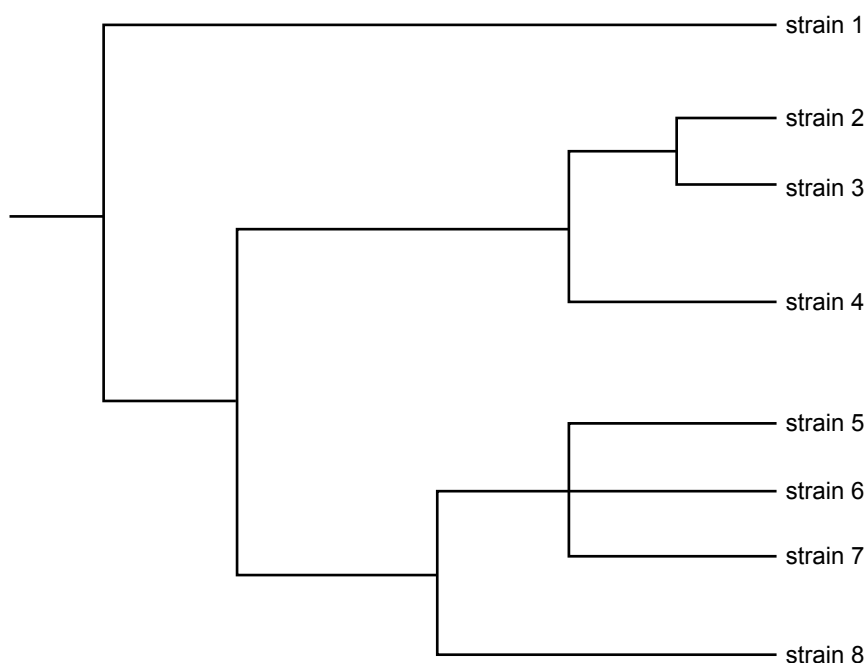
Scientists suspected that the virus had been transmitted to humans from some other animal. Testing was completed on several animal species. Strains of the coronavirus similar to those found in humans were identified in different species of horseshoe bats (genus *Rhinolophus*) and palm civets (*Paguma larvata*). Samples were taken from the different sources and the virus's RNA from each sample was sequenced.

- a. What molecular information would the scientists obtain from sequencing RNA?

1 mark

The molecular information enabled the scientists to draw an evolutionary tree for different strains of the coronavirus.

The following evolutionary tree was drawn.



- b. Coronavirus strains 2 and 3 are the most similar of the strains.

Using your knowledge and the information given in the evolutionary tree, give **two** possible explanations as to why they are the most similar of the strains.

2 marks

Strain 7 is found in palm civets, and strains 5 and 6 in humans. All other strains are found in different species of horseshoe bats.

- c. What conclusion can be drawn about the origin of the strain of virus that causes SARS in humans?

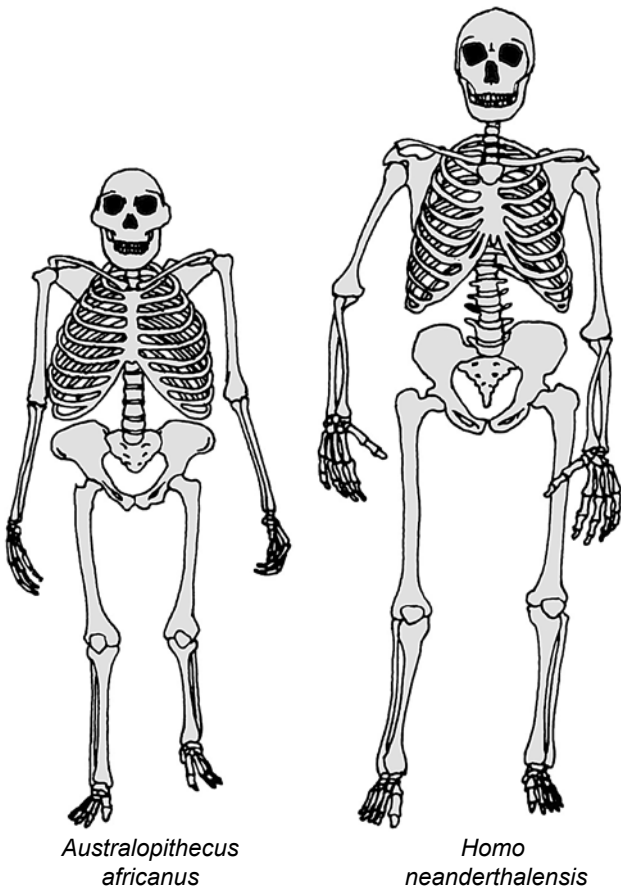
1 mark

SECTION B – continued
TURN OVER

NO WRITING ALLOWED IN THIS AREA

Question 11 (7 marks)

The skeletal structures of two extinct members of the hominin family tree, *Australopithecus africanus* and *Homo neanderthalensis*, are shown below.



- a. Examine the skeletal structures. For each of the features listed in the table below, describe the difference between the two species and state the significance of the difference. 4 marks

Feature	Description of difference	Significance of difference
pelvic structure		
arm to leg length ratio		

Neanderthals lived in the cold climate of Europe and Asia from 200 000 to 30 000 years ago. Modern humans and Neanderthals coexisted for around 10 000 years. Fossil evidence indicates Neanderthals shared much behaviour with modern humans. Scientists are undertaking research to find reasons why Neanderthals became extinct, but modern humans survived. Fossil evidence of the use of sewing needles and the division of labour between men and women was found only for modern humans, but not for Neanderthals.

- b.** Suggest **one** advantage each of the following would have had for the survival of populations of modern humans.

2 marks

use of sewing needles

division of labour between men and women

People today with non-African heritage carry some Neanderthal DNA.

- c.** State a hypothesis to account for these findings.

1 mark

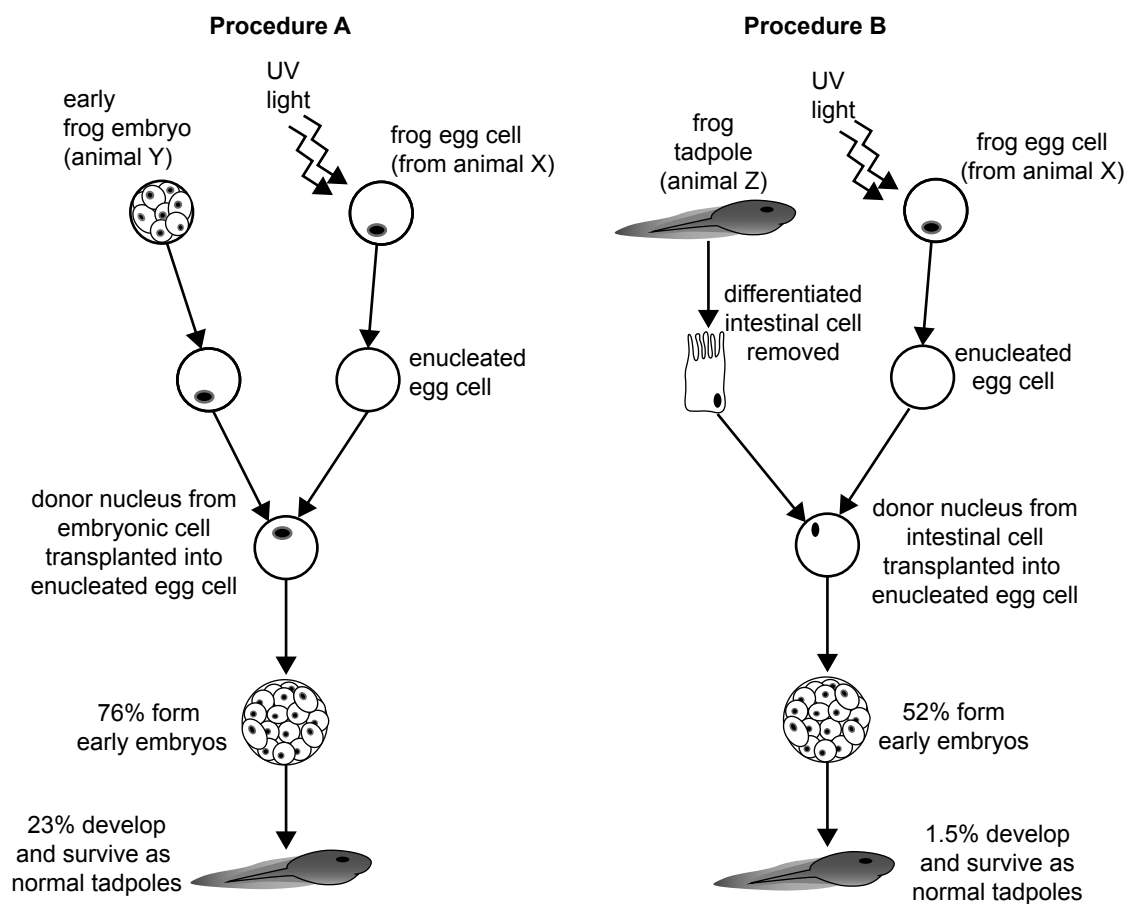
Question 12 (6 marks)

Early research into animal cloning included an experiment on the frog tadpole *Xenopus laevis*.

a. What is a clone?

1 mark

The early cloning experiment is summarised in the flow chart below.



- b. i.** Why were the frog egg cells from animal X exposed to UV light? 1 mark

- ii.** Describe the genetic make-up of the final tadpole in procedure A. Justify your answer, referring to the information in the flow chart. 2 marks

- c.** State the hypothesis being tested in the experiment and explain whether the results support the hypothesis. 2 marks
