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Student name

BIOLOGY
Units 3 & 4
Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 2 hours 30 minutes

Structure of book

Section	Number of questions	Number of marks
A	40	40
B	10	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 32 pages, with a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and on the answer sheet for multiple-choice questions.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses should 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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STAV Publishing

2017

BIOLOGY

Units 3 & 4 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

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

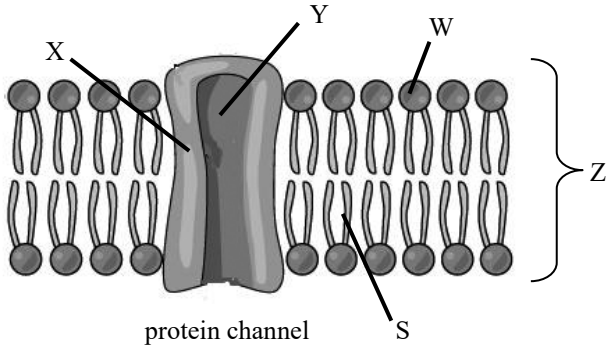
SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Question 1

The diagram below shows a section of a cell membrane. The membrane has hydrophobic and hydrophilic parts.



It can be stated that:

A. the hydrophilic areas would be X, Y and W.
B. the hydrophobic areas would be X, S and Y.
C. the protein channel would be hydrophobic at X and hydrophilic at Y.
D. Z would be hydrophobic.

Question 2

In the fluid mosaic model of the cell membrane the fluid part refers to the:

A. ability of water to flow through the phospholipid bilayer of the cell membrane.
B. ability of surface proteins to move through the cell membrane.
C. movement of charged particles across the cell membrane.
D. sideways movement of most of the phospholipids and some of the proteins in the cell membrane.

Question 3

The best description of the order of organelles involved in the pathway of the secretion of a protein from a eukaryotic cell is:

A. carrier vesicle → endoplasmic reticulum → cytosol → carrier vesicle → exocytosis.
B. cytosol → endoplasmic reticulum → carrier vesicle → golgi body → secretory vesicle → exocytosis.
C. cytosol → golgi body → carrier vesicle → endoplasmic reticulum → secretory vesicle → exocytosis.
D. endoplasmic reticulum → golgi body → cytosol → carrier vesicle → exocytosis.

Question 4

β pleated sheets:

A. are part of the tertiary structure of a protein.
B. are a common folding pattern due to the formation of covalent bonds between polypeptide strands.
C. can be parallel or antiparallel.
D. are coiled peptide chains held in place by hydrogen bonds between peptide bonds in the same chain.

Question 5

When comparing DNA and RNA it can be stated that:

A. DNA is self-replicating whereas RNA is synthesised from DNA.
B. both are double helices due to complimentary base pairing.
C. only DNA and not RNA is found in the nucleus of the cell.
D. only DNA and not RNA contains a 5 carbon sugar.

Question 6

Concerning photosynthesis, lowering the temperature has:

A. little effect on both the light dependent and light independent stages.
B. little effect on the light dependent stage but a significant effect on the light independent stage.
C. little effect on the light independent stage but a significant effect on the light dependent stage.
D. a significant effect on both the light dependent and light independent stages.

Question 7

The endosymbiotic theory:

A. was proposed because mitochondria and free living prokaryotes have similar cell nuclei.
B. proposes that eukaryotic cells evolved from prokaryotic cells.
C. proposes that mitochondria in eukaryotic cells arose from the engulfing of aerobic prokaryotes.
D. is supported by the fact that the outer membrane of mitochondria is the same as prokaryotes.

Question 8

A gene is made up of introns, exons, a promoter site, and stop and start codons. It can be stated that:

A. the promoter region is where transcription starts.
B. only exons are transcribed.
C. introns have no function.
D. exons and not introns code for protein.

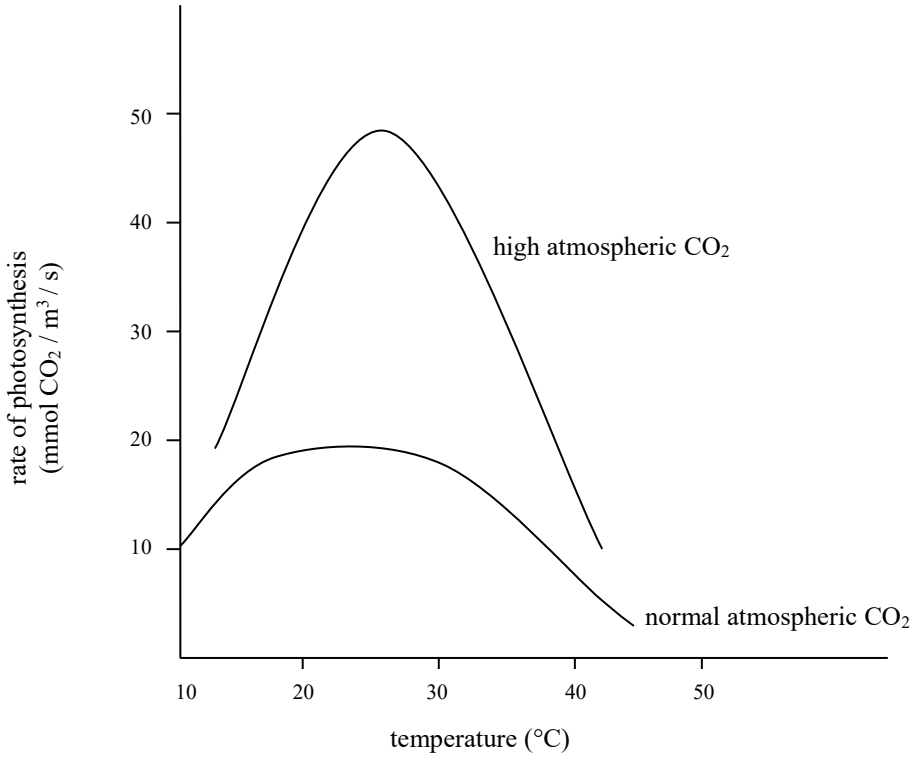
Question 9

Arginine protease is a proteolytic enzyme that breaks the peptide bond between the amino acid arginine and the next amino acid in a peptide chain. Glutamyl endopeptidase is a proteolytic enzyme that breaks the peptide bond between glutamine and aspartate in a peptide chain. This difference is due to:

A. arginine protease being a protein and glutamyl endopeptidase not being a protein.
B. the reaction involving arginine protease being endergonic and the reaction involving glutamyl endopeptidase being exergonic.
C. the shape of the active site of arginine protease being different from the shape of the active site of glutamyl endopeptidase.
D. the reaction involving arginine being a hydrolysis reaction and the reaction between glutamine and aspartate being a condensation reaction.

Question 10

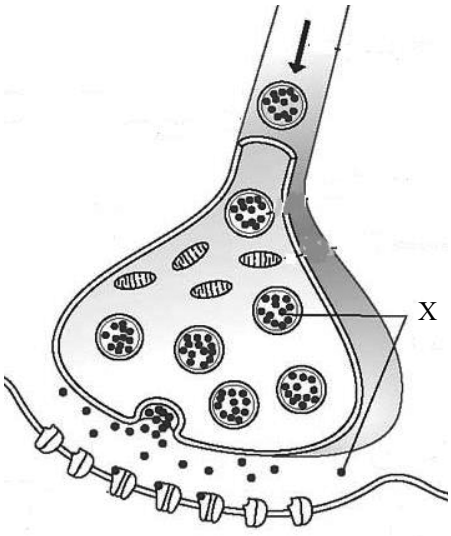
Increased levels of CO_2 in the atmosphere contribute to global warming as well as affecting the rates of photosynthesis. Scientists have carried out experiments to show how the rate of photosynthesis will change with increased levels of CO_2 and an increased rate of global warming. The graph below shows their results for many plants.



From the graph it can be stated that:

A. an increase in temperature increases the rate of photosynthesis.
B. at a temperature below 20°C high atmospheric concentration of CO_2 has a reduced rate of photosynthesis compared to normal atmospheric CO_2.
C. the rate of photosynthesis at both concentrations of CO_2 depends on the light availability.
D. increased levels of CO_2 concentration will result in increased levels of photosynthesis.

Questions 11 and 12 refer to the following labelled diagram.



Question 11

The molecule labelled X in the diagram is:

A. a nervous impulse.
B. an enzyme.
C. a neurotransmitter.
D. a neurohormone.

Question 12

The activity of molecule X is terminated by its:

A. movement across the synapse.
B. breakdown by hydrolytic enzymes.
C. movement into the post synaptic cell.
D. attachment to the postsynaptic receptors.

Question 13

A biology student investigated the rate of respiration in mice at two different temperatures, 10°C and 25°C. She measured the rate of oxygen consumption per gram of mouse over several 5 minute intervals and obtained the following data.

temperature (°C)	**average respiration rate (mL O_2 / g / min)**
10	0.0526
25	0.0328

Based on these results it can be stated that the mice at:

A. 25°C were more active than the mice at 10°C.
B. 10°C had a higher rate of ATP production than the mice at 25°C.
C. 10°C respire mainly aerobically whereas the mice at 25°C respire mainly anaerobically.
D. 25°C had a higher metabolic rate than the mice at 10°C.

Question 14

Some cancer therapies involve the administration of drugs that inhibit the signal transduction pathway. A drug that acts in such a way could enter the:

A. nucleus of the target cell and prevent transcription of mRNA.
B. target cell and inhibit apoptosis of the target cell.
C. nucleus of the target cell and inhibit DNA replication.
D. target cell and inhibit an enzyme that is responsible for the formation of a second messenger.

Question 15

An allergic response occurs when:

A. allergens bind to specific receptors on the mast cells resulting in the release of IgE antibodies that then release histamine.
B. foreign protein that has different major histocompatibility complex markers enters the body.
C. allergens enter the body releasing histamines that bring about an allergic response.
D. allergens bind to IgE antibodies on mast cells resulting in the mast cells releasing histamine.

Question 16

Lymph nodes would contain:

A. plasma cells, macrophages and B and T lymphocytes.
B. B and T lymphocytes and red blood cells.
C. only B and T lymphocytes.
D. B lymphocytes only.

Question 17

Australia has a comprehensive vaccination programme for children. This includes vaccination against diphtheria. For diphtheria, the government aims at a minimum vaccination rate of 85% as this will result in unvaccinated school children being protected. These unvaccinated children are protected because:

A. the high level of immunisation provides herd immunity.
B. they are passively protected by maternal antibodies.
C. diphtheria no longer exists in Australia because of the vaccination programme.
D. they have an innate natural immunity against diphtheria.

Questions 18 and 19 refer to the following information.

The viral disease rubella, when contracted in the first three months of pregnancy, can damage the developing foetus. A woman, who was two months pregnant and had not had rubella or been vaccinated against it, was concerned that a child with whom she had just had contact with, now had rubella. Her doctor advised an injection.

Question 18

This injection would contain:

A. antibiotics against the rubella virus.
B. antibodies against the rubella virus.
C. a weakened strain of the rubella virus.
D. B lymphocytes that would then produce antibodies against the rubella virus.

Question 19

This is an example of:

A. artificially acquired active immunity.
B. naturally acquired active immunity.
C. artificially acquired passive immunity.
D. naturally acquired passive immunity.

Questions 20 and 21 refer to the following information.

In 2004, hurricane Francis hit the islands in the Bahamas. One heavily forested island, Iron Cay, was spared the hurricane. Scientists took mating pairs of brown anole lizards, *Anolis sagrei*, from Iron Cay and set them free on seven small islands that had a bush environment and no large trees and where there were no lizards due to the hurricane. The lizard population on Iron Cay had evolved long legs to cope with the broad forest trees. The lizards that were wiped out on the other seven islands had short legs to dart around in the scrubby bushes. The researchers returned to the seven islands every year and measured the average leg length of the new population of lizards. The new populations of lizards all initially had long legs, however, over the time of the experiment this average length was getting shorter with each generation.

Question 20

The observation that the new generations of lizards initially had long legs is an example of:

A. genetic drift.
B. the founder effect.
C. natural selection.
D. gene flow.

Question 21

The gradual decrease in the length of the legs of the lizards on the seven islands is due to:

A. selection pressures leading to natural selection.
B. the movement of individuals from one island to another and cross breeding.
C. the lizards changing their leg length to suit the scrubby bush environment.
D. generation fluctuations in gene frequencies.

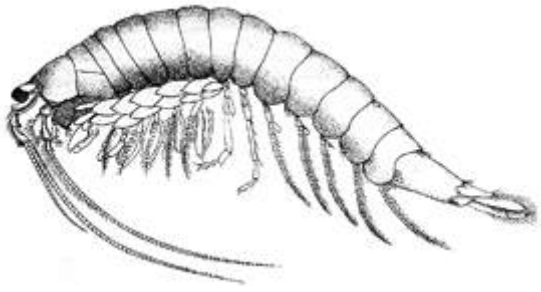
Question 22

Polyploidy is common in plants, especially flowering plants and is a significant driving force in plant evolution. This is because polyploids:

A. have higher fertility rates.
B. have fewer chromosomes so have fewer unfavourable mutations.
C. have increased allelic diversity.
D. produce more gametes than diploid plants.

Questions 23 and 24 refer to the following information.

The mountain shrimp, *Anaspides tasmaniae,* (shown below) is only found in fresh water streams above 300 m in Tasmania. It is termed a 'living fossil' as it is almost identical to a 230 million year old fossil, *Anaspidites antiquus,* that was found in New South Wales. Currently its closest relatives are found in New Zealand and South America.



Question 23

The similarity of *Anaspides tasmaniae* to *Anaspidites antiquus* suggests that:

A. this species has not been subjected to natural selection.
B. the environment of this species has remained relatively constant over this time period of 230 million years.
C. there has been no evolution of this species.
D. this species needs a longer time to evolve.

Question 24

The distribution of closely related species to *Anaspides tasmaniae* provides evidence for:

A. comparative anatomy of species.
B. divergent evolution.
C. the different environments of these shrimp.
D. the existence of the supercontinent Gondwana.

Question 25

An index fossil is:

A. one that shows a gradual change in an organism over time.
B. used to determine the absolute age of other fossils by comparison.
C. useful for dating sedimentary rocks of the same age in different locations.
D. a footprint left by an extinct animal.

Questions 26 and 27 refer to the following information.

Humans have a gene, LCT, that codes for the enzyme lactase. Lactase digests lactose, the sugar that occurs in milk. In most people LCT is active in children but is turned off in adults. Most Europeans and people from east and north Africa and the Middle East have mutations in the control region of the lactase gene that enables the gene to be expressed and active in adults. These mutations and their position in the gene are shown in the table below.

people	mutation
Europeans	**C** ⟶ **T** at position 13910
East Africans	**T** ⟶ **G** at position 13915
Middle Eastern	**G** ⟶ **C** at position 14010

Question 26

The type of mutations depicted are

A. frame shift mutations.
B. insert mutations.
C. deletion mutations.
D. point mutations.

Question 27

The ability to break down lactose in these different populations is an example of:

A. divergent evolution.
B. homology.
C. convergent evolution.
D. the evolution of different races of people.

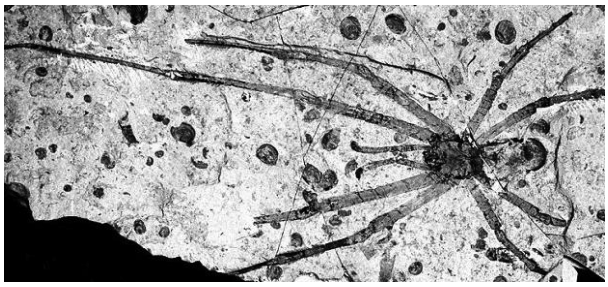
Question 28

A farmer has a large flock of turkeys with an average weight of 5 kg. He decided to only allow birds with the highest body weight to breed. Over several generations the average body weight is now 6 kg. This is an example of:

A. active selection.
B. reproductive selection.
C. natural selection.
D. selective breeding.

Question 29

In 2014 the largest fossil spider, *Mongolarachne jurassica,* was found in volcanic ash in Mongolia. It had a body length of 1.65 cm. and was calculated to be 160 million years old.



The age of this fossil would have most likely been determined by:

A. the technique of carbon-14 dating.
B. using a molecular clock.
C. comparing it to index fossils.
D. extracting DNA and hybridising it with other fossil spider DNA.

Question 30

The sweet potato and the potato are similar in appearance. Both grow underground and are storage structures for the plant. The sweet potato is a modified root and the potato is a modified stem.

sweet potato

potato

These structures are:

A. homologous structures pointing to a common ancestry.
B. analogous structures pointing to a common ancestry.
C. vestigial structures as the potato is not a real stem and the sweet potato is not a real root.
D. analogous structures that developed independently as adaptations for food storage.

Question 31

Genes that are best suited to be used as molecular clocks should:

A. have a large number of base pairs.
B. have a consistent rate of mutation.
C. be acted upon by natural selection.
D. have more exons than introns.

Question 32

Early *Homo* species had a larger brain than species of *Australopithecines.* It can also be stated that:

A. *Australopithecines* were not bipedal whereas species of *Homo* were.
B. early *Homo* species but not *Australopithecines* were able to manufacture tools.
C. early *Homo* species had a smaller face and teeth than *Australopithecines.*
D. the big toe of *Australopithecines* could be moved like the thumb, whereas the big toe of *Homo* species cannot.

Question 33

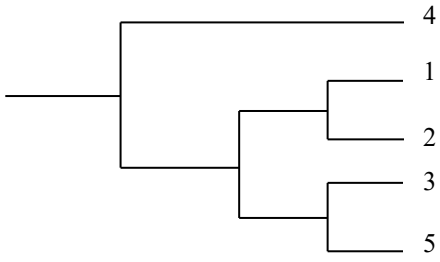
A scientist investigated changes in nucleotide sequences in a single gene in order to determine the evolutionary relationship between 5 related species of insects. The nucleotide differences are tabulated below.

number of nucleotide differences

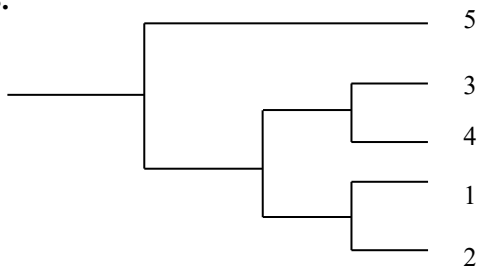
species	1	2	3	4	5
1		2	10	22	8
2			10	25	11
3				22	2
4					20
5					

Using this data, the phylogenetic tree that best shows the relationship between these species would be:

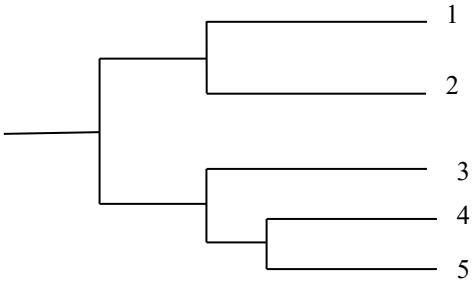
A.



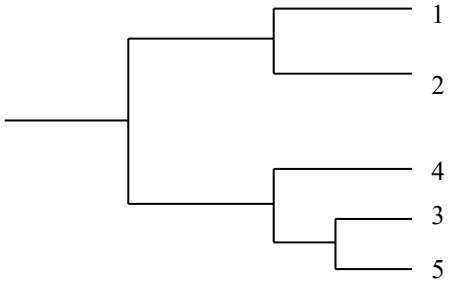
B.



C.

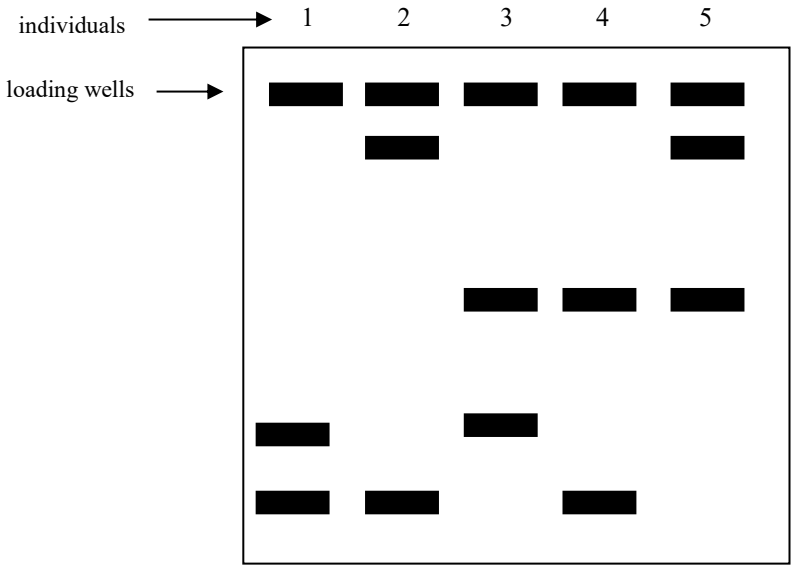


D.



Questions 34 and 35 refer to the following information.

The electrophoresis gel shown below shows the results of a restriction enzyme digest of five individuals, a mother and father and their three children.



Question 34

The pattern shown by the fragments on the gel is a result of the:

A. heaviest fragments moving the furthest towards the negative pole of the gel.
B. lightest fragments moving the furthest towards the negative pole of the gel.
C. lightest fragments moving the furthest towards the positive pole of the gel.
D. heaviest fragments moving the furthest towards the positive pole of the gel.

Question 35

From the results, it can be stated that:

A. individuals 2 and 3 are the parents and 1, 4 and 5 are the children.
B. individuals 4 and 5 are the parents and 1, 2 and 3 are the children.
C. individuals 1 and 5 are the parents and 2, 3 and 4 are the children.
D. individuals 2 and 4 are the parents and 1, 3 and 5 are the children.

Question 36

The restriction endonuclease EcoR1 cuts the DNA molecule between G and A in the recognition sequence G A A T T C.
In the diagrams below the cut site is shown as a line. The diagram that best corresponds to the cutting pattern of EcoR1 would be:

A. 5' G| A A T T C

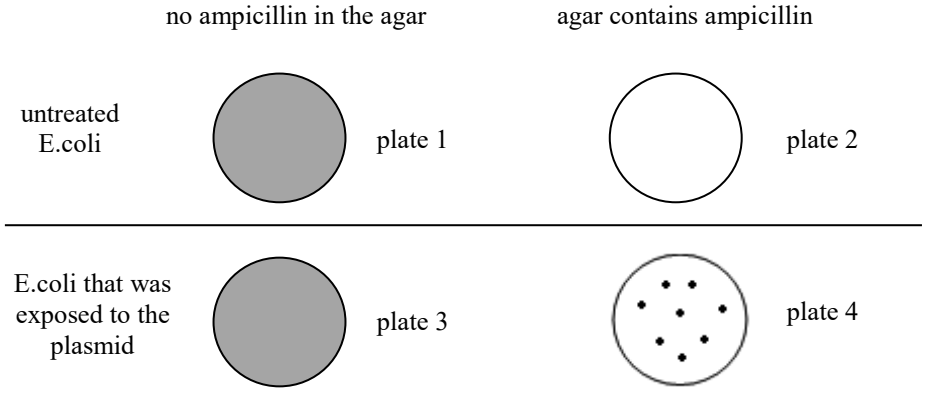
B.
5' G|A A T T C 3'
3' C T T A A|G 5'

C.
5' G|A A T T C 3'
3' G|A A T T C 5'

D.
5' G|A A T T|C 3'
3' C|T T A A|G 5'

Questions 37 to 39 refer to the following information.

In an experiment, a gene giving resistance to the antibiotic ampicillin was inserted into a bacterial plasmid. E. coli bacteria that were fully sensitive to ampicillin were treated so that they would take up the plasmid. Bacteria were plated on agar plates and the results of the experiment are shown below. The shaded plates indicate extensive growth of the bacteria and the dots indicate separate colonies of bacteria.



Question 37

Part of this experiment would have been to use:

A. DNA ligase to join the ampicillin resistant gene into the plasmid.
B. The same restriction enzyme to cut the plasmid and to cut the circular DNA of E.coli so the plasmid is inserted at complementary sticky ends.
C. DNA ligase to insert the plasmid into the circular chromosome of E.coli.
D. DNA polymerase to increase the number of plasmids.

Question 38

With respect to the growth of bacteria it can be stated that:

A. plates 3 and 4 would contain only bacteria that contained the ampicillin resistant plasmid.
B. only plasmids are growing on plate 2.
C. all the bacteria growing on plate 4 have been successfully transformed.
D. plates 1 and 3 contain only bacteria that are sensitive to ampicillin.

Question 39

Plates 1 and 3 are included in the experiment:

A. as positive controls.
B. in order to show that the E.coli has taken up the plasmid.
C. in order to make sure that the E.coli are viable.
D. as negative controls.

Question 40

Rational drug design:

A. involves trial and error testing of chemical substances on cultured cells or animals.
B. is used in the design of effective vaccines.
C. results in drugs with no side effects as the drug only binds to the target molecule.
D. involves the design of small molecules that are complementary in shape and charge to a biomolecular target.

END OF SECTION A

SECTION B

Instructions for Section B

Answer all questions in the spaces provided. Write using blue or black pen.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1

Amylase is an enzyme that breaks down starch to maltose. A student investigated the effect of pH on the activity of amylase. The activity of the enzyme was measured by testing for the presence of starch at short intervals. The following results were obtained.

pH	4.0	5.0	6.0	7.0	8.0	9.0
mean amylase activity (% maximum)	22	65	97	100	54	27

a Outline the steps that would be taken by the student for this investigation and what conditions would be required.

(4 marks)

b Suggest **two** reasons why the activity of amylase is so low at pH 4.0 and pH 9.0.

(2 marks)

The student concluded that the optimum pH for the amylase activity was exactly 7.0. It was suggested by another student that the optimum pH may be slightly different to this value.

c How might the first student improve this experiment in order to satisfy the possibility of another optimum pH?

_____

_____

(1 mark)

An investigation was carried out on the effect of two different inhibitors of amylase. One was a competitive inhibitor and the other was a non-competitive inhibitor.

d How do the actions of a competitive and a non-competitive inhibitor differ?

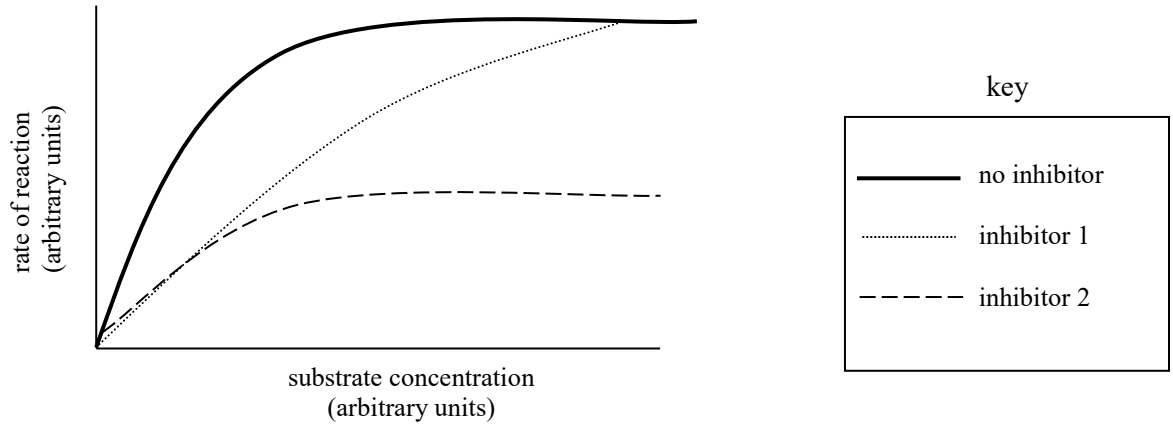
_____

_____

_____

(1 mark)

The following graph shows the results of the reaction rate without an inhibitor and the reaction rates with the two different inhibitors described above.



e State which lines on the graph refer to each type of inhibitor and give a reasoning for your answers.

inhibitor 1: _____

inhibitor 2: _____

Reasoning _____

_____

_____

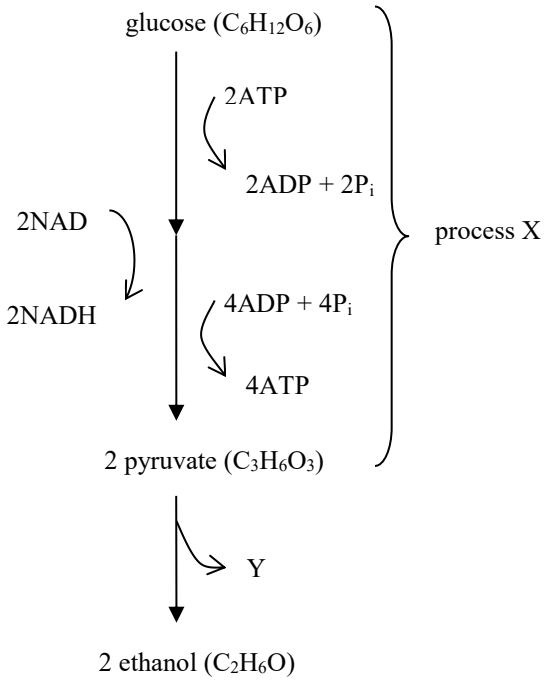
_____

(2 marks)

Total 10 marks

Question 2

The following diagram shows the main stages of anaerobic respiration in yeast.



a Name process X: _____

(1 mark)

b Name product Y: _____

(1 mark)

A student investigated the effect of temperature on the rate of anaerobic respiration in yeast by measuring the rate of production of product Y.

A measured amount of yeast was added to a solution containing a fixed amount of glucose in a sealed container. The amount of product Y produced in 5 minutes was measured. This was repeated 3 times and an average volume of product Y calculated. The results are tabulated below.

temperature (°C)	**average volume of product Y produced after 5 minutes (mL)**
22	32.5

c Why was this experiment done in a sealed container?

_____

_____

_____

(1 mark)

d Why did the student repeat the procedure 3 times and calculate an average volume?

_____

_____

_____

(1 mark)

The student then repeated the experiment at 30°C.

e Would you expect the average volume of product Y at 30°C to be greater than, equal to, or less than the average volume at 22°C if all other factors were the same? Explain your answer.

_____

_____

_____

_____

_____

(2 marks)

f Suggest **two** factors, apart from temperature, that might limit the rate of production of product Y.

_____

_____

_____

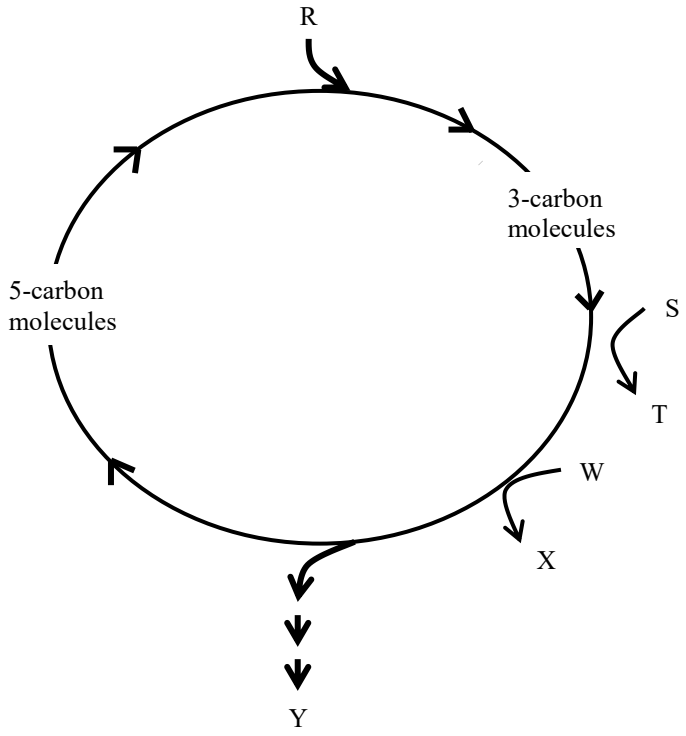
_____

(2 marks)

Total 8 marks

Question 3

The diagram below is a simplified flow diagram of a series of chemical reactions that occur during photosynthesis.



a Name the cycle that is represented by the flow diagram above **and** state exactly where it takes place.

_____

_____

(1 mark)

b Complete the following table for the letters on the flow diagram above.

letter	name or chemical symbol
R	
S	
T	
W	
X	
Y	

(4 marks)

c What is the source of the chemical substances S and W?

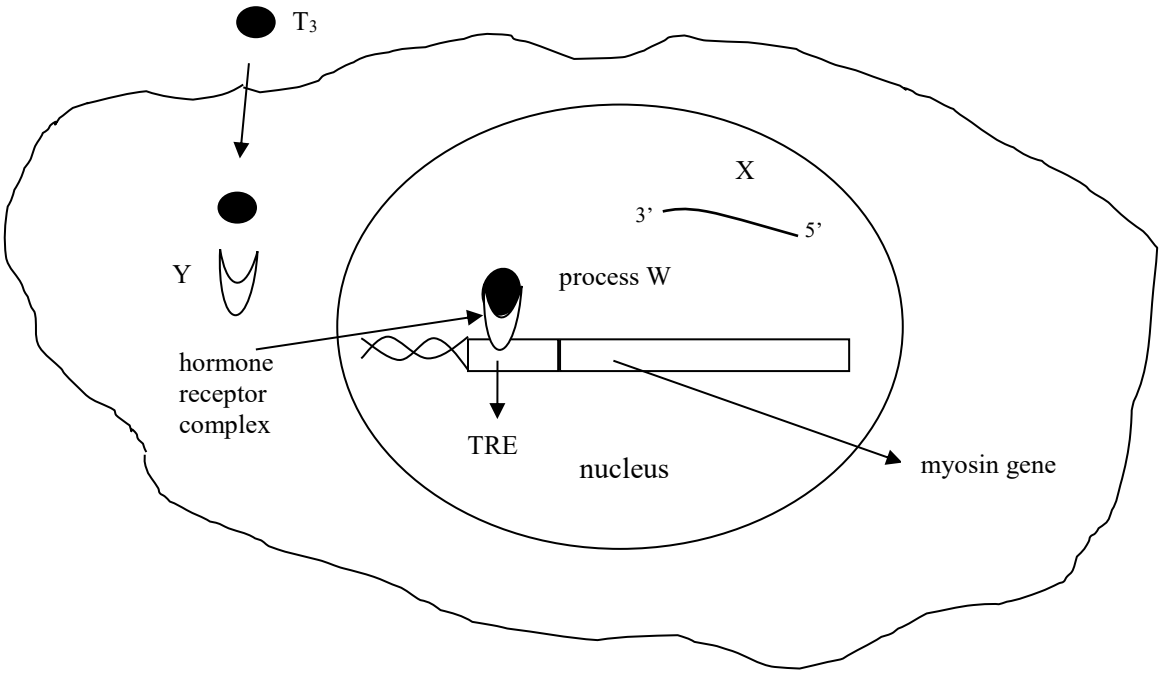
_____

(1 mark)

Total 6 marks

Question 4

Triodothyroxine, or T_3, is a thyroid hormone. It affects many physiological processes in the body. T_3 binds to sections of DNA, T_3 response elements (known as TRE), as shown in the diagram below. T_3, although it has the ability to diffuse through the cell membrane, it is in fact carried by transmembrane carrier proteins.



a What property of T_3 would enable it to diffuse across the cell membrane?

_____

(1 mark)

The increased strength of contraction of the heart muscle depends on the ratio of different myosin proteins in the heart muscle cells. Production of some types of myosin protein is stimulated by T_3, and the production of other myosin protein is inhibited by T_3, so the ratio of myosin proteins can be altered.

b What is the molecule labelled Y?

_____

(1 mark)

c Name the process labelled W **and** its immediate product molecule X.

_____

_____

(2 marks)

Before molecule X leaves the nucleus, it needs to undergo modification.

d Describe **three** ways molecule X is modified before it exits the nucleus.

_____

_____

_____

_____

_____

_____

(3 marks)

e Explain how T_3 could be able to stimulate the production of some myosin protein molecules and prevent the production of other myosin molecules in cardiac muscle cells.

_____

_____

_____

_____

_____

(2 marks)

Total 9 marks

Question 5

In 2015 the mosquito-borne Zika virus was linked to causing microcephaly (small head) and other brain damage in babies if the mother contracted the virus during pregnancy. These cases occurred in Brazil. The disease itself is usually mild, with the symptoms being similar to other viral infections such as a cold so that an individual may not even be aware of being infected with the Zika virus.

a Suggest a way of determining if someone has been exposed to the Zika virus.

_____

_____

(1 mark)

b How might the body use the second line of defence against viruses such as the Zika virus?

_____

_____

_____

_____

(2 marks)

Because of the seriousness of the disease for pregnant women, together with the Olympic games being in Brazil in 2016, scientists have endeavoured to develop a vaccine for this otherwise mild disease.

c Name the two different types of cells that enable a vaccine to be effective and the role they play.

Name of cell type: _____

Role of this cell: _____

_____

_____

_____

_____

Name of cell type: _____

Role of this cell: _____

_____

_____

_____

_____

(2 marks)

d Outline the steps that would be involved in the development of a vaccine that could be safely released to vaccinate the public.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3 marks)

Total 8 marks

Question 6

Huntington's disease is a late onset dominantly transmitted neurological disease, usually appearing when an individual is well over 40 years of age.

The gene codes for the huntingtin protein and has a section near its beginning consisting of repeats of the codon CAG. The increase in the number of these repeats results in Huntington's disease. Huntington's disease causes the progressive breakdown and death of nerve cells in the brain. The following table shows the influence of the number of CAG repeats on the development of the disease.

number of CAG repeats	outcome
10 – 35	normal functioning
> 40	Huntington's disease

Second base letter

First base letter	U	C	A	G	Third base letter
U	Phenylalanine Phenylalanine Leucine Leucine	Serine Serine Serine Serine	Tyrosine Tyrosine ***Stop*** ***Stop***	Cysteine Cysteine ***Stop*** Tryptophan	**U** **C** **A** **G**
C	Leucine Leucine Leucine Leucine	Proline Proline Proline Proline	Histamine Histamine Glutamine Glutamine	Arginine Arginine Arginine Arginine	**U** **C** **A** **G**
A	Isoleucine Isoleucine Isoleucine Methionine	Threonine Threonine Threonine Threonine	Asparagine Asparagine Lysine Lysine	Serine Serine Arginine Arginine	**U** **C** **A** **G**
G	Valine Valine Valine Valine	Alanine Alanine Alanine Alanine	Aspartic acid Aspartic acid Glutamic acid Glutamic acid	Glycine Glycine Glycine Glycine	**U** **C** **A** **G**

a Use the table above to determine what the codon CAG codes for: _____

(1 mark)

Research has shown that one effect in Huntington's disease is the activation of caspases.

b Outline how the activation of caspases could result in Huntington's disease.

_____

_____

_____

_____

_____

_____

(2 marks)

People suspected of carrying the gene for Huntington's disease can undergo genetic testing. Genetic testing raises ethical issues.

c Suggest **two** ethical issues that could arise from genetic testing.

_____

_____

_____

_____

_____

(2 marks)

Total 5 marks

Question 7

Some genes are master control genes.

a What is a master control gene?

_____

_____

(1 mark)

The master control gene, BMP4 or bone morphogenetic protein 4 gene, produces a protein that acts as a signalling molecule that is important in the formation of heavy, wide beaks in birds. Another master control gene is the calmodulum gene, CaM, that influences the length of the beak. The final beak length and width is influenced by the amount of gene product from these two genes as shown in the table below.

gene level	beak characteristic
low level of BMP4	narrow beak
high level of BMP4	deep beak
low level of CaM	short beak
high level of CaM	long beak

The following diagram shows the ancestor of Galapagos finches and the relative amount of gene product BMP4 and CaM.

BMP4: low
CaM: low

b Complete the table below based on the data provided. Indicate if each gene is high, medium or low for each finch listed.

finch	BMP4 (high / medium / low)	CaM (high / medium / low)
 *Geospiza scandens*		
 *Geospiza conirostris*		
 *Geospiza magnirostris*		

(3 marks)

c Outline the sequence of events involving the master control genes BMP4 and CaM along with natural selection that resulted in the evolution of the different beak sizes in the Galapagos finches.

_____

_____

_____

_____

_____

_____

_____

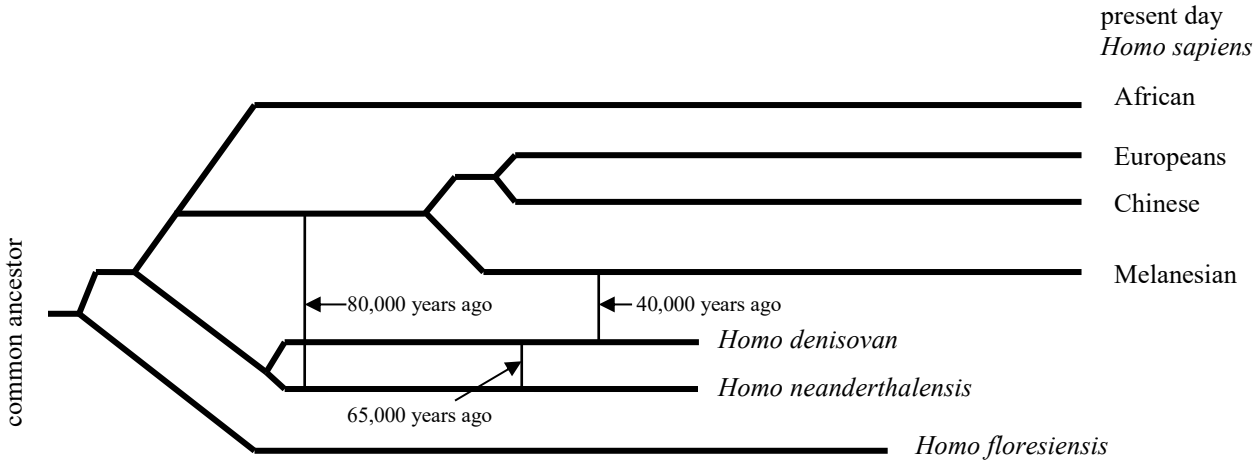
_____

(3 marks)

Total 7 marks

Question 8

Homo neanderthalis and *Homo denisovan* were both ancient hominin species that existed side by side. Denisovan fossils have been found in Siberia and Neanderthal fossils have been found across Europe and the Middle East. The diagram below (not to scale) shows a proposed relationship between ancient populations and current modern humans.



a From your knowledge of human evolution, suggest a common ancestor of the genus *Homo* for the individuals above.

_____

(1 mark)

Africans in the diagram do not have any Neanderthal DNA.

b Suggest why modern Africans do not have any Neanderthal DNA in their genomes.

_____

_____

(1 mark)

c Name the people from the diagram above that would have some Neanderthal DNA.

_____

(1 mark)

d Use the diagram to suggest how and when Neanderthal DNA could have entered their genomes.

_____

_____

(2 marks)

DNA sequencing of an ancient Australian aborigine has shown that Australian aborigines have larger segments of Denisovan DNA than they do Neanderthal DNA, however, Australian aborigines have less Denisovan DNA than people in Papua New Guinea. There is little Denisovan DNA in Asians and Europeans.

e How does this evidence support the settlement of Australia by the ancestors of Australian aborigines about 70,000 years ago?

_____

_____

_____

_____

_____

_____

(2 marks)

f Give **two** ways in which cultural evolution differs from biological evolution.

_____

_____

_____

_____

(2 marks)

Both *Homo neanderthalensis* and *Homo sapiens* used tools. Neanderthals had a slightly larger brain than early humans, and yet, according to some scientists, their tool-making skills did not change markedly over a few hundred thousand years compared to the innovation and development of tools shown by *Homo sapiens.*

g Suggest why *Homo neanderthalensis* did not show the development of tool-making and innovation shown by *Homo sapiens* even though they had larger brains at the time.

_____

_____

_____

_____

_____

_____

(2 marks)

Total 11 marks

Question 9

PCR is a tool used by scientists.

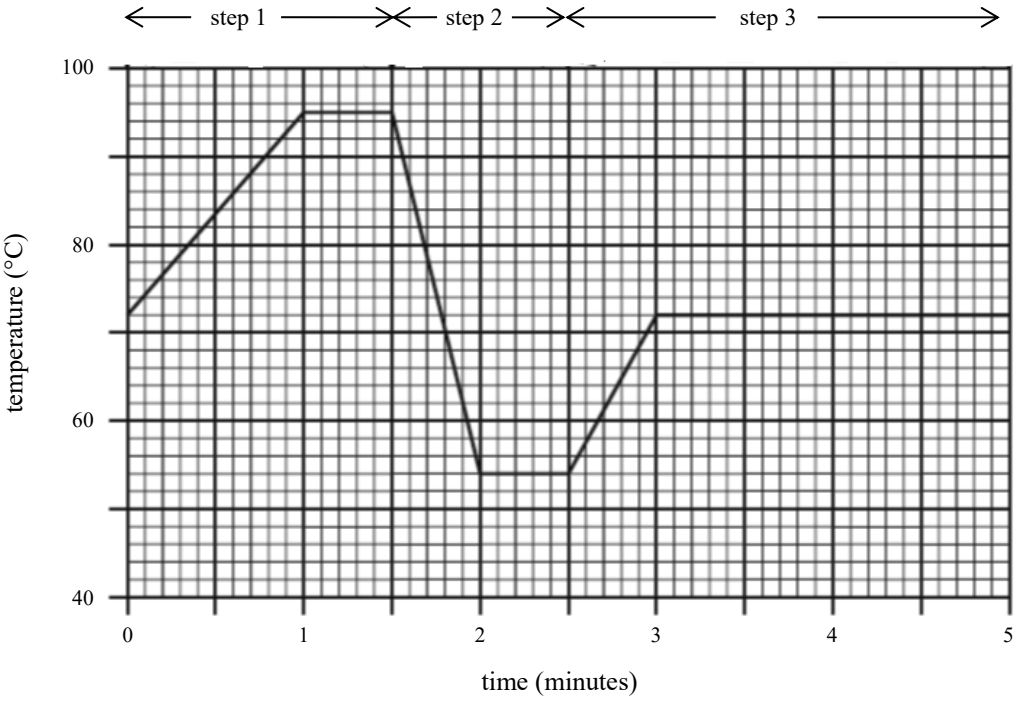
a What is the function of PCR?

_____

_____

(1 mark)

The graph below shows the change in operating temperature during one cycle of PCR.



b Name and describe what is happening at each of the steps shown on the graph above.

step 1 Name: _____

Description: _____

_____

_____

step 2 Name: _____

Description: _____

_____

_____

step 3 Name: _____

Description: _____

_____

_____

(3 marks)

c Suggest why the temperature is raised to 72°C in step 3.

_____

_____

(1 mark)

Total 5 marks

Question 10

Anti-viral drugs and antibiotics are both used to fight infections.

a Explain **how the action** of anti-viral drugs differs from the action of antibiotics.

_____

_____

_____

_____

(1 mark)

'Rational drug design' or 'designed drug' has been used in the development of many drugs including anti-viral drugs.

b Explain what is meant by the term 'designed drug' or 'rational drug design'.

_____

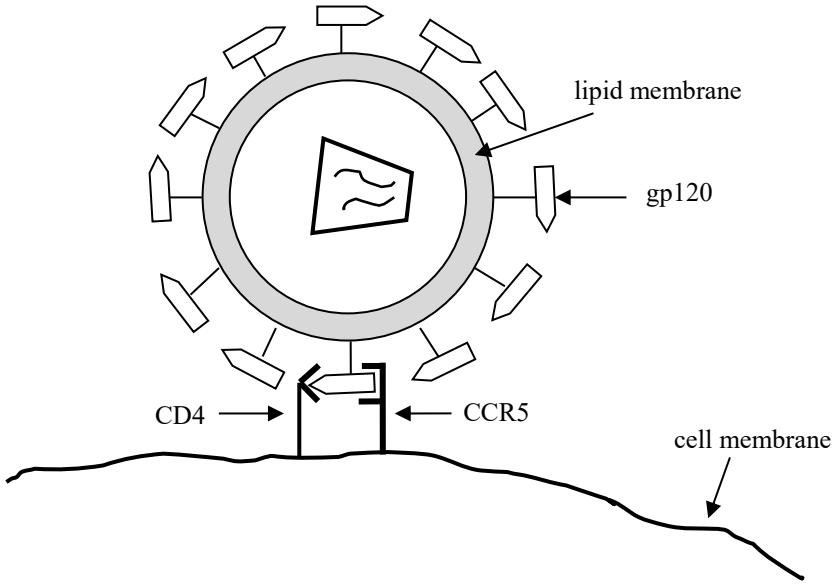
_____

_____

_____

(1 mark)

The human immunodeficiency virus (HIV) attaches to a susceptible cell of the immune system that has a CD4 receptor. The glycoprotein, gp120, on the envelop of the virus, binds to the CD4 receptor and then to another co-receptor on the cell called CCR5. This sequential binding allows the cell membrane and the virus membrane to fuse and the subsequent entry of the viral genetic material to occur. The simple diagram below shows the attachment of HIV to the cell membrane.



Scientists have used drug design to design a drug that can prevent the binding of the virus to the CCR5 co-receptor.

c Use the diagram above to draw a possible shape for this fusion inhibitor drug **and** state why you have chosen this shape.

shape: reasoning: _____

_____

_____

_____

(2 marks)

d Suggest how such a drug could help an individual who has contracted this virus.

_____

_____

_____

_____

(1 mark)

e How would the effectiveness of such a drug be determined?

_____

_____

_____

_____

_____

_____

_____

(3 marks)

Monoclonal antibodies are currently being investigated as a possible treatment for HIV.

f What are monoclonal antibodies?

_____

_____

(1 mark)

g Why would monoclonal antibodies be a more effective treatment than anti-viral drugs?

_____

_____

_____

_____

_____

_____

(2 marks)

Total 11 marks

END OF TRIAL EXAMINATION

Acknowledgements:
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