

insight™
YEAR 12 Trial Exam Paper
2014
BIOLOGY
Written examination

STUDENT NAME:

Reading time: 15 minutes
Writing time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	40	40	40
B	12	12	70
			Total 110

- Students are permitted to bring pens, pencils, highlighters, erasers, sharpeners and rulers into the examination.
- Students are NOT permitted to bring blank sheets of paper and/or white-out liquid/tape into the examination.
- Calculators are not allowed in this examination.

Materials provided

- Question and answer book of 47 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the box provided.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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

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

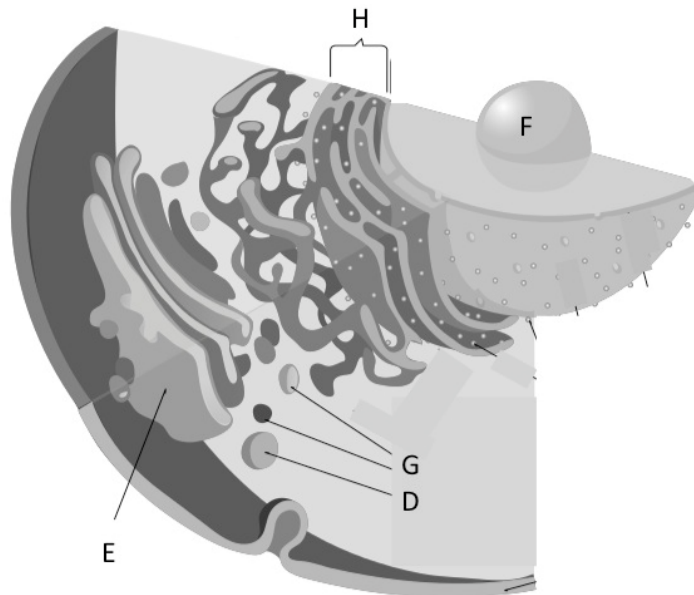
Choose the response that is **correct** for the question.

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

Marks will not be taken away for incorrect answers.

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

Use the following information to answer Questions 1 and 2.



Source: http://en.wikipedia.org/wiki/File:Endomembrane_system_diagram_en.svg

Question 1

A section of a cell from the small intestine is shown above. Trypsin is secreted by this cell. The pathway taken by an amino acid that is found in trypsin would be

- A. EFG
- B. DFG
- C. FHD
- D. HEG

Question 2

It is logical to expect that the increased number of mitochondria present in the cell would be associated with the

- A. active transport of glucose into cells for cellular respiration.
- B. active transport of trypsin out of the cell for protein digestion.
- C. increased rates of photosynthesis performed by intestinal cells.
- D. increased rates of anaerobic cellular respiration performed by intestinal cells.

SECTION A – continued

Question 3

Eukaryotic animal cells would contain one or more of which of the following organelles?

- A. ribosomes
- B. chloroplasts
- C. microfilaments
- D. lysosomes

Question 4

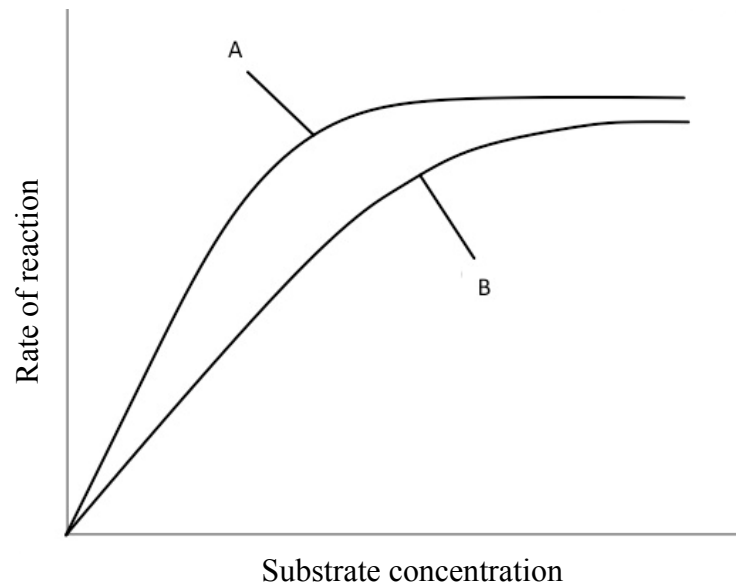
An example of an endergonic reaction would be

- A. $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- B. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
- C. sucrose $\rightarrow$ glucose + fructose
- D. $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$

SECTION A – continued
TURN OVER

Use the following information to answer Questions 5, 6 and 7.

Succinate is found in the Krebs cycle of aerobic respiration and binds to the active site of the dehydrogenase enzyme. Malonate is a competitive inhibitor and is structurally similar to the substrate succinate but is not normally involved in the Krebs cycle. The graph shows the action of dehydrogenase on a substrate.



Question 5

The graph indicates that

- A. as dehydrogenase become saturated, the reaction rate increases.
- B. the rate of product formation increases with increasing substrate concentration.
- C. the amount of substrate increases as the reaction proceeds.
- D. the amount of product decreases as the reaction proceeds.

Question 6

It would be reasonable to conclude that

- A. A shows the breakdown of malonate in the presence of succinate.
- B. B shows the breakdown of malonate in the presence of succinate.
- C. A shows the breakdown of succinate in the presence of malonate.
- D. B shows the breakdown of succinate in the presence of malonate.

Question 7

The graph also shows that an increase in the substrate concentration will lead to

- A. a maximum rate of reaction.
- B. an exponential increase in the rate of reaction.
- C. a decline in the rate of reaction.
- D. no change in the rate of reaction.

Question 8

Apoptosis refers to cell death and is

- A. a failure in the translation or transcription mechanism.
- B. the accumulation of genetic errors.
- C. essential to normal development and can be programmed.
- D. always biologically detrimental to an organism.

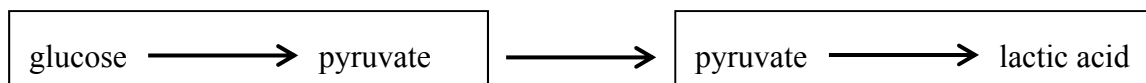
Question 9

In cellular respiration, the function of acetyl CoA is to link

- A. the Krebs cycle and oxidative phosphorylation.
- B. glycolysis to the Krebs cycle.
- C. glycolysis to the Calvin cycle.
- D. the Calvin cycle to oxidative phosphorylation.

Use the following information to answer Questions 10 and 11.

The following diagram represents a biochemical reaction that occurs in some organisms.

**Question 10**

This diagram shows the process of

- A. aerobic fermentation.
- B. alcoholic fermentation.
- C. aerobic respiration.
- D. anaerobic respiration.

Question 11

This reaction would take place in the

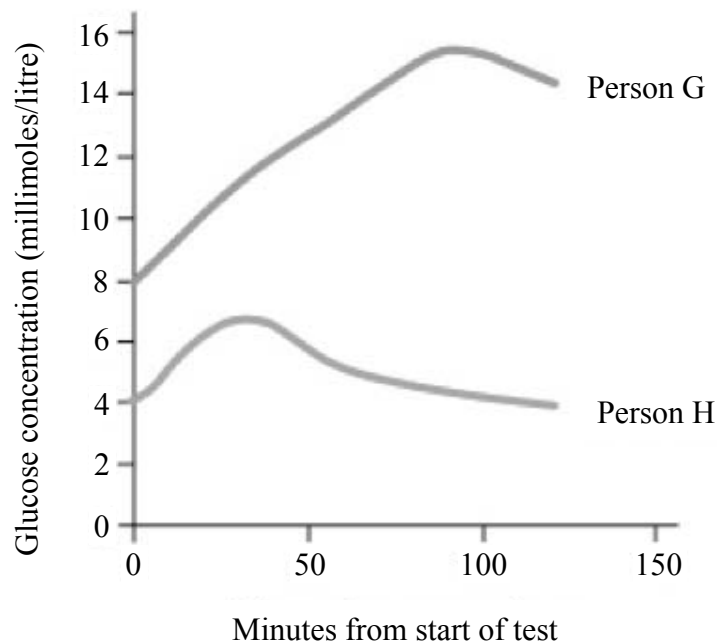
- A. cytosol of the cell.
- B. matrix of the mitochondria.
- C. stroma of the chloroplast.
- D. extracellular fluid bathing the cells.

SECTION A – continued
TURN OVER

Use the following information to answer Questions 12 and 13.

Gestational diabetes mellitus (GDM) is a condition that is diagnosed when higher than normal blood glucose levels first appear during pregnancy. In Australia, 8–10% of pregnant women will develop GDM around the 24th to 28th week of pregnancy, which is why routine screening occurs at this time. Women take a glucose challenge test that involves drinking a glucose solution and testing the amount of glucose that remains in the blood after one hour.

The graph shows the results of GDM glucose challenge tests that were taken by two women.



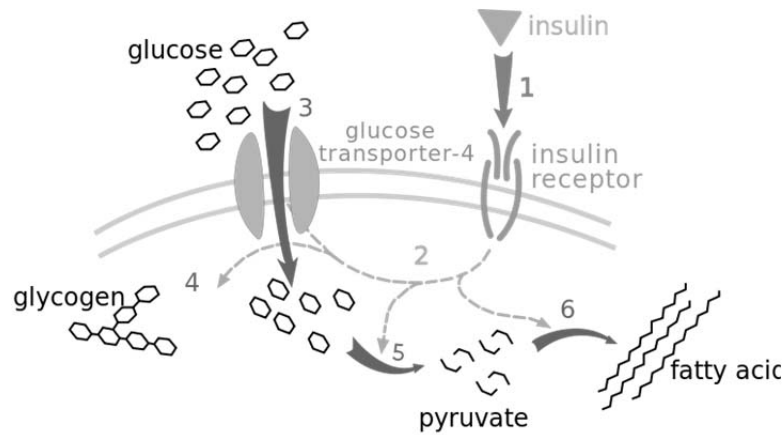
Question 12

From the graph it is possible to conclude that

- A. Person G does not have diabetes as the amount of glucose in her blood begins to decline after around 100 minutes after drinking the glucose solution.
- B. Person H does not have diabetes as the level of glucose in her bloodstream peaks for a short time then returns to its original level.
- C. both patients have diabetes.
- D. neither patient has diabetes.

Question 13

Insulin is the peptide hormone responsible for the regulation of carbohydrate and fat metabolism in humans. The diagram shows the effect of insulin on glucose uptake and metabolism.



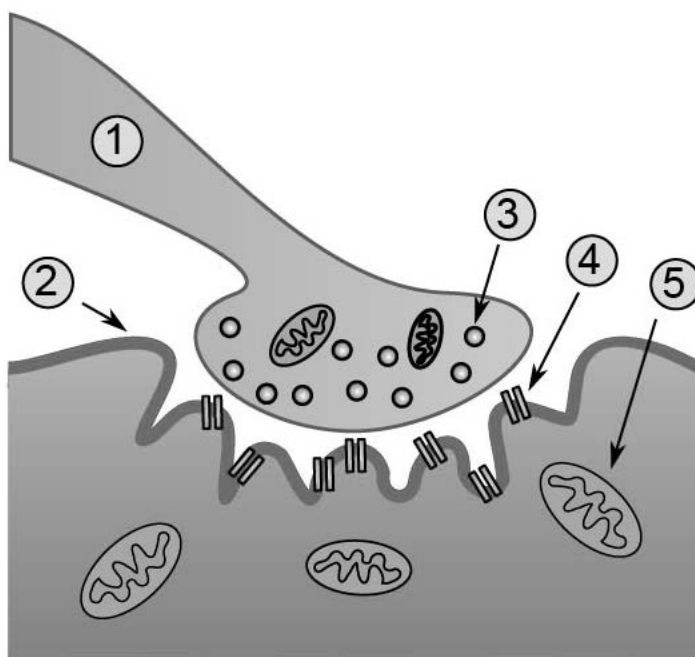
Source: http://en.wikipedia.org/wiki/File:Insulin_glucose_metabolism_ZP.svg

Using the information in the graph and the diagram, it is reasonable to conclude that in response to the intake of glucose solution

- A. neither Person G nor Person H produced insulin.
- B. both Person G and Person H produced insulin.
- C. Person G produced insulin.
- D. Person H produced insulin.

SECTION A – continued
TURN OVER

Use the following information to answer Questions 14 and 15.



Source: http://commons.wikimedia.org/wiki/File:Synapse_diag4.png

Question 14

Compound S is secreted from 3 and differs from a hormone in its action because its effect is

- A. not sustained and it is required in high concentration at its site of action.
- B. not sustained and it is not required in high concentration at its site of action.
- C. sustained and it is required in high concentration at its site of action.
- D. sustained and it is not required in high concentration at its site of action.

Question 15

The correct labels for the numbers in the diagram would be

	1	2	3	4	5
A.	synaptic vesicle	mitochondrion	acetylcholine receptor	membrane	presynaptic terminal
B.	presynaptic terminal	synaptic vesicle	acetylcholine receptor	mitochondrion	membrane
C.	presynaptic terminal	membrane	synaptic vesicle	acetylcholine receptor	mitochondrion
D.	acetylcholine receptor	synaptic vesicle	mitochondrion	presynaptic terminal	membrane

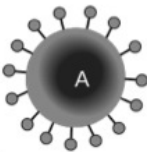
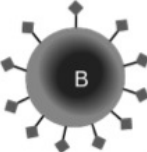
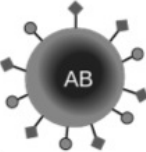
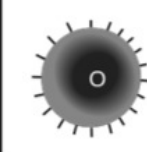
Question 16

Animals have many strategies to reduce infection by pathogens. Which one of the following is **not** an example of a first line chemical defence?

- A. lysozyme
- B. eosinophil
- C. lactoferrin
- D. defensin

Question 17

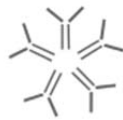
The table shows the four blood groups found in humans.

	Group A	Group B	Group AB	Group O
Red blood cell type				

modified from http://en.wikipedia.org/wiki/File:ABO_blood_type.svg

The antibodies found in the plasma of a person with blood group O would be

A.



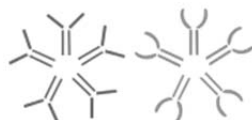
Anti-B

B.



Anti-A

C.



Anti-A and Anti-B

D.

None

SECTION A – continued
TURN OVER

Use the following information to answer Questions 18, 19 and 20.

There are three types of influenza (flu) viruses: A, B and C. Influenza A viruses are grouped according to the two proteins on the surface of the virus: haemagglutinin (H) and neuraminidase (N). Human influenza A and B viruses cause seasonal epidemics and when small changes occur in gene expression, new and different influenza viruses emerge. An annual vaccine has been developed that can protect people from the frequently changing influenza virus. The vaccine contains non-living strains from three different flu viruses.

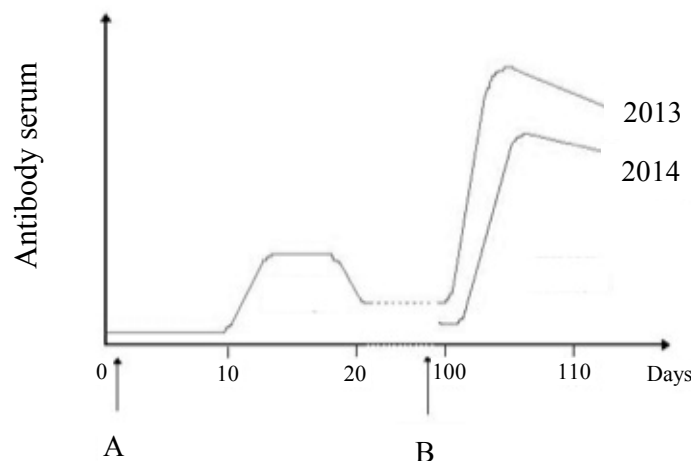
Question 18

When the flu vaccination is given, the recipient is considered to have

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

Question 19

The graph shows the immune response of a woman who has received a flu vaccination (A) in 2013. In 2014 an analysis of her blood shows a high level of immunoglobulin A (IgA) antibodies. IgA is associated with intracellular neutralisation of flu viruses. The woman had not received a flu vaccination in 2014 nor had she experienced any flu symptoms.



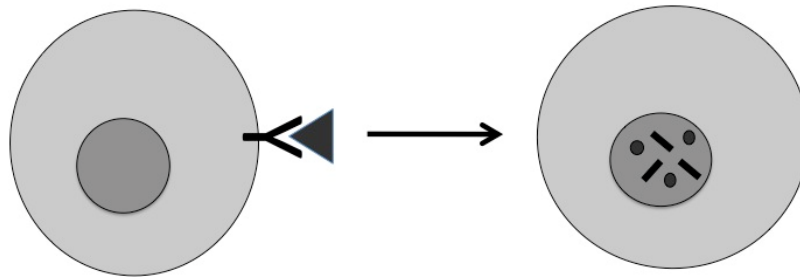
On the graph, what is the specific name given to the event commencing at B?

- A. secondary response
- B. primary response
- C. immune response
- D. infection response

Question 20

The most likely explanation for the spike in IgA in 2014 is that the woman has encountered a strain of flu virus that is

- A. so similar to the 2013 flu virus that the response is almost as strong as the secondary response shown in 2013.
- B. identical to the 2013 flu virus inducing very similar response to that shown in 2013.
- C. different from the 2013 flu virus, but she now has immunity to all flu viruses.
- D. similar enough to the 2013 flu virus to induce a primary response like that shown in 2013.

Question 21

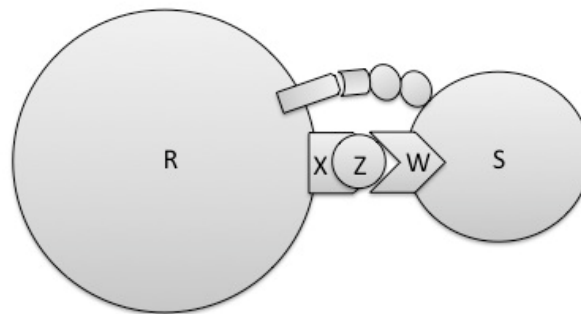
The process shown in the diagram above is associated with

- A. innate immunity.
- B. non-specific immunity.
- C. humoral response.
- D. cell-mediated response.

SECTION A – continued
TURN OVER

Use the following information to answer Questions 22 and 23.

Question 22



The diagram shows the activation of a

- A. T cell (R), which is presenting a peptide (Z) to a T cell receptor (S).
- B. T cell (R), which is presenting a peptide (X-Z) to a T cell receptor (W).
- C. B cell (R), which is presenting a peptide (X-Z) to a T cell receptor (S).
- D. B cell (R), which is presenting a peptide (Z) to a T cell receptor (W).

Question 23

Following the activation event there will be

- A. proliferation of both the B cell and the T cell.
- B. proliferation of the B cell only.
- C. proliferation of the T cell only.
- D. no proliferation of either cell.

Question 24

During metaphase I of meiosis

- A. homologous pairs of chromosomes are drawn apart to opposite sides of the dividing cell.
- B. homologous pairs of chromosomes are assembled together on the spindle of the dividing cell.
- C. sister chromatids separate and are drawn apart to opposite sides of the dividing cell.
- D. sister chromatids are still connected and assemble together on the spindle of the dividing cell.

Question 25

In the cell cycle, DNA replication takes place in

- A. S phase.
- B. G₁ phase.
- C. G₂ phase.
- D. M phase.

Question 26

A cell cycle checkpoint would be best described as

- A. a site in the cytoplasm where proteins are inspected for mutations.
- B. either G₁, S, G₂, prophase, metaphase, anaphase or telophase.
- C. specific stages where further progress of the cell cycle can be halted.
- D. any step where the cell cycle is blocked by a mutated protein.

Question 27

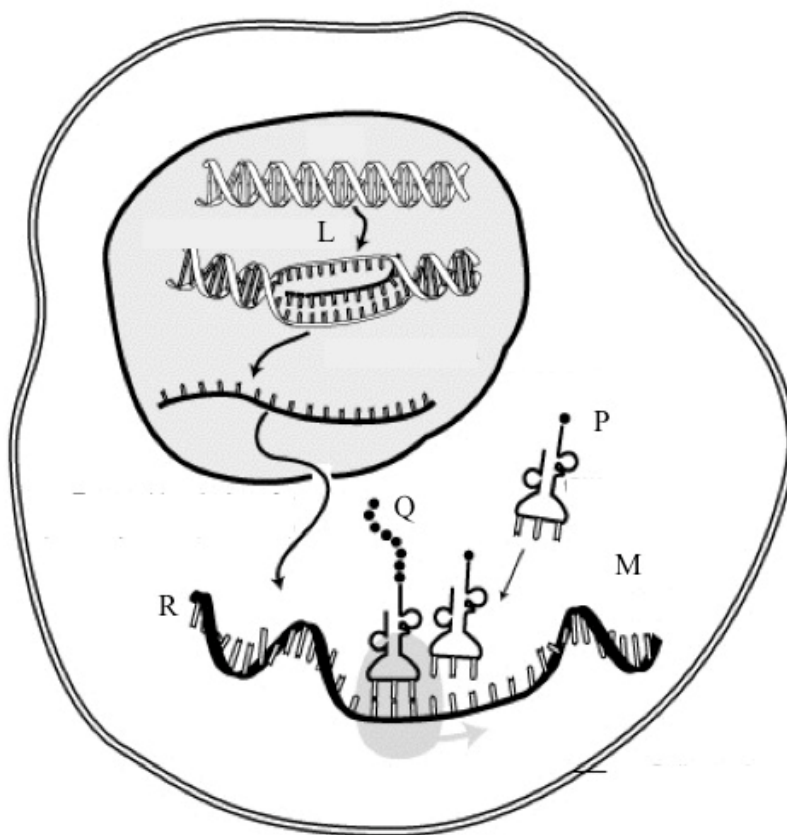
Mitochondrial DNA is located in mitochondria. It is useful for studying the evolutionary relationships of organisms because it is

- A. not highly conserved and has a slow mutation rate.
- B. not highly conserved and has a rapid mutation rate.
- C. inherited patrilineally and is highly conserved.
- D. inherited matrilineally and is highly conserved.

SECTION A – continued
TURN OVER

Question 28

The diagram below shows a process that occurs in all nucleated cells.



modified from http://en.wikipedia.org/wiki/Protein_biosynthesis

The correct labelling for this diagram is

	L	M	P	Q	R
A.	translation	transcription	mRNA	protein	DNA
B.	translation	transcription	tRNA	polypeptide	DNA
C.	transcription	translation	mRNA	protein	tRNA
D.	transcription	translation	tRNA	polypeptide	mRNA

Question 29

Werner syndrome is a rare, autosomal recessive condition, which is characterised by the appearance of premature ageing. Affected individuals typically grow and develop normally until puberty. The condition is most often realised when the adolescent growth spurt is not observed.

Two unaffected parents have an affected child. The chance that their next child will be affected is

- A. 100%.
- B. 75%.
- C. 50%.
- D. 25%.

Use the following information to answer Questions 30 and 31.

In cucumbers, leaves can be heart-shaped or normal-shaped, and stems can have numerous fruit spines or few fruit spines. A true breeding cucumber plant with heart-shaped leaves and numerous fruit spines is crossed with a cucumber plant that is true breeding for normal-shaped leaves and few fruit spines. The F_1 all have heart-shaped leaves and numerous fruit spines. The F_1 are crossed with plants that have normal-shaped leaves and few fruit spines. The table shows the results of the cross.

heart-shaped leaves, numerous fruit spines	normal-shaped leaves, few fruit spines	heart-shaped leaves, few fruit spines	normal-shaped leaves, numerous fruit spines
253	237	56	72

Question 30

It is reasonable to conclude that the alleles for heart-shaped leaf and numerous fruit spines are

- A. recessive.
- B. dominant.
- C. co-dominant.
- D. multiple alleles.

Question 31

From the results of the cross it can be seen that the genes for leaf shape and number of fruit spines are linked. The recombinant offspring are

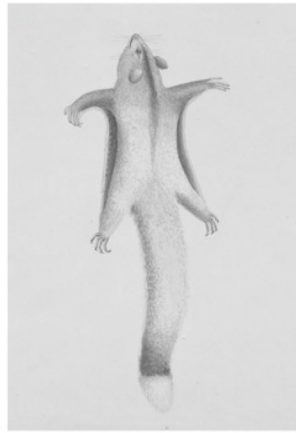
- A. heart shaped, few spines and normal shaped, numerous spines.
- B. heart shaped, numerous spines and normal shaped, few spines.
- C. heart shaped, numerous spines and heart shaped, few spines.
- D. normal shaped, few spines and normal shaped, numerous spines.

SECTION A – continued
TURN OVER

Use the following information to answer Questions 32 and 33.

Question 32

The two animals shown below are ecologically similar extant species of mammal.



sugar glider



squirrel glider

collated from

http://commons.wikimedia.org/wiki/File:SLNSW_480137_Item_03_Dabbii_sugar_glider_1797.jpg and
http://en.wikipedia.org/wiki/Japanese_giant_flying_squirrel

In determining the phylogeny of these two mammals, the best data could be obtained from

- A. a comparison of DNA sequences.
- B. a comparison of embryological development.
- C. the fossil record.
- D. a quantitative analysis of morphological similarities and differences.

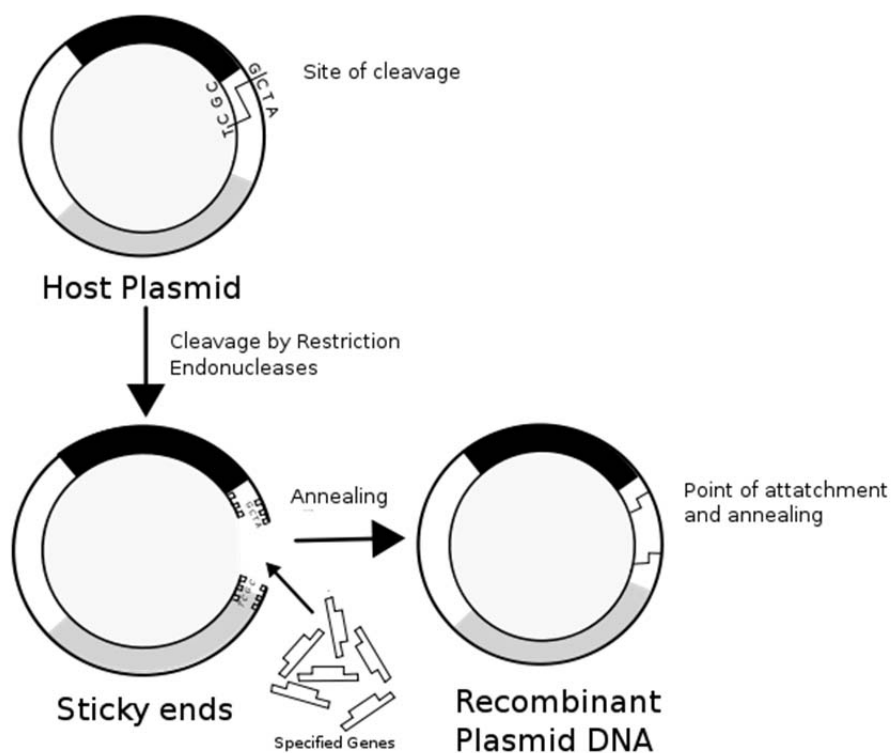
Question 33

The resemblance shown between these two mammals has come about through

- A. allopatric speciation.
- B. extinction.
- C. convergent evolution.
- D. divergent evolution.

Question 34

The diagram below shows the process followed to make a recombinant plasmid.



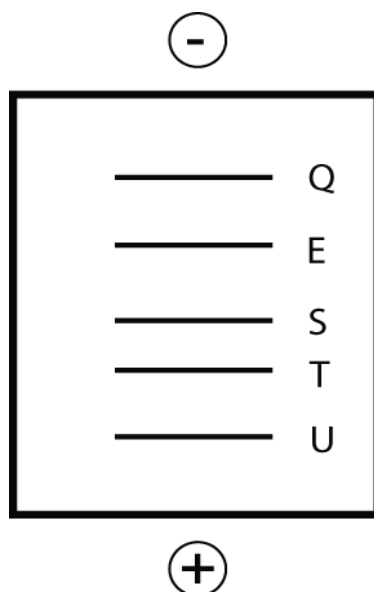
Source: http://en.wikipedia.org/wiki/File:Recombinant_formation_of_plasmids.svg

The sticky ends of the host plasmid are annealed with

- A. a buffer.
- B. DNA ligase.
- C. DNA polymerase.
- D. an endonuclease.

Question 35

A segment of circular DNA was isolated and cut using a restriction enzyme. The fragments of DNA were then placed in a gel and separated by electrophoresis. The diagram shows a representation of the gel and the fragments at the end of the electrophoresis.



Prior to cutting with the restriction enzyme, how many restriction sites would be present in the DNA?

- A. 4
- B. 5
- C. 7
- D. 10

Question 36

The ancestor of modern domestic dogs is the grey wolf *Canis lupus pallipes*. The first dog breeds are thought to have originated in China around 15 000 years ago and since then, have spread around the world. Over time humans have bred dogs to produce more than 400 different breeds with desirable physical and behavioural characteristics.

Selective breeding has contributed to changes in the gene pool of domestic dogs by

- A. removing genes that code for less desirable traits.
- B. favouring genes that code for less desirable traits.
- C. retaining genes that code for less desirable traits.
- D. removing genes that code for desirable traits.

Question 37

A GMO is an organism

- A. whose genome has been artificially changed.
- B. whose genome has been altered by recombination during meiosis.
- C. that has been cloned.
- D. that has been exposed to mutagens.

Question 38

Radiometric dating is possible if a rock contains measurable amounts of

- A. only parent isotopes.
- B. only daughter isotopes.
- C. both parent and daughter isotopes.
- D. either parent or daughter isotopes.

SECTION A – continued
TURN OVER

Use the following information to answer Questions 39 and 40.

Neanderthal DNA may make up only 1.6 to 1.8 per cent of the Eurasian genome. In a study of 1000 human genomes, researchers found that Neanderthal DNA is most common in regions of the genome with the greatest genetic variability. Some parts of non-African genomes contain no Neanderthal DNA, but other regions, including those containing genes that affect our skin and hair share a high proportion of genes.

Question 39

This would suggest that Neanderthal DNA

- A. originated in the Eurasian genome.
- B. had sections that conferred some benefit and were kept during evolution.
- C. will have undergone no change since interbreeding with modern humans.
- D. will continue to accumulate in the Eurasian genome.

Question 40

The gene *BNC2* is involved in skin pigmentation, influencing the saturation of skin colour. Different forms of the gene can produce skin colour ranging from olive-coloured to pale white. Skin colour influences the amount of UVB light that skin can absorb from the sun. Some UVB is necessary to produce vitamin D, but too much can cause damage. Light skin is an advantage at higher latitudes because it is more efficient at generating vitamin D from sunlight.

When modern humans moved out of Africa they had dark skin. It is reasonable to conclude that

- A. modern humans who first migrated out of Africa did not carry the *BNC2* gene.
- B. the *BNC2* gene appears to have been positively selected for in ancestral Europeans.
- C. Eurasians owe their paler skins entirely to Neanderthals.
- D. Eurasians owe their paler skins to the first modern humans who migrated from Africa.

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

Answer **all** questions in the spaces provided. Use a black or blue pen.

Question 1 (4 marks)

Following a recent study published in the *Lancet Neurology* medical journal, Australian researchers feared that vaccination rates in Australia would decline. The results of the study seemed to suggest that childhood vaccines may trigger early onset of a severe form of infant epilepsy. Epilepsy is a condition in which individuals experience seizures that occur due to abnormal electrical signals in the brain. There are many types of epilepsy and the condition affects 2% of the human population. Approximately one-third of epilepsies are genetic.

- a. What kind of brain cell would be directly associated with electrical signals? 1 mark

- b. Infant epilepsy, also known as Dravet syndrome, is caused by a mutation in the SCN1A gene that codes for the production of sodium ion channels, a particular type of membrane transport protein.

Why are sodium ion channels required in a membrane?

1 mark

- c. Dravet syndrome generally begins with seizures at around six months of age, coincidentally, at around the same time as vaccinations are commonly given. In a study, 11 out of 14 infants who experienced seizures soon after vaccination were found to have the SCN1A mutation. Further investigation showed that the babies in the study would most likely have developed seizures within months, regardless of whether they had received the vaccine or not.

Explain why community immunity is so important to society.

2 marks

SECTION B – continued
TURN OVER

Question 2 (8 marks)

A student is given four unlabelled test tubes. He is required to complete a laboratory investigation to identify the compounds in each tube. The laboratory notes indicate that the four samples include arginine (an amino acid), isomaltose (a disaccharide), insulin (a protein hormone) and RNA.

He performs four tests and the following table shows the results he obtained.

Test tube	hydrolysis	nitrogen	phosphate	sulfur
1	occurs	present	high	not present
2	occurs	present	negligible	present
3	does not occur	present	negligible	not present
4	occurs	not present	negligible	not present

- a. i.** Identify the contents of test tube 1.

1 mark

- ii.** Explain your answer to part **a.i.**

1 mark

- iii.** Use a labelled diagram to show the structure of a monomer that would be found in test tube 1.

1 mark

- b. i.** Identify the contents of test tube 2. 1 mark

- ii.** Explain your answer to part **b.i.** 1 mark

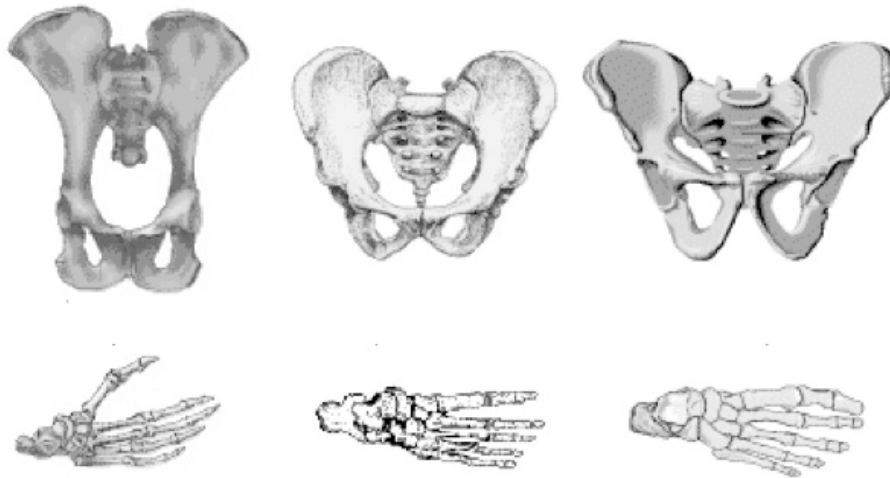
- c. i.** Explain what would have occurred to the compounds in test tubes 1, 2 and 4 during the hydrolysis reaction. 2 marks

- ii.** Why was there no hydrolysis in test tube 3? 1 mark

SECTION B – continued
TURN OVER

Question 3 (10 marks)

The skeletal structures of three primates are shown below.

*Pan troglodytes**Australopithecus africanus**Homo sapiens*

Source: http://anthro.palomar.edu/hominid/australo_2.htm

- a. i. Which one of these primate skeletal structures is least likely to be from a hominin?

1 mark

- ii. What principal physical characteristic distinguishes hominins from all other primates?

1 mark

- b.** Consider the skeletal structures opposite. For each of the structures stated in the table, describe the difference between *Pan troglodytes* and *Homo sapiens* and identify the significance of the difference.

4 marks

Characteristic	Difference	Significance of difference
pelvic structure		
foot structure		

Analysis of hominin dentition has shown that as evolution has taken place, teeth (in particular molars) and jaws have become significantly reduced in size. In modern humans, teeth are small and functionally less specific.

- c. i.** Identify the cultural practice that would have driven this reduction in tooth size.

1 mark

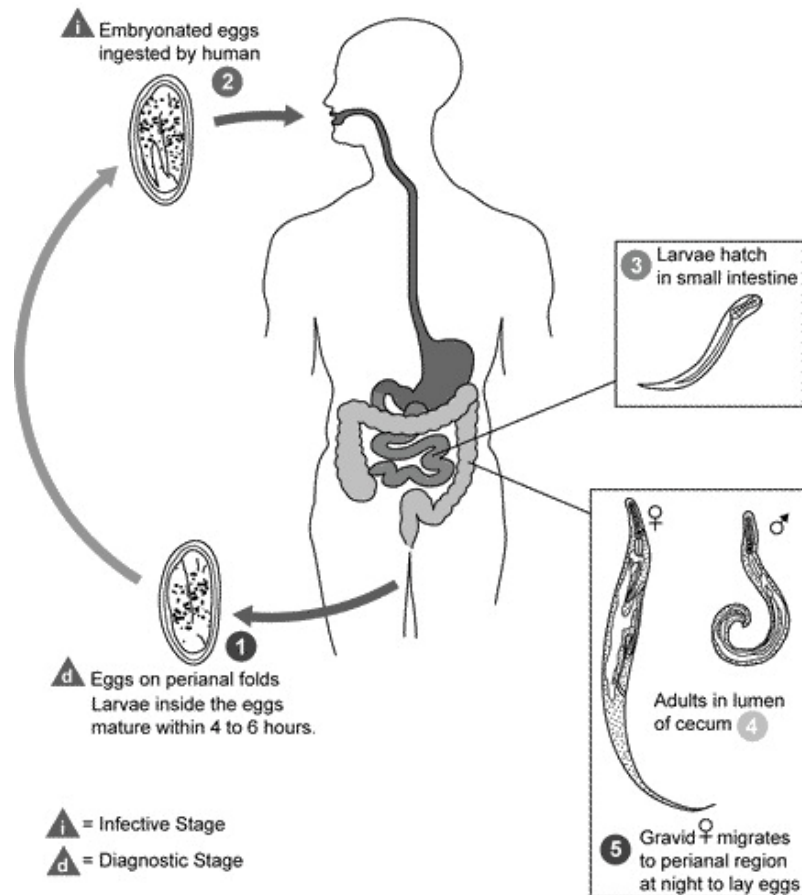
- ii.** Explain how your answer to part **c.i.** acted as a selection pressure.

3 marks

SECTION B – continued
TURN OVER

Question 4 (5 marks)

The pinworm (genus *Enterobius*) is a parasitic nematode that infects humans. The life cycle occurs in the gastrointestinal tract of a single human host. The life cycle is shown in the diagram below.



Source: http://en.wikipedia.org/wiki/File:Enterobius_vermicularis_LifeCycle.gif

Adult pinworms mate in the last section of the small intestine. The males die shortly after mating and are passed out in faeces. The females attach to the mucosa (internal skin surface) and obtain nutrients in the first area of the large intestine. The egg-bearing females migrate through the large intestine, emerging from the anus, and while moving on the skin near the anus, deposit their eggs. After depositing the eggs, the female dies. Worms occur widely in children.

- a. i.** Suggest why the female pinworm would emerge from the anus of the host to deposit eggs.

1 mark

- ii.** Explain how the itching caused by the worm is likely to ensure the continuity of its life cycle.

1 mark

- b.** Archaeological and genetic evidence supports the theory that the pinworm is an 'heirloom parasite'.

Explain the likely meaning of the expression 'heirloom parasite'.

1 mark

- c. i.** An untreated pinworm infection can go away without medical intervention.

Identify one way that the immune system would try to fight an infection of pinworms.

1 mark

- ii.** However, research has shown that the eradication of pinworm infection is not due to an immune response.

Explain why an immune response to pinworms is unlikely to be successful.

1 mark

SECTION B – continued
TURN OVER

Question 5 (5 marks)

In an effort to treat peanut allergies, immunotherapy has been used for many years (with inconclusive results). Immunotherapy is a treatment strategy that gradually exposes the immune system to the substance that normally causes the allergic response.

- a. Outline the sequence of events that would lead a person to become sensitised to peanuts.

3 marks

- b. What is the name given to the type of immunotherapy described above?

1 mark

- c. A study was carried out to develop a new approach to immunotherapy. Researchers randomly assigned a group of children with peanut allergies to either a group receiving gradually increasing doses of peanut protein (OIT) or to a control group (avoiding peanuts) for 26 weeks. They then retested their peanut allergies. The results are summarised in the table below.

From the results in the table, what conclusion can be made about the study?

	OIT	Control
Able to tolerate 800 mg peanut flour/day	84%	0%

1 mark

Question 6 (9 marks)

A group of students carried out an investigation into the movement of substance occurring in slices of potato. Students cored 'Desiree' potatoes and cut the cores into 15 slices (approximately 2 mm thick). The potato slices were immersed in sugar solutions of varying molar concentration for 24 hours. The total mass of the slices in each petri dish was recorded at the beginning and at the end of the experiment.

The results of the experiment are shown in the table below.

concentration of sucrose solution	starting mass (g)	final mass (g)	% mass gain or loss
water	4.59	5.49	19.6
0.1M	2.36	2.40	1.69
0.2M	4.96	4.62	-6.85
0.3M	3.13	2.58	-17.57
0.4M	3.84	3.08	-19.79
0.6M	4.82	3.51	-27.18
1.0M	3.55	2.72	-32.68

- a.** Considering the sucrose solutions used in the experiment, for the same volume, which one contains the greatest number of water molecules?

1 mark

- b. i.** Explain what has happened to the potato slices in 0.6M sucrose solution.

2 marks

SECTION B – Question 6 – continued
TURN OVER

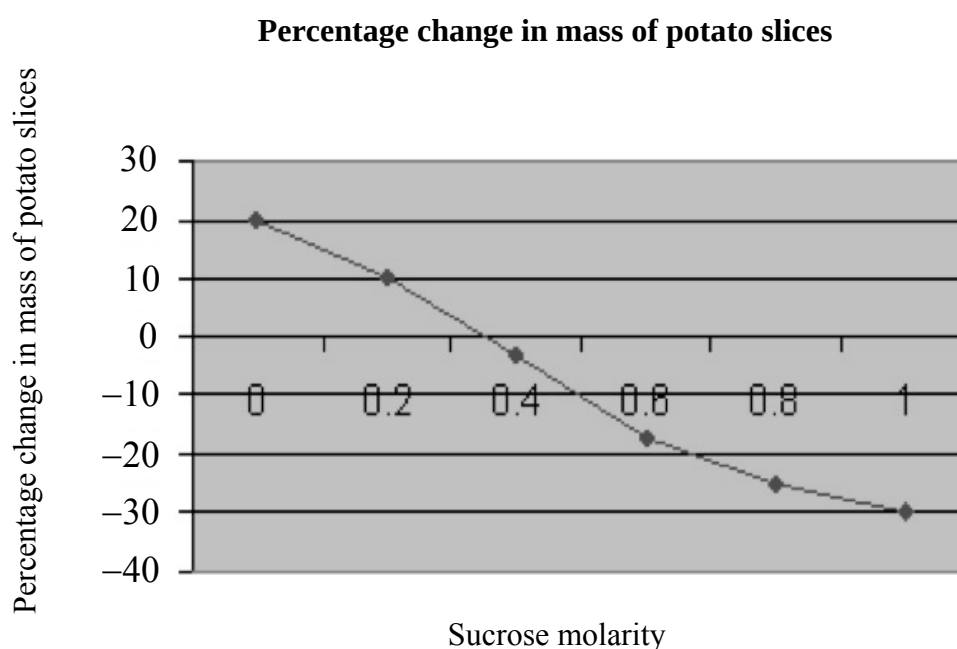
- ii. In relation to the cytosol in the cells of the potato, is the 0.6M sucrose solution hypertonic, hypotonic or isotonic?

1 mark

- c. i. Identify one controlled variable in this experiment.

1 mark

The graph below shows one student's representation of the result of the experiment.



- ii. Using the graph, explain which sucrose molarity is isotonic relative to the potato slices.

2 marks

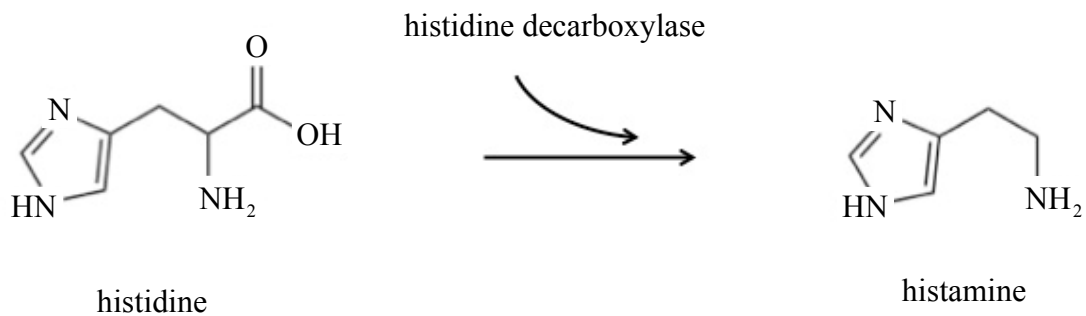
- d.** Draw the appearance of a potato cell that has been immersed in 0.5M sucrose solution. Label relevant structures and clearly show the direction of net water movement.

2 marks

SECTION B – continued
TURN OVER

Question 7 (8 marks)

Histidine is an amino acid that exists naturally in the muscle of many types of fish. On contact with air at temperatures above 15°C, it is converted to histamine by histidine decarboxylase. Once histamine has been produced in fish tissue, it accumulates. Histidine decarboxylase is produced by bacteria that colonise fish intestines. The diagram shows this conversion process.



compiled from http://en.wikipedia.org/wiki/Scombroid_food_poisoning and
<http://en.wikipedia.org/wiki/Histamine>

- a. i.** What is the role of the molecule histidine decarboxylase in the conversion of histidine to histamine?

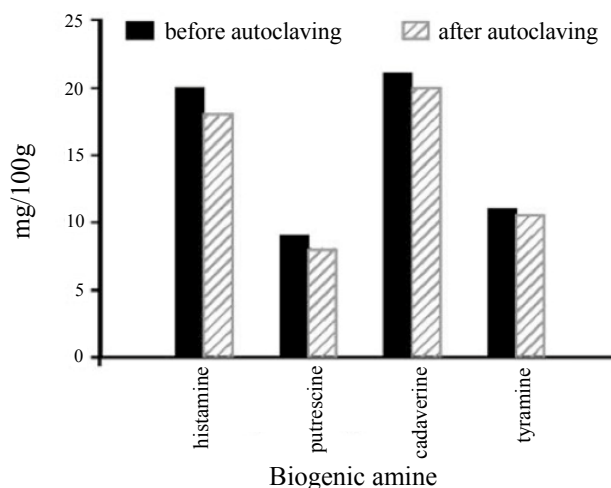
1 mark

- ii.** What event is likely to trigger the release of histidine decarboxylase in fish?

1 mark

An experiment was carried out to investigate the effect of autoclaving on the tissue of a fish (mackerel) that had been spiked with a biogenic amine. Autoclaving is a sterilising process that involves subjecting objects to high pressure saturated steam at 121°C for around 15–20 minutes.

Effect of heating on mackerel spiked with biogenic amines before autoclaving



Source: <http://www.fao.org/docrep/006/y4743e/y4743e0a.htm>

- b. What reasonable conclusion could be drawn about the effect of heating on the concentration of biogenic amines?

1 mark

Use the following information to answer Questions 7c. and 7d.

In January 2014, a rare form of food poisoning caused the deaths of an Australian mother and daughter holidaying in Bali.

- c. Suggest a common agent that could cause food poisoning.

1 mark

- d. i. The pair had eaten a meal that included cooked mahi-mahi fish. Unlike many types of food poisoning, the deaths of the mother and daughter, both of whom suffered from mild asthma, were not brought about by any common agent of food poisoning.

Using the information presented in this question, present a probable explanation for the deaths of the mother and daughter from food poisoning after eating.

2 marks

- ii.** What medical intervention may have saved the lives of the pair?

1 mark

- iii.** What food handling recommendation should be made as a result of this event?

1 mark

SECTION B – continued
TURN OVER

Question 8 (4 marks)

Haemoglobin is a complex protein essential in the transport of oxygen in the blood.

- a. i.** Name the metabolic process that occurs and is dependent on oxygen. 1 mark

- ii.** Where in a cell does this metabolic reaction take place? 1 mark

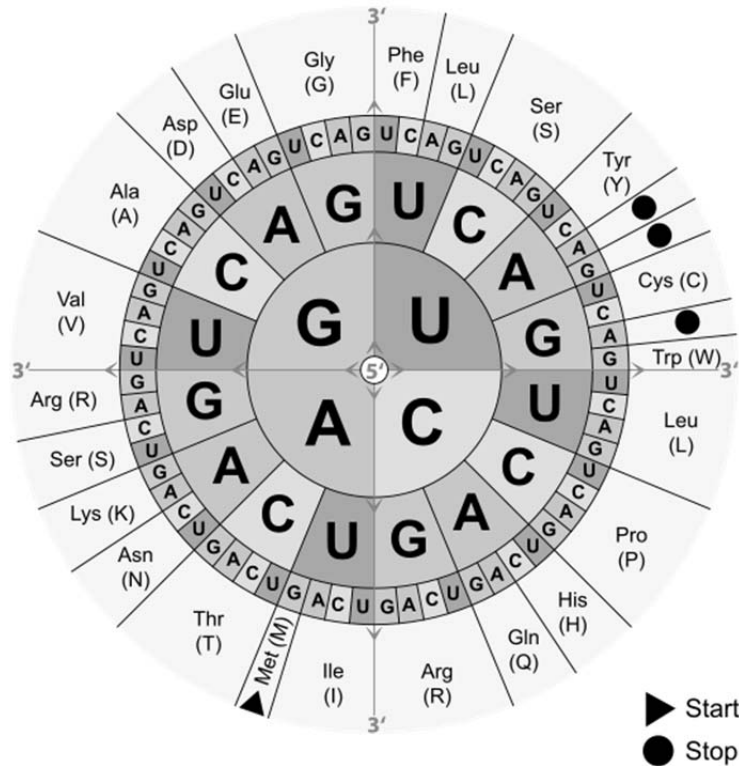
A section of the mRNA sequence that codes for the production of haemoglobin is shown below.

C A G G U G G A C U A U G G A C A C

- b.** Identify the sequence of DNA that would have coded for this mRNA strand. 1 mark

- c. Use the diagram to list the order of amino acids in this section of haemoglobin.

1 mark



Source: http://commons.wikimedia.org/wiki/File:Aminoacids_table.svg

SECTION B – continued
TURN OVER

Question 9 (4 marks)

Chlorophyll a is the main photosynthetic pigment of plants and gives leaves their green colour.

- a. In green plants, what colours of light are absorbed by *chlorophyll a* and used for photosynthesis?

1 mark

Halobacteria, present day organisms, are purple in colour due to the presence of a pigment bacteriorhodopsin, which is used to absorb light for the production of ATP. Bacteriorhodopsin is related to the retinal pigment rhodopsin. Early life forms on Earth were retinal based.

The table compares plants and halobacteria.

Organism	Pigment	Colour of organism	First appeared in the fossil record
plants	chlorophyll	green	450 million ya
halobacteria	bacteriorhodopsin	purple	2.7 billion ya
early microbes	retinal based	purple	4 billion ya

- b. In which stage of photosynthesis in plants is ATP generated?

1 mark

The Sun transmits most of its energy in the green part of the visible spectrum.

- c. i.** Drawing on the information presented in this question, suggest how plants have come to use the colours of visible light they do, even though the energy yield is less.

1 mark

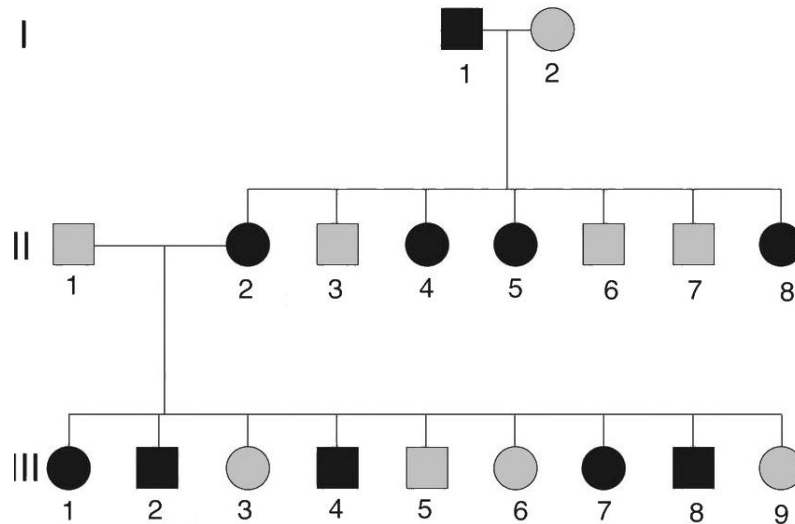
- ii.** What can be inferred about the efficiency of chlorophyll relative to retinal-based pigments?

1 mark

SECTION B – continued
TURN OVER

Question 10 (5 marks)

Martin–Bell syndrome is an inherited condition that is the most widespread single-gene cause of autism and inherited cause of intellectual disability. The diagram below shows the inheritance of Martin–Bell syndrome in a family.



- a. Using the above pedigree, explain the mode of inheritance of Martin–Bell syndrome.

2 marks

Individuals with more than 40 repeats of a CGG trinucleotide in the gene have Martin–Bell syndrome. The unique sequence outside the repeat region is shown below.

5' CAGTATGCA (CGG)_N ATGCGTAAT 3'
 3' GTCATACGT (CGG)_N TACGCATTA 5'

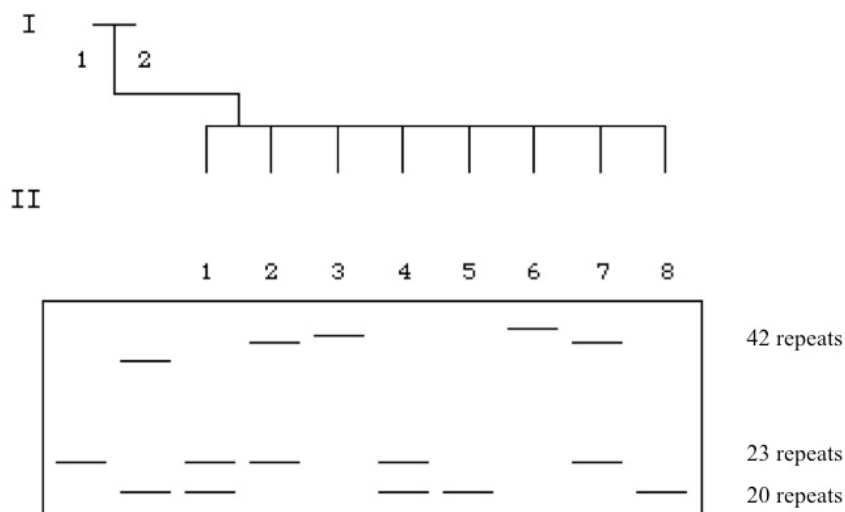
A student plans to use PCR to amplify the trinucleotide repeat region. She has access to 5 primers of different sequences. Consider the primers in the table below.

Primer 1	5'-GTCATACGT-3'
Primer 2	5'-ATTACGCAT-3'
Primer 3	5'-ATGCGTAAT-3'
Primer 4	5'-CAGTATGCA-3'
Primer 5	5'-TGCATACTG-3'

- b.** Indicate which two of these primers you would advise her to use.
 Circle your choices.

1 mark

The image shows a branch of a pedigree from another family with a history of Martin–Bell syndrome. There is also a representation of a gel showing PCR-amplified fragments that detect the number of CGG repeats. The DNA corresponding to each individual is directly below his or her place in the pedigree.



- c. Based on the information you have been given, use appropriate symbols to show the genotypes of Individual 3 and Individual 7.

2 marks

Individual 3:

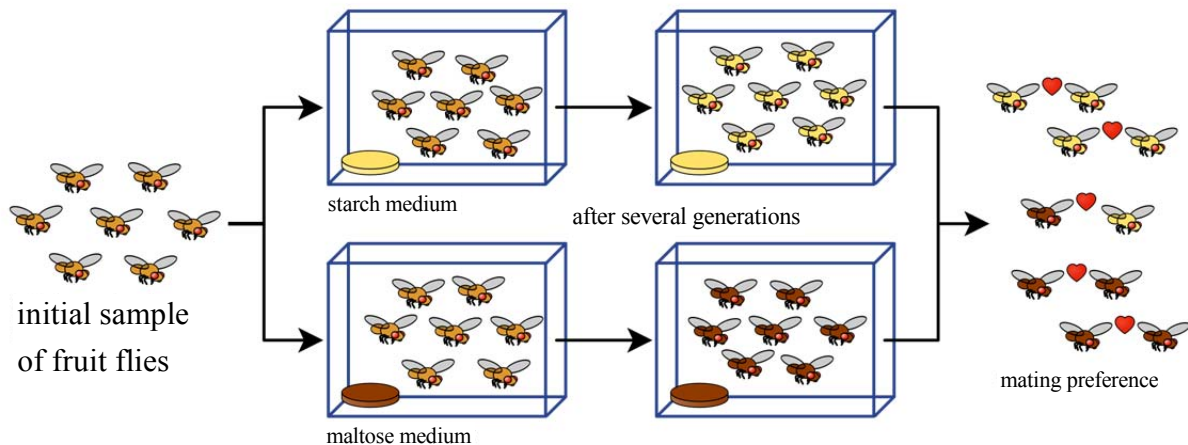
Individual 7:

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SECTION B – continued
TURN OVER

Question 11 (5 marks)

In a laboratory experiment, fruit flies from a single population were divided into separate populations and placed in different cages. Half of the populations lived on maltose-based food, and the other populations lived on starch-based foods. After many generations, the flies were tested to see which flies they preferred to mate with. It was found that ‘maltose flies’ preferred to mate with other ‘maltose flies’, and ‘starch flies’ preferred to mate with other ‘starch flies’.



Source: http://en.wikipedia.org/wiki/File:Drosophila_speciation_experiment.svg

- a. What type of bond is found between the subunits of the maltose- and starch-based food?

1 mark

- b. What cause of speciation is being modelled by placing the flies in two different cages in the experiment above?

1 mark

- c. In order for speciation to occur in this experiment, what must have existed in the original fly population?

1 mark

- d.** What conclusion can be drawn from this experiment?

1 mark

- e.** Suggest one reason why it is necessary to use models to make predictions about speciation in populations.

1 mark

SECTION B – continued
TURN OVER

Question 12 (3 marks)

In chickens, dwarfed legs and wings are due to a dominant allele and normal legs and wings to its recessive allele. A poultry farmer crossed a chicken heterozygous for dwarfed leg and wing with a normal chicken.

- a.** Assign appropriate alleles to the condition and show the expected F1 offspring from the cross between the two chickens.

2 marks

The farmer decided to breed the F1 dwarfed leg and wing chickens but was confused by the outcome of the crosses.

2 dwarfed leg/wing chickens : 1 normal chicken

b. Explain the outcome of the cross.

1 mark

END OF QUESTION AND ANSWER BOOK