

Trial Examination 2018

## VCE Biology Units 3&4

Written Examination

### Suggested Solutions

#### SECTION A – MULTIPLE-CHOICE QUESTIONS

1	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
2	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
3	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
4	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
5	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
6	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
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8	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
9	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
10	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
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13	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
14	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
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38	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
39	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
40	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D

**Question 1      D**

Ribosomes on the endoplasmic reticulum are not membrane bound, whereas the chromatin (DNA and protein) is enclosed by a nuclear envelope. Structure X (Golgi apparatus) and structure Y (vesicle) are involved in the packaging and secretion of a biomolecule but it will move out of the cell by exocytosis not endocytosis. Structure U (mitochondria) is not directly involved in the manufacture and secretion of the biomolecule but it does provide ATP for many of the aspects involved. The mitochondria contain a matrix which is separated from other parts of the cell (or compartmentalised).

**Question 2      B**

An aerobic prokaryote is one that could generate a larger amount of ATP than an anaerobic prokaryote. If this was endocytosed by a larger cell and provided energy to the cell but was protected at the same time, then this type of relationship is described as endosymbiosis. Collectively this is known as the endosymbiotic theory.

**Question 3      C**

The genome in all cells of a multicellular individual is the same, as the process of mitosis that produces them generates identical genomes. The proteome within each cell is the product of which genes are activated and this depends on the location of the cell in the multicellular organism. There are many fewer genes within a cell that are active (compared to the total number of genes in the genome), and the proteome is subject to change throughout the life of the cell. For example, a stem cell differentiating into a specialised cell has a different combination of genes active.

**Question 4      A**

As this particular enzyme has ten polypeptide chains that work together to form a functional protein, it is functioning at the quaternary level. The conversion of ADP into ATP is a condensation reaction.

**Question 5      D**

Introns and exons are part of the pre-mRNA, which is the initial product of transcription. Introns are spliced out and recycled within the cell, but the exons are joined and form a final product that is shorter than the initial product. The way that this occurs is that a spliceosome cleaves out the components not needed (introns) and joins the fragments that are needed (exons). The exons are then stabilised with a methylated cap and a poly-A tail.

**Question 6      D**

Ribosomes are involved with protein synthesis. To complete this process, mRNA is required to provide the string of codons. To provide the complementary anticodons as well as a specific amino acid (tRNA is required). As the ribosome units are comprised of several of these molecules as well as 'ribosomal' proteins (rRNA is also required).

**Question 7      A**

Substrates in a chemical reaction are what goes into the reaction; in this case, the protein and lipid are the substrates. This can be inferred by the enzymes that are present in the washing powder. The substrate for a protease enzyme would be a protein and the substrate for a lipase enzyme would be lipid. The products of these reactions would be amino acids and fatty acids, which presumably would be dissolved in solution.

**Question 8 C**

The washing powder works best below 40°C, making **A** incorrect. One cup in 20 L is the recommended powder concentration. **B** is working with the same concentration, **C** is working with twice the recommended concentration and **D** is working with the recommended concentration at a lower temperature, meaning **D** is incorrect. The choice is either **B** or **C** and as both are at 40°C, the higher enzyme concentration would probably lead to a faster enzyme-catalysed reaction, making **C** the required response.

**Question 9 A**

The light-dependent reaction is the part of the photosynthetic reaction occurring within the chloroplast within the granum lumen as well as on the thylakoid membrane. It is where light energy is trapped and water is split to produce oxygen and hydrogen ions. It does not occur in the stroma of the chloroplast; that is where the light-independent reaction occurs. Chloroplasts do not have a matrix (this is the central part of the mitochondria).

**Question 10 D**

Controlled conditions are those that should be the same when one independent variable is being tested. In the context of this experiment, the number and size of the leaf sections should be the same. The volumes of solution used should also be the same and as photosynthesis is working well in bright light, that would also be a condition that could be controlled.

**Question 11 C**

The data collected had a reasonable measure of precision, where each set of results do not seem to have any significant outliers (data that was far from the average). The data is measured (time) and so is quantified rather than qualitative. We do not know if the data is accurate, as the true values have not been provided; however, the experimenter has followed a method quite well, presumably, as the results are quite precise. The experiment has been repeated four times for each independent variable tested.

**Question 12 B**

Based on this particular experiment it is reasonable to conclude that bright light and warm conditions lead to the most efficient photosynthesis. This is due to the short time needed for the leaf sections to rise in both environments. It would be expected that in the bright light and dim light the temperature would be warm (a controlled condition). It would also be expected that in warm and cold temperature the light would be bright (a controlled condition).

**Question 13 D**

When a signalling molecule travels through the air from one member of a particular species to another member of the same species to elicit a response, a pheromone is involved.

**Question 14 A**

Cytokines are a signalling molecule usually secreted from macrophages and some lymphocytes. Their function is to elicit a response on cells they are in contact with. If the cell releasing the cytokine was a specific cytotoxic T cell, the effect could be target cell apoptosis triggered by an external signal. Mitochondrial stress leading to apoptosis is an internal signal. Phagocytosis may be stimulated by signals but it is not apoptotic in nature. Glands produce hormones that are usually homeostatic in nature, not apoptotic.

**Question 15     B**

A virus (S) is a pathogenic agent as it is not cellular, but it is still pathogenic. A bacteria (Q) that is pathogenic is prokaryotic as well as cellular. A eukaryotic cell (R), as the name indicates, is cellular.

**Question 16     D**

The lymphatic system is a one-way system that connects most body cells to a series of lymphatic ducts and nodes that are associated with immunity and fighting off infection. The brain, liver, bones and kidneys are not involved in this process. The tonsils, adenoids, spleen and thymus are all part of the lymphatic system.

**Question 17     D**

Transplanted cells carry different self-markers and so will be rejected by the recipient rather than accepted, making **A** incorrect. Antigens would activate the immune system due to the antigen being recognised as non-self, making **B** incorrect. Antibody/antigen interactions are important in immunological health, but antigens, not antibodies, are on the surface of bacteria, making **C** incorrect. All cells in the one individual have the same self-markers, which is how foreign antigens can be detected efficiently.

**Question 18     A**

Clonal selection involved the discovery that there were many different naive B cells, each one having a different antigen receptor on its surface. When the correct naive B cell came in contact with a complementary antigen, the cell divided and differentiated. This was called clonal selection. The same rule can be applied to the expansion of naive T cells; however, the reasons for both responses is different. The selected naive cell does not undergo genetic change; this has already occurred in the bone marrow to form the differentiated naive cell.

**Question 19     B**

Vaccines provide active immunity against a particular disease, in this case, HPV. Recent media reports suggest that 90% of Australian children are receiving vaccines, which confers herd immunity (meaning the chance of the disease spreading is very low). The subsidies offered are endeavouring to achieve this with HPV; however, it only protects against nine strains, not all strains.

**Question 20     D**

Upon first exposure to the HPV antigen, the immune system would respond slowly as the correct naive B cell needs to be selected, cloned and differentiated. Once this is complete, the level of antibodies increases and then tapers off. The second vaccine encounters a high number of B memory cells which can all respond, collectively generating a very large number of antibodies very quickly. The immune system is activated in case the virulent strain of HPV is contracted.

**Question 21     D**

The activation of an allergic response is due to histamines released from activated mast cells. The mast cells have antibodies bound to their surface against the allergen as it was initially treated as an antigen within the individual with the allergy. The antibodies bind to mast cells which cluster near body surfaces that are likely to encounter the allergen (airways, gut).

**Question 22 D**

An allergic response can increase with repeated exposures. This can lead to inflamed airways as well as severe diarrhoea, which can be life threatening. Without treatment, death is possible. **A** is incorrect because the human is less likely to survive as a result of exposure. **B** is incorrect as the allergen does not need to be in the body for too long (or in high amounts) to elicit a response. **C** is incorrect as any factor that places humans at risk could be regarded as a selective pressure, hence affecting evolution.

**Question 23 A**

The definition within the stem of the question relates to allopatric speciation. Gene flow is the movement of alleles between populations due to them still being able to successfully breed. Artificial breeding is where humans intervene in the natural process, and there is no evidence of this being the case. The founder effect is when a single population splits into two (or more) populations due to random events. The founding population is smaller and unrepresentative of the original population and can lead to rapid speciation.

**Question 24 D**

The diagram illustrates that a chunk of chromosome 4 is missing with individuals suffering Wolf-Hirschhorn Syndrome. This is brought about due to a natural process during meiosis (cross-over) occurring between chromosomes; however, the chromosome chunk was not reattached. As it is a section of a chromosome, the type of mutation is a multi-gene deletion.

**Question 25 C**

The bottleneck effect is brought on when a catastrophic event leads to a population depleting in numbers near to the point of extinction. However, if they do survive over time the gene pool is likely to show less variety compared to the original gene pool prior to the catastrophic event. **B** and **D** illustrate the founder effect and so are excluded as possible answers.

**Question 26 D**

Fossil 4 is higher than a volcanic layer of 100 million years ago and so is younger than that. **B** is incorrect as fossil 5 is in the range of 50 million years ago compared to fossil 1 which is in the range of 100 million years ago making it older, not younger. Fossil 3 existed between 50 and 70 million years ago as well as between 70 and 100 million years ago (evidenced in area R and A). Area S contains a volcanic layer of 50 million years ago and fossil 5 above this layer. Fossil 4 is the next youngest which is below fossil 5, making area S contain the youngest fossils.

**Question 27 D**

To get a 4.6 billion-year-old rock, the 1 arbitrary unit would need to decay between 3 and 4 half-lives.

1 unit of potassium-40 would decay into 0.5 units in 1.3 billion years.

0.5 units of potassium-40 would decay into 0.25 units in a further 1.3 billion years.

0.25 units of potassium-40 would decay into 0.125 (0.13) units in a further 1.3 billion years.

0.13 units of potassium-40 would decay into 0.065 units in a further 1.3 billion years.

This makes the total 5.2 billion years. Therefore, there would need to be about 3.5 half-lives of potassium-40 in the 4.6 billion years, leaving about 0.09 units.

**Question 28 B**

The gene involved is called the Bone Morphogenetic Protein 4 (BMP4) gene and it is a regulatory gene that controls the activation of several structural genes in bone, jaw and beak formation. The longer the gene is active the more structural gene expression occurs leading to (in this case) bigger beaks.

**Question 29 C**

Mutations in the BMP4 gene could explain the variation in beak sizes of the Galapagos finches. These mutations would need to be pre-existing, leading to variation in beak size in a given population, this makes both **A** and **D** incorrect. Food availability is regarded as the main selective agent in this case study. Birds with larger beaks would be more likely to obtain energy as they are more able to consume the large seeds. Passing this trait to their offspring ensures their survival. Predators such as killer whales would find it hard to catch birds (other than penguins).

**Question 30 C**

The genus *Australopithecus* existed prior to the genus *Homo*. They existed 3–4 million years ago and there were several species of them. They demonstrated that bipedalism evolved prior to an increase in cranial capacity. This massive evolutionary step occurred in the African Savannah where members of the genus theoretically moved more easily between tree to tree when standing upright. Over time the tendency for features suiting bipedalism were selected for.

**Question 31 A**

Hybridisation involves initially amplifying specific loci from different organisms (or species), as the purpose is to compare these loci with each other. The strands are heated separately to ‘melt’ the DNA (separate the two strands from each other). The samples are then mixed together, and within that mixture there may be some hybridisation between strands from the two sources. The amount of similarity between the strands can be measured by remelting the sample. The lower the similarity, the lower the temperature of melting.

**Question 32 A**

Circular DNA needs to be cut in three places to liberate three separate strands of DNA.

EcoRI will only cut the DNA in two places, liberating two strands.

TaqI will only cut the DNA once, liberating one strand.

PstI, BamHI and EcoRI collectively cut the DNA in five places, liberating five strands.

HindIII and BamHI collectively cut the DNA in three places, liberating three strands.

**Question 33 A**

The DNA moves from the negative end of the gel towards the positive end of the gel, making **C** incorrect. The smaller fragments move further than the larger fragments in the same amount of time, making **B** incorrect. Suspect 1 is homozygous at locus 2, liberating more DNA in the preparation phase (PCR) and so the band for this sample would be bigger than the other two bands from locus 1.

**Question 34 B**

For the individuals tested, both loci 1 and 2 have three different RFLPs each, so **A** cannot be correct. Just because suspect 1 and 4 have a profile that is the same as the crime scene does not mean they are both guilty and/or identical twins. More gene loci would need to be tested to ensure resolution between suspects 1 and 2, and the crime scene sample.

**Question 35 D**

The genetically modified (GM) canola is regarded as transgenic as well as genetically modified, making **A** incorrect. Based on the stem of the question, it cannot be predicted that GM canola is not harmful; however, it would be assumed that it has been rigorously tested for commercial use. It also cannot be predicted that the seeds would cost more. Over time the cost would drop if the proportion of GM canola crops increased, making **B** incorrect. A statement saying 25% of the crops are GM is not enough data to state that it is a clear indicator of acceptance, making **C** incorrect. The use of GM canola is to increase productivity (as the stem of the question suggests) and the use of herbicides to kill weeds in the pastures could be harmful to the environment.

**Question 36 B**

The pathogen in question is not cellular or viral, as the first two tests enabled this conclusion to be made. However, when proteins were destroyed, so was the pathogen. This makes the pathogen a protein, which means it is a prion.

**Question 37 C**

Neuroaminidase is an enzyme located on the surface of the influenza virus that binds with proteins within cells that the influenza virus has replicated inside. The enzyme cuts the tie with this protein and as a result is released from the cell. Relenza is a designed drug that stops the action of neuroaminidase with the protein, thus preventing the virus from exiting cells. This is a form of treatment against influenza.

**Question 38 A**

Independent variables are those that the experimenter deliberately changes ensuring all other factors are kept the same (controlled variables). In this case the IV is the different oxygen levels that the carrots were exposed to.

**Question 39 C**

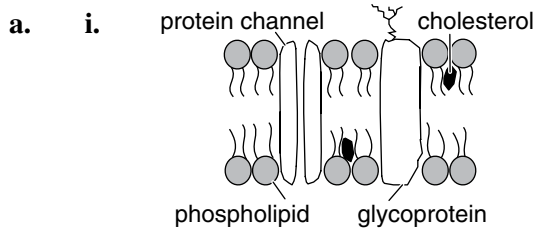
When there is no quantitative measure for oxygen levels the graph cannot be a line graph (or a scatter plot) as both axis should have numerical measurements. A histogram plots the distribution of data and as there are three results, this graphing format would be impossible. A bar graph would be the most appropriate way to present the data.

**Question 40 C**

Conclusions can still be made without the presence of a control in an experiment such as this, which would be zero levels of oxygen. As carrots are being used there are no ethical arguments that could be mounted as all that is being varied is oxygen levels. The data collected was quantitative rather than qualitative. The experiment has no repeatability and, in soundly organised experimentation, experimental groups should be repeated until results show a reasonable amount of precision.

**SECTION B**

**Question 1** (9 marks)



3marks

*1 mark for correct label.*

*1 mark for an accurate diagram.*

*1 mark for including all of the elements.*

ii. Any two of:

- Phospholipids are not bonded to each other, the hydrophobic tails face away from water and hydrophilic heads are in contact with water. This maintains a 'mosaic' appearance on either side of the membrane.
- The proteins are held within the cell membrane and are able to move along the membrane rather than being held in a fixed position.
- Cholesterol maintains the fluidity of membranes when exposed to a variety of temperatures.

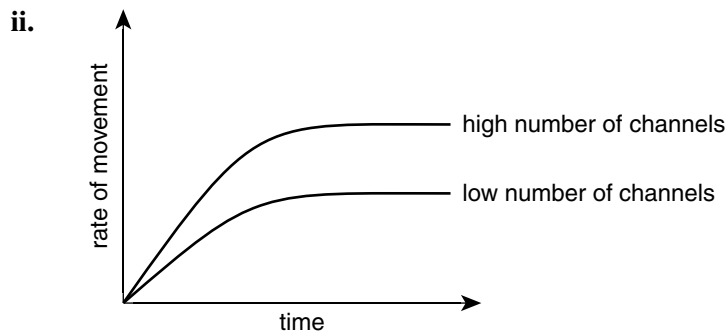
2 marks

b. i. Temperature above the optimum will denature the proteins involved in facilitated diffusion.

1 mark

This will reduce the capacity for the molecules that rely on this method of transport to be transported across the membrane.

1 mark



2 marks

*1 mark for graph shape and starting at zero.*

*1 mark for two graph lines.*



**Question 2** (10 marks)

a. i. *Any one of:*

- The 5' and 3' means 'five prime' and 'three prime', which indicates the carbon numbers in the ribose component of each nucleotide.
- Each strand of DNA is orientated in the same fashion because each nucleotide is connected to the phosphate of the next nucleotide onto the 'three prime' carbon.
- DNA is antiparallel, enabling the correct strand to be read in the correct direction.

1 mark

ii. 5' AUGCGUACUCGAUCGAUC 3'

1 mark

*Note: Both the orientation (5 to 3) and the correct sequence are required for full marks.*

b. Met-Arg-Thr-Arg-Ser-Ile

1 mark

*Note: Consequential on answer to part a. ii.*

c. The change would lead to the fourth DNA triplet being TCT rather than GCT and so the codon of AGA would code for the same amino acid Arg.

1 mark

The overall shape of the polypeptide would not change as the same amino acid is being coded for (silent mutation).

1 mark

d. A **regulatory gene** codes for a **transcription factor** that binds to a **repressor molecule**, which changes shape and detaches from the operator portion of the gene. The **RNA polymerase** can then bind to the **promotor** region of the gene and move downstream to express the gene as the repressor is not impeding the process.

2 marks

*Note: Give full marks for appropriate use of all five words and only one mark for appropriate use of 3–4 words.*

e. *Any three of:*

- No information was given as to the health status of the volunteers; all should have been ill with chronic myeloid leukaemia and with a similar level of sickness.
- Only six volunteers were used, and repetition is important in scientific experiments.
- No placebo and experimental groups were used to compare, so the effect of the drug cannot be truly measured.
- Knowledge of extreme side effects should have been known about prior to the trials by using animal models.
- The level of the drug administered should have been less, as this could have led to milder side effects.

3 marks

**Question 3** (9 marks)

a. i. Krebs's cycle

1 mark

ii. (3) NADH, ATP, (2) CO<sub>2</sub>

1 mark

*Note: All three outputs required for full marks; quantities are not required.*

b. Citrate synthase is an enzyme that catalyses specific chemical reactions.

1 mark

It combines two substrates (C<sub>4</sub> and C<sub>2</sub>) to form one product (C<sub>6</sub>).

1 mark

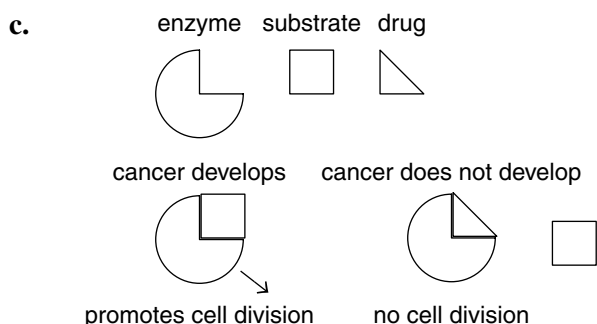
- c.** *Any two of:*
- no ATP formed
  - a build-up of the first C<sub>4</sub> compound in the cycle
  - a lack of C<sub>4</sub> substrate for the citrate synthase reaction
  - a slowing down (or stopping) of the whole cycle
  - less CO<sub>2</sub> and NADH
- 2 marks
- d.** As fumarase deficiency is very rare there is not a great deal of research being done because there is little money that will be made by discovering a cure – the disease is rare and so less people can benefit from the therapy. 1 mark
- Also, research costs money and so it is less likely to be funded if the potential profit margin is lower than diseases that are more common. 1 mark
- e.** Plants could be fumarase deficient as they possess mitochondria. 1 mark

**Question 4** (6 marks)

- a. i.** A signalling molecule binds to a receptor, which activates a secondary messenger to finally be converted into a cellular response. 1 mark
- ii.** As nitrous oxide binds to intracellular receptors, it must be lipid soluble so it can move across the cell membrane. 1 mark
- b.** Nitrous oxide has a complementary shape to the NMDA and GABA receptors. 1 mark
- Nitrous oxide can bind to both receptors and inhibit/stop the signal transduction of the usual NMDA response (excitation) and promote the signal transduction of the GABA response (relaxation). 1 mark
- c.** Neurotransmitters in the synapse will bind to receptors on the post-synaptic side of the synapse. 1 mark
- The activation of these receptors leads to the depolarisation of the next neuron/muscle or gland and subsequent excitation response. 1 mark

**Question 5** (5 marks)

- a. i.** protein; synthesised at the ribosomes 1 mark
- Note: Accept enzyme as an alternative for protein.*
- ii.** *Any one of:*
- Macrophages recognise non-self cells.
  - Macrophages phagocytose/endocytose foreign material/worn out cells.
  - Macrophages display foreign antigens to other immune cells.
  - Macrophages secrete cytokines that signals responses such as inflammation.
- 1 mark
- b.** Cancerous regions are producing more cells than is required, and so the rate of cell reproduction is greater than the rate of apoptosis. 1 mark



2 marks

*1 mark for correctly labelling the three-quarter symbol as the enzyme.  
1 mark for showing the change between the cancer developing and not developing.*

*Note: The substrate/drug can be either of the non-three-quarter circle symbols.*

**Question 6** (5 marks)

- a. i. multiple sclerosis 1 mark
- Note: Accept any reasonable answer.*
- ii. Thyroid cells in a body without Hashimoto's disease will display surface antigens that are recognised by the immune system as self and the immune system will not be activated. 1 mark
- Sometimes cells in the thyroid gland start to display surface proteins that are recognised by the immune system as non-self, thus activating an immune response. 1 mark
- b. A naive B cell comes into contact with the non-self antigens from the thyroid cell in lymph nodes. 1 mark
- This cell divides and differentiates into a B plasma cell that produces antithyroid antibodies against the non-self antigen. These are circulated in the bloodstream. 1 mark

**Question 7** (7 marks)

- a. The gene pool is the sum of all the alleles within a population in a particular place at a particular time when the environment is stable. 1 mark
- A short life cycle and large numbers of offspring means that many individuals are present with much variation. In a changing environment some individuals may be more suited and they will be able to repopulate fast, altering the allele proportions within the gene pool. 1 mark
- b. i. the smaller locusts (less likely to overheat) that have a resistance to the insecticide the farmers have used 1 mark
- ii. Most locusts will not be resistant to the insecticide. 1 mark
- Some locusts will have a selective advantage as they are resistant (and small) to the insecticide, and so only a few will survive leading to less locusts present. 1 mark

c. Any one of (similarities):

- Both allopatric speciation and natural selection rely on variation within the individuals being case-studied.
- Both allopatric speciation and natural selection rely on environmental change, so individuals can be favoured.

1 mark

Any one of (differences):

- Allopatric speciation requires geographic isolation of two or more groups, whereas natural selection can occur with a single population.
- Allopatric speciation leads to a group of organisms no longer being able to successfully reproduce, whereas natural selection only refers to the changes within each population.

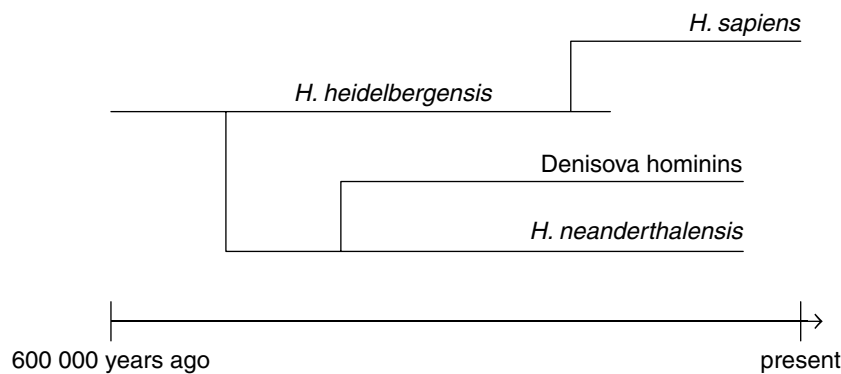
1 mark

**Question 8 (10 marks)**

a. The term hominin refers to *Homo sapiens*, all their bipedal ancestors and any other individual along the evolutionary branch leading to modern humans.

1 mark

b.



3 marks

1 mark for correct scaling.

1 mark for correct extinction times.

1 mark for correct evolutionary branching.

c. When *H. sapiens* were migrating out of Africa about 200 000 years ago, they came into contact with *H. neanderthalensis*. Some interbreeding occurred that produced fertile offspring, leaving some human lines with 4% of their genome being from *H. neanderthalensis*.

1 mark

This suggests that, at the time of this interaction, the two groups should be regarded as the same species as opposed to two different species.

1 mark

d. i. Any one of:

- Any fossil find is of importance, and if it provides evidence then it should be treated seriously.
- If the evidence shows a 6% correlation with many humans that migrated to southern Asia, then it should be treated seriously.
- In conjunction with dates and migration, it can be used to plot-out human movements.

1 mark

ii. *Any one of:*

- Two or three pieces of evidence are not enough data to formulate sound conclusions.
- Two or three bones could have been carried by ancestors and dropped in the location where they were found.

1 mark

e. mtDNA only shows variation due to mutation, which occurs at a set rate and so can be used as a tool to determine evolutionary relationships.

1 mark

By comparing the mtDNA-relatedness of indigenous Africans, indigenous groups elsewhere and any groups in between, migration patterns can be established.

1 mark

### Question 9 (10 marks)

a.	Step 1	Isolation of DNA from a human cell.
	Step 2	<b>Amplification of the human insulin gene,</b>
	Step 3	<b>Mixing the restricted plasmid and the restricted human insulin gene together.</b>
	Step 4	<b>Insertion of the modified plasmids into bacteria.</b>
	Step 5	<b>Selection of the genetically modified bacteria.</b>
	Step 6	Extraction of the insulin protein.

2 marks

*1 mark for each two correct answers.*

b. The same restriction enzyme should be used for both the plasmid and the human gene so that they have complementary sticky ends.

1 mark

When added together with ligase, the complementary sticky ends will have a chance of annealing together with the human gene connected to the plasmid in a ring of DNA.

1 mark

c. Plasmids (sometimes) contain **bacterial antibiotic resistance genes**, as well as **restriction enzyme binding sites** that are usually separate from each other.

1 mark

After the uptake of the modified plasmid by bacteria, the bacteria are exposed to the antibiotic the plasmid will confer resistance to. The bacteria surviving are the colonies that have been genetically modified.

1 mark

d. It is both genetically modified as well as transgenic. The bacteria is genetically modified as it has had its genome altered artificially to achieve a desired outcome. It is also transgenic because DNA from a human has been transferred into the bacterial genome via a genetically altered plasmid.

1 mark

e. Stage 1: Denaturation of the DNA cooled to 60°C for annealing.

1 mark

Stage 2: Primer anneals to section of DNA complementary to the primer.

1 mark

Stage 3: Extension of the target DNA.

1 mark

**Question 10** (9 marks)

- a. i.** *Any one of:*
- If the dose of Zanamivir (mg) increases then the amount of relief (%) will also increase.
  - If the dose of Zanamivir (mg) increases then the time taken for relief (in days) will decrease.
- 1 mark
- ii.** *Any one of:*
- The amount of relief improved by 25% when the dose was 6 to 8 mg compared to 0% relief when there was no Zanamivir given.
  - The time taken for relief was reduced from 10 to 4 days when 6 to 8 mg of Zanamivir was given.
- 1 mark
- iii.** Other researchers must be able to perform exactly the same experiment under the same conditions and generate the same results, meaning the method must be easy to follow.
- 1 mark
- b.** Maleimide
- 1 mark
- The two-day period taken for relief in someone who had recent contact is better than a longer time for relief offered by the other drugs. This is because the virus has probably not had time to make an individual sick, meaning a high amount of relief is not necessary.
- 1 mark
- c.** Controlled variables are those that are kept the same so the conclusions made can relate to the independent variable – in this case the drug type. Such factors would include:
- the amount of each drug
  - the frequency of the administration of the drug
  - the health status of the individuals in the trial
  - how long the disease was contracted for before the drug was first administered.
- 2 marks
- 1 mark for explanation.*
- 1 mark for two controlled variables.*
- d.** Pandemics are outbreaks of disease in many areas around the world.
- 1 mark
- In the likely areas where the bird flu may outbreak, stockpiles of these drugs could be administered to the general public to reduce the chance of viral reproduction until a vaccine is produced.
- 1 mark