



YEAR 12 *Trial Exam Paper*

2020

BIOLOGY

Written examination

Worked solutions

This book presents:

- high-level sample answers
- explanatory notes
- mark allocations
- tips.

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SECTION A – Multiple-choice questions

Question	Answer
1	<i>A</i>
2	<i>D</i>
3	<i>B</i>
4	<i>B</i>
5	<i>D</i>
6	<i>C</i>
7	<i>B</i>
8	<i>B</i>
9	<i>C</i>
10	<i>B</i>
11	<i>A</i>
12	<i>D</i>
13	<i>B</i>
14	<i>A</i>
15	<i>C</i>
16	<i>A</i>
17	<i>B</i>
18	<i>B</i>
19	<i>D</i>
20	<i>A</i>

Question	Answer
21	<i>C</i>
22	<i>C</i>
23	<i>A</i>
24	<i>A</i>
25	<i>A</i>
26	<i>C</i>
27	<i>D</i>
28	<i>B</i>
29	<i>B</i>
30	<i>C</i>
31	<i>D</i>
32	<i>D</i>
33	<i>B</i>
34	<i>D</i>
35	<i>D</i>
36	<i>D</i>
37	<i>C</i>
38	<i>B</i>
39	<i>B</i>
40	<i>B</i>

Question 1**Answer: A****Explanatory notes**

The length of the potato cylinder decreased due to water diffusing out of the potato cells via osmosis, causing them to become flaccid. Therefore, options B and D can be eliminated.

The direction in which the water molecules move is determined by the concentration gradient of water molecules between the cytosol and the external solution. Because the water diffused out of the cells, the salt solution is hypertonic.

Question 2**Answer: D****Explanatory notes**

The information provided identifies the enzyme as having human origin. Therefore, the optimum temperature would be 37 °C. The enzyme is secreted into the mouth where the pH is approximately 7. Therefore, the combination of a temperature of 37 °C and a pH of 7 would enable salivary amylase to function optimally and cause the starch to be broken down fastest.

Question 3**Answer: B****Explanatory notes**

These proteins have different functions, and therefore their three-dimensional structures would have to be different because the three-dimensional structure of a protein determines its function.

**Tip**

- *It is important to remember that the functional diversity of proteins means that they play a role in many of the processes covered in Unit 3. Your knowledge of the structures and functions of proteins can be tested in questions about material transport, enzymes, cellular respiration, photosynthesis, signalling molecules and immunity. You should remember that attributes such as specificity relate to all proteins, not just to enzymes.*

Question 4**Answer: B****Explanatory notes**

The diagram indicates that the integral protein is an alpha helix. This is an example of a secondary structure.

Question 5**Answer: D****Explanatory notes**

When DNA is transcribed, a primary transcript of RNA (also referred to as pre-mRNA) is produced. There is no thymine in RNA because it is replaced by uracil.

Question 6**Answer: C****Explanatory notes**

Nucleotides are joined by a condensation reaction, during which a molecule of water is released.

Question 7**Answer: B****Explanatory notes**

This temperature is so high that the enzymes become denatured. This changes the shape of their active sites and prevents them from carrying out their function.

Question 8**Answer: B****Explanatory notes**

Option A is incorrect because splicing of RNA fragments occurs in the nucleus, not the cytosol.

Option B is correct because during RNA processing, a polyA tail is joined to the end of the mRNA molecule.

Option C is incorrect because introns are not retained in mRNA.

Option D is incorrect because the primary transcript contains introns and exons. Introns are removed during RNA processing.

Question 9**Answer: C****Explanatory notes**

The repressor binds to the operon at the operator.

**Tip**

- *Knowledge of specific terms is important because some questions are based on your ability to remember terms and apply them to the question. If you have not learned a term such as 'operator', then it is unlikely to be the correct response.*

Question 10**Answer: B****Explanatory notes**

NADPH plays a role in photosynthesis, which means options A and D are incorrect because they describe cellular respiration. NADPH is a loaded carrier that transports electrons and a proton from the grana to the stroma where the proton will be used in the Calvin cycle to produce glucose.

**Tip**

- *You should remember the difference between NADH and NADPH – doing so makes it much easier to identify whether a question is referring to cellular respiration or photosynthesis. Associating the P in NADPH with the P for photosynthesis is a simple way of remembering this.*

Question 11**Answer: A****Explanatory notes**

Option A is correct because reliability refers to the degree of agreement between independent results and can be improved by repeating the experiment.

Option B is incorrect because validity refers to the appropriateness of the method in addressing the aim of the experiment and testing the effect of the independent variable on the dependent variable.

Option C is incorrect because accuracy is the degree of closeness to the true value of the quantity being measured and is difficult to quantify.

Option D is incorrect because precision refers to the degree of closeness between two or more measurement values. In this example, three of the results are very similar but one is different, so precision is an issue. However, the precision, or lack thereof, does not relate to the fact that each of the students only performed the experiment once. Given that there are only four results, the experiment should be repeated.

Question 12**Answer: D****Explanatory notes**

Light intensity continues to increase, so this cannot be the limiting factor. The photosynthetic rate is initially higher as carbon dioxide concentration increases, but eventually the saturation point for light absorption is reached and carbon dioxide concentration becomes limiting.

Question 13**Answer: B****Explanatory notes**

Evidence of the bacterial origin of chloroplasts and mitochondria includes the double membrane surrounding these organelles, the presence of DNA that is different from genomic DNA and the presence of ribosomes, which enable these organelles to synthesise proteins.

Question 14**Answer: A****Explanatory notes**

The information provided states that cortisol is a steroid hormone. Because cortisol is lipophilic, it is able to diffuse across the plasma membrane of the target cell and bind to the receptors in the cytosol. The hormone–receptor complex subsequently enters the nucleus and binds to a steroid response element, triggering a cellular response.

Question 15**Answer: C****Explanatory notes**

The data provided shows that the ESP1 secreted by male 1 affects other mice: male 2 and female 1. Pheromones are secreted externally and affect other organisms, usually those of the same species.

Question 16**Answer: A****Explanatory notes**

Bcl-2 acts as an anti-apoptotic protein because it prevents the release of cytochrome c. Cytochrome c leads to caspase activation and, ultimately, apoptosis.

**Tip**

- Remember that it can be useful to draw on the paper. Drawing a cross on the arrow between cytochrome c and the caspase enzymes makes the effect of the action of Bcl-xL more obvious and will help you to answer the question.

Question 17**Answer: B****Explanatory notes**

Option A is incorrect because antigen detection and response is not sequential in the manner suggested.

Option B is correct because the different proteins are the result of the expression of different genes. The genes that code for surface proteins are structural rather than regulatory.

Option C is incorrect because the presence of two antigens means that it is possible to produce two different antibodies.

Option D is incorrect because there can only be two antibodies produced, not three.

**Tip**

- *You should remember that antibodies, like all proteins, are specific. Antibodies have two identical antigen binding regions. The most common mistake is thinking that an antibody can have two different antigen binding regions.*

Question 18**Answer: B****Explanatory notes**

Hormones are only able to affect target cells that have the specific receptor for the hormone to bind to. The fact that the kidneys are the only organ to respond to ADH means that they are the only organ in the table with receptors for the hormone.

Question 19**Answer: D****Explanatory notes**

The Sydney funnel-web spider venom is injected into animals, such as horses, causing them to produce antibodies against the venom. These antibodies are then collected from the animal's blood and purified. The result is referred to as antivenom or antivenin.

Question 20**Answer: A****Explanatory notes**

Vaccines contain antigens. Their purpose is to provide primary exposure to the antigen and cause the vaccinated individual to produce memory B cells that remain in the lymphatic system. This is an example of active immunity because the child will produce their own antibodies against the diphtheria antigen as well as produce memory B cells.

Question 21***Answer: C*****Explanatory notes**

This question specifically asks for the net yield. Glycolysis produces 4 ATP molecules but 2 of these are used during the process. The 6 carbon input is broken down into 2 pyruvate molecules, each of which has 3 carbon atoms. During this process 2 NAD⁺ carriers are loaded to become NADH.

Question 22***Answer: C*****Explanatory notes**

Option A is incorrect because the change in allele frequency is not due to acclimatisation.

Option B is incorrect because the allele for black fur has not been eliminated from the population. There are two heterozygous individuals in the tenth generation.

Option C is correct because mice with light brown fur are surviving in higher numbers than those with black fur, suggesting that the light brown fur phenotype is conferring a selective advantage, most likely improving the ability of the mice to camouflage themselves from the foxes.

Option D is incorrect because the number of individuals with the aa genotype decreased over the first five generations and therefore did not provide a selective advantage.

Question 23***Answer: A*****Explanatory notes**

To function effectively as a molecular clock, the mutations must occur at a known rate.

Question 24***Answer: A*****Explanatory notes**

Trace fossils are traces of the organism rather than part of the organism. Trace fossils commonly include coprolite and footprints. Trace fossils can provide information about the behaviour or diet of the organism, rather than its appearance.

Question 25***Answer: A*****Explanatory notes**

Acclimatisation is the process of an organism becoming accustomed to changing conditions within its own lifetime. Allopatric speciation is a process that occurs over many generations.

Question 26**Answer: C****Explanatory notes**

The fact that tar displaces carbon-14 makes it difficult to carry out absolute dating, and it would be impossible to carry out relative dating since the remains have been mixed up due to the churning action of the tar.

**Tip**

- *You should know the names of at least two different methods of absolute dating as well as the age of fossils they are appropriate for these methods. Radiocarbon dating is only useful for dating fossils up to about 50 000 years. For anything older, potassium to argon dating is a useful example to remember.*

Question 27**Answer: D****Explanatory notes**

Option A is incorrect because there is no evidence that having type AB or type B blood confers a selective disadvantage.

Option B is incorrect because the Dunker population is unlikely to have inherited type O blood from the surrounding Pennsylvanian population because they tend to intermarry.

Option C is incorrect because the Dunkers immigrated to Pennsylvania from Germany and their ancestors were related to the ancestors of the modern German population.

Option D is correct. This is an example of the founder effect. The difference in the frequencies of type A and O blood is most likely to have occurred because the 50 families that left Germany were not a representative sample of the German population at that time.

Question 28**Answer: B****Explanatory notes**

Aneuploidy is where an individual has an abnormal number of chromosomes. In this example, the affected individual would have 47 chromosomes instead of 46.

Question 29**Answer: B****Explanatory notes**

The star is located high up the y-axis, which means that the bird would have a deep beak. It is only a short distance along the x-axis, which means that the bird's beak would be short.

Question 30***Answer: C*****Explanatory notes**

Option A is incorrect because there is no information to suggest that any species have ceased evolving.

Option B is incorrect because, although the DNA and proteins are similar, they are not identical.

Option C is correct because these two species have similar DNA and proteins. This means that they share a recent common ancestor.

Option D is incorrect because there is no information about the number of chromosomes present in the cells of either species.

Question 31***Answer: D*****Explanatory notes**

Adaptive radiation is the diversification of an ancestral species into many modern species to take advantage of available ecological niches.

Question 32***Answer: D*****Explanatory notes**

Complementary sticky ends are essential in the isolated gene and the plasmid. This enables the genes to be inserted into the plasmid and annealed.

Question 33***Answer: B*****Explanatory notes**

I is relevant because bipedal individuals have a distinctive bowl-shaped pelvis.

II is relevant because the foramen magnum of a bipedal organism will be in the centre of the base of the skull.

III is not relevant because jaw shape has no bearing on bipedalism. The parabolic jaw is, however, an indication that the organism is a hominin.

IV is not relevant because, although the big toe affects an organism's gait, the position of the big toe is not used to prove whether an organism is bipedal or not.

Question 34**Answer: D****Explanatory notes**

Option A is incorrect because the age of the remains is irrelevant. There is nothing to connect these bones to either species of hominin.

Option B is incorrect because there is no indication of the origin of the charcoal. It could have been the result of a natural fire.

Option C is incorrect because the presence of cave paintings does not give any indication as to when they were produced.

Option D is correct because if the Neanderthals were extinct 32 000 years ago, they would not have been able to produce tools 27 000 years ago.

Question 35**Answer: D****Explanatory notes**

The information provided states that the mutated *talpid²* gene is longer than the normal gene. Therefore, it would not have travelled as far through the gel as the normal gene. The samples from chicks 1, 2 and 5 show the presence of the mutated gene, which means that these chicks would be able to develop teeth.

Question 36**Answer: D****Explanatory notes**

The mutated *talpid²* gene came from other chickens of the same species. Therefore, the chickens are not transgenic. Foreign DNA has been inserted into the genomes of the chickens that developed teeth; therefore, they have been genetically modified.

Question 37**Answer: C****Explanatory notes**

Option A is incorrect because there is no information that supports this option.

Option B is incorrect because, although the antibody would bind to HER2, this would have no real effect on the cells.

Option C is correct because the antibody targets HER2, delivering the chemotherapy drug directly to the cancer cells. This means that the dose is much lower than in standard chemotherapy.

Option D is incorrect because there is no information about whether the patient is exposed to radioactive chemicals. There is a difference between chemotherapy and radiation therapy.

Question 38***Answer: B*****Explanatory notes**

By determining the structure of pathogenic antigens, it is possible to produce drugs that will specifically bind to and neutralise these antigens.

Question 39***Answer: B*****Explanatory notes**

Option A is incorrect because prevention and control involve ensuring that all concerned parties receive appropriate information and that strategies designed to control or prevent the transmission of pathogens are carried out promptly and effectively.

Option B is correct because carrying out and applying research involves using research to inform and optimise the ability of health systems to respond to potential outbreaks. This is accomplished by developing and distributing tools, equipment or strategies to contain a pathogen or by evaluating and improving current strategies.

Option C is incorrect because providing training and infrastructure involves ensuring that there is sufficient infrastructure in place to cope with a pandemic and that there are sufficient trained personnel to implement appropriate strategies.

Option D is incorrect because improvement of surveillance and response involves detecting, investigating and monitoring emergent pathogens.

Question 40***Answer: B*****Explanatory notes**

The bacteria is unable to ferment lactose, so can only be *Shigella* or *Salmonella*. It is also able to use citric acid as a sole carbon source, which means it can only be *Salmonella*. The inability to produce acetoin is irrelevant.

SECTION B

Question 1a.

Worked solution

A hummingbird's body temperature decreases as its oxygen consumption decreases.

Oxygen is an input for the process of aerobic cellular respiration. Metabolic heat is a by-product of this reaction. As oxygen consumption decreases, the rate of cellular respiration also decreases, so less heat is produced, causing the hummingbird's body temperature to decrease.

Mark allocation: 2 marks

- 1 mark for identifying that body temperature decreases as oxygen consumption decreases
- 1 mark for explaining the links between oxygen consumption, the rate of aerobic respiration and body temperature

Question 1b.

Worked solution

The hummingbird would have gone into torpor at approximately 17 minutes.

As the bird goes into torpor, the rate of aerobic respiration decreases, as does oxygen consumption. The 17 minute point on the graph is the point at which oxygen consumption begins to decrease.

Mark allocation: 2 marks

- 1 mark for identifying the time as being approximately 17 minutes
- 1 mark for providing an appropriate explanation as to why this was an appropriate choice



Tip

- *You should be prepared for questions in which you are required to read or extrapolate information from a graph. There is a specific small range that would be accepted as an answer. For this reason, it is a good idea to ensure that you take a ruler into the examination with you.*

Question 1c.**Worked solution**

Two factors are the availability of glucose and the availability of oxygen. The hummingbird is not obtaining any nutrients and therefore does not have a supply of glucose. Because the heart rate has slowed, oxygen is being delivered to the tissues at a much slower rate. Both of these factors are inputs for aerobic cellular respiration. As a result of the much lower availability of these inputs, the rate of cellular respiration will decrease.

Mark allocation: 4 marks

- 1 mark for identifying two appropriate factors, such as glucose availability, oxygen availability or temperature
- 1 mark for identifying that the rate of cellular respiration will decrease
- 1 mark for explaining that glucose and oxygen are the inputs of cellular respiration
- 1 mark for explaining why the reaction rate decreases

Question 2a.**Worked solution**

The absence of glucose and the presence of lactose.

Mark allocation: 1 mark

- 1 mark for identifying that glucose needs to be absent and lactose needs to be present

Question 2b.**Worked solution**

The structures labelled 6 and 7 are the repressor proteins. The repressor protein is normally in the shape represented at the number 6. When in this conformation, the repressor protein binds to the operator, which prevents RNA polymerase from binding to the promoter. When lactose (structure 8) is present, a form of lactose called allolactose binds to the repressor protein, causing it to change conformation and release from the operator gene. RNA polymerase is now able to bind to the promoter and the *lac* operon will be expressed.

Mark allocation: 2 marks

- 1 mark for explaining that the repressor protein binds to the operator preventing RNA polymerase from binding to the promoter
- 1 mark for explaining that the repressor protein releases the operator, which enables RNA polymerase to bind to the promoter

Question 2c.**Worked solution**

LacI is a regulatory gene. *LacZ*, *lacY* and *lacA* are structural genes.

A structural gene codes for the synthesis of a protein that becomes part of the structure of an organism or governs a specific function.

A regulatory gene governs the expression of one or more other genes.

Mark allocation: 3 marks

- 1 mark for providing an example of a regulatory gene and a structural gene
- 1 mark for providing a definition of a structural gene
- 1 mark for providing a definition of a regulatory gene

**Tip**

- *The lac operon is the most common model of the expression of gene regulation in the Study Design. You should be familiar with all of the structures and their purposes.*

Question 3a.**Worked solution**

An allergen is an antigen that specifically causes an allergic response, whereas an antigen is any foreign substance that causes an immune response.

Mark allocation: 1 mark

- 1 mark for an answer that clearly indicates that an antigen is any substance that causes an immune response, whereas an allergen is an antigen that, although not intrinsically harmful, causes an allergic response

**Tip**

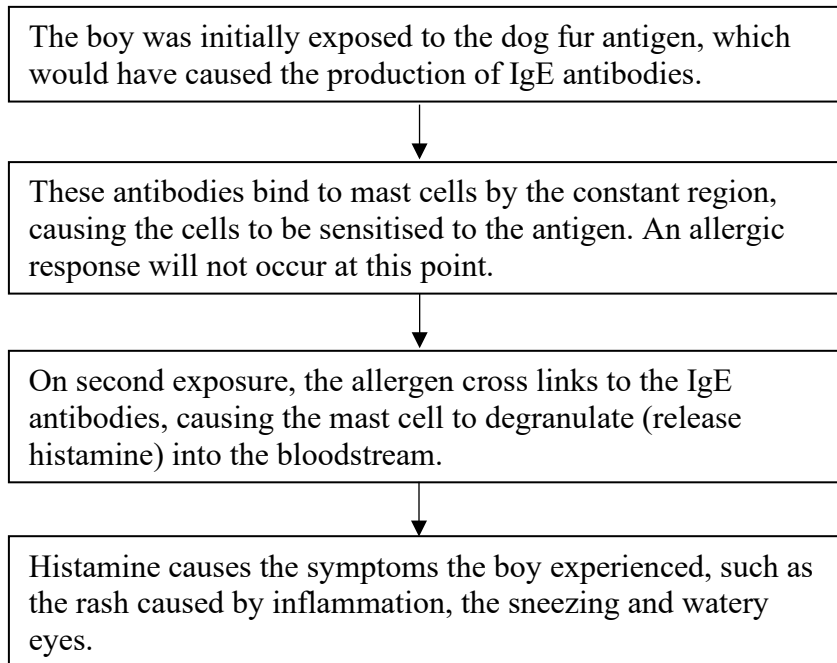
- *Some comparison questions may use the word 'compare' but, in many questions, the requirement to compare two things is implied. Assessor reports state that failing to make a comparison is one of the most common mistakes.*

Question 3b.**Worked solution**

Histamine is included in the scratch test to provide a baseline of comparison. Different people have different responses to histamine, so it is helpful to compare the response to histamine to the response to allergens.

Mark allocation: 1 mark

- 1 mark for identifying that the response to histamine is used as a comparison for the degree of response to allergens

Question 3c.**Worked solution****Mark allocation: 4 marks**

- 1 mark for stating that the initial exposure causes the production of IgE antibodies
- 1 mark for stating that the antibodies bind to the mast cells and cause them to be sensitised, and that an allergic response will not happen yet
- 1 mark for stating that, on the second exposure, the allergen forms cross links with the antibodies on the surface of the mast cells, causing degranulation
- 1 mark for identifying that the symptoms are caused by the histamine

**Tip**

- *You should always pay attention to the mark allocation for each question. This question does not state that there should be four stages shown in your answer. However, the fact that there are four marks indicates that your answer needs to contain four distinct points.*

Question 3d.**Worked solution**

Antihistamine is used to treat allergic reactions. These chemicals are used because they either block the action of histamine or reduce its effect.

Mark allocation: 2 marks

- 1 mark for identifying antihistamine
- 1 mark for explaining why antihistamines are prescribed

Question 4a.**Worked solution**

The man should have washed his hands after changing his daughter's nappy.

OR

The man could have worn gloves while changing the nappy.

AND

This might have prevented him from becoming infected because polio is transmitted by the faecal–oral route. He must have become contaminated from the child or the nappy during the changing process. This was later transferred to his mouth. Had he washed or covered his hands, the contaminated waste would have been removed and he would not have become infected.

Mark allocation: 2 marks

- 1 mark for stating an appropriate action that the man could have taken before or just after changing the nappy

Note: This could be preventative, such as wearing gloves, or good hygiene, such as washing hands.

- 1 mark for explaining why taking this action might have prevented the infection from occurring

**Tip**

- *When a question asks for an identification, then it is essential that the answer specifically relates to the scenario provided.*

Question 4b.**Worked solution**

The viral particles are antigenic. They are detected as being foreign, resulting in an immune response and the development of memory B cells that remain in the lymphatic system.

Mark allocation: 1 mark

- 1 mark for providing an answer that identifies the viral particles as being antigenic, resulting in the development of memory B cells that are specific for the polio virus

Question 4c.**Worked solution**

The two lists are identical. The second exposure is referred to as a booster shot because it increases the exposure to the antigen, resulting in an increased number of memory B cells.

Mark allocation: 1 mark

- 0 marks are awarded for stating that the lists are identical, but this statement is required to get full credit for the response
- 1 mark is awarded for an answer that provides information about the reason for carrying out booster shots

Question 4d.**Worked solution**

herd immunity

Mark allocation: 1 mark

- 1 mark for identifying that the risk of polio is low in Australia due to herd immunity

Question 4e.**Worked solution**

The number of deaths decreased from approximately 0.7 per 100 000 in 1954 to zero from 1959 to 1970.

This decrease occurred due to the introduction of the polio vaccine, which provided herd immunity.

Mark allocation: 2 marks

- 1 mark for identifying the trend for the period indicated
- 1 mark for suggesting that this trend was due to the introduction of the polio vaccine

Question 5a.**Worked solution**

Process	What happens during this process
transcription	The gene that codes for calcitonin is transcribed, ultimately producing mRNA.
translation	mRNA is read by a ribosome bound to the rough endoplasmic reticulum, assembling a polypeptide chain which is modified and processed by the Golgi body into calcitonin.

Mark allocation: 2 marks

- 1 mark for briefly outlining transcription
- 1 mark for briefly outlining translation

Question 5b.**Worked solution**

Calcitonin is released into the bloodstream by the process of exocytosis.

Mark allocation: 1 mark

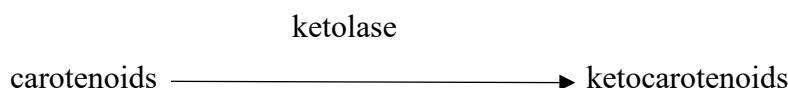
- 1 mark for identifying exocytosis

Question 5c.**Worked solution**

Stage	What happens during this stage
reception	Calcitonin binds to specific receptors on the external surfaces of cells lining the collecting tubule of the kidneys.
transduction	A series of metabolic reactions inside the cells transmit and amplify the signal.
(cellular) response	The cells of the collecting tubule become less permeable to calcium ions, decreasing the ability of the body to reabsorb them.

Mark allocation: 3 marks

- 1 mark for identifying reception as the first stage and for giving an explanation of reception, specifically relating to calcitonin
- 1 mark for identifying transduction as the second stage and for giving an explanation of the events that occur during transduction
- 1 mark for identifying cellular response as the third stage and for giving an explanation of a cellular response specifically relating to calcitonin

Question 6a.**Worked solution****Mark allocation: 1 mark**

- 1 mark for showing carotenoids as the reactants or substrate and ketocarotenoids as the product with ketolase written above the arrow

Question 6b.**Worked solution**

Bird 2 is the only bird that will have red colouration. It is the only bird that has the *CYP2J19* gene present in the skin and the liver. The gene must be expressed in both locations for the bird to have the red colouration.

Mark allocation: 2 marks

- 1 mark for identifying bird 2 as being the only bird with this colouration
- 1 mark for explaining that bird 2 is the only bird that has the *CYP2J19* gene in both the skin and the liver

Question 6c.**Worked solution**

The yellow colouration is more likely to be due to an environmental stress or a poor diet.

There is a point mutation in the fourth codon. However, both codons code for the amino acid leucine (leu) and the mutation will not have affected the structure of the protein. There is no genetic reason why the bird should have yellow feathers.

Mark allocation: 2 marks

- 1 mark for identifying that the cause is environmental, such as stress or poor diet, instead of genetic
- 1 mark for using the data to explain that, although there is a mutation, it does not affect the bird's ability to produce ketolase

Question 6d.**Worked solution**

This is an example of selective breeding or artificial selection. The initial birds with the pale yellow plumage were bred together. Offspring with the brightest yellow plumage were selected and bred with other canaries showing yellow plumage. This process continued over many generations.

Mark allocation: 2 marks

- 1 mark for identifying selective breeding or artificial selection
- 1 mark for explaining that people selected canaries showing the trait of yellow plumage for breeding purposes and continued this practice over many generations

Question 6e.**Worked solution**

Note: Interpretation of the student's answer is at the teacher's discretion. Any answer demonstrating an appropriate level of understanding should be accepted.

Example 1:

Disagree.

Genetic modification is a result of the application of genetic engineering. In this example, red factor canaries were produced by breeding canaries with siskins, rather than carrying out genetic engineering. Species are defined as separate because they cannot produce fertile offspring. Therefore, the ability to introduce a trait from one species to another is atypical.

Example 2:

Agree.

Although selective breeding has been carried out for a long time, this is the first known example of introducing a genetic trait from one species to another.

Mark allocation: 1 mark

- 0 marks for providing agreement or disagreement only
- 1 mark for providing a valid reason for either agreeing or disagreeing with the statement

**Tip**

- *Some questions in an examination paper are more holistic than others. This means that they may draw on more than one topic, more than one study area or even from different units. Gaining a thorough understanding of how different topics link together is an important skill to develop because it better prepares you for this type of question.*

Question 7a.**Worked solution**

morphological features

OR

homologous structures

Mark allocation: 1 mark

- 1 mark for identifying either of these terms

Question 7b.**Worked solution**

Relatedness may be determined by comparing DNA sequences, comparing mitochondrial DNA or comparing amino acid sequences.

Species that are closely related will have molecular sequences that are very similar. The extent of similarity decreases as evolutionary distance increases.

OR

DNA hybridisation can be used.

Single strands of DNA from two different species are joined to produce a DNA hybrid. The temperature at which the hybridised strands separate may be used to determine relatedness. A hybrid from two species that are not closely related will have fewer similarities and a lower melting point than a hybrid from more closely related species.

Mark allocation: 2 marks

- 1 mark for identifying a technique that enables molecular homology to be determined
- 1 mark for stating that the similarity between molecular sequences is used to determine the extent of relatedness between different species

Question 7c.**Worked solution**

When the Bering land bridge disappeared, a geographical barrier was established between the ancestors of the *Thermophis* snakes and the ancestors of the South American snakes. The isolated populations were subjected to different selection pressures, so different phenotypes were favoured. Genetic changes accumulated over time in both populations until they were so genetically different that they could no longer successfully interbreed.

Mark allocation: 3 marks

- 1 mark for identifying the specific geographical barrier that separated the ancestors of both groups of snakes
- 1 mark for stating that the different populations would have been subjected to different selection pressures
- 1 mark for stating that the accumulation of genetic changes in different populations eventually leads to speciation occurring

**Tip**

- *The explanations for some processes, such as speciation and natural selection, are sequential in nature. If you can memorise the correct sequence then it is easier to apply to the specific details from the scenario.*

Question 7d.**Worked solution**

Divergence between the ancestors of the *Thermophis* snakes and the South American snakes occurred approximately 30 million years ago. This is a very distant relationship.

Mark allocation: 1 mark

- 1 mark for stating that divergence between the two groups of snakes occurred approximately 30 million years ago, which is why the *Thermophis* genus snakes lack close living relatives

**Tip**

- *Be careful with questions that appear to only need rewritten information to get a mark – always add something to your answer.*

Question 7e.**Worked solution**

The adaptations enabling the *Thermophis* genus snakes to survive by living near hot springs were acquired by their ancestors only after they had been geographically isolated from the ancestors of the South American snakes.

Mark allocation: 1 mark

- 1 mark for identifying that the unique adaptations were only acquired after geographical isolation

Question 8a.**Worked solution**

The foot of *Homo luzonensis* had an opposable (or lateral facing) big toe. The position of the big toe in *Homo sapiens* is fixed and points straight ahead. This means that *H. luzonensis* would have been far better at climbing trees than *H. sapiens*, who are adapted for walking on the ground.

Mark allocation: 2 marks

- 1 mark for providing a comparative statement regarding the difference in foot structure between *H. luzonensis* and *H. sapiens*
- 1 mark for providing a comparative statement that *H. luzonensis* would have a superior ability at climbing trees than *H. sapiens*

**Tip**

- You should be able to make links between theory that you are familiar with and unfamiliar examples, such as that the foot structure of *Homo luzonensis* was similar to that of *Australopithecus*. You should be familiar with the major structural, functional and cognitive changes occurring from *Australopithecus* to *Homo sapiens*.

Question 8b.**Worked solution**

The human fossil record is open to interpretation when new evidence becomes available to challenge our current understanding.

Mark allocation: 1 mark

- 1 mark for stating that new evidence, such as the discovery of *Homo luzonensis*, causes us to reinterpret or change our current understanding of human evolution

Question 8c.**Worked solution**

The fact that the fossils and the bone were found in the same layer of sediment suggests that they are of approximately the same age.

Mark allocation: 1 mark

- 1 mark for stating that the hominin fossils and the bone are approximately the same age

**Tip**

- *You should always be careful to answer the question that is being asked, rather than something else. In this case, the question was about the similar location of the deer bone and the hominin fossils. This question was not about identifying that the deer had to have been butchered by members of Homo luzonensis.*

Question 8d.**Worked solution**

cultural evolution

Mark allocation: 1 mark

- 1 mark for identifying that this is an example of cultural evolution

Question 8e.**Worked solution**

The members of *H. luzonensis* were already present in Asia before there is evidence that members of *H. sapiens* arrived in Asia.

OR

These bones have been identified as coming from three different individuals rather than one.

Mark allocation: 1 mark

- 1 mark for providing a plausible piece of evidence

Question 9a.**Worked solution**

rational drug design

Mark allocation: 1 mark

- 1 mark for identifying rational drug design

Question 9b.**Worked solution**

Relenza binds to the active site of neuraminidase.

This prevents the release of influenza viruses into the body, thereby preventing them from spreading and infecting other cells.

Mark allocation: 2 marks

- 1 mark for describing the role played by Relenza
- 1 mark for discussing the therapeutic benefit of taking Relenza

Question 9c.**Worked solution**

It would be biologically ineffective to use an antibiotic to treat viral influenza.

Many antibiotics target the cell walls of bacteria. Viruses do not have a cell wall and therefore cannot be targeted by an antibiotic.

Mark allocation: 2 marks

- 1 mark for stating that it would not be biologically effective to treat a viral infection with an antibiotic
- 1 mark for providing a plausible reason to explain why antibiotics are ineffective against bacteria

Question 9d.**Worked solution**

It is believed that mitochondria and their ribosomes have a bacterial origin. Drugs that target bacterial ribosomes may also target mitochondrial ribosomes.

This will decrease the ability of ribosomes to synthesise the proteins necessary for mitochondria to carry out their functions effectively, resulting in symptoms such as fatigue.

Mark allocation: 2 marks

- 1 mark for identifying that mitochondria are believed to have a bacterial origin and that the mitochondrial ribosomes may be targeted
- 1 mark for explaining that the ability of the mitochondria to carry out cellular respiration as efficiently as normal may be affected, therefore leading to lower energy release and fatigue

Question 10a.**Worked solution**

A mass extinction is the extinction of a large number of species within a short period. Although the numbers of Wollemi pine decreased to the point where the species nearly became extinct, the loss of most of the population is not an example of mass extinction, particularly because it is a single species.

Mark allocation: 2 marks

- 1 mark for explaining what a mass extinction is
- 1 mark for stating why this is not an example of a mass extinction

Question 10b.**Worked solution**

potassium to argon dating

Mark allocation: 1 mark

- 1 mark for the identification of any appropriate absolute dating technique
- Note:** Radiocarbon dating would not be appropriate because it cannot be used to date fossils of this age.

Question 10c.**Worked solution**

The lack of genetic diversity of the cloned plants could make the trees more susceptible to diseases or to environmental changes. This is because such a change will affect all individuals equally.

Mark allocation: 1 mark

- 1 mark for identifying a specific disadvantage, such as susceptibility to diseases or to environmental changes

Question 10d.**Worked solution**

If human cloning were carried out then totipotent cells would be required. Currently these can only be obtained from the inner cell mass of blastocysts. Obtaining these destroys the blastocyst and so that life is lost. By comparison, the cloning of plants is much easier and can be performed with little damage to the plant and no effect on its long-term survival.

Note: There are many potential answers to this question. An argument could be based on the sentience of humans and lack of sentience of plants. The source of the cells for human cloning versus plant cloning is another point that may be made.

Mark allocation: 2 marks

- 1 mark for discussing a reason why the cloning of an entire human is considered unethical
- 1 mark for discussing a reason why the cloning of an entire plant is not considered unethical

Question 10e.**Worked solution**

Araucaria is the common ancestor to both *Wollemia* and *Agathis* species plants.

Mark allocation: 1 mark

- 1 mark for writing a plausible conclusion that is based on the data supplied

Question 11a.**Worked solution**

As the light intensity decreases, the rate at which oxygen is produced decreases.

Mark allocation: 1 mark

- 1 mark for correctly identifying the link between light intensity and the rate at which photosynthesis occurs

Question 11b.**Worked solution**

The student assumed that the bubbles were oxygen gas. They made this assumption because the plant is carrying out photosynthesis. Oxygen gas is an output of photosynthesis.

Mark allocation: 2 marks

- 1 mark for identifying that the student assumed that the bubbles consisted of oxygen gas
- 1 mark for stating that this assumption was based on the fact that oxygen gas is an output of photosynthesis

Question 11c.**Worked solution**

The water bath prevents the water from heating up due to the presence of the lamp.

Mark allocation: 1 mark

- 1 mark for identifying a reason to explain why the water bath was used

**Tip**

- *Avoid writing vague answers, such as 'to get more accurate results' or 'so that it will be a fair test'. You should remember to answer the question clearly and address the purpose of the piece of equipment in the scenario provided.*

Question 11d.**Worked solution**

Experimental precision refers to how closely two or more measurement values agree with each other. The second student is correct. The student who performed the experiment only has one set of results and therefore has no way to determine the precision of these results.

Mark allocation: 2 marks

- 1 mark for providing a definition of precision
- 1 mark for explaining why a single set of results cannot be precise

Question 11e.**Worked solution**

This is most likely to be a personal error. The student might have mistakenly switched the results relating to 10 cm with those relating to 20 cm (it is more likely that the result for 10 cm was 29 bubbles and the result was 20 cm for 20 bubbles because these results are consistent with the results from experiments 1 and 2).

Mark allocation: 2 marks

- 1 mark for stating that this is an example of a personal error
- 1 mark for identifying a plausible source of the error

**Tip**

- *The VCAA website contains information relating to scientific investigations and definitions of the measurement terms used in these investigations. It is useful for you to know the meaning of each of these terms, as there is commonly a question in the examination in which having this knowledge is essential.*

Question 11f.**Worked solution**

The student should redo the experiment for the 10 cm and 20 cm distances between the lamp and the plant.

Mark allocation: 1 mark

- 1 mark for identifying that the student should redo the experiment for just the 10 cm and 20 cm distances between the lamp and the plant

END OF WORKED SOLUTIONS