

**SOLUTION PATHWAY****Answers to Section A: Multiple choice**

<b>Question</b>	<b>Correct Answer</b>	<b>Explanation</b>
<b>1</b>	<b>D</b>	Ethanol is able to diffuse through the plasma membrane. CO <sub>2</sub> is able to diffuse so therefore must not be lipophobic. Amino acids cross by facilitated diffusion and water moves from high to low concentration so C is incorrect.
<b>2</b>	<b>B</b>	'A' is the ribosome and therefore site of protein synthesis, D is the golgi apparatus for modification, packaging and export.
<b>3</b>	<b>B</b>	Phagocytosis is a type of endocytosis. Endocytosis is an active transport process hence A and C are incorrect. Vesicles are not formed internally via the Golgi apparuts therefore C is incorrect.
<b>4</b>	<b>B</b>	Condensation reactions release a water molecule as the new bonds form. Hydrolysis reactions release energy. DNA is a polymer of nucleic acids, not amino acids.
<b>5</b>	<b>C</b>	Secondary structures, like an alpha helix can form part of the tertiary structures. More than one polypeptide chain would be a quaternary structure.
<b>6</b>	<b>A</b>	D is incorrect because it is referring to multiple organisms. The proteome refers to all of the proteins that are produced by a cell or organism.
<b>7</b>	<b>B</b>	Some amino acids have more than one codon that can code for it. This is because there are 64 codons, while there are only 20 different amino acids.
<b>8</b>	<b>C</b>	The molecule is RNA, as DNA is not found in the cytosol. Each monomer of RNA contains a phosphate group and one of the bases A, U, G, C.
<b>9</b>	<b>C</b>	Exons are present in both the DNA and the mRNA transcript that they code for.

<b>10</b>	<b>C</b>	1.RNA polymerase, 2.Repressor Protein, 3.Promotor Region, 4.Operator.
<b>11</b>	<b>A</b>	The shape that binds with the repressor protein (2) to remove it is only matched by A.
<b>12</b>	<b>C</b>	As the concentration of product (acetic acid increases) there must be a greater amount of substrate (acetylcholine).
<b>13</b>	<b>A</b>	Competitive inhibitors bind to the active site (stem of question – therefore cannot be a non-competitive inhibitors) and are reversible.
<b>14</b>	<b>C</b>	ATP has formed from lower energy state ADP. NAD, FAD and NADP are not ‘loaded’ as they have not bound to a H <sup>+</sup> .
<b>15</b>	<b>B</b>	In the absence of cytosol, glycolysis will not occur therefore A and C are incorrect. Kreb’s cycle and electron transport chain can still occur, resulting in production of CO <sub>2</sub> , therefore B is correct. Water and oxygen are not inputs for cellular respiration.
<b>16</b>	<b>A</b>	Gibberellins have a role in cell elongation.
<b>17</b>	<b>C</b>	Food poisoning is caused by bacterial infections.
<b>18</b>	<b>D</b>	Prions have the same amino acid sequence but changes to secondary structure.
<b>19</b>	<b>B</b>	Plants produce galls as a defence mechanism to bacterial infections.
<b>20</b>	<b>C</b>	Lymphatic system is the site of B and T cell activity in response to foreign antigens. The lymphatic system contains lymph nodes, that trap antigens including cancer cells.
<b>21</b>	<b>A</b>	Monocytes and neutrophils are two types of white blood cell that act as phagocytes.
<b>22</b>	<b>D</b>	The correct order of events is: B plasma cells produce specific antibodies, Immunoglobulin E binds to mast cells, Allergens react with IgE, Degranulation occurs, Inflammation occurs.
<b>23</b>	<b>A</b>	MS is an autoimmune disorder that occurs due to the mis-identification of self cells of the myelin.

<b>24</b>	<b>D</b>	A, B and C are all correct roles of monoclonal antibodies in cancer treatment. They do not induce necrosis hence D is the correct answer.
<b>25</b>	<b>A</b>	The answer is A, as this person is having an immune response to antigens and will make antibodies and memory cells.
<b>26</b>	<b>B</b>	This is an example of selective breeding/artificial selection – where the farmers are shown to have manipulated the gene pool of their crops over the generations.
<b>27</b>	<b>D</b>	A is not correct as the populations must be isolated for a large amount of time. The role of the physical barrier is to prevent immigration and emigration (gene flow).
<b>28</b>	<b>C</b>	This causes a frameshift mutation and therefore will affect the largest number of codons.
<b>29</b>	<b>A</b>	Mutations increase the variation, while the other options all reduce the variation.
<b>30</b>	<b>C</b>	It is a transitional form as it shows characteristics of modern whales and earlier mammal species.
<b>31</b>	<b>B</b>	Stratigraphy determines relative age, the other 3 techniques determine absolute age.
<b>32</b>	<b>A</b>	The molecular clock concept measures the rate of changes to a nucleotide sequence.
<b>33</b>	<b>D</b>	Neanderthals could not have bred with African populations (there is no evidence of them having ever been in Africa). The accurate evidence is that as humans left Africa, they encountered Neanderthals and bred then.
<b>34</b>	<b>A</b>	Hominins are upright walking while the apes are not. This would be evidenced by a bowl shaped pelvis. Hominins have smaller teeth, both can communicate and hominins have shorter arms.
<b>35</b>	<b>A</b>	Early species of the genus Homo had smaller brain cases than their modern counterparts.
<b>36</b>	<b>C</b>	Species 3 has the most bands in common with the common ancestor.

		A is not correct as it has not 'diverged' from the common ancestor.
<b>37</b>	<b>D</b>	DNA moves towards the positive electrode and smaller fragments move the fastest. The band closest to the bottom of the gel contains the smallest fragments.
<b>38</b>	<b>A</b>	Restriction enzymes cut the DNA at a specific sequence, cutting the DNA into fragments. DNA polymerase is needed for DNA replication and DNA ligase joins DNA fragments together.
<b>39</b>	<b>B</b>	Transgenic has the DNA from a different species inserted into the organism. The cystic fibrosis gene is a human gene inserted into a another human.
<b>40</b>	<b>D</b>	Regulatory genes can be inserted (if needed) for transcription of the new gene to occur. They are not needed in the vector.

**Answers to Section B: Short Answer****Question 1****a. i.** *Cholesterol***ii.** *Glycolipid***iii.** *Protein channel*

(1 mark for 3 correct labels)

**b.** *To maintain fluidity of the plasma membrane* (1 mark).**c.** *Exocytosis AND neurotransmitters are packaged into vesicles that fuse with the plasma membrane and are released* (1 mark).**d. i.** *Neurotransmitters must have a complementary shape to the receptors on the receiving neuron* (1 mark).**ii.** *As receptors are outside the cell, neurotransmitters must be hydrophilic/lipophobic* (1 mark).**Question 2****a.**

rRNA	<i>Produce ribosomes that are the sight of protein synthesis.</i>
mRNA	<i>Are the temporary copy of the DNA that are needed to transfer the code to outside of the nucleus.</i>
tRNA	<i>Bring in a specific amino acid (as the anti-codon joins to the codon) to add to the polypeptide.</i>

(3 marks)

**b.** *As proteins rarely act in isolation OR The venom is comprised of a number of substances, therefore many proteins need to be studied* (1 mark).**c.** *This is a tertiary structure,(1) it is a 3 dimensional structure, made of a single polypeptide that includes secondary structures* (1). (2 marks)**Question 3****a.** *They could produce a protein at certain times in the development of the placenta to stop the over-replication of other cells* (1). *This would allow for a normal functioning placenta to deliver the oxygen and nutrients to the baby* (1). (2 marks)**b.** *Genes that supress rapidly dividing cells, like those that produce tumours in cancer, could have applications in reducing the cancer* (1 mark).

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c.

**Structural**

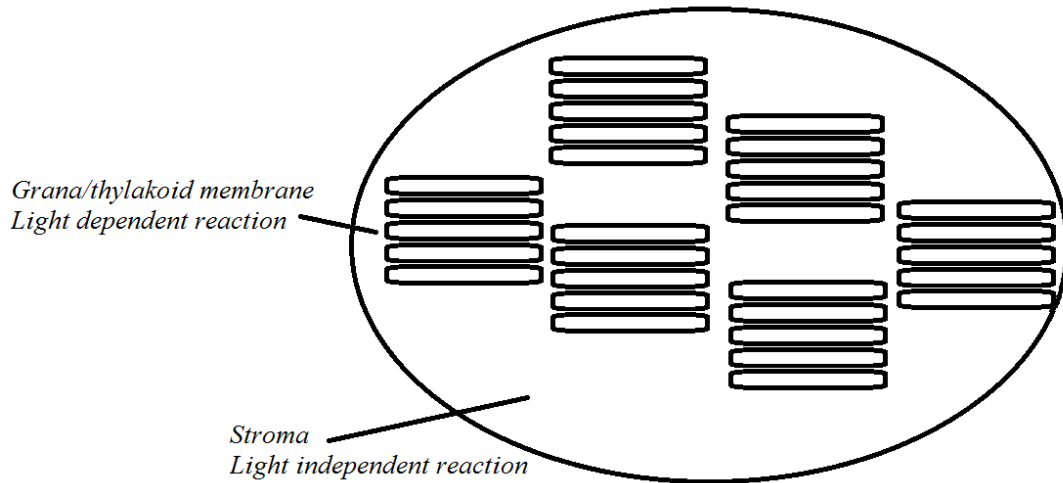
**Regulatory**

AND

*Structural genes code for the proteins associated with the organisms phenotype (and do not directly regulate the expression of other genes) (1 mark).*

**Question 4**

a. i.



(1 mark for 2 correct labels)

ii.

Name of stage:	<i>Light dependent stage</i>
Give one Input:	<i>ADP + Pi OR H<sub>2</sub>O OR NADP</i>
Give one Output:	<i>ATP OR O<sub>2</sub> OR NADPH</i>
Role of output (above)	<i>ATP: to provide energy for the light independent reactions O<sub>2</sub>: released as a product of photosynthesis NADPH: supplies energy and hydrogen ions for the light independent reactions.</i>

(1 mark for 2-3 correct boxes, 2 marks for 4 correct boxes)

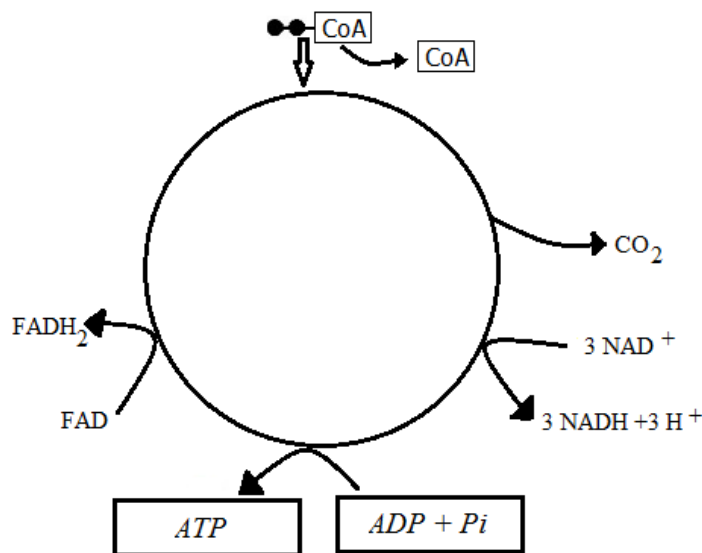
**b. i.** A non-protein substance that is essential for the activity of some enzymes (1 mark).

**ii.**

Temperature	Change	Explanation
	Increase/ stay the same/ decrease	
10°C	Decrease	Slower movement of enzymes and substrate particles reduces the amount of collisions.
70°C	Decrease	The enzyme may become denatured, changing the shape of the active site so the enzyme cannot bind to the substrate.

(1 mark for each correct line)

**c. i.**



(1 mark)

**ii.** *Kreb's cycle AND second biochemical pathway of cellular respiration where pyruvate is broken down and carbon dioxide is produced* (1 mark).

- e. *Chloroplasts have ribosomes OR chloroplasts have circular molecules of DNA OR chloroplasts have a double membrane OR chloroplasts divide by a fission like process OR chloroplasts are similar in size compared to prokaryotic cells (1 mark).*

### Question 5

- a. *RNA surrounded by a protein coat (1 mark).*
- b. *Mosquito AND remove water sources from around the home OR use insect repellent OR mosquito nets for beds OR install flyscreens on windows and doors (1 mark).*
- c. *After exposure to chikungunya antigens, specific antibodies are produced (1 mark) and (B) memory cells are formed for a rapid response to future infection (1 mark).*
- d. *Interferon AND increases the resistance to viral infection of surrounding cells (1 mark) OR cytokines AND communication molecules for coordination of immune response (1 mark) OR Interleukin-1 AND stimulates hypothalamus to increase body temperature (1 mark).*
- e. *An attenuated version of a pathogen (i.e. chikungunya virus) that stimulates and immune response (1 mark).*
- f. *Arrange two groups with 50 mice of same the species/age/health in each group. Vaccinate (independent variable) one group and leave the other untreated (control) (1 mark). Infect both groups with the chikungunya virus. Keep all mice in the same conditions i.e. temperature and diet (1 mark). After a period of time, examine both groups for symptoms of chikungunya virus (dependent variable). If less mice in the vaccinated group show symptoms, the vaccine can be considered effective (1 mark).*
- g. *The child would NOT have long term immunity as it has not produced its own memory cells (1 mark).*

### Question 6

- a. *The genetic diversity/variation was lowered/reduced (1 mark).*
- b. *Mechanism: Founder effect (1). The differences from the founding populations have persisted even after 10 years eg the founding lizards with longer legs still had longer legs compared to the other islands after 10 years. (1)*
- c. *Variation exists in a population of lizards with regards to limb length, and a struggle for survival occurs (1). Selection pressures such as food availability mean that those that have shorter limbs have a selective advantage (1). Over time, the shorter limbed lizards reproduce more and there is an accumulation of their genes in the population (1). (3 marks)*



**Question 7**

**a.** *The thylacine and grey wolf do not share a recent common ancestor but have evolved to show similarities due to similar selection pressures in their environments (1 mark).*

**b.** *Structure: Analogous (1 mark).*

*Explanation: structure have developed similar functions but have evolved independently as a result of the same selection pressures (1 mark).*

**c. i.** *Potassium-Argon dating, because the fossil is older than 50,000-60,000 years old, therefore carbon dating is ineffective (1 mark).*

**ii.** *Presence of hard parts – more likely to be preserved (1 mark).*

*OR rapid burial – reduce chance of scavengers (1 mark).*

*OR low oxygen environment – less microbial decomposition (1 mark).*

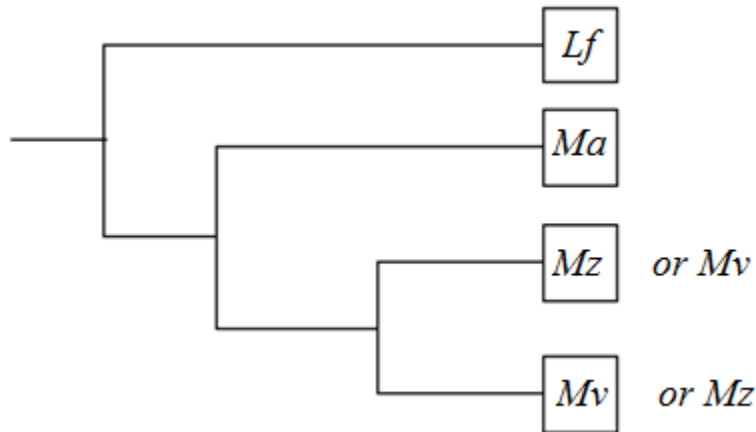
**d.** *No sightings of living individuals AND no evidence of their existence (1 mark).*

**Question 8**

**a.**

- *By controlling other structural genes that produce proteins that influence gene expression (1 mark).*
- *By controlling regulatory genes that code for transcription factors that bind to promoter regions to induce or repress gene expression (1 mark).*

b.



1 mark for 2 – 3 correct positions, 2 marks for 4 correct.

c. DNA-DNA hybridisation. DNA strands from the species could be heated to dissociate strands, allowed to cool, and the amount of pairing between species can be used to determine degree of relatedness (1 mark).

### Question 9

a. Modern *Homo sapiens* and their extinct upright walking ancestors (1 mark).

b. Interbreeding occurred as the human population moved through Asia and encountered the denisovans. (1) Denisovans did not ever live in Africa or Europe (Only in Asia) (1) (2 marks).

c. Cultural evolution: Writing / Articulate Speech Advantage Humans could have more sophisticated ways to pass on/record knowledge to successive generations (2 marks).

d. *H. erectus* was the first species to have left Africa. As Denisovans were found in Russia they must be a later species (1 mark).

### Question 10

a. Gel electrophoresis. (1 mark)

b. Aneuploidy is when the cells (of the baby) have the wrong number of chromosomes AND The mother would be concerned as it would lead to disorders such as Down syndrome (1 mark).

c. It is less of risk to the baby OR it is less invasive OR less risk of miscarriage (1 mark).

d. Denaturation: Double stranded DNA is heated to 94°C to separate the strands (1).

*Annealing: Cooled to 55°C the primers that are added bind to the separated DNA strands (1).  
 Extension: The primers are extended as free nucleotides are joined in to complete the complementary strands (1).  
 The process is repeated in many cycles to make many copies of the DNA.*

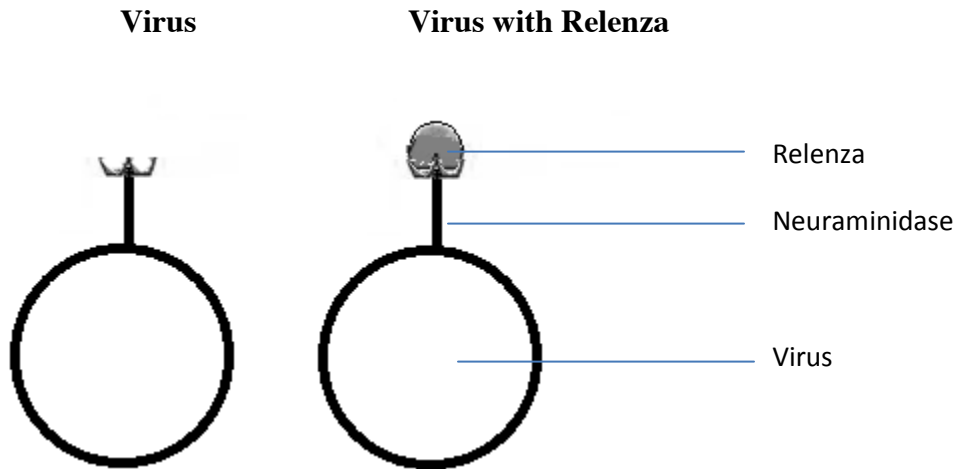
NOTE : Mentioning the process being repeated is needed for the awarding of the full 3 marks.

### Question 11

**a.** *Is the analysis of the structure of the disease or agent and developing a drug with a specific shape to treat the disease (1 mark).*

**b.** *Sialic Acid (1 mark)*

**c.**



(2 marks)

**d.** *Stop flights to Asia OR develop a quarantine for people who have visited that country (1 mark).*

**e.** *Epidemics are a rapid spread of influenza over a wide geographic area/across a country, where as a pandemic is considered a global threat (1 mark).*