



## SOLUTION PATHWAY

**NOTE: This task is sold on condition that it is NOT placed on any school network or social media site (such as Facebook, Wikispaces, etc.) at any time.**

**NOT FOR PRIVATE TUTOR USE.**

### Answers to Section A: Multiple choice

Question	Correct Answer	Explanation
1	C	Engulfing is taking into the cell via vesicles. A and D are both examples of exocytosis.
2	B	A → U, T → A, C → G, G → C.
3	D	mRNA production begins at the start of the gene at the start codon, although the RNA polymerase is able to bind to the DNA in the upstream regions.
4	A	Every codon (3 bases) codes for 1 amino acid. The final codon is a Stop codon with no amino acid added.
5	D	Option D is a post-translational modification.
6	A	Use of inhibitors are mostly reversible. Poisons can be irreversible.
7	D	A, B and C includes parts of the lac operon, but is not a description of it.
8	C	ADP can be converted to ATP by the addition of a phosphate. The other answers cannot be readily converted between each other.
9	C	The cell shrinks as a stage, it doesn't get bigger.
10	C	This is due to fewer collisions at slow temperatures.

<b>11</b>	<b>C</b>	Energy is released and the substrate is broken into multiple products.
<b>12</b>	<b>B</b>	All other factors in the experiment, apart from the independent variable should be kept the same. This includes using the same amount of enzyme.
<b>13</b>	<b>D</b>	All enzymes are composed of proteins. Enzymes are not composed of lipids or nucleotides. Co-factors are non-organic groups that bind to enzymes.
<b>14</b>	<b>B</b>	Competitive inhibitors ‘compete’ for the active site of an enzyme with the substrate. This will lower the rate of reaction only a small amount compared to other types of inhibition. Line A shows no inhibition.
<b>15</b>	<b>C</b>	A cell membrane refers to the outermost plasma membrane. Mitochondria have a plasma membrane but not a cell membrane.
<b>16</b>	<b>D</b>	32 ATP are produced in electron transport (36 for the complete aerobic metabolism of glucose). Water is also produced as a by-product of this phase. Carbon dioxide is produced during Krebs Cycle. (Citric Acid Cycle)
<b>17</b>	<b>C</b>	Interferon is a communication molecule of the immune system.
<b>18</b>	<b>C</b>	Vaccination of dogs would prevent the virus being able to infect dogs – therefore reducing the transmission to humans.
<b>19</b>	<b>D</b>	Complement proteins are able to increase the action of macrophages by binding to pathogens.
<b>20</b>	<b>C</b>	The region at the end of the heavy chains is where the drug is attached. The variable region, formed by part of the light chains is antigen binding.
<b>21</b>	<b>B</b>	HIV is a virus
<b>22</b>	<b>C</b>	The tonsils become inflamed as this is the site of T and B cells interacting with pathogens.
<b>23</b>	<b>C</b>	The cell pictured is a mast cell, able to release histamine.

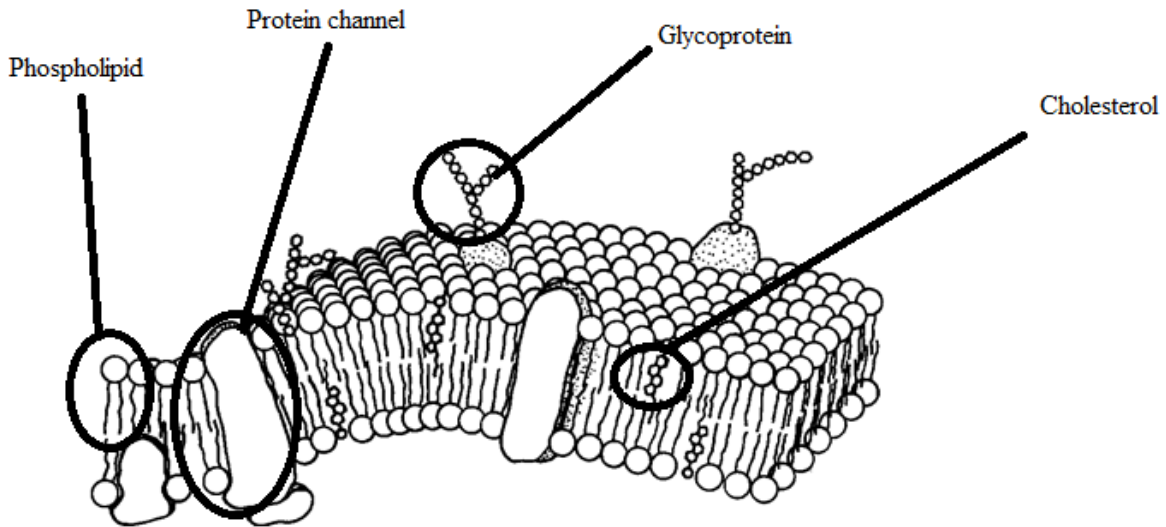
<b>24</b>	<b>A</b>	It is a phagocyte or macrophage.
<b>25</b>	<b>D</b>	The digestive enzymes are not released outside of the cell. It does break down the phagosome into smaller products in a catabolic reaction.
<b>26</b>	<b>C</b>	Difference in food availability is an environmental difference that could increase genetic differences and therefore contribute to speciation.
<b>27</b>	<b>C</b>	Water is useful in fossilisation if there are sedimentary layers placed over the remains. Water by itself does not assist the process. Large bones are slower to decompose, making them more likely to fossilise.
<b>28</b>	<b>A</b>	Aneuploidy is having an extra chromosome, as shown by the 3 chromosome number 21s.
<b>29</b>	<b>B</b>	The diagram shows the same ancestral structure being the forelimbs of mammals, used to perform different functions as a result of different selection pressures.
<b>30</b>	<b>B</b>	1 and 2 show the positions of divergence where the recent common ancestor was shared.
<b>31</b>	<b>B</b>	Hominins are humans that their extinct upright walking ancestors.
<b>32</b>	<b>A</b>	High Calmodulin causes a pointy beak. The thickness of the beak is controlled by BMP4 – which is low/moderate.
<b>33</b>	<b>C</b>	Gene flow can be a source of new alleles for a population. All of the other choices reduce alleles in the population.
<b>34</b>	<b>B</b>	DNA evidence is the proof of that mating occurred, other factors may have contributed but the sharing of genes of European descended individuals provides the definitive proof that mating occurred.
<b>35</b>	<b>B</b>	Hybridisation allows DNA from different species to anneal, separate and therefore make comparisons.
<b>36</b>	<b>B</b>	A higher temperature of separation means that there are more nucleotides in common and therefore a closer evolutionary relationship.

<b>37</b>	<b>A</b>	Recombinant plasmids can be used as vectors to transform bacteria.
<b>38</b>	<b>D</b>	A good experiment will only be testing the effect of the independent variable, trying to keep all other factors constant.
<b>39</b>	<b>B</b>	The DNA will be broken into 2 fragments. The AluI will cut the DNA at 1 site. This will cut the recognition sequence for HindIII which will then not have a recognition sequence and not cut the DNA.
<b>40</b>	<b>B</b>	DNA profiling can be used to compare the DNA to living relatives.

## Section B: Short Answer

### Question 1 (11 marks)

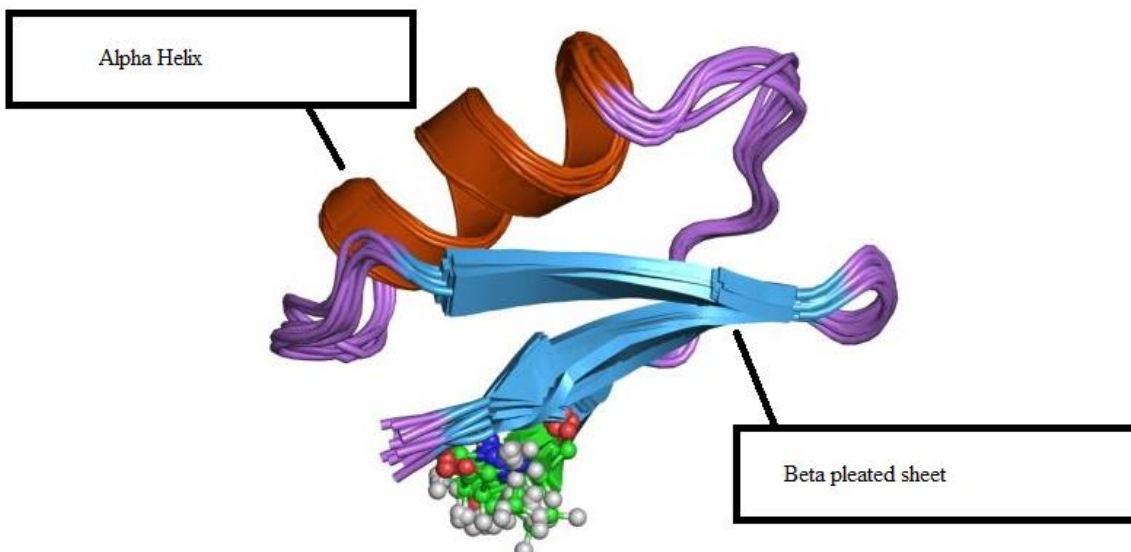
a.



1 mark for 2-3 correct labels, 2 marks for 4 correct labels.

- b. i. *Facilitated diffusion* (1) and *passive movement of ions via a protein carrier (with specific shape), along the concentration gradient/no energy required* (1).  
 ii. *They are charged*
- c. *Ribosomes AND site of protein synthesis*  
 OR *Rough Endoplasmic reticulum AND transport and modification of proteins within the cell*  
 OR *Golgi apparatus AND packages and modifies proteins for export from the cell.*  
 1 mark for each named organelle AND accurate role.  
**Note:** endoplasmic reticulum must be 'rough'.

d.

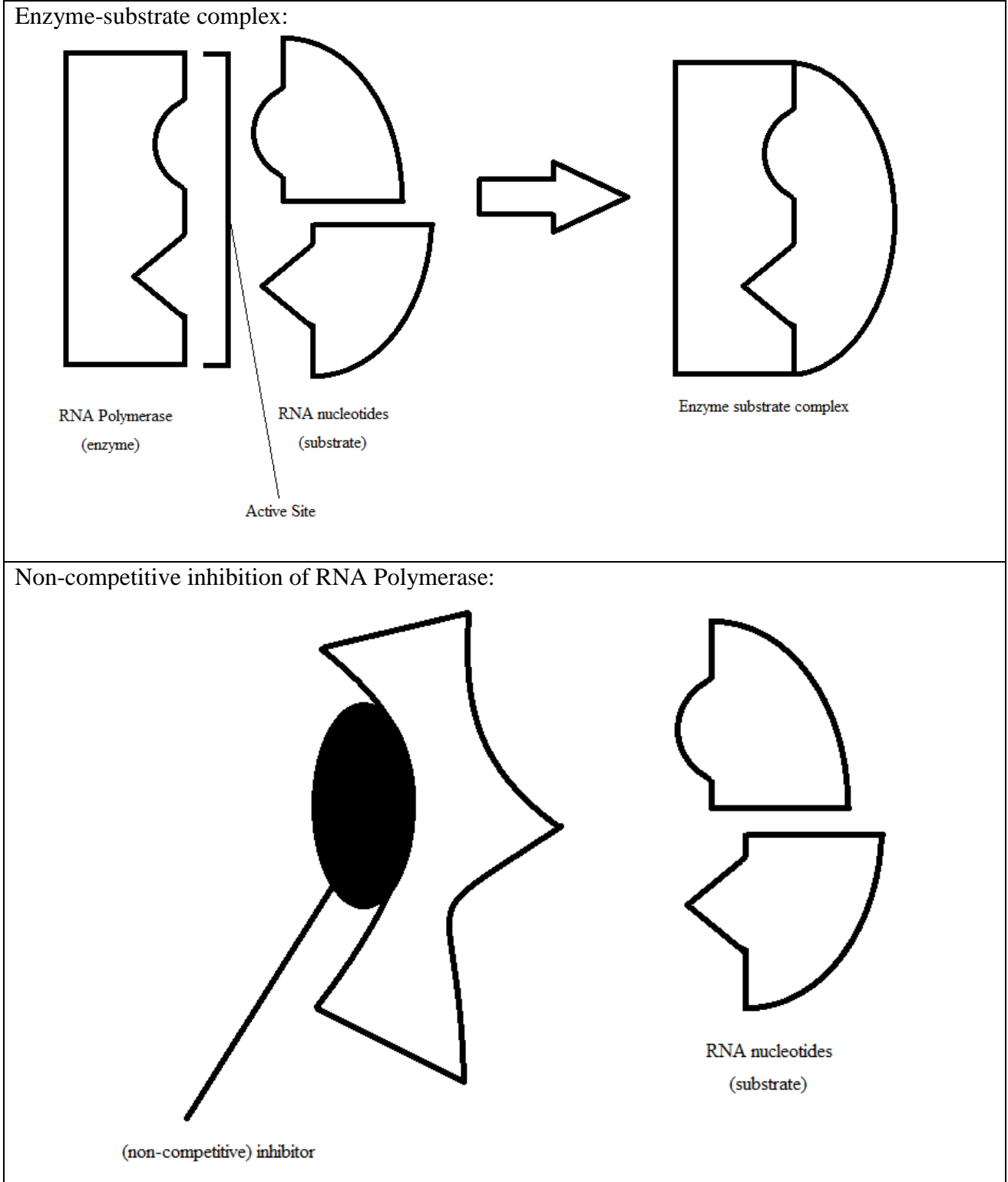


No other answer accepted

- e. *3D folded structure, containing one polypeptide chain consisting of secondary structures.*
- f. *The immune system fails to recognise self (connective tissue) cells and produces autoantibodies against the self-cells OR induces an immune response.*

**Question 2** (8 marks)

- a. *Enzymes collide/bind to briefly with the substrate (1). This means that less energy is needed for bonds to form/break OR the reaction can occur faster (1).*  
1 mark for the enzyme and substrate coming into contact.  
1 mark for either speeding up or lowering the activation energy required.
- b. See over page



1 mark for correct labelling of enzyme and substrate, showing complementary shape.

1 mark for showing inhibition that prevents binding of substrate.

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- c. *Anabolic AND smaller substrates (nucleotides) are joined to form larger product (mRNA molecule).*  
 d. *RNA polymerase joins RNA nucleotides (1).*  
*A water molecule is released (1).*  
*Energy is required/energy is an input/reaction is endergonic (1).*

**Question 3** (6 marks)

- a. *Introns (1)*  
 b. *Spliceosomes/enzymes are able to splice them out (1).*  
 c. *A pairs with U, U pairs with A, C pairs with G, G pairs with C.*

1 mark for each 2 correct responses.

- d. *tRNA (1) brings a specific amino acid to the ribosome (to be joined to the polypeptide) (1).*

**OR**

*rRNA (1) folds and forms the structure of a ribosome (1).*

**Question 4** (7 marks)

- a. *Aerating is needed to add in carbon dioxide to the water for photosynthesis to occur (1).*  
 b. *That chlorella will photosynthesise more at higher light intensities.*

To be awarded the mark, the hypothesis must be a testable, observable statement.

- c. *To make a comparison with the independent variable.*  
 d. i)

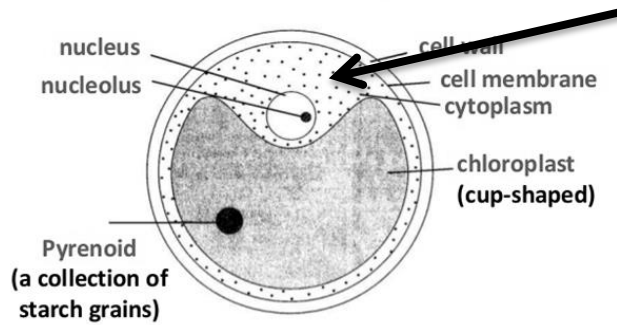
Test Tube #	Distance from light source (cm)	Predicted Results
1	0	<i>Alkaline</i>
2	25	
3	50	
4	75	
5	100	
6	Kept in a dark cupboard	<i>Acidic.</i>

ii) *At distance 0cm. Carbon dioxide is removed from the solution, (1) turning the solution more alkaline OR both the light dependent and independent stages can occur, therefore the rate of photosynthesis is higher than the rate of cellular respiration with CO<sub>2</sub> being used, turning the solution more alkaline (1)*

*In the cupboard: Photosynthesis cannot occur, due to absence of light, so carbon dioxide will be produced through respiration (1) OR the reactants for the light independent stage of photosynthesis will be used and therefore only respiration occurs, producing CO<sub>2</sub> (1).*



- e. Arrow must clearly point to the cytoplasm



**Question 5** (9 marks)

- The capillaries around the wound become more leaky (1). This allows more phagocytes to the site to fight infection (in this case the pigment or other pathogens) (1).*
- By phagocytosis or endocytosis.*
- The pigment would have antigens on its cell surface (1). These antigens would be recognised as foreign as they are different from the self (MHC markers) antigens (1).*
- The macrophages do not present the foreign antigens to B lymphocytes (1). (Because they become trapped due to the size of the pigment).*
- Cytotoxic T cell (1) and it causes the transplant tissue to undergo apoptosis (1).*

**Question 6** (6 marks)

- ABA is complementary to receptors OR ABA has the same/similar shape of normal binding ligand (1).*
- It is hydrophobic or lipophilic (1) and hormone-receptor complex binds to target DNA, directly regulating gene expression (1).*
- Identification of the molecular cause of a disease and designing a drug that is complementary to the target molecule to block the receptor/active site (1).*
- To find a drug that is more effective in human treatment/safe for human treatment/has less side effects than other drugs (1).*
  - Inhibits growth OR prevents seed germination OR promote plant dormancy OR stomatal closure OR leaf abscission (1).*

**Question 7** (7 marks)

- Frameshift mutation (1): a single nucleotide change that changes every downstream codon (1).  
OR  
Nonsense mutation (1) a single nucleotide change that results in a premature stop codon (1).*
- It is able to save energy OR no longer attracts butterflies therefore preventing caterpillars from eating leaves. (1)*
- Variation exists in the population with regards to how much pyrrolizidine alkaloids are produced (1). There could have been an environmental change where the mammals were no longer sensitive to the pyrrolizidine alkaloid poison AND making some variations more successful (1).*

*Over time, the plants that produced no toxin reproduced more and passed on more of their genetics to the next generation (1).*

**d.** Tannins OR gums.

**Question 8** (7 marks)

**a.** Mammals

**b.** Potassium-argon dating AND the fossil is significantly older than 50,000-60,000 years and no carbon would be present.

**c.** Two of:

- Rapid burial to avoid scavengers
- Covered with sedimentary layers, pressure exerted
- Minerals replace bones/cast or mould is preserved

**d.** Transitional fossils show an intermediate form/characteristics of an ancestral group and descendants (1). Archaeopteryx shows characteristics of both birds (such as beak, wings) and reptiles (claws, bony tail) (1).

**e.** Divergent evolution – modern birds and dinosaurs shared a relatively recent common ancestor (1).

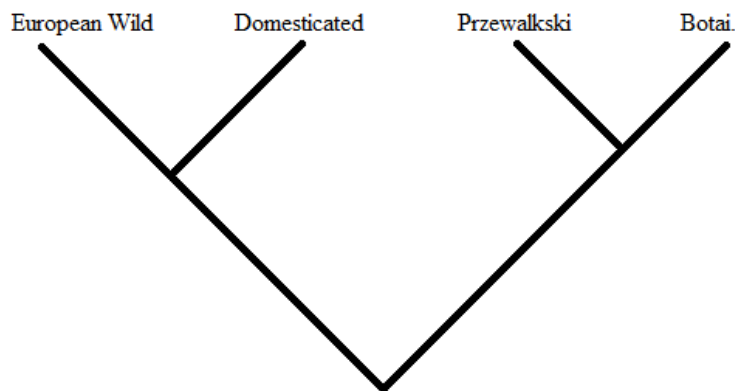
**Question 9** (5 marks)

**a.** A molecular clock analyses a gene that has a predictable mutation rate (1). The horse DNA is studied at this gene locus and the number of mutations are analysed.

*Horses with less differences are more closely related OR horses with more differences are less closely related (1).*

**b.** 1 mark for European Wild and Domesticated as being closely related AND (1) Przewalski and Botai as being closely related (1).

To be awarded the full 2 marks both pairs of horses must be joined showing a common ancestor.



**c.** By only allowing the horses with spots to reproduce (1).

**Question 10** (7 marks)

- a. *(No evidence) that humans were in Europe at that time* (1).  
 b. *Cave paintings can be used to show the passing on of ideas or knowledge* (1)..  
 c.

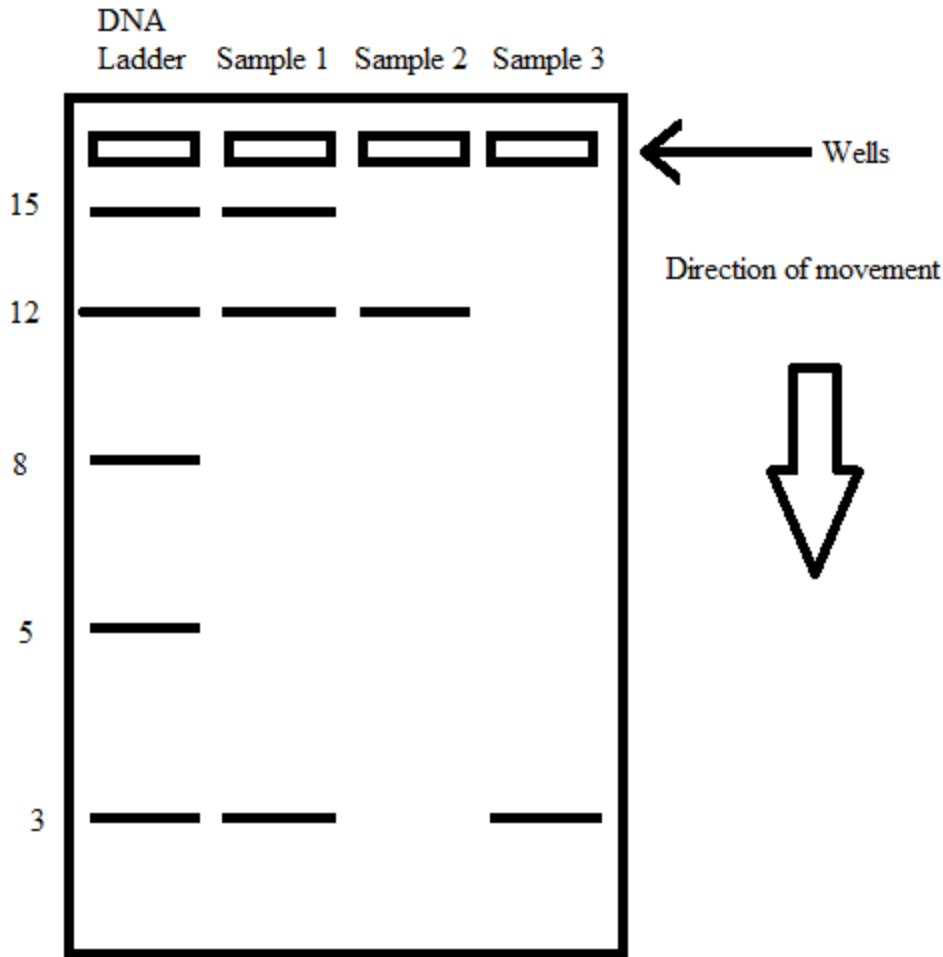
<b>Evidence</b>	<b>Suggestions about the Neanderthals</b>
Use of pigments	They had knowledge and could grind up and make pigments from the minerals in their surroundings.
Caves were dark	They could build fire that could be transported to light up the caves.
Images in the paintings	They had the ability to interpret the world in a complex way.
Distance between caves	Showed that they were able to communicate the strategies for cave paintings to other tribes.
Images	May show evidence of working together and not being 'brutish'.

1 mark for each piece of evidence AND suggestion about Neanderthals

- d. *Humans and the great apes and their extinct relatives* (1).  
 e. *They are different species that lived during a common period. They evolved from a common ancestor* (1).

**Question 11** (7 marks)

a.



- b. It contains the recombinant plasmid (15kb) (1) AND as well as separate plasmids (3kb) and gene fragments (12kb) (1).
- c. 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.