OXFORD

INTERNATIONAL AQA EXAMINATIONS

Topic Test: OxfordAQA International A level Biology

The diversity of living organisms

Name: _____

Class: _____

Date: _____

Time: **83 minutes**

Marks: **70 marks**

Comments:

1 Read the following passage.

Emphysema is a disease that affects the alveoli and elastic tissue in the human lungs. It can be caused by the inhalation of irritants including chemicals found in cigarette smoke.

One effect of these chemicals is that they stimulate neutrophils (a type of white blood cell) to release an enzyme called elastase that breaks down elastic tissue.

Elastase is a protease enzyme. It breaks down elastic tissue through the hydrolysis of peptide bonds in the target proteins. The specific peptide bonds broken are those on the carboxyl side of hydrophobic amino acids such as alanine and valine.

(a) Elastic tissue contains a structural protein. What type of tertiary structure does this protein have?

Tick (✓) **one** box.

- Conjugated ☐
- Fibrous ☐
- Globular ☐
- Prosthetic ☐

(1)

(b) Elastase only catalyses the breakdown of the structural protein in the elastic tissue.

Explain why elastase does **not** break down other molecules.

_____

_____

_____

_____

(2)

(c) Elastase breaks the peptide bonds on the carboxyl side of hydrophobic amino acids such as alanine and valine (lines 7–8).

The R group in alanine is CH_3.

Draw the structure of alanine.

(1)

(Total 4 marks)

2 (a) Describe how you would test a piece of food for the presence of lipid.

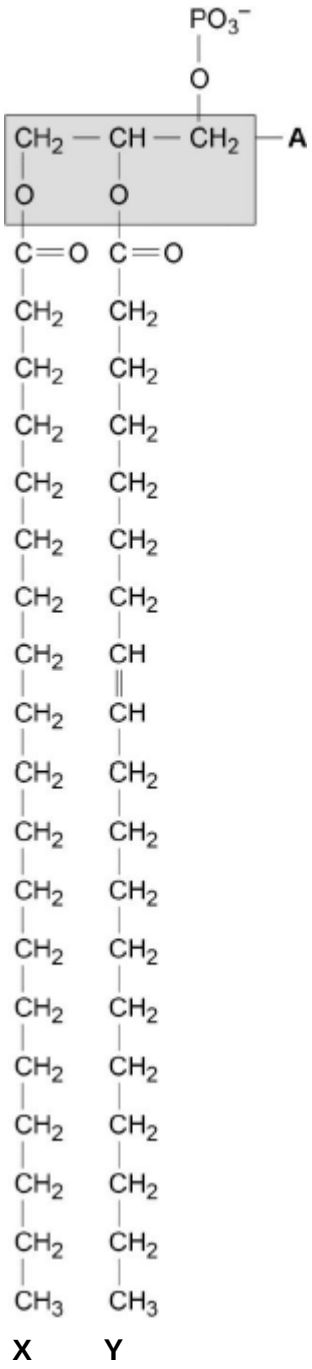
_____

_____

_____

(2)

The figure below shows a phospholipid.



(b) The part of the phospholipid labelled **A** is formed from a particular molecule. Name this molecule.

_____

(1)

(c) Name the type of bond between **A** and fatty acid **X**.

_____

(1)

(d) Which of the fatty acids, **X** or **Y**, in the figure above is unsaturated? Explain your answer.

_____

_____

_____

_____

(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	**Percentage of lipid in plasma membrane by mass**		
	Cell lining ileum of mammal	**Red blood cell of mammal**	**The bacterium *Escherichia coli***
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

_____

_____

_____

_____

(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

_____

_____

_____

(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)

3 A student uses potato cylinders to investigate the effect of sucrose concentration on the uptake and loss of water from plant tissue.

The student:

- makes five dilutions of sucrose solution using a 1.0 mol dm^{-3} sucrose solution and distilled water
- cuts five cylinders from a potato, blots them dry and weighs them
- puts each cylinder in a different concentration of sucrose solution for 24 hours
- removes the cylinders from the sucrose solutions, blots them dry and weighs them.

The table below shows the student's results.

Concentration of sucrose solution / mol dm^{-3}	**Percentage change in mass of the potato cylinders**
0	+5.8
0.2	+2.5
0.4	−6.1
0.6	−18.1
0.8	−25.2
1.0	−25.5

(a) Describe how the student could use the 1.0 mol dm^{-3} sucrose solution to make 25 cm^3 of 0.2 mol dm^{-3} sucrose solution.

_____

_____

_____

(1)

(b) Why did the student blot the potato cylinders dry before weighing them?

_____

_____

_____

(1)

(c) The student left the potato cylinders in the sucrose solution for the same length of time.

Suggest **two** other variables the student controlled.

1. _____

_____

_____

2. _____

_____

_____

(2)

(d) Describe how the student calculated the percentage change in mass of a potato cylinder.

_____

_____

_____

(1)

(e) Why did the student calculate the **percentage** change in mass of the potato cylinders instead of just the change in mass?

_____

_____

_____

(1)

(f) Describe how the student could use the results in the table to find the sucrose concentration that is in equilibrium with the solution in the cells of the potato tissue.

(2)

(g) Explain the change in mass of the potato tissue in the 0.2 mol dm^{-3} sucrose solution.

(2)

(Total 10 marks)

4 (a) Describe how phospholipids are arranged in a plasma membrane.

(2)

(b) Cells that secrete enzymes contain a lot of rough endoplasmic reticulum (RER) and a large Golgi apparatus.

(i) Describe how the RER is involved in the production of enzymes.

_____

_____

_____

_____

(2)

(ii) Describe how the Golgi apparatus is involved in the secretion of enzymes.

_____

_____

_____

(1)

(Total 5 marks)

5 (a) Describe the part played by the diaphragm in causing air to enter the lungs during breathing.

_____

_____

_____

_____

_____

_____

(3)

Seals are mammals. They have lungs and must breathe air. They can dive and remain under water for a long time. The table shows the flow of blood to the lungs and to the diaphragm in a seal when it is on land and when it is under water.

Organ	Blood flow / $cm^3\ min^{-1}\ g^{-1}$	
	On land	Under water
Lungs	0.88	0.52
Diaphragm	0.21	0.02

(b) Explain why the figures in the table are given per gram of tissue.

_____

_____

_____

_____

(2)

(c) Calculate the percentage by which blood flow to the lungs is reduced when a seal is swimming under water. Show your working.

Answer _____

(2)

(d) There is a greater percentage reduction in blood flow to the diaphragm than to the lungs during a dive. Explain the advantage to a diving seal of

(i) blood continuing to flow to the lungs;

_____

_____

(1)

(ii) a large reduction in blood flow to the diaphragm.

_____

_____

_____

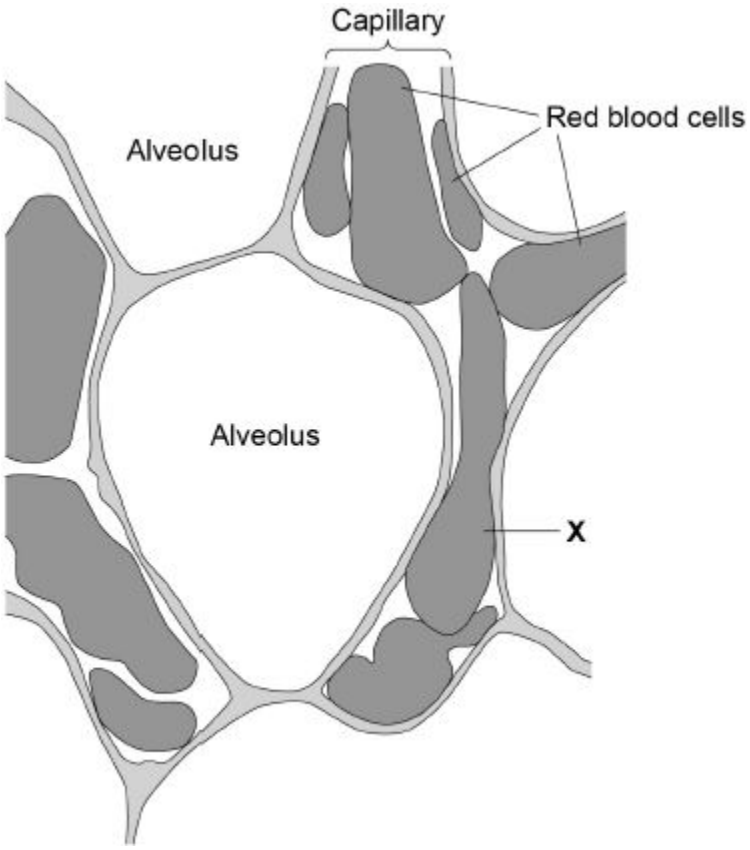
_____

(2)

(Total 10 marks)

6 **Figure 1** shows a section through human lung tissue.

Figure 1



(a) The red blood cells in **Figure 1** differ in shape.

Suggest **one** reason for this.

_____

_____

(1)

(b) The maximum diameter of the red blood cell labelled **X** is 8 micrometres.

Calculate the magnification of **Figure 1**.

Magnification =_____

(2)

(c) Red blood cells contain haemoglobin. Haemoglobin has a high affinity for oxygen.

This causes a high rate of diffusion of oxygen from the alveoli into the blood.

Give the reason why.

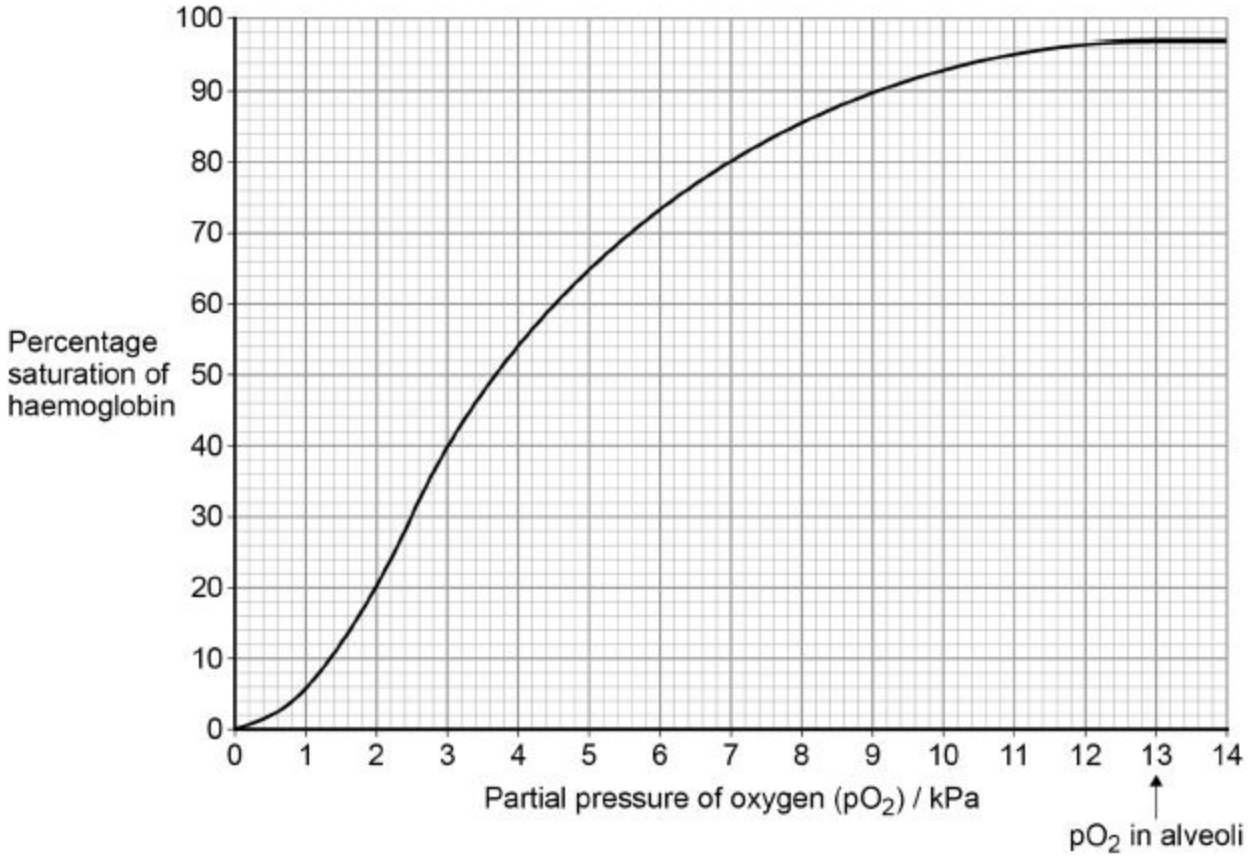
_____

_____

(1)

(d) **Figure 2** shows the dissociation curve for oxyhaemoglobin in the blood of a person at rest.

Figure 2



The partial pressure of oxygen in resting skeletal muscle is 2.5 kPa.

Use information from the graph to determine the percentage saturation of haemoglobin in the blood leaving the resting muscle.

Percentage saturation = _____ %

(1)

(e) Blood leaving the lungs contains 20 cm^3 of oxygen per 100 cm^3 of blood.
This blood is 97% saturated with oxygen.

Calculate the volume of oxygen released per 100 cm^3 of blood as it passes through the resting muscle.

Volume of oxygen released = _____ cm^3

(2)

(f) During exercise, a person produces more carbon dioxide than at rest and the temperature of the person's blood increases. Both of these factors displace the oxyhaemoglobin dissociation curve, shown in **Figure 2**, above.

Explain the advantage of this to a person during exercise.

_____

_____

_____

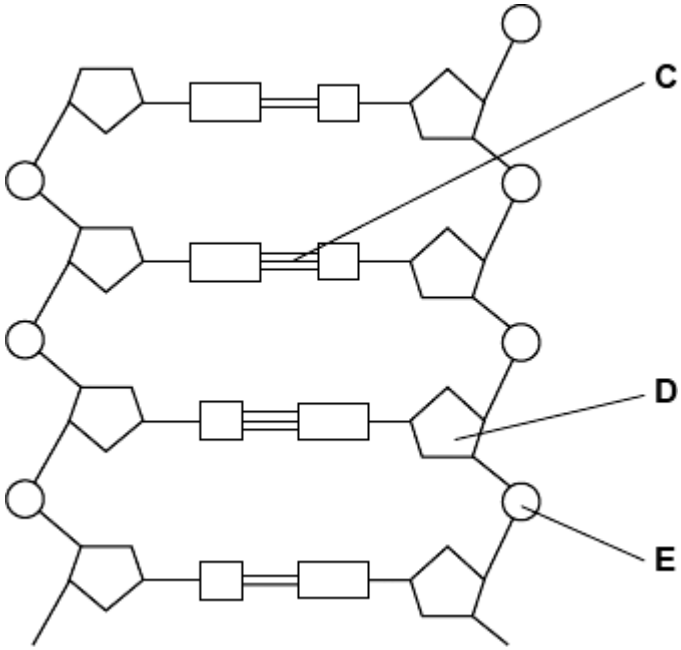
_____

_____

(2)

(Total 9 marks)

7 The diagram shows part of a DNA molecule.



(a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

_____

_____

_____

(1)

(ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C** _____

Part **D** _____

Part **E** _____

(3)

(iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2)

(b) A polypeptide has 51 amino acids in its primary structure.

(i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1)

(ii) The gene for this polypeptide contains more than this number of bases.

Explain why

(1)

(Total 8 marks)

8 A scientific magazine recently produced an article with the headline

'At least 75% of the DNA in our genome is useless junk after all.'

(a) Define the term 'genome'.

(1)

(b) Use your knowledge of DNA to suggest what the author of the article meant by 'useless junk'.

In your answer you should clearly describe where this junk DNA is located within the human genome.

(2)

The image shows one complete turn of a DNA helix. Within the complete turn of the helix, each strand of DNA contains ten nucleotides.

(c) A particular human chromosome is 1 metre long and contains 124 500 000 complete turns in its DNA helix.

Use this information to calculate the length of one nucleotide in nanometres.

Answer _____ nm

(2)

E. coli bacteria were allowed to grow and divide in a solution that contained the four DNA nucleotides. These were called **group A bacteria**.

Some of the group A bacteria were then transferred to a second solution, where they were allowed to grow and divide once. These were called **group B bacteria**.

The second solution was the same as the first, except that the nucleotides containing thymine were radioactive.

DNA from each group was tested for radioactivity.

The table shows these results.

Group A bacteria	No radioactivity
Group B bacteria	All DNA molecules were radioactive

(d) Explain why **all** the DNA molecules in **group B bacteria** were radioactive.

Use your knowledge of DNA replication.

(4)

(Total 9 marks)

9 **Table 1** shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists.

Table 1

Taxon	Name of taxon
Domain	Eukaryota
	Animalia
	Chordata
	Aves
	Passeriformes
	Muscicapidae
Genus	
Species	

(a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

(2)

A group of scientists investigated genetic diversity in different species of bird. For each species, the scientists:

- collected feathers from a large number of birds
- extracted DNA from cells attached to each feather
- analysed the samples of DNA to find genetic diversity.

Table 2 summarises their results.

Table 2

Species of bird	Number of genes examined	Number of genes examined that showed genetic diversity
Willow flycatcher	708	197
House finch	269	80
Bluethroat	232	81

(b) In this investigation, what is meant by **genetic diversity?**

_____

_____

(1)

(c) The scientists concluded that the bluethroat showed greater genetic diversity than the willow flycatcher. Explain why they reached this conclusion. Use calculations to support your answer.

_____

_____

_____

_____

(2)

(Total 5 marks)

1

(a) Fibrous;

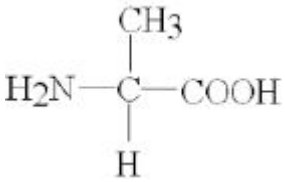
1

(b) Any **two** from:

1. Idea of specific active site <u>shape</u>;
   Accept active site tertiary/3D structure
   Accept idea of specific substrate shape
2. Only the proteins in the elastic tissue <u>complementary</u> shape (to active site);
   Accept converse about other molecules
   Accept only the proteins in the elastic tissue <u>fit</u> shape of active site;
3. Enzyme-substrate/E-S complexes **only** formed between protein in the elastic tissue and elastase;
   Must be in context of other molecules not forming these
   Accept idea that only a specific substrate can bind

2 max

(c)



allow $^{+}H_3N$ instead of H_2N

allow COO^{-} instead of COOH

1

[4]

2

(a) 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid.

2

(b) Glycerol.

1

(c) Ester.

1

(d) **Y** (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain.

1

(e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100.

2

(f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;

Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape.

1

(g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

3

(a) 5 cm^3 (1.0 mol dm^{-3}) sucrose solution and 20 cm^3 (distilled) water;

1

(b) Water/solution on the outside would increase the mass/weight of the potato cylinders;

Allow idea that student only wants to measure change in mass due to water entering/leaving potato tissue

1

(c) 1. Cylinders same length;

Allow same size/surface area/starting mass

2. Cylinders cut from same potato;

Allow from the same variety of potato

3. (Cylinders and solutions kept at same) temperature;

4. (Cylinders kept in same) volume of sucrose solution;

Ignore references to pH of solution

2 max

(d) $\frac{(\text{final mass} - \text{start mass})}{\text{start mass}} \times 100$

OR

[(final mass ÷ start mass) × 100] − 100 ;

1

(e) To allow comparison (of potato cylinders)/(Potato cylinders had) different starting masses;

1

(f) 1. Plot a graph with concentration (of sucrose) of on the x-axis and percentage change (in mass) on the y-axis;

Allow idea of repeating experiment with concentrations between 0.2 and 0.4 mol dm^{-3}

2. Find concentration where percentage change in mass is 0/find concentration where line crosses x-axis / find x-axis intercept;

2

(g) 1. Water has entered (potato tissue) by osmosis/diffusion/(potato tissue) has gained water by osmosis/diffusion;

2. Water potential of solution is higher than that of potato tissue/water potential of solution is less negative than that of potato tissue;

Accept Ψ for water potential

Accept converse

Must be comparative statement − greater/higher/more

Allow solute potential / Ψ_S / osmotic potential instead of water potential

Ignore references to water concentration

Allow references to solution being hypotonic or potato cells/tissue as hypertonic

[10]

4

(a) 1. Bilayer;

Accept double layer

Accept drawing which shows bilayer

2. Hydrophobic / fatty acid / lipid (tails) to inside;

3. Polar / phosphate group / hydrophilic (head) to outside;

2. & 3. need labels

2. & 3. accept water loving or hating

2 max

(b) (i) 1. (Rough endoplasmic reticulum has) ribosomes;

accept "contains / stores"

2. To make protein (which an enzyme is);

Accept amino acids joined together / (poly)peptide

Reject makes amino acids

Ignore glycoprotein

2

(ii) (Golgi apparatus) modifies (protein)

OR

packages / put into (Golgi) vesicles

OR

transport to cell surface / vacuole;

Accept protein has sugar added

Reject protein synthesis

Accept lysosome formation

1

[5]

5 (a) Diaphragm (muscle) contracts;
Flattens / Increases volume of chest;
Reduced pressure allows air to enter;

3

(b) Allows comparison;
As organs differ in size / as larger organs will need more blood;

2

(c) 2 marks for 40.91 / 40.9 / 41
1 mark for 59.09 / 59.1 / 59

2

(d) (i) Some oxygen still in lungs (which will enter the blood) / removal of carbon dioxide (from blood);

1

(ii) More blood available for other organs;
Supplying oxygen / glucose / removing carbon dioxide;
OR
Diaphragm muscles not contracting (as not breathing);
Will not require (as much) oxygen / glucose;

2

[10]

6 (a) Cut in different planes

or

Squashed out of shape in narrow capillaries;

1

(b) 6.000;

Correct answer = 2 marks

If measurement = 48 ± 1mm − allow answer correct for this for 2 marks

or

$\frac{48\,000}{8}$ **or** $\frac{48}{0.008}$ **or** '6' but wrong order of magnitude;

= 1 mark

Allow 1 mark for ecf from incorrect measurement

2 max

(c) Increases concentration gradient or maintains conc. grad.

or

Lowers concentration of (free) oxygen in the blood;

1

(d) 30;

Allow ± 1

1

(e) 13.81/13.8;

Correct answer = 2 marks

or $\frac{20}{97}$ × 30 **or** 6.19 **or** 20 − 6.19 but no answer/incorrect answer

= 1 mark

or 97 − 30% of 20.619 **or** 67% of 20.619 but no answer/incorrect answer

= 1 mark

Allow 97 − 30 = 67 and 67% of 20 = 13.4 for 1 mark

***or** 100 − 30 = 70 and 70% of 20 = 14 for 1 mark*

2 max

(f) Release more oxygen (to the muscles);

Need 'more' at least once for full marks

or release oxygen more easily;

For use in respiration/energy release;

Reject energy production

Reject anaerobic respiration

Allow less anaerobic respiration/less lactate produced

2

[9]

7 (a) (i) Repeating units / nucleotides / monomer / molecules;

Allow more than one, but reject two

1

(ii) 1. C = hydrogen bonds;

2. D = deoxyribose;

Ignore sugar

3. E = phosphate;

Ignore phosphorus, Ignore molecule

3

(iii)

Name of base	Percentage
Thymine	34
Cytosine / Guanine	16
Adenine	34
Cytosine / Guanine	16

Spelling must be correct to gain MP1

First mark = names correct

Second mark = % correct, with adenine as 34%

2

(b) (i) 153;

1

(ii) Some regions of the gene are non-coding / introns / start / stop code / triplet / there are two DNA strands;

Allow addition mutation

Ignore unqualified reference to mutation

Accept reference to introns and exons if given together

Ignore 'junk' DNA / multiple repeats

1

[8]

8 (a) All/the complete set of DNA/genes/genetic material in a cell/organism/species/person /human/individual;

Accept: the haploid set of chromosomes of an organism

1

(b) 1. DNA that is non coding/does not code for a polypeptide protein;

2. Introns within a gene;

Accept introns within pre-mRNA

Accept correct description of an intron

Accept non-coding length of DNA within a gene for 2 marks

3. (Non-coding) multiple repeats (of base sequences) between genes;

Ignore reference to introns here

2 max

(c) 0.8 nm;

Any answer with 8 − eg 80, 800 score 1 mark

Accept 1.0×10^9 / 12.5×10^8 = 8.0 for 1 mark

Accept 8.0 / 10 = 0.8 nm for 2 marks

2

(d) 1. DNA strands separate;

Accept idea that hydrogen bonds are broken

Accept idea that bonds between the (complementary) bases are broken

2. Each/one strand of old DNA acts as template;

3. New (DNA) stand consists of one old and one new strand;

Accept reference to semi-conservative (replication)

4. Suitable ref. to H-bonding between bases;

Accept correct reference to complementary base pairing

5. New (DNA) chain will incorporate *T(-nucleotides) (from solution);

6. Correct reference to DNA polymerase in joining (adjacent) nucleotides together (to form new strand);

Reject any reference to DNA polymerase forming hydrogen bonds between complementary bases

4

[9]

9

(a) 1. Kingdom, Phylum, Class, Order, Family;
2. *Luscinia svecica.*

1 mark for each correct column

Allow Genus and Species if both placed in box for species but not if both placed in genus box

2

(b) Number of different alleles of each gene.

Accept number of different base sequences (found) in each gene

1

(c) 1. Has greater proportion of genes / percentage of genes showing diversity;
2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278

2

[5]