Protein synthesis

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Nucleic acids and protein synthesis
Sub Topic	Protein synthesis
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **69 minutes**

Score : **/ 57**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 DNA replication is an important event in the cell cycle.

(a) State when, during the cell cycle, DNA replication occurs.

.....[1]

(b) Fig. 2.1 shows pairing between two bases, **X** and **Y**, in a DNA molecule.

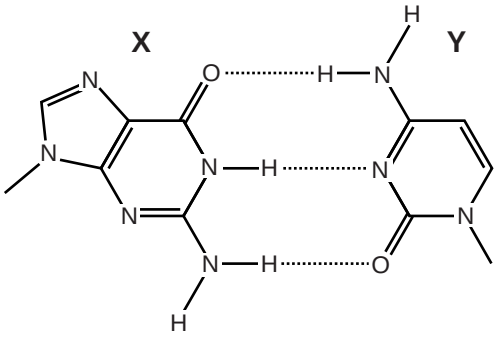

Fig. 2.1

(i) Name the type of bond shown by the dotted lines between the bases.

.....[1]

(ii) State which base, **X** or **Y**, is a pyrimidine **and** explain your answer.

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.....[1]

(c) The compound benzopyrene, found in tar from tobacco smoke, can become chemically changed in cells and interferes with DNA replication, causing gene mutations.

(i) State what is meant by the term *gene mutation*.

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.....[2]

(ii) Mutations that occur in dividing cells of the gas exchange system may result in lung cancer.

Suggest the differences in the cell cycle of a cancer cell compared with that of a normal cell of the same type.

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.....[2]

[Total: 7]

2 **(a)** Complete the table to **describe** three differences between DNA replication and DNA transcription.

DNA replication	DNA transcription

[3]

(b) Errors during replication may lead to gene mutations.

Define the term *gene mutation*.

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..... [2]

(c) Some disease-causing organisms undergo frequent mutation, changing their surface antigens and making the disease much more difficult to control with a vaccination programme.

(i) Explain why existing vaccines may no longer be effective when the surface antigens of a disease-causing organism change.

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..... [2]

(ii) State precisely the type of immunity gained by a person who has been vaccinated.

..... [1]

(d) The virus causing measles is said to be antigenically stable as it rarely mutates. Measles vaccination programmes have been successful in preventing epidemics in many areas.

Outline **two** reasons why measles is still common in many parts of the world, even though the vaccine is available.

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..... [2]

[Total: 10]

3 Read the following passage.

> A method called *in vitro* translation is often used by scientists to produce proteins in the laboratory. The method uses extracts from animal cells, plant cells or bacteria. These are chosen because they have high levels of protein synthesis. The cells are treated so that the cell walls, if present, and cell membranes are broken down and then treated so that any of the cell's own DNA and mRNA are destroyed. When mRNA from any source is added to these extracts, it will be translated into the corresponding protein.

(a) Explain why:

(i) the cells are chosen on the basis of their high level of protein synthesis

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..... [2]

(ii) the cell walls (if present) and cell membranes need to be broken down

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..... [1]

(iii) the cell's own mRNA needs to be destroyed

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..... [1]

(iv) mRNA from any source can be translated in any type of extract.

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..... [2]

(b) State **two** differences between the cell structures used in translation in prokaryotes and eukaryotes.

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..... [2]

(c) Scientists usually find that the method of *in vitro* translation is less efficient than *in vivo* translation, which occurs in cells.

Suggest a reason for this.

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..... [1]

[Total: 9]

4 Haemoglobinopathies are inherited conditions linked to the structure and function of haemoglobin. Sickle cell anaemia is one of these conditions in which the transport and delivery of oxygen to tissues is less than normal.

An investigation was carried out to discover the effect of sickle cell anaemia on the ability of blood to carry oxygen. Blood samples were taken from two people:

- person **L** without sickle cell anaemia
- person **M** with sickle cell anaemia.

The percentage saturation of haemoglobin with oxygen was determined over a range of partial pressures of oxygen.

Fig. 3.1 shows oxygen haemoglobin dissociation curves for the two blood samples.

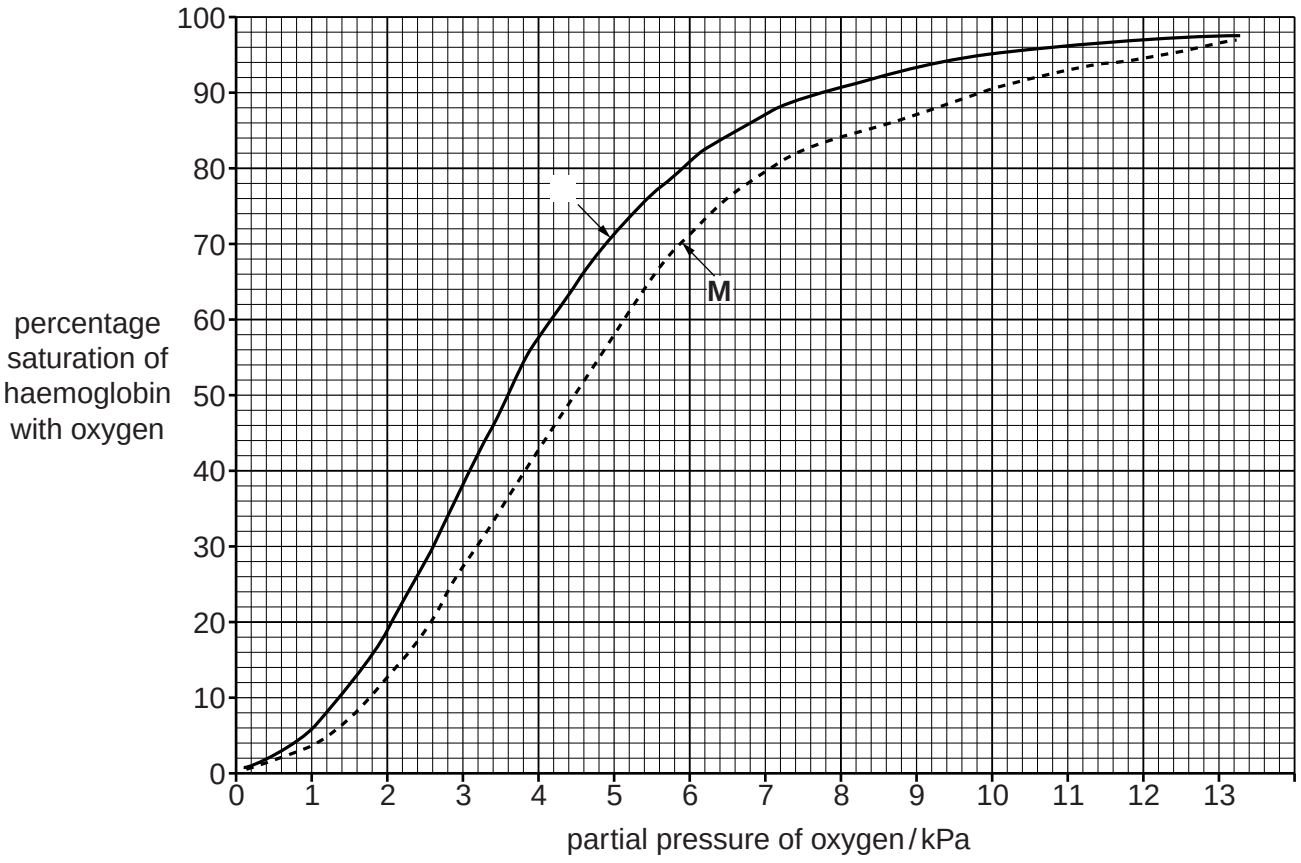

Fig. 3.1

(a) P50 is the partial pressure of oxygen at which haemoglobin is 50% saturated with oxygen. It is taken as a measurement of the affinity of haemoglobin for oxygen.

(i) State the P50 for the two blood samples, **L** and **M**.

L .....

M ..... [1]

(ii) With reference to Fig. 3.1, describe how the dissociation curve for person **M differs** from the dissociation curve for person **L**.

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..... [3]

(b) Explain the advantage of the position of the dissociation curve for people with sickle cell anaemia.

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..... [3]

(c) The partial pressure of oxygen in the lungs at sea level is about 13.5 kPa. At an altitude of 3000 metres the partial pressure of oxygen in the lungs is about 7.5 kPa.

When people move from sea level to high altitude they become adapted to the low partial pressure of oxygen.

Describe **and** explain how humans become adapted to the low partial pressure of oxygen at high altitude.

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..... [4]

(d) Vaccination is used to control the spread of diseases, such as measles.

Explain why vaccination cannot be used to prevent sickle cell anaemia.

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[Total: 13]

5 DNA and RNA are important biological molecules that are involved in the production of polypeptides.

(a) Fig. 4.1 shows two nucleotides joined by a covalent bond.

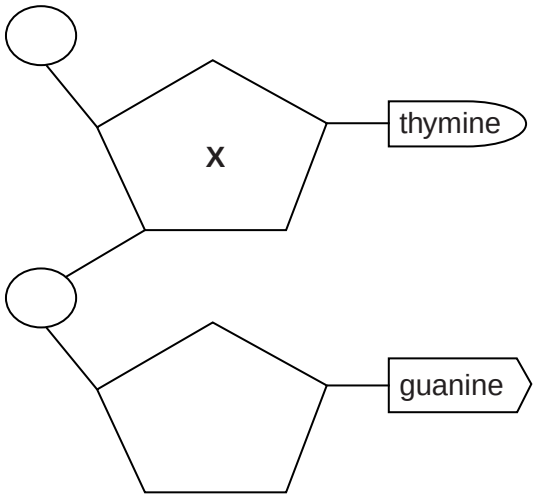

Fig. 4.1

(i) Fig. 4.1 represents part of a DNA molecule, **not** part of an RNA molecule.

Explain why.

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..... [1]

(ii) Name the covalent bond between the two nucleotides.

..... [1]

(iii) Name component **X**.

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..... [1]

(b) Outline the role of transfer RNA (tRNA) in the production of a polypeptide.

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..... [2]

(c) Describe how a peptide bond is formed between two amino acids during polypeptide production.

You may use the space below to help with your answer.

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..... [3]

[Total: 8]

6 The two strands of a DNA molecule are held together by hydrogen bonds between complementary base pairs.

(a) Explain why the hydrogen bonding between the two strands of DNA is important for it to carry out its functions.

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.....[4]

Switching genes on and off allows proteins to be synthesised only when required.

Processes **P** and **Q** occur when a gene is switched on, as shown in Fig. 4.1.

Fig. 4.1

(b) Name processes **P** and **Q**.

P .....

Q .....[1]

DNA is a very stable molecule. This means that it is not broken down either chemically or by enzymes during the normal life of the cell.

In contrast, mRNA is described as being highly labile. This means that most mRNA molecules are broken down in the cytoplasm within a few hours of their release from the nucleus.

(c) Suggest the significance of:

(i) DNA being very stable

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..... [2]

(ii) mRNA being highly labile.

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..... [2]

[Total: 9]