Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

6225987961

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Blank pages are indicated.

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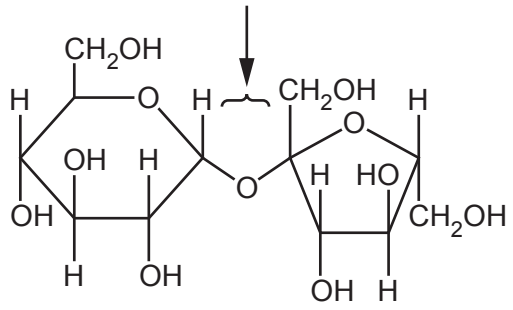
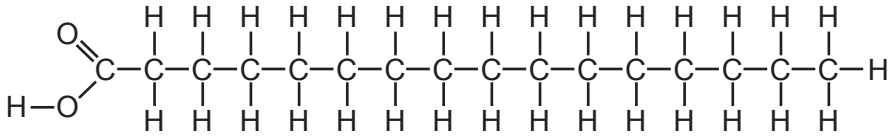
Answer **all** questions.

1 Fig. 1.1 shows five biological molecules.

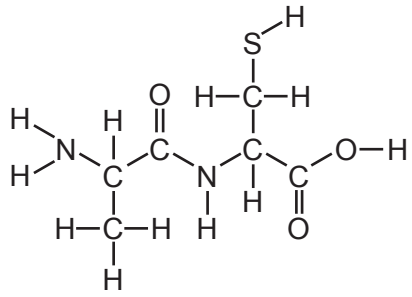
A



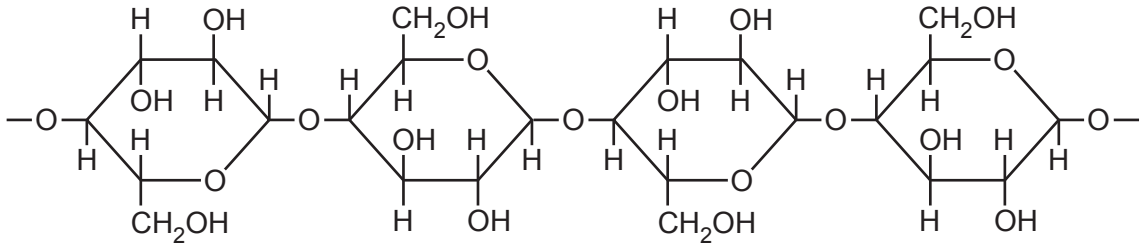
B



C



D



E

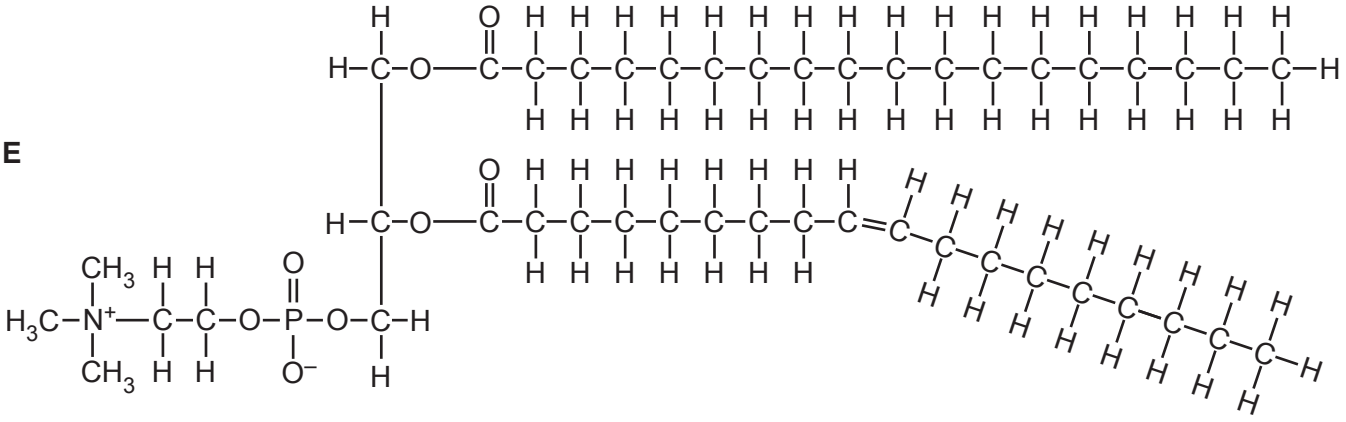


Fig. 1.1

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(a) State the name of the bond in molecule **A** indicated by the arrow.

..... [1]

(b) Molecule **B** is described as a saturated fatty acid.

State why molecule **B** is described as a saturated fatty acid.

.....

..... [1]

(c) Molecule **D** is a polymer.

State the name of the monomer that is used to synthesise this polymer.

..... [1]

(d) State the letter of the molecule that could be formed during the hydrolysis of a polypeptide.

..... [1]

(e) State the letter of the molecule that forms part of the cell surface membranes of eukaryotic cells.

..... [1]

(f) Molecule **A** and molecule **C** dissolve in water. Molecule **B** does **not** dissolve in water.

Explain why molecule **A** and molecule **C** dissolve in water, but molecule **B** does **not** dissolve in water.

.....

.....

..... [1]

[Total: 6]

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2 Fig. 2.1 shows some stages of the cell cycle in the meristematic tissue in the root tip of a plant. Three of these stages, **P**, **Q** and **R**, are identified in Table 2.1.

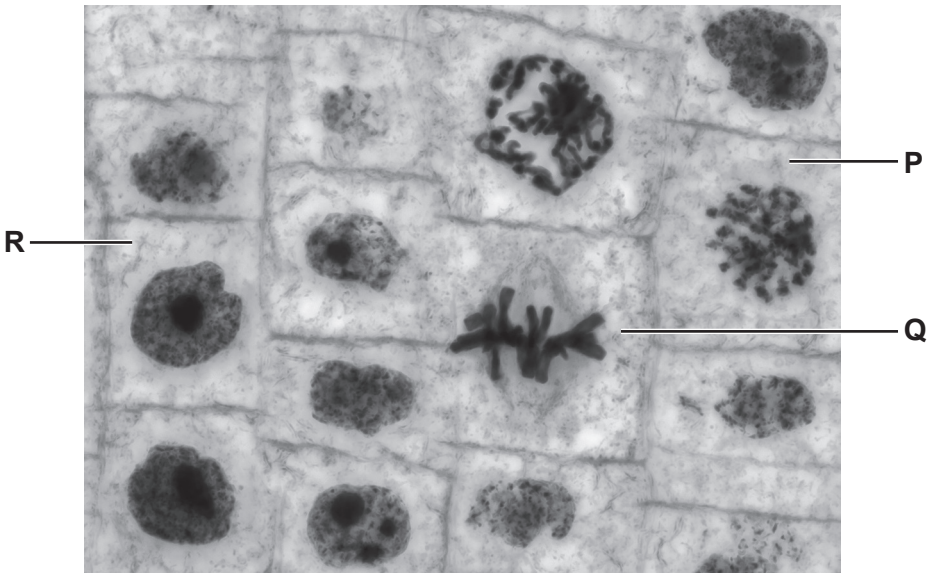

Fig. 2.1

(a) Complete Table 2.1 by stating **one** feature, **visible in Fig. 2.1**, that is used to identify each stage.

Table 2.1

cell	stage of cell cycle	reason
P	prophase of mitosis	
Q	metaphase of mitosis	
R	interphase	

[3]

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(b) **(i)** Draw a labelled diagram to show **one** chromosome at metaphase of mitosis.

On the chromosome you have drawn add labels to show:

- the position of a telomere
- a chromatid
- the centromere.

[4]

(ii) State the type of protein that is associated with DNA in chromosomes.

..... [1]

(iii) Describe how the spindle is involved during the process of mitosis.

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.....

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..... [3]

[Total: 11]

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3 The enzyme glucose 6-phosphate dehydrogenase (G6PD) is composed of two identical polypeptide chains.

(a) Students investigated the activity of two forms of G6PD, **J** and **K**, at different concentrations of substrate. **K** is a form of the enzyme that results from a mutation that changes one amino acid in the polypeptide.

The results are shown in Fig. 3.1.

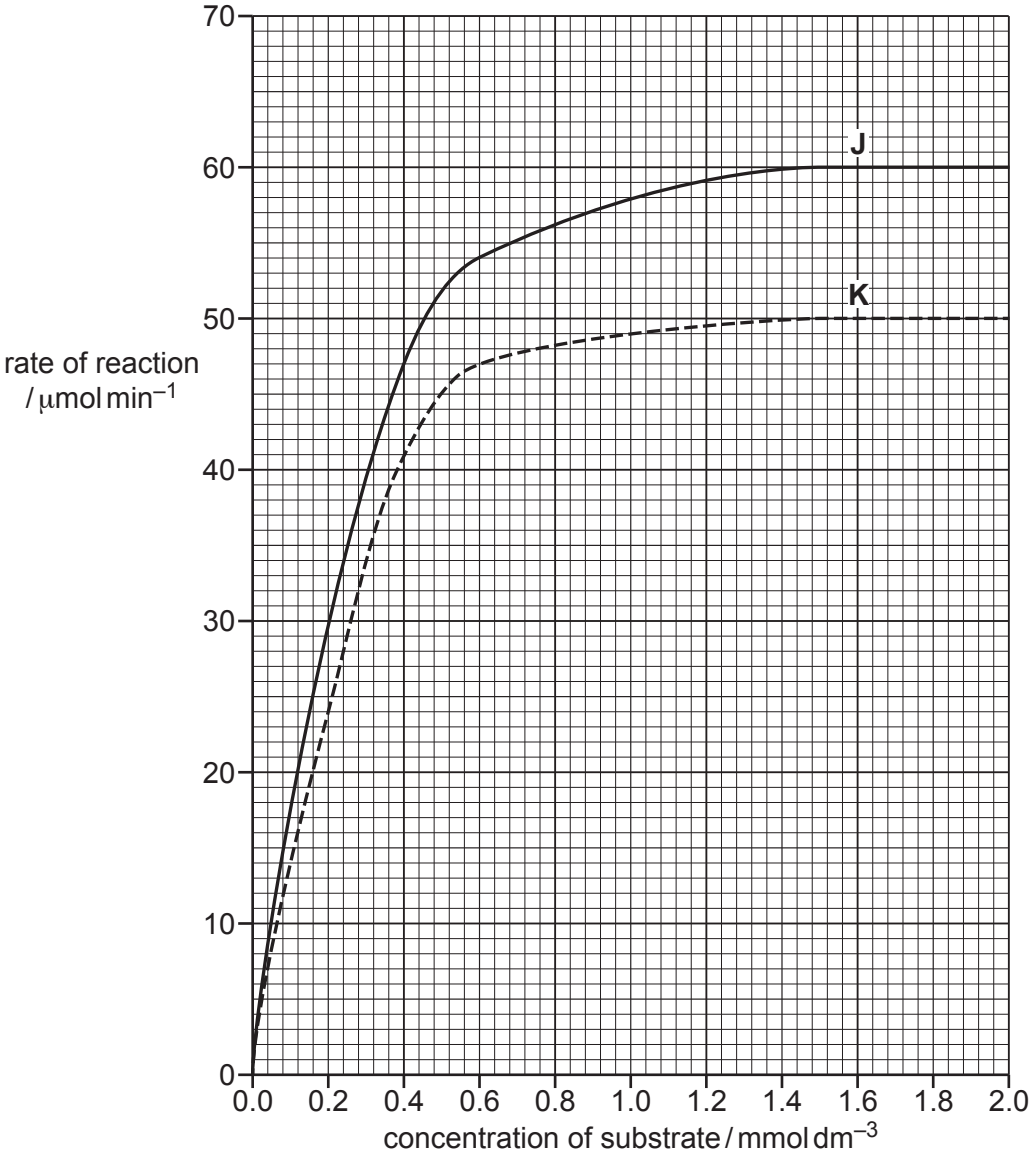

Fig. 3.1

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(i) Use Fig. 3.1 to complete Table 3.1 by stating:

- the V_{max} and the K_m for enzymes **J** and **K**
- the units for V_{max} and K_m.

Table 3.1

	V_{max} /	K_m /
J		
K		

[3]

(ii) With reference to Fig. 3.1 and Table 3.1, describe the effect of the mutation on the activity of G6PD **and** suggest an explanation for this effect.

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..... [4]

(b) In certain conditions, G6PD may also exist as four identical polypeptide chains rather than two identical polypeptide chains.

Explain why both of these types of G6PD have all four levels of protein structure.

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..... [2]

[Total: 9]

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4 Fig. 4.1 shows the site of gas exchange in the mammalian lung.

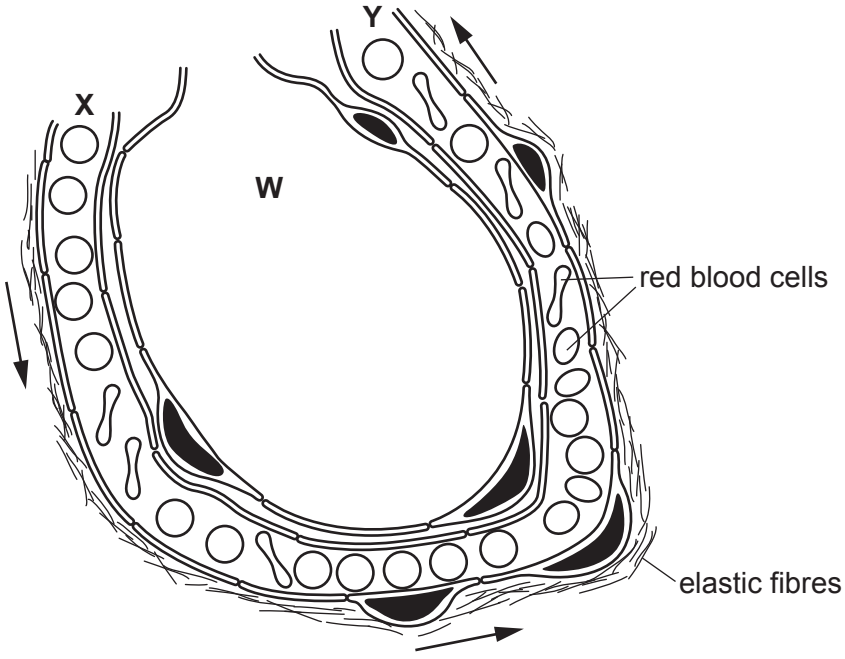

Fig. 4.1

(a) State **two** ways in which carbon dioxide is transported in the blood.

1 .....

2 .....
[2]

(b) Table 4.1 shows the partial pressures of oxygen (pO_2) and carbon dioxide (pCO_2) at locations **W**, **X** and **Y** in Fig. 4.1.

Table 4.1

partial pressure	locations within tissue		
	W	**X**	**Y**
pO_2 / kPa	13.87	5.33	13.87
pCO_2 / kPa	5.33	6.00	5.55

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With reference to Fig. 4.1 and Table 4.1, describe the exchanges that occur as blood flows from **X** to **Y**.

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..... [4]

(c) Elastic fibres are present in tissues at the site of gas exchange in the lungs.

Describe the roles of elastic fibres in the gas exchange system **and** in the cardiovascular system.

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..... [4]

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(d) Scientists in Peru investigated the effect of moving from sea level to high altitude on the composition of blood. The scientists studied 10 students. Each student had lived at sea level since birth and then moved to live in the Andes at a height of 4500 metres above sea level.

The scientists took samples of blood from each student before they moved to live at high altitude. The scientists took further blood samples at intervals after the students had moved to high altitude.

The relative proportions of red blood cells and plasma in each sample were determined.

The total volume of blood for each student was also determined at each sampling time. As the students were all of different body mass, the total volumes were converted to a volume per kg of body mass ($cm^3 kg^{-1}$).

Fig. 4.2 shows for each sampling time:

- the mean volume of blood per kg of body mass
- the proportions of red blood cells and plasma.

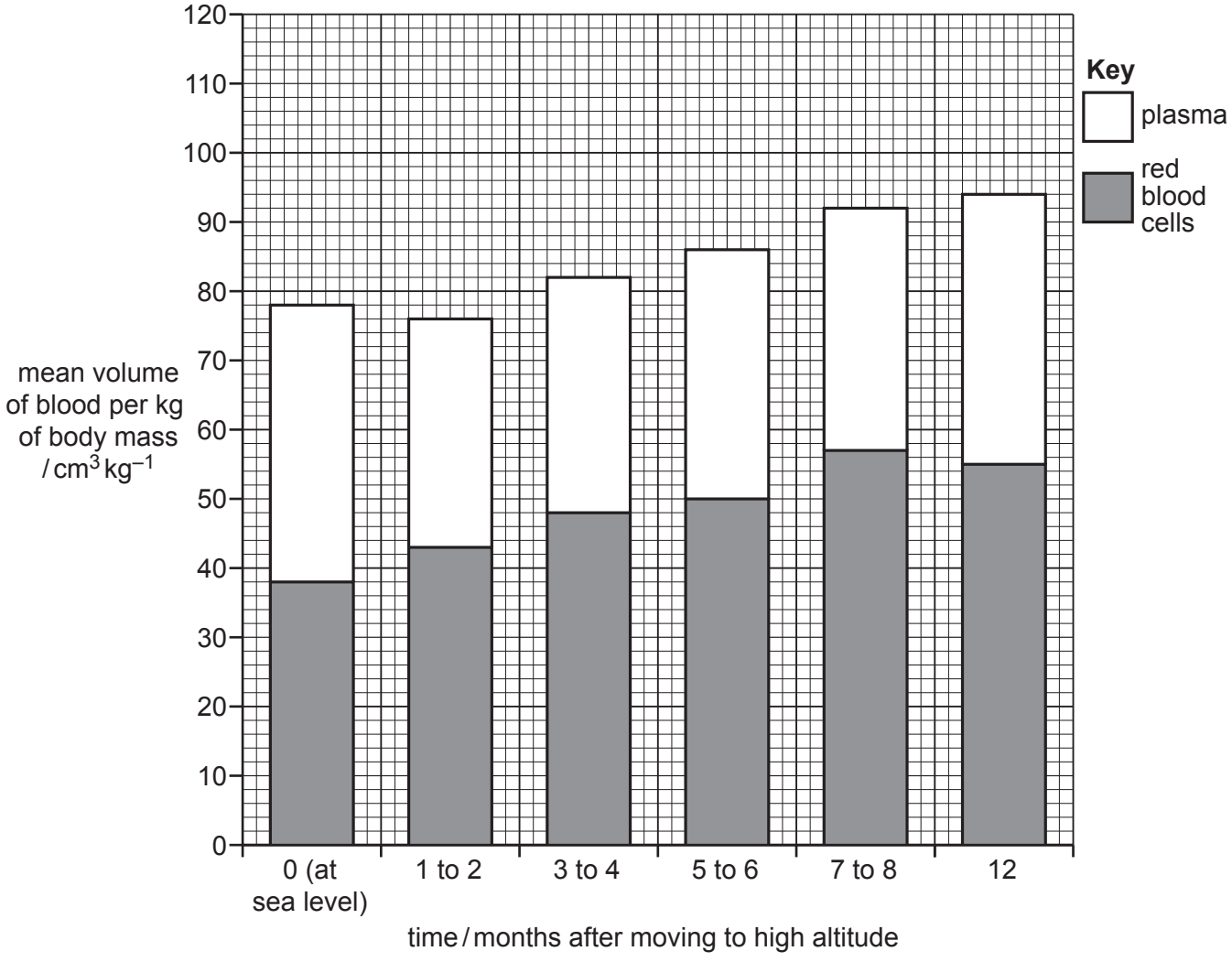

Fig. 4.2

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(i) The percentage of mean blood volume that is represented by red blood cells for the samples taken at sea level is 48%.

Calculate the percentage of mean blood volume that is represented by red blood cells at 5 to 6 months after living at high altitude.

Show your working and give your answer to the nearest whole number.

answer = ...% [2]

(ii) Describe **and** explain the results in Fig. 4.2.

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..... [4]

[Total: 16]

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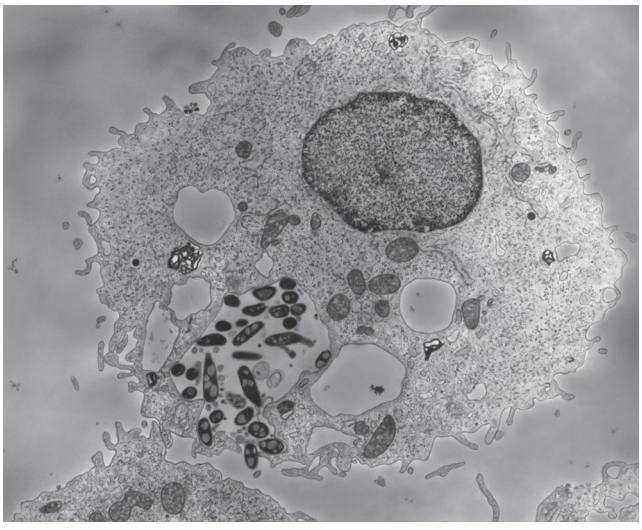
5 The vaccine used to control tuberculosis (TB) is known as Bacillus Calmette-Guérin (BCG). The vaccine contains live bacteria that have been selected so that they do not cause disease in humans.

Fig. 5.1 shows a macrophage that is in the process of engulfing the bacteria in the vaccine.



magnification ×4400

Fig. 5.1

(a) **(i)** Name the pathogen that causes TB.

..... [1]

(ii) Describe how this pathogen is transmitted.

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..... [2]

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(b) Describe the events that occur in the body after the macrophage has engulfed the bacteria until the production of antibodies in response to the BCG vaccine.

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..... [5]

(c) Vaccines, such as BCG, stimulate the formation of memory cells.

Explain the role of memory cells in the body's defence against the TB pathogen.

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..... [3]

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(d) Suggest why vaccination with BCG has not yet eradicated TB.

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..... [3]

[Total: 14]

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6 Fig. 6.1 shows the formation of a polypeptide during translation in a eukaryotic cell.

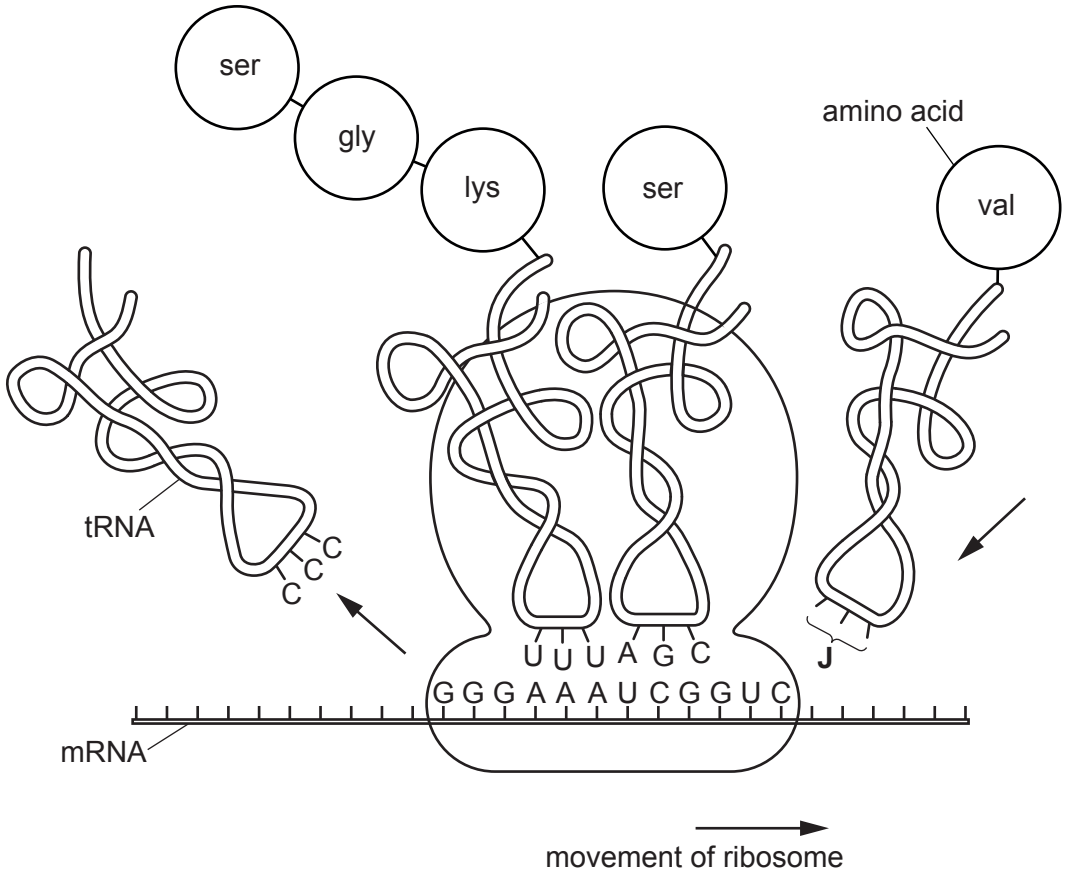

Fig. 6.1

(a) Name the purine bases shown in Fig. 6.1.

..... [1]

(b) State the name given to the group of three bases found at **J** on the tRNA molecule.

..... [1]

(c) Identify the three bases at **J**.

..... [1]

(d) State how the three bases at **J** on tRNA interact with the bases on mRNA.

..... [1]

[Total: 4]

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