Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

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BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2016**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

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Answer **all** the questions.

1 Match the description for each of statements **A** to **E** to a correct cell structure.

A Double membrane-bound organelle, absent in animal cells, that produces ATP.

.....

B Partially permeable membrane surrounding the large permanent vacuole of plant cells.

.....

C Formed from microtubules during mitosis.

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D Has peptidoglycan as one of its major components.

.....

E Site of assembly of 80S ribosomes.

.....

[5]

[Total: 5]

[Turn over

2 Phloem sap containing sucrose is transported in phloem sieve tubes from the source to the sink.

(a) A student carried out an experiment using Visking tubing to investigate osmosis. The student prepared a sucrose solution to represent phloem sap at the source. This was put into Visking tubing that was tied at one end, so that the tubing was approximately 75% full.

The rest of the procedure is summarised in Fig. 2.1. The tubing was removed after 20 minutes, dried and re-weighed.

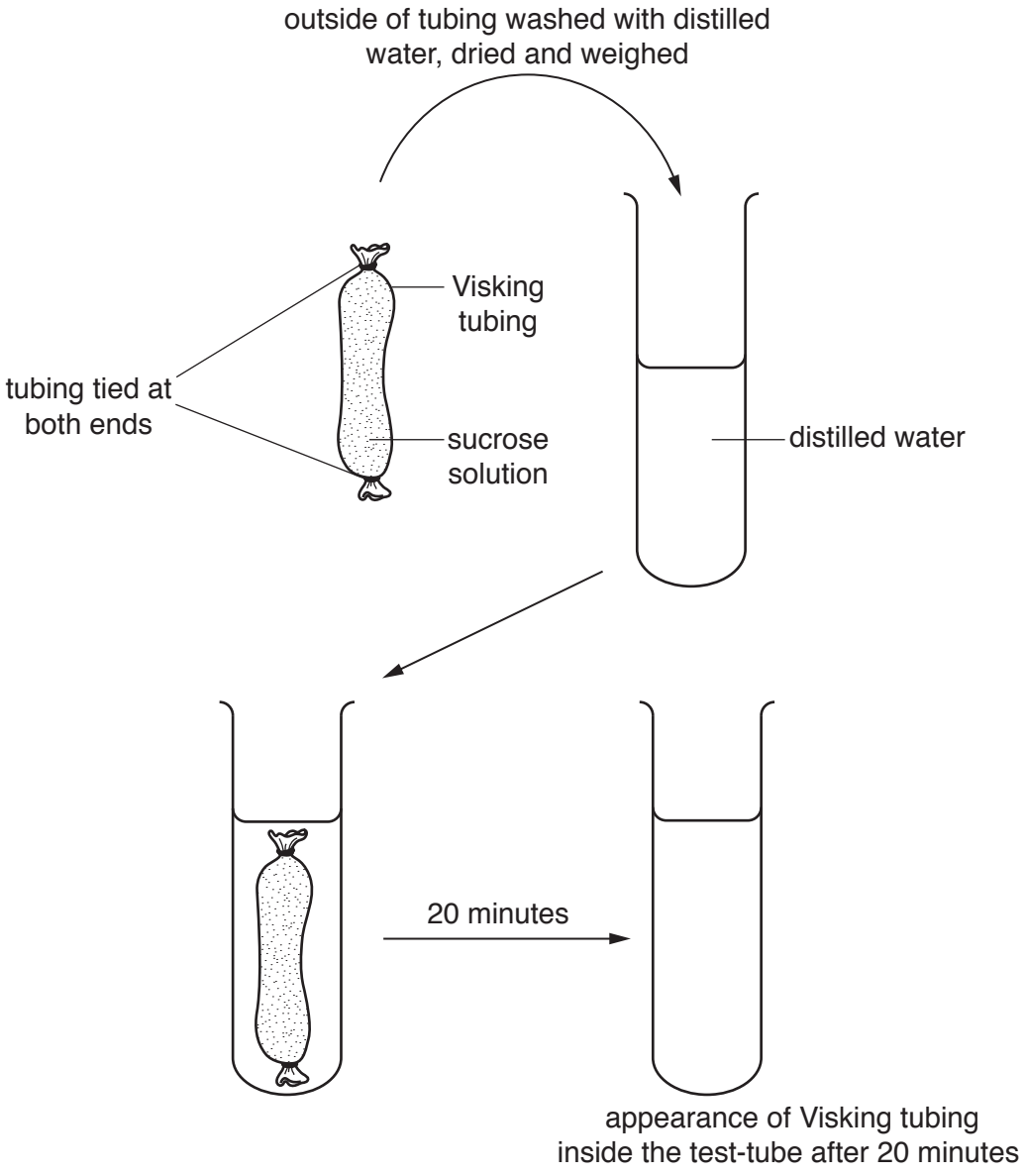

Fig. 2.1

(i) Complete Fig. 2.1 to show the appearance of the Visking tubing inside the test-tube after 20 minutes. [1]

(ii) State, **with reasons**, whether there would be a change in the mass of the Visking tubing containing the sucrose solution after 20 minutes.

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.....[3]

(b) Explain how osmosis is involved in the mass flow of phloem sap.

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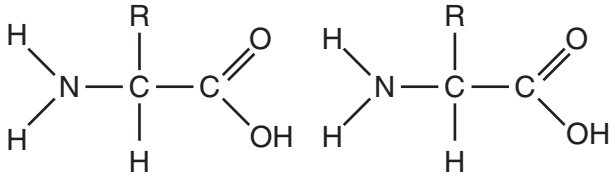
.....[3]

(c) Amino acids synthesised in the mesophyll cells of leaves are also transported in phloem sap to other locations where they are used to synthesise polypeptides.

Amino acids are joined by peptide bonds to form the polypeptides.

Two amino acids are shown below. Describe the formation of a peptide bond between these two amino acids. You may use the space below.



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[Total: 9]

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3 High fructose corn syrup, made from maize, can be used as a replacement for sucrose to sweeten food and drink products.

Commercial production of high fructose corn syrup involves the enzyme glucose isomerase, extracted from bacteria.

(a) Fructose and sucrose are both sugars.

State two structural differences between fructose and sucrose.

1 .....

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2 .....

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.....[2]

(b) The glucose isomerase used in the production of high fructose corn syrup is extracted from a strain of a bacterium, *Thermus thermophilus*, which is found in hot springs. The enzyme has an optimum temperature of 95 °C.

Suggest **and** explain the advantages of using glucose isomerase from *T. thermophilus* to produce high fructose corn syrup, rather than using glucose isomerase that has an optimum temperature of 37 °C.

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.....[3]

(c) The commercial production of high fructose corn syrup uses immobilised glucose isomerase.

Fig. 3.1 shows the effect of pH on the activity of immobilised glucose isomerase compared to glucose isomerase free in solution.

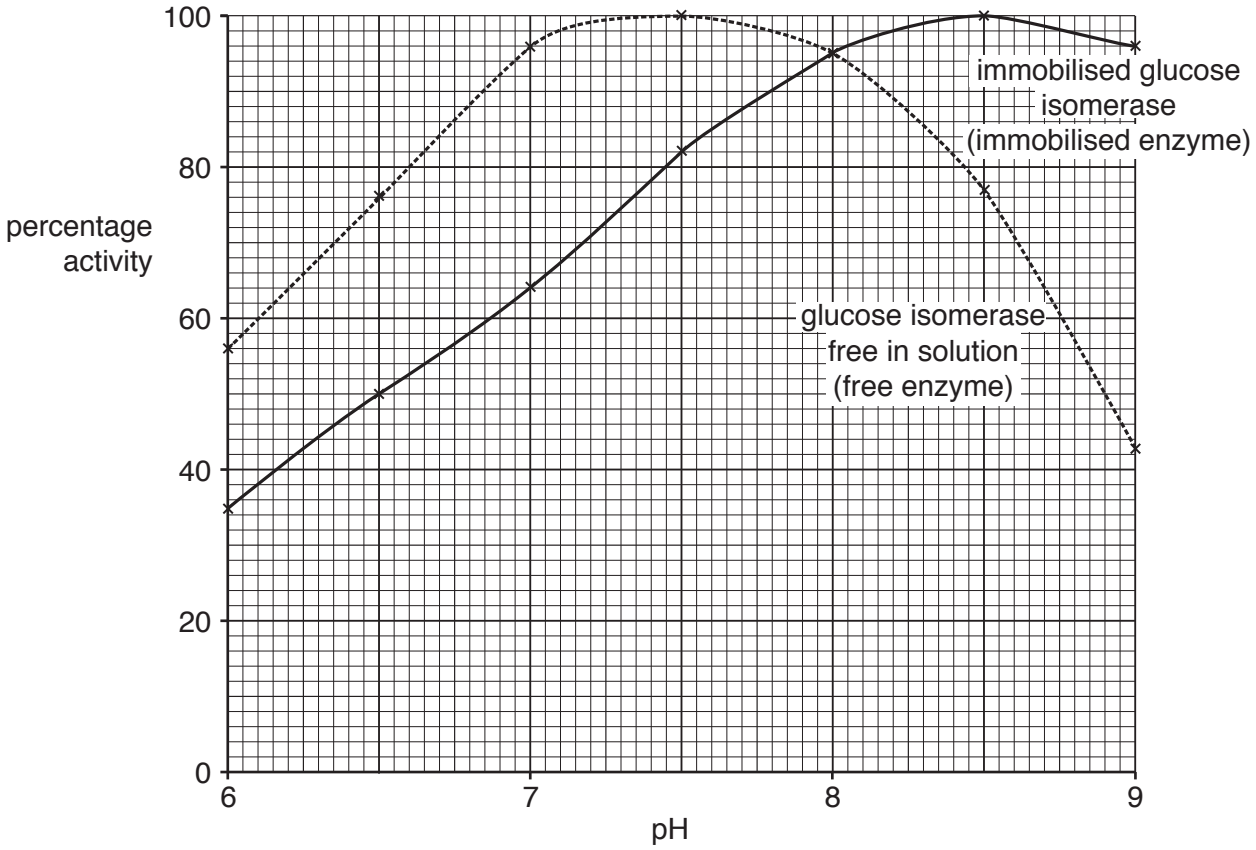

Fig. 3.1

With reference to Fig. 3.1, describe the differences shown between the immobilised enzyme and the free enzyme as pH changes.

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(d) The amino acid sequence of the enzyme glucose isomerase has been determined. The first five amino acids of this sequence are shown in Table 3.1.

Table 3.2 (on page 11) shows the genetic code (mRNA codons).

A student was asked to use Table 3.2 to work out an mRNA nucleotide sequence that would correspond to the first five amino acids of glucose isomerase. The student's sequence is shown in Table 3.1.

Table 3.1

amino acid sequence	met	tyr	glu	pro	lys
student's nucleotide sequence	AUG	UAU	GAC	CCU	UGU
correct = ✓ incorrect = ✗					

(i) Complete Table 3.1 using a ✓ or a ✗ to indicate whether the student has used Table 3.2 correctly to identify the codons for each amino acid in the nucleotide sequence. [1]

(ii) Discuss, with reasons, how an mRNA nucleotide sequence worked out to correspond to the first five amino acids using Table 3.2 may not be the same as the mRNA nucleotide sequence for those amino acids present in the bacterial cell.

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.....[3]

Table 3.2

first position	second position				third position
	U	C	A	G	
U	phe	ser	tyr	cys	U
	phe	ser	tyr	cys	C
	leu	ser	STOP	STOP	A
	leu	ser	STOP	trp	G
C	leu	pro	his	arg	U
	leu	pro	his	arg	C
	leu	pro	gln	arg	A
	leu	pro	gln	arg	G
A	ile	thr	asn	ser	U
	ile	thr	asn	ser	C
	ile	thr	lys	arg	A
	met	thr	lys	arg	G
G	val	ala	asp	gly	U
	val	ala	asp	gly	C
	val	ala	glu	gly	A
	val	ala	glu	gly	G

[Total: 12]

4 Fig. 4.1 is a cross-section of a human renal artery, a vessel that supplies blood to the kidney.

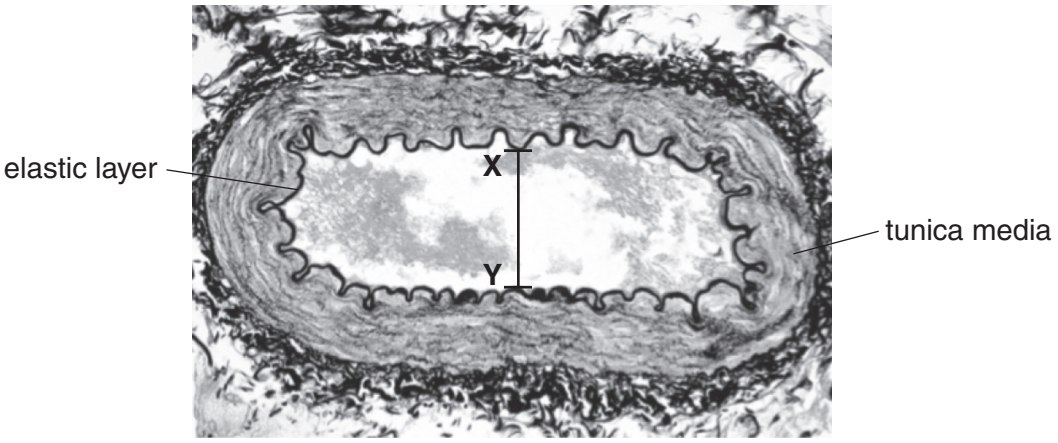

Fig. 4.1

(a) The elastic layer shown in Fig. 4.1, located between the endothelium and the tunica media, is one feature that suggests that the blood vessel is the renal artery and not the renal vein, which may be of a similar size.

Complete the sentence to state **one** additional structural feature, **visible in Fig. 4.1**, that would identify the blood vessel as an artery.

This is an artery because it has .....

.....

.....

.....[1]

(b) Explain the relationship between the structure of the tunica media and the function of an artery, such as the renal artery.

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.....[2]

(c) The actual diameter of the lumen of the renal artery at the point **X–Y** in Fig. 4.1 is 5.2 mm.

Calculate the magnification of the image shown in Fig. 4.1. Write down the formula you will use to make your calculation and show your working.

formula

magnification × .....[3]

(d) Blood plasma contains approximately 90% water. Many of the properties of water are due to its ability to form hydrogen bonds.

Outline how the properties of water make it ideal as the largest component of plasma.

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.....[3]

[Total: 9]

5 A disease can be described as infectious or non-infectious.

(a) Lung cancer is a non-infectious disease.

(i) Explain the term *non-infectious disease*.

non-infectious .....

.....

.....

disease .....

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.....[2]

(ii) In a person with lung cancer one or more healthy cells undergo changes to produce cancerous cells that can form a tumour.

Suggest **and** explain the cellular changes that occur in the development of lung cancer.

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.....[4]

(b) Fig. 5.1 is a summary of some infectious diseases.

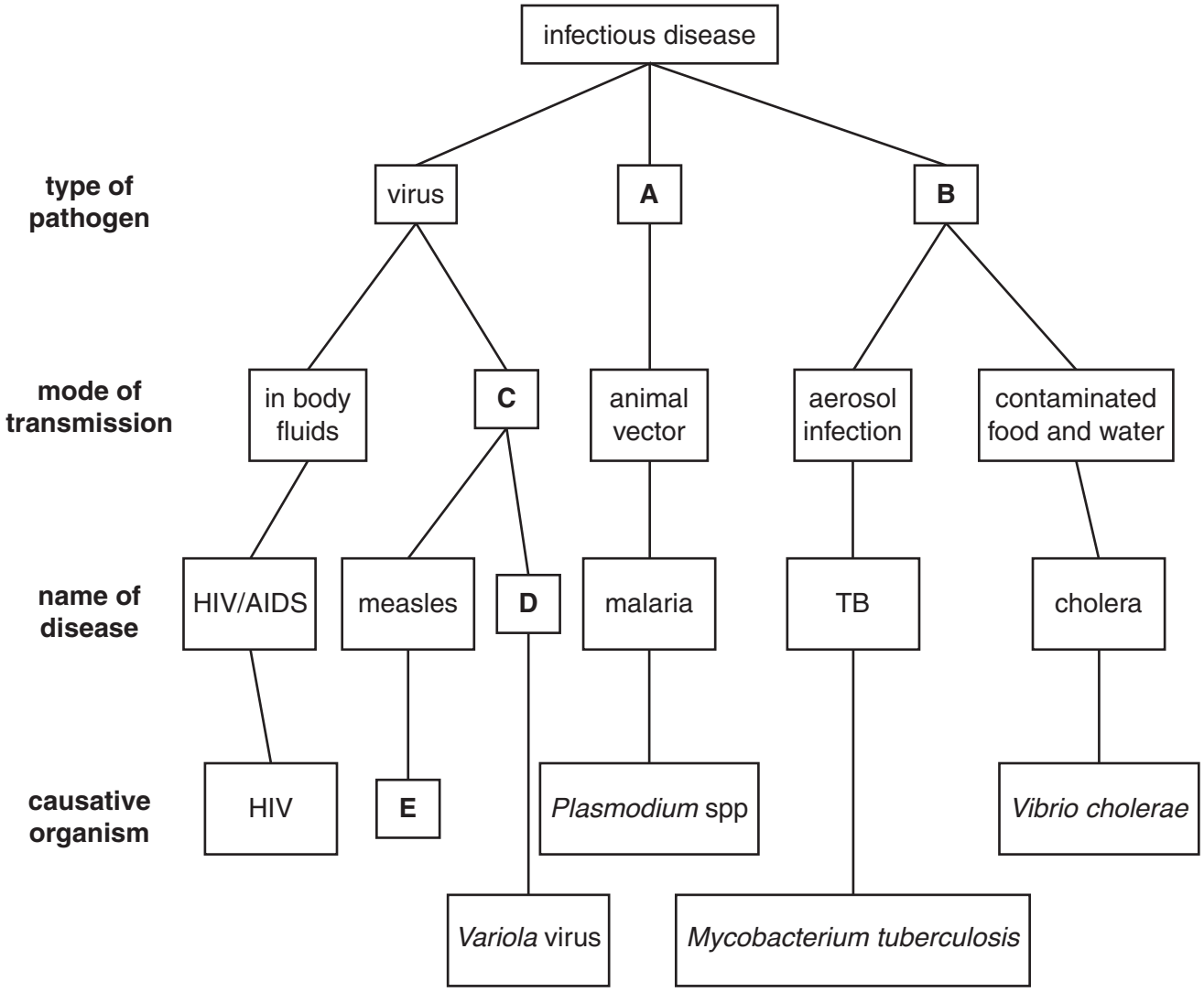

Fig. 5.1

Use the information in Fig. 5.1 to answer parts **(i)** to **(iv)**.

(i) Name the type of pathogen represented by **A** and **B**.

A .....

B ..... [2]

(ii) State the mode of transmission represented by **C**.

.....[1]

(iii) Name the disease represented by **D**.

.....[1]

(iv) Name the causative organism represented by **E**.

.....[1]

(c) Explain how vaccination can control infectious diseases.

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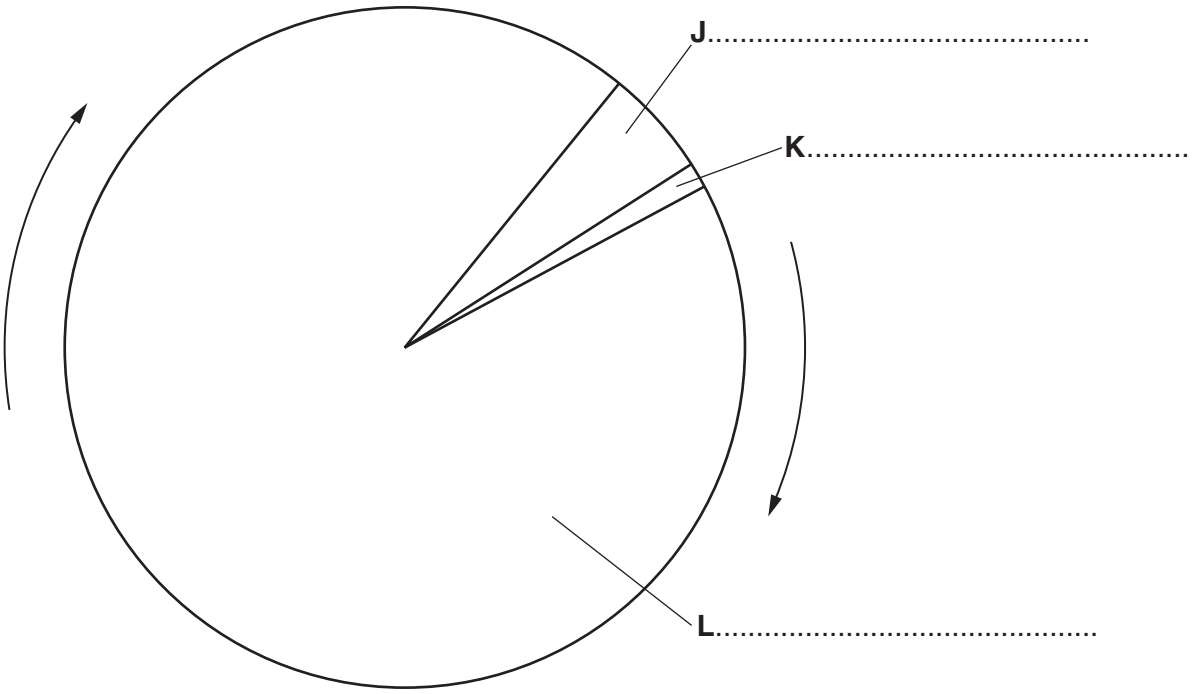
.....[3]

[Total: 14]

6 **(a)** Fig. 6.1 represents one complete cell cycle for a eukaryotic cell.

(i) Complete Fig. 6.1 by naming the stages represented by **J**, **K** and **L**.



[3]

Fig. 6.1

(ii) Name the stage in the cell cycle in which semi-conservative replication of DNA occurs.

.....[1]

The development of stem cells to become neutrophils occurs in several stages. Some of these stages are capable of cell division.
Fig. 6.2 is a summary of neutrophil development. Some details of cellular structure are included.

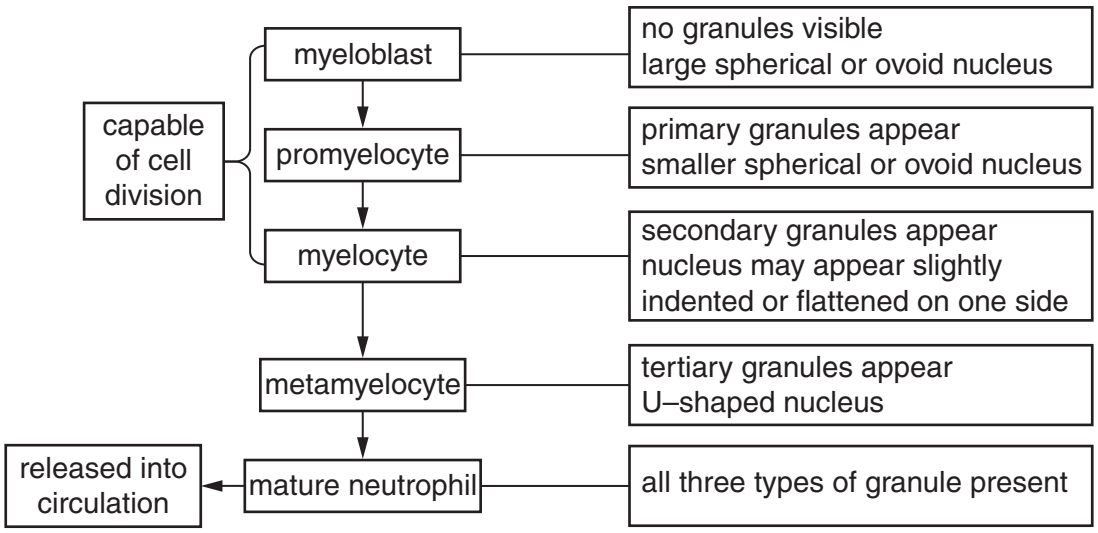


Fig. 6.2

All three types of granule indicated in Fig. 6.2 are membrane-bound cell structures containing hydrolytic enzymes. Each type of granule contains a different group of enzymes and other chemicals that enable the neutrophil to carry out its role.

(b) (i) State the location in the body where development and maturation of the neutrophil occurs.

.....[1]

(ii) Describe the shape of the nucleus in the mature neutrophil.

.....[1]

(iii) State the alternative name of the cell structures described in Fig. 6.2 as “granules”.

.....[1]

(c) (i) Primary granules contain proteins known as defensins. These bind to cell surface membranes of bacteria and form very small pores in the membrane.

Suggest how defensins contribute to the role of the neutrophil in killing bacteria.

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.....[2]

(ii) Secondary granules contain lysozyme. This is an enzyme that breaks bonds in peptidoglycan molecules.

Explain how the action of lysozyme will lead to the destruction of the bacterial cell.

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.....[2]

[Total: 11]

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