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Answer ALL questions in the spaces provided.

1. Read through the following account and then write on the dotted lines the most appropriate word or words to complete the account.

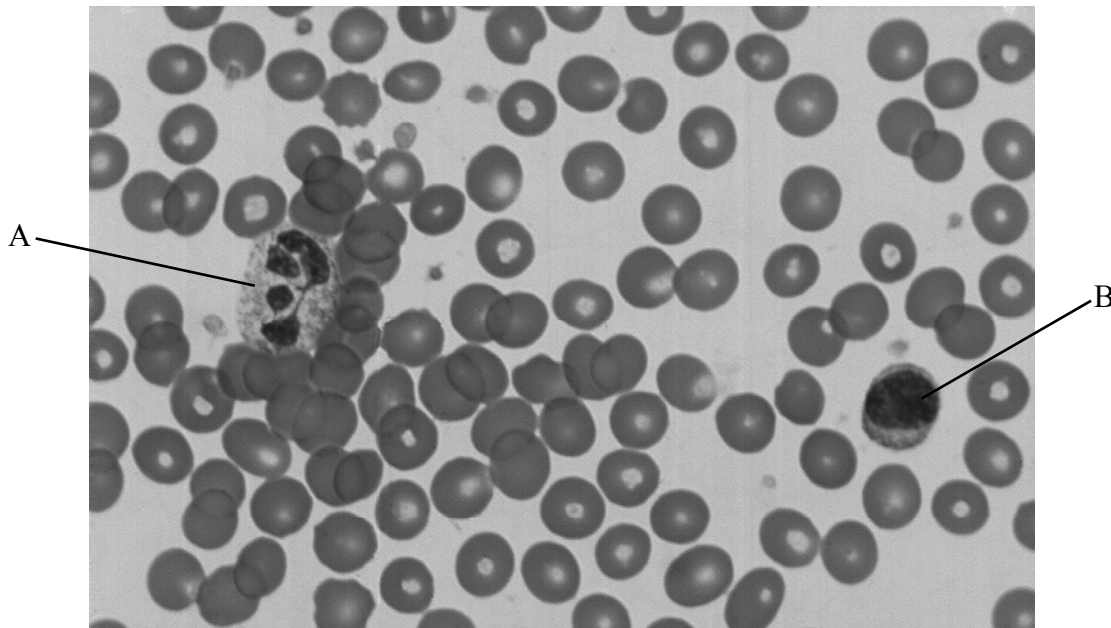
The movement of air into (inspiration) and out of (expiration) the lungs is known as ventilation. During inspiration, the diaphragm and the
intercostal muscles both This causes the volume of the thoracic cavity to and the pressure
..... so air moves into the lungs.

(Total 4 marks)

Q1



2. The photograph below shows human blood cells, as seen using a light microscope.



Magnification $\times 1000$

(a) Name the cells labelled A and B.

Cell A

Cell B.....

(2)

(b) Describe how cell B is involved in defence against disease.

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(2)



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(c) Explain the role of erythrocytes (red blood cells) in the transport of carbon dioxide.

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(3)

Q2

(Total 7 marks)



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3. The table below shows the concentrations of protein and sodium ions in blood plasma and in tissue fluid.

Solute	Concentration in blood plasma	Concentration in tissue fluid
Protein	70.0 g dm ⁻³	0.0 g dm ⁻³
Sodium ions	140.0 mmol dm ⁻³	140.0 mmol dm ⁻³

(a) Explain how **tissue fluid** is formed.

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(b) Suggest explanations for each of the following.

(i) Protein is present in the plasma but absent from tissue fluid.

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(ii) The concentrations of sodium ions in plasma and tissue fluid are the same.

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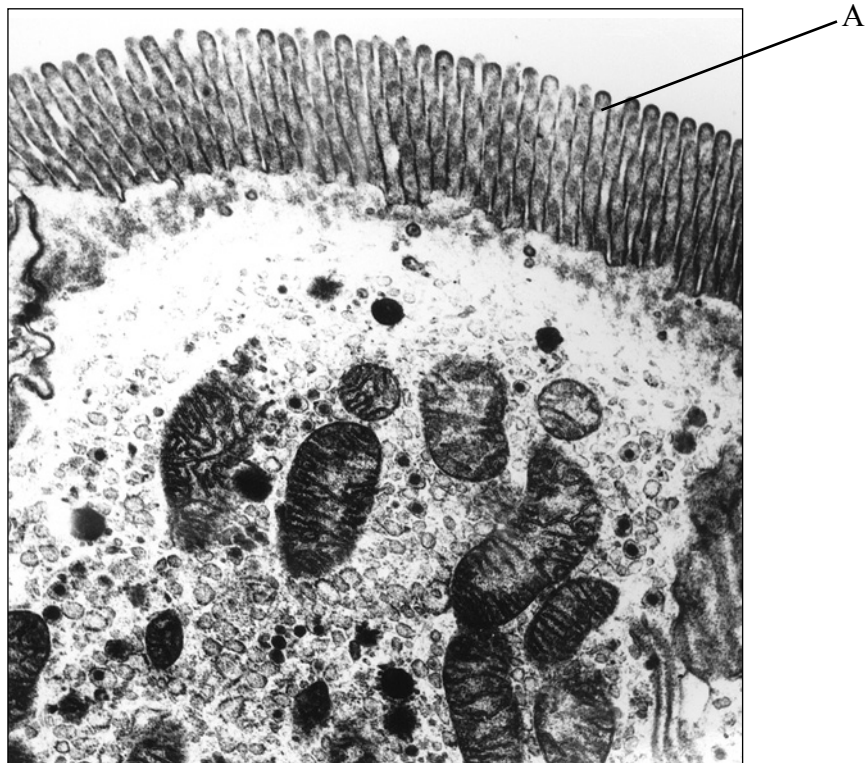
(2)

Q3

(Total 7 marks)



4. (a) The photograph below shows part of the surface of one epithelial cell facing the lumen of the ileum, as seen using an electron microscope.



Magnification $\times 15\,000$

- (i) Name the structure labelled A.

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(1)

- (ii) Explain how the membrane of structure A is involved in the digestion of carbohydrates.

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(b) Describe how glucose is absorbed in the ileum.

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(4)

(c) Suggest why the concentration of glucose in the blood rises more quickly after a meal of white bread and jam, than after a meal containing wholemeal bread only.

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(Total 10 marks)

Q4

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5. An electrocardiogram (ECG) is a recording of the electrical activity of the heart during the cardiac cycle.

(a) Explain what is meant by the term **cardiac cycle**.

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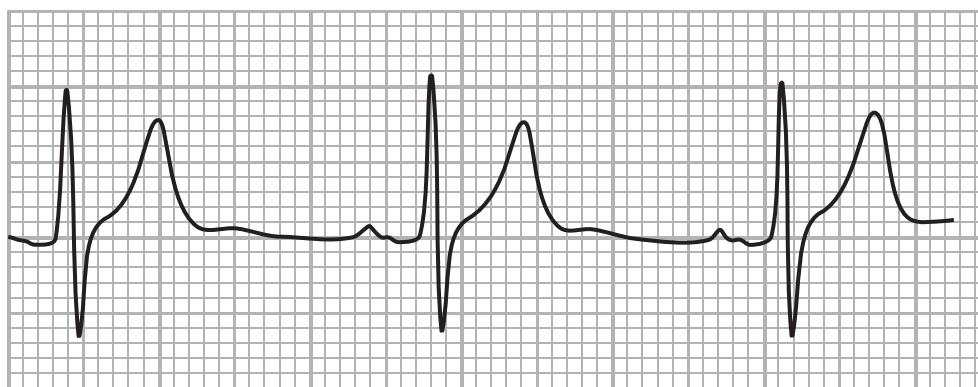
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(3)

(b) The recording below shows an ECG from a healthy person.



(i) On the ECG, label an R wave.

(1)



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(ii) The time interval between the start of the P wave and the start of the R wave indicates the time taken for the impulse to travel along the bundle of His. This time interval varies from about 0.13 to 0.16 seconds. Explain why it is important that there is a short delay between the P and R waves.

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(3)

Q5

(Total 7 marks)



6. The table below gives information about the relationship between altitude and air pressure. It shows how the percentage saturation of haemoglobin with oxygen varies for people when breathing air at different altitudes. It also shows the percentage saturation of haemoglobin with oxygen when breathing pure oxygen at different altitudes.

Altitude / m	Air pressure / kPa	Percentage saturation of haemoglobin with oxygen (%)	
		Breathing air	Breathing pure oxygen
0 (sea level)	100	97	100
3 000	70	90	100
6 000	45	70	100
9 000	30	20	99
12 000	4	5	87

[Data adapted from: Guyton: *Textbook of Medical Physiology*]

- (a) Describe how air pressure changes as altitude increases.

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(2)

- (b) Calculate the difference in the percentage saturation of haemoglobin with oxygen when breathing air, compared with breathing pure oxygen, at an altitude of 12 000 m.

Show your working.

Answer%
(1)



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(c) Using the information in the table, explain why mountaineers usually need cylinders of oxygen when climbing high mountains (over 3000 m).

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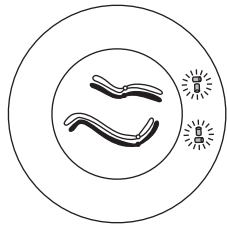
(4)

Q6

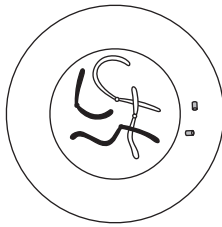
(Total 7 marks)



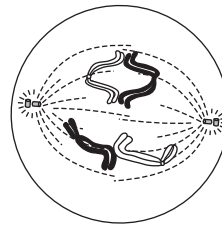
7. The diagrams below show some of the stages of meiosis I in an animal cell.



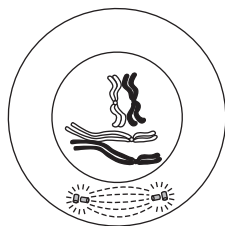
A



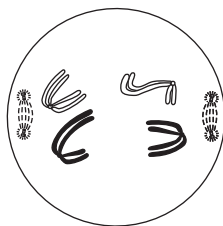
B



C



D



E

(a) State the diploid ($2n$) number of this cell.

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(b) Write the letters in the correct order to show the sequence of stages in meiosis I.

..... **(2)**



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(c) Explain the importance of meiosis in spermatogenesis.

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(d) Semen contains about 100 million sperm per cm³. Suggest why the chances of fertilisation are significantly reduced if this number falls below about 30 million per cm³.

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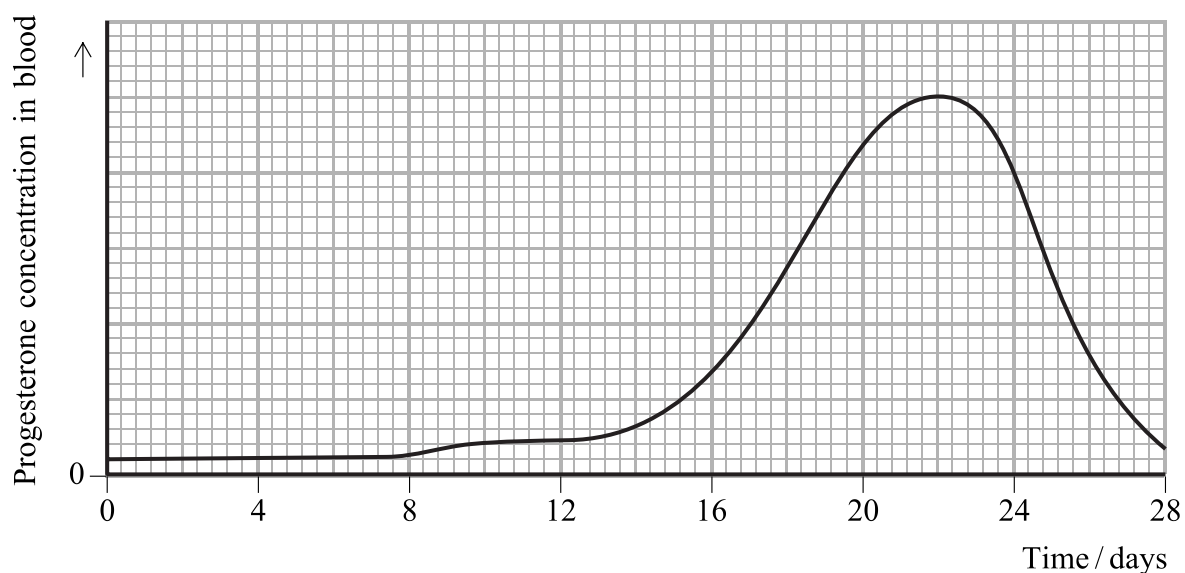
(2)

(Total 9 marks)

Q7



8. The graph below shows changes in the concentration of progesterone in the blood during the menstrual cycle.



(a) Name the structure in the ovary that produces progesterone during the menstrual cycle.

..... (1)

(b) Give **two** effects of progesterone.

1

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2

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..... (2)

(c) If fertilisation occurs on day 14, the concentration of progesterone changes from that shown in the graph.

On the graph above, draw a line to show this change in concentration of progesterone in the blood, from day 22 to day 28. (2)



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(d) Describe the roles of oxytocin in birth and lactation.

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(4)

Q8

(Total 9 marks)

TOTAL FOR PAPER: 60 MARKS

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