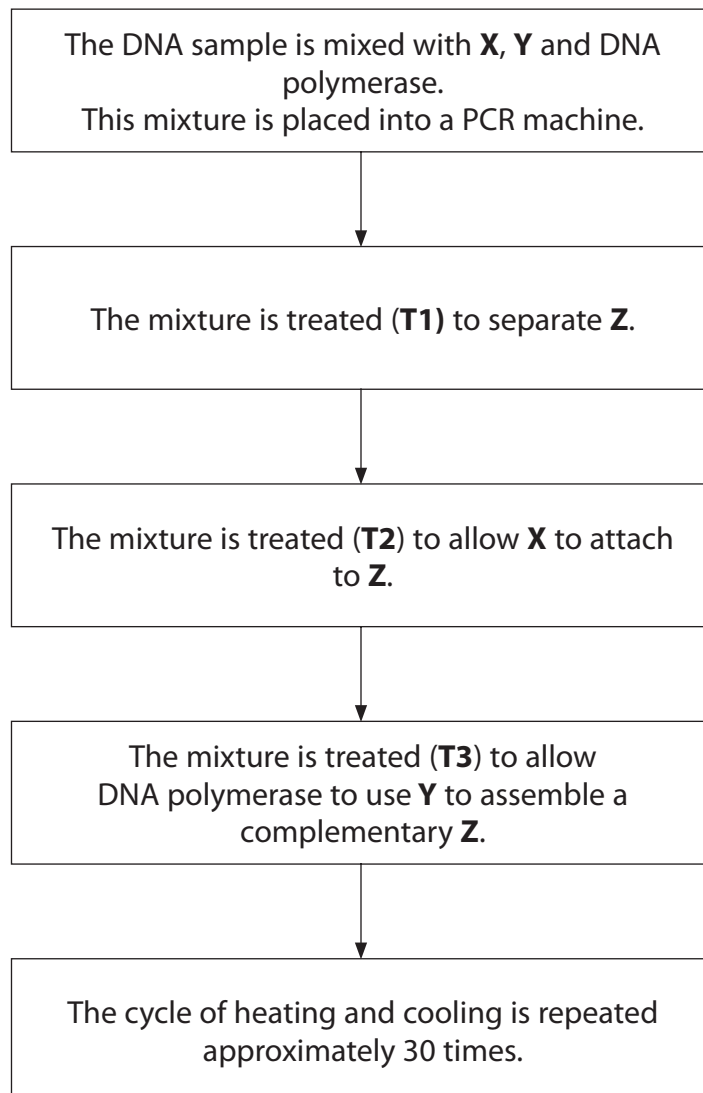


Answer ALL questions.

Some questions must be answered with a cross . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

- 1** During DNA profiling, the polymerase chain reaction (PCR) can be used to amplify a sample of DNA.

The diagram below shows how substances **X**, **Y** and **Z** are involved in the PCR. It also gives the temperature treatments **T1**, **T2** and **T3** at various stages.



(a) Name substances **X**, **Y** and **Z**.

(3)

Substance **X**.....

Substance **Y**.....

Substance **Z**.....

(b) Place a cross in the box next to the correct statements for treatments **T1**, **T2** and **T3**.

(3)

(i) Treatment **T1**

- A** heated to 90–95 °C
- B** heated to 75 °C
- C** cooled to 55–60 °C
- D** cooled to 4 °C

(ii) Treatment **T2**

- A** heated to 90–95 °C
- B** heated to 75 °C
- C** cooled to 55–60 °C
- D** cooled to 4 °C

(iii) Treatment **T3**

- A** heated to 90–95 °C
- B** heated to 75 °C
- C** cooled to 55–60 °C
- D** cooled to 4 °C

(c) Suggest reasons for each of the following.

(i) DNA polymerase from human sources is not suitable for use in a PCR machine.

(2)

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(ii) Species of plants cannot be identified from woody (xylem) material using PCR and DNA profiling.

(2)

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(Total for Question 1 = 10 marks)

2 The diagram below summarises the interconversion of ATP and ADP.



(a) Place a cross ☒ in the box that identifies each of the following.

(3)

(i) Substance **W**

- A** carbon dioxide
- B** an electron
- C** inorganic phosphate
- D** a proton

(ii) Reaction **S**

- A** carboxylation
- B** hydrolysis
- C** phosphorylation
- D** photolysis

(iii) Reaction **T**

- A** carboxylation
- B** hydrolysis
- C** phosphorylation
- D** photolysis

Question 3 & 4: N/A

- 5 (a) The table below gives some of the features of bacteria and viruses.

Place **one** tick (✓) in each row to indicate whether the feature is found in bacteria only, viruses only or both bacteria and viruses.

(3)

Feature	Found in		
	Bacteria only	Viruses only	Both bacteria and viruses
Nucleic acid			
Cytoplasm			
Protein capsid			

- (b) In human populations, the bacterium, *Helicobacter pylori*, is associated with the development of severe chronic atrophic gastritis (SCAG) in the stomach. SCAG is the first step that can lead to the most common form of stomach cancer.

The table below shows the reported new cases of stomach cancer in 2006 in the UK.

The mean rate of stomach acid secretion for each age group is also shown.

Age group / years	Mean acid secretion / mg hour ⁻¹	New cases of stomach cancer
11–15	170	0
16–20	160	0
21–25	150	0
26–30	120	0
31–35	100	4
36–40	90	10
41–45	60	55
46–50	60	95
51–55	60	183
56–60	50	263
61–65	40	424
66–70	40	633

(i) Suggest why patients with SCAG may be given antibiotics as part of their treatment.

(2)

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*(ii) Using the information about SCAG and the data, describe and suggest explanations for the trends shown in the table.

(5)

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(Total for Question 5 = 10 marks)

Question 6: N/A

7 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. In this condition, part of the immune system is destroyed.

(a) The genetic material in HIV consists of two strands of RNA.

Place a cross in the box next to the term used to describe each of the sub-units in a molecule of RNA.

(1)

- A amino acid
- B inorganic phosphate
- C nucleotide
- D saccharide

(b) (i) Name **two** types of cell that HIV enters in the immune system.

(2)

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(ii) Explain how HIV is able to enter these cells.

(3)

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(iii) Describe the sequence of events following infection of these cells by HIV, that may lead to the death of the patient.

(6)

Dotted lines for writing the answer.

(Total for Question 7 = 12 marks)

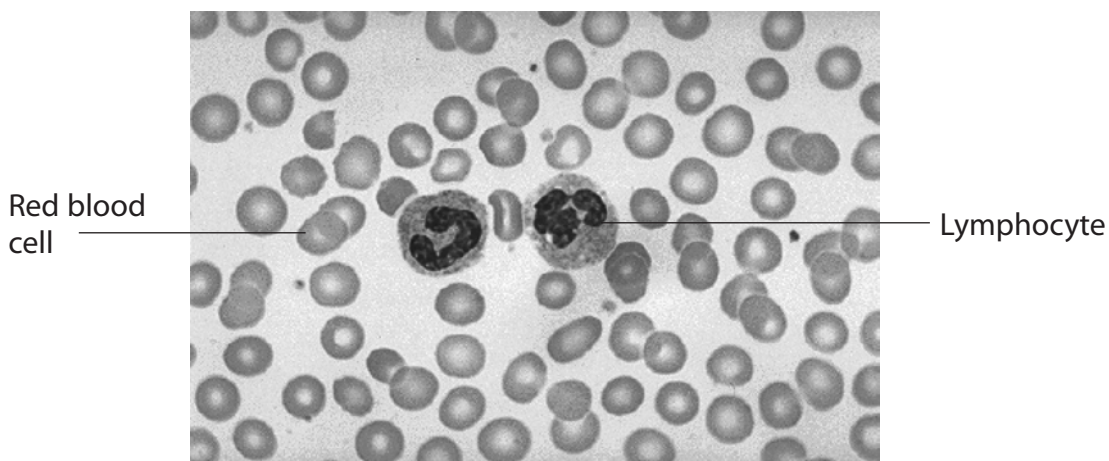
- 8 (a) The table below describes some features of the lymphocytes that are involved in the immune system.

Place a tick (✓) in the appropriate column to indicate whether the description is true or false.

(4)

Description	True	False
B and T cells are formed in the bone marrow		
B cells stimulate T cells to produce clones of memory cells		
T helper cells produce chemicals that destroy pathogens		
B and T cells are able to form clones by mitosis		

- (b) A sample of blood was taken from a person with a bacterial infection. The photograph below shows some of the cells in this blood sample.



Suggest **two** reasons why the bacteria that caused the infection are not visible in the photograph.

(2)

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(c) Suggest how a further sample of blood, taken a few days later, might differ from the one shown in the photograph, in each of the following circumstances. Give a reason for each answer.

(i) If the person is treated with antibiotic drugs.

(2)

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(ii) If the person is given a placebo.

(2)

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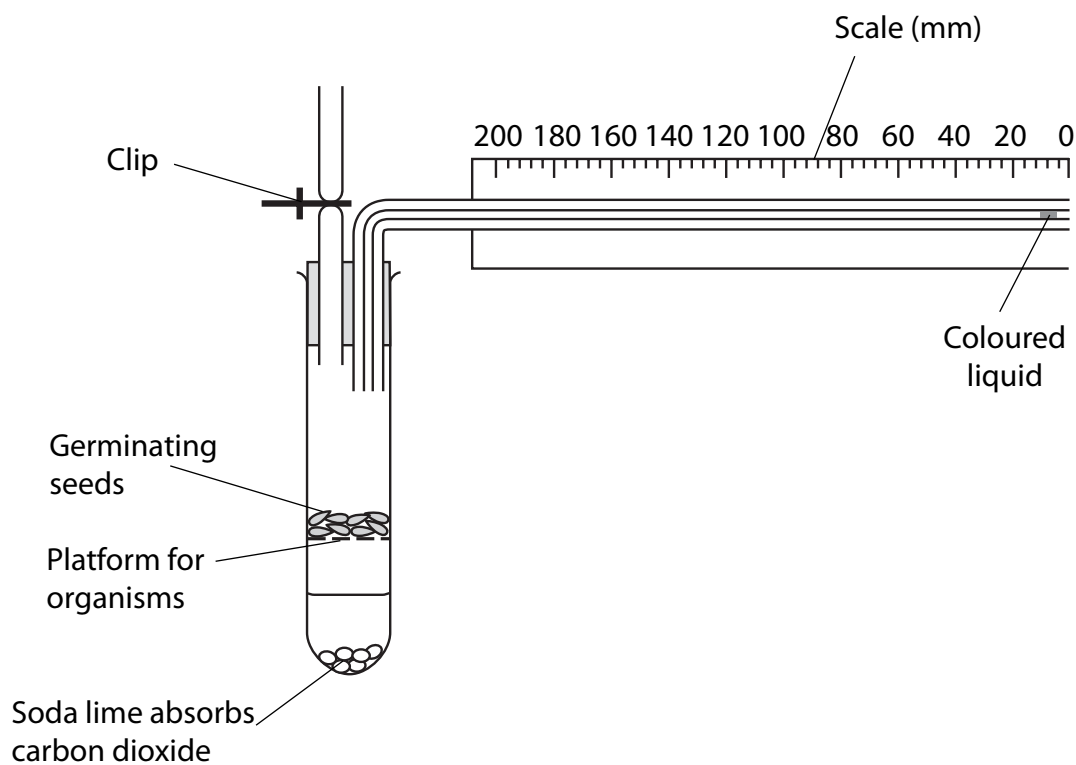
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(Total for Question 8 = 10 marks)

9 The apparatus shown in the diagram below was used to measure the rate of respiration of germinating seeds in air. The distance moved by the coloured liquid was measured at 15-minute intervals for one hour.

This was repeated with the air replaced by nitrogen gas.

The rate of respiration of small insects in air was measured using the same apparatus.



(a) Suggest reasons for absorbing carbon dioxide in this apparatus.

(2)

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(b) The table below shows results recorded by a student using this apparatus.

Organism	Distance moved by liquid in 15-minute intervals / mm				Mean rate of respiration / mm min ⁻¹
Germinating seeds	7	6	5	6	0.4
Germinating seeds in nitrogen gas	0	0	0	0	0
Insects	12	11	13	12	

- (i) In the space below, calculate the mean rate of respiration for the insects, expressed as movement of liquid in millimetres per minute. Show your working.

(2)

Answer mm min⁻¹

- (ii) The seeds in the experiment with nitrogen gas continued to germinate. Suggest an explanation for the lack of movement of the liquid.

(2)

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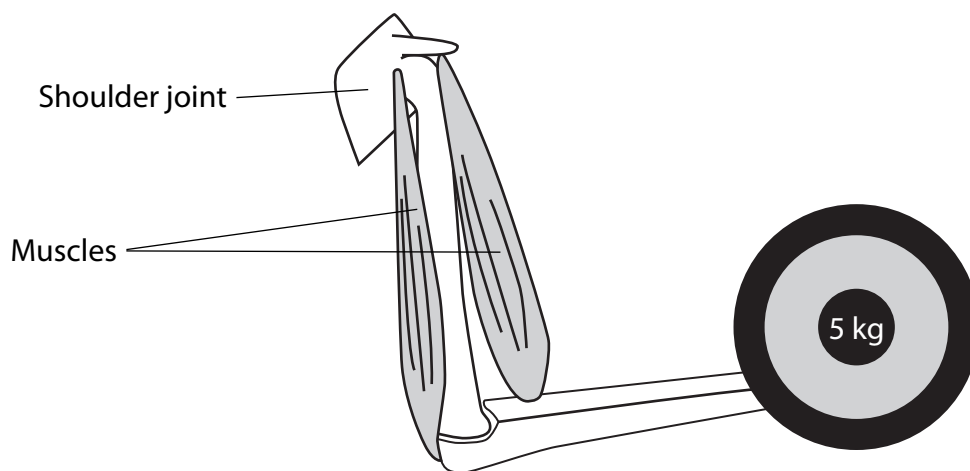
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Turn over ►

10 The diagram below shows the arrangement of muscles and bones in an arm. A 5 kg mass was held steady in the position shown and then lifted upwards towards the body.



(a) In the table below, show which of the muscles are contracted when holding the mass steady and when lifting it. Put a cross ☒ in the box beside muscles that are **contracted**.

(2)

Muscle	Muscle contracted when	
	Holding steady	Lifting upwards
Extensor	☒	☒
Flexor	☒	☒

(b) Name the structures that connect muscles to bones.

(1)

(c) Explain why muscles occur in antagonistic pairs.

(2)

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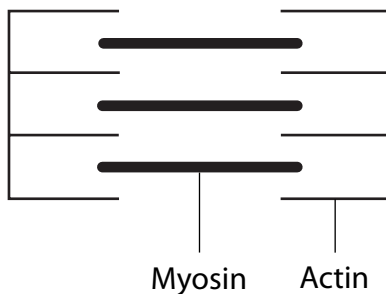
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(d) The diagram below shows the arrangement of actin and myosin myofilaments in part of an extended muscle.



Complete the diagram below to show accurately the arrangement of actin and myosin when the muscle is contracted.

(3)



*(e) Describe and explain the role of calcium ions and ATP in muscle contraction.

(5)

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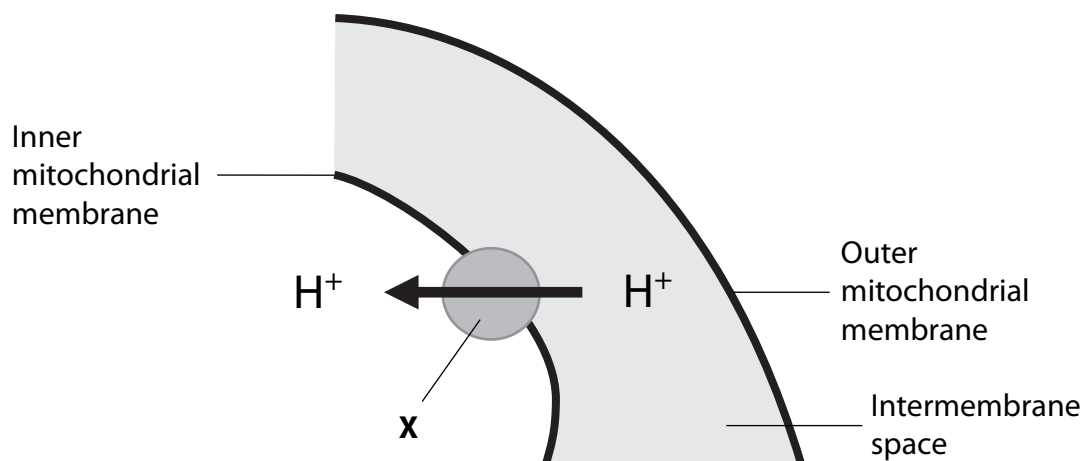
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(Total for Question 10 = 13 marks)

Turn over ►

11 The diagram below shows part of the process of chemiosmosis in a mitochondrion.



(a) Name the enzyme labelled **X** involved in chemiosmosis.

(1)

(b) Explain how a high concentration of hydrogen ions (H^+) is maintained in the intermembrane space.

(3)

(c) Describe the role of the hydrogen ion concentration gradient in making available an accessible supply of energy for biological processes.

(2)

(Total for Question 11 = 6 marks)