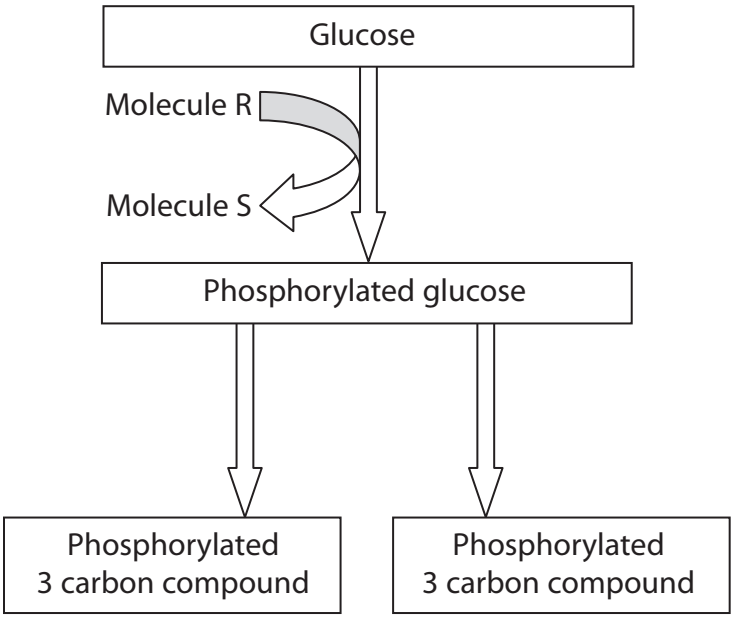
1 Respiration is a vital process in living organisms.
All organisms carry out glycolysis. The Krebs cycle also occurs in some organisms.

(a) The diagram below shows some of the stages in glycolysis, using the hexose sugar glucose.



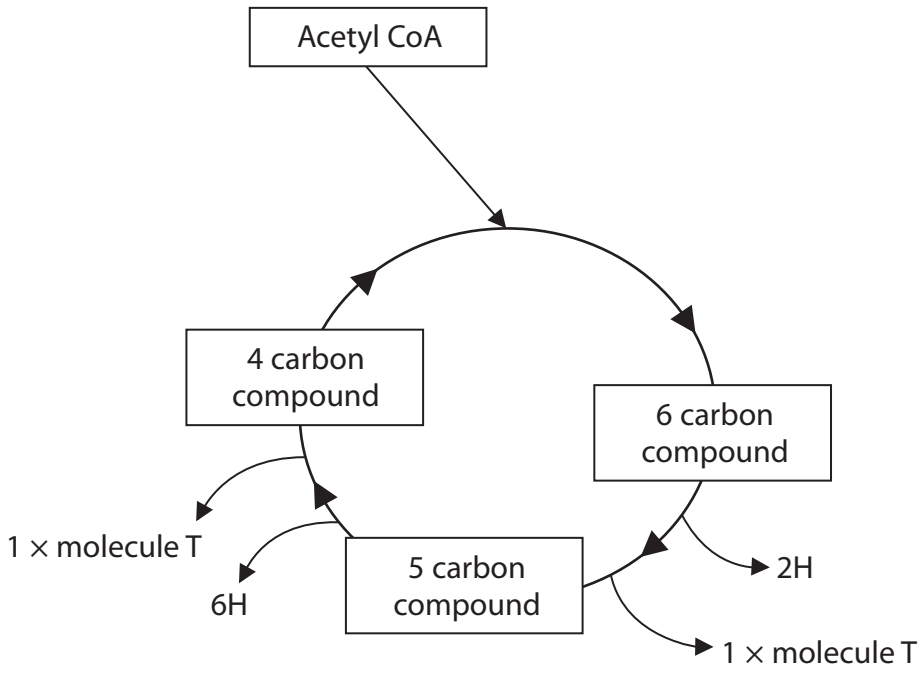
Name the molecules R and S shown in the diagram.

(2)

Molecule R .....

Molecule S .....

(b) The diagram below shows some of the stages in the Krebs cycle.



(i) Name molecule T and use the information in the Krebs cycle diagram to give a reason for your answer.

(2)

.....

.....

.....

.....

(ii) Using information in the diagram, suggest what would happen in the Krebs cycle if acetyl CoA became unavailable.

(3)

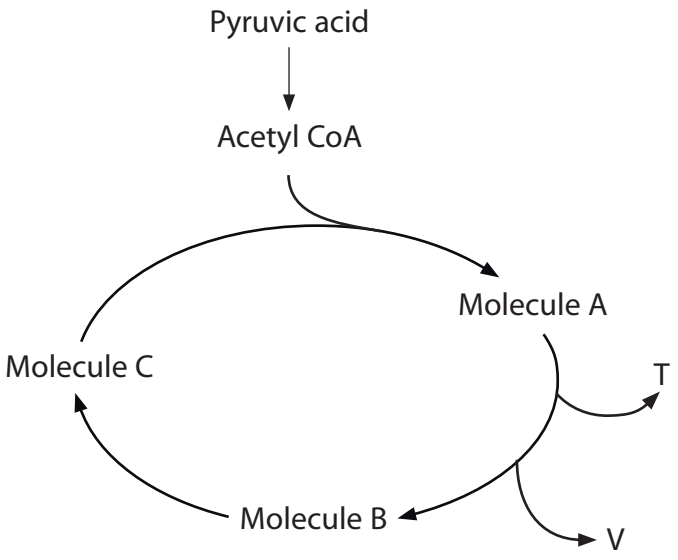
(c) The hydrogen (H) from the Krebs cycle enters the electron transport chain and oxidative phosphorylation occurs.

Explain what is meant by the term **oxidative phosphorylation**.

(3)

(Total for Question 1 = 10 marks)

2 The diagram below summarises some of the reactions in aerobic respiration.



(a) Name the process that produces pyruvic acid.

(1)

.....

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

(i) The waste product V

(1)

☒ **A** ATP

☒ **B** Carbon dioxide

☒ **C** Lactic acid

☒ **D** Water

(ii) The molecule T that becomes reduced during the process

(1)

☒ **A** ADP

☒ **B** Oxygen

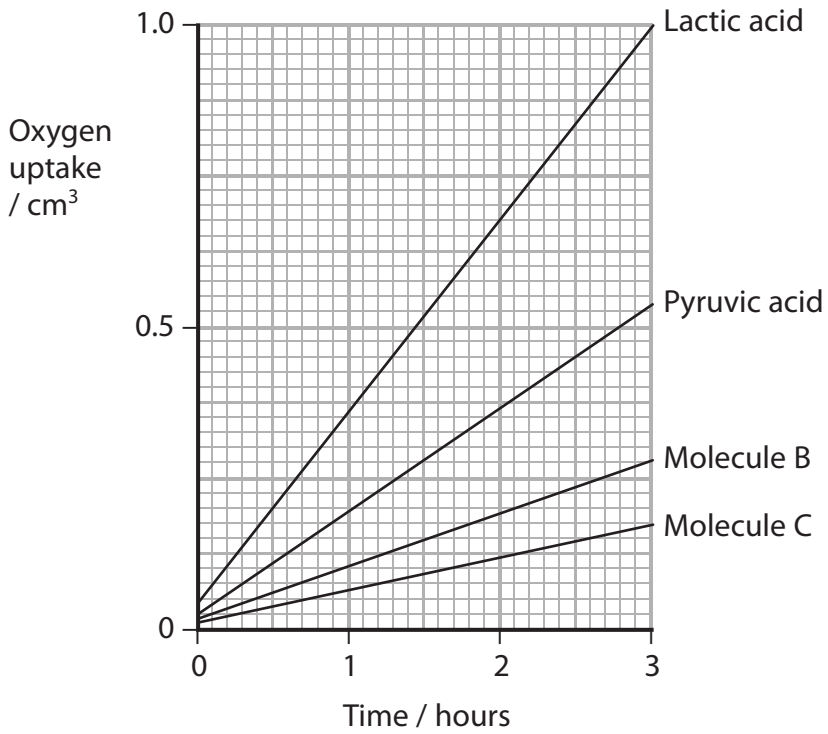
☒ **C** NAD

☒ **D** Water

(c) An investigation was carried out into the ability of bacteria to use different substances as substrates for aerobic respiration.

Cultures of bacteria were grown separately in media containing lactic acid or one of the substances shown in the diagram (pyruvic acid, molecule B or molecule C). The initial concentration of each of these substances in the media was the same. The oxygen uptake of each culture was measured over a period of time.

The results are shown in the graph below.



(i) Using the information in the diagram and the graph, suggest an explanation for the differences in oxygen uptake between bacteria using pyruvic acid, molecule B and molecule C as a substrate.

(4)

(ii) Suggest **one** reason for the rapid oxygen uptake by bacteria in a medium containing lactic acid. Give an explanation for your answer.

(2)

(Total for Question 2 = 9 marks)

3 Carrots are root vegetables that are eaten by many organisms.

An investigation was carried out to study the respiration rate of carrots.

100 g of carrot cubes were placed in a plastic bag containing air. The bag containing the carrot cubes was stored at 1 °C for three days.

All other variables were kept constant.

The percentages of oxygen and carbon dioxide in the bag were measured at the start of the investigation and at the end.

The results are shown in the table below.

Stage of the investigation	Percentage of each gas in the bag (%)	
	Oxygen	Carbon dioxide
Start	21.0	0.04
End	5.3	8.14

(a) (i) Suggest **two** variables, other than temperature, that need to be kept constant in this investigation so that valid results can be collected.

(2)

(ii) Explain the role of oxygen in the cells of the carrot cubes.

(3)

(b) Explain how the carrots produce carbon dioxide at the start of this investigation.

(4)

(c) The investigation was repeated at storage temperatures of 5 °C and 10 °C.

The table below shows the change in percentage of carbon dioxide in the bag at the end of the investigation compared with the start of the investigation for all three storage temperatures.

Storage temperature / °C	Change in percentage of carbon dioxide (%)
1	+ 8.
5	+ 14.
10	+ 16.

Explain the effect of temperature on the change in the percentage of carbon dioxide in the bag.

(3)

(d) Suggest why the carrot tissue could survive when no oxygen was left in the bag.

(1)

(Total for Question 3 = 13 marks)