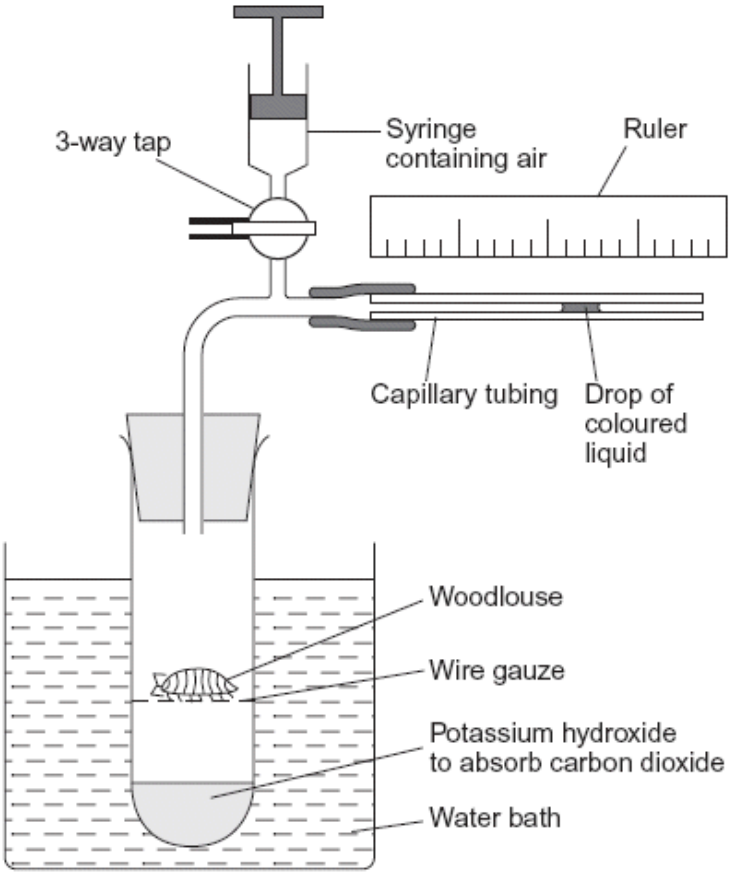
Q1. (a) A student measured the rate of aerobic respiration of a woodlouse using the apparatus shown in the diagram.



(i) The student closed the tap. After thirty minutes the drop of coloured liquid had moved to the left. Explain why the drop of coloured liquid moved to the left.

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(3)

(ii) What measurements should the student have taken to calculate the rate of aerobic respiration in mm^3 of oxygen g^{-1} h^{-1}?

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(3)

(b) DNP inhibits respiration by preventing a proton gradient being maintained across membranes. When DNP was added to isolated mitochondria the following changes were observed

- less ATP was produced
- more heat was produced
- the uptake of oxygen remained constant.

Explain how DNP caused these changes.

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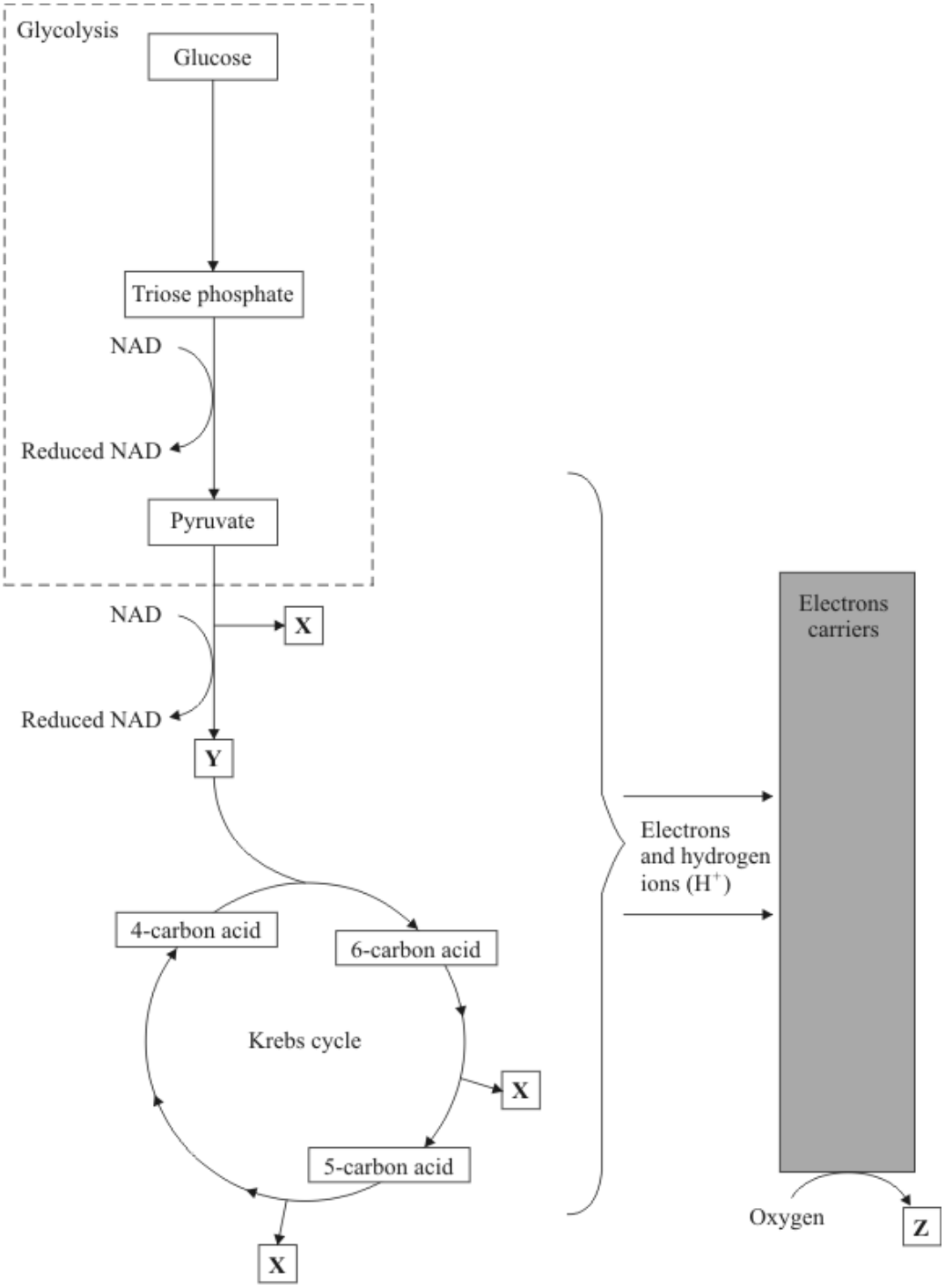
(3)
(Total 9 marks)

Q2. The diagram gives an outline of the process of aerobic respiration.



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

X .....

Y .....

Z .....

(3)

(b) Give the location of each of the following in a liver cell.

(i) Glycolysis .....

(ii) The Krebs cycle .....

(2)

(c) (i) Write the letter **A** on the diagram to show **one** step where ATP is used.

(ii) Write the letter **B** on the diagram at **two** steps where ATP is produced.

(3)

(d) Apart from respiration, give **three** uses of ATP in a liver cell.

1 .....

2 .....

3 .....

(3)

(e) Human skeletal muscle can respire both aerobically and anaerobically. Describe what happens to pyruvate in anaerobic conditions and explain why anaerobic respiration is advantageous to human skeletal muscle.

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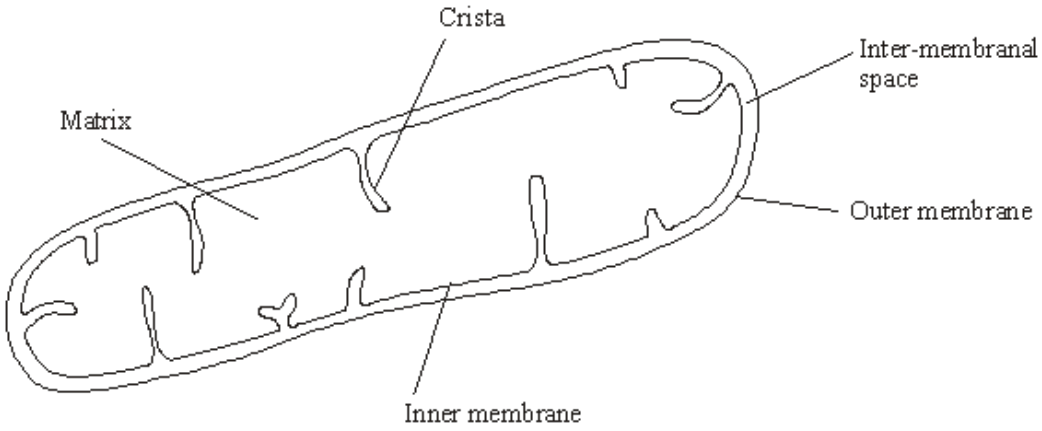
(4)
(Total 15 marks)

Q3. The diagram shows the structure of a mitochondrion.



(a) In which part of the mitochondrion does the Krebs cycle take place?

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(1)

(b) Name **two** substances for which there would be net movement into the mitochondrion.

1 .....

2 .....

(2)

(c) The mitochondria in muscles contain many cristae. Explain the advantage of this.

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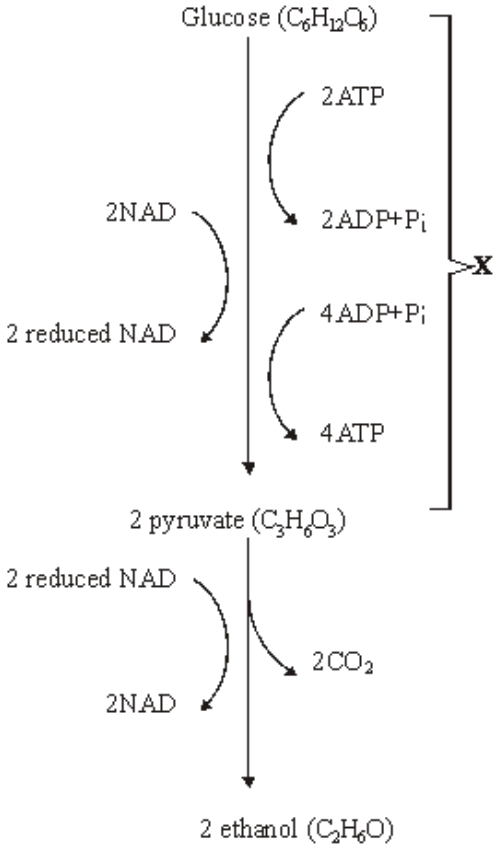
(2)

(Total 5 marks)

Q4. (a) The main stages in anaerobic respiration in yeast are shown in the diagram.



(i) Name process **X**.

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(1)

(ii) Give **one** piece of evidence from the diagram which suggests that the conversion of pyruvate to ethanol involves reduction.

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(1)

(iii) Explain why converting pyruvate to ethanol is important in allowing the continued production of ATP in anaerobic respiration.

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(2)

(b) Give **two** ways in which anaerobic respiration of glucose in yeast is

(i) similar to anaerobic respiration of glucose in a muscle cell;

1 .....

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2 .....

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(2)

(ii) different from anaerobic respiration of glucose in a muscle cell.

1 .....

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2 .....

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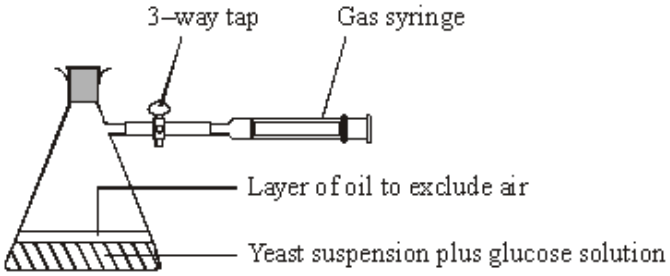
(2)

(c) Some students investigated the effect of temperature on the rate of anaerobic respiration in yeast. The apparatus they used is shown in the diagram. The yeast suspension was mixed with glucose solution and the volume of gas collected in five minutes was recorded.



(i) Each student repeated the experiment and the results were pooled. Explain the advantages of collecting a large number of results.

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(2)

(ii) At 30 °C, one student obtained the following results.

Volume of gas collected in 5 minutes / cm^3	Result 1	Result 2	Result 3
	38.3	27.6	29.4

Calculate the mean rate of gas production. Give your answer in $cm^3\ s^{-1}$.

Answer ..... $cm^3\ s^{-1}$

(2)

(iii) If aerobic respiration had been investigated rather than anaerobic respiration, how would you expect the volumes of gas collected at 30°C to differ from these results?

Explain your answer.

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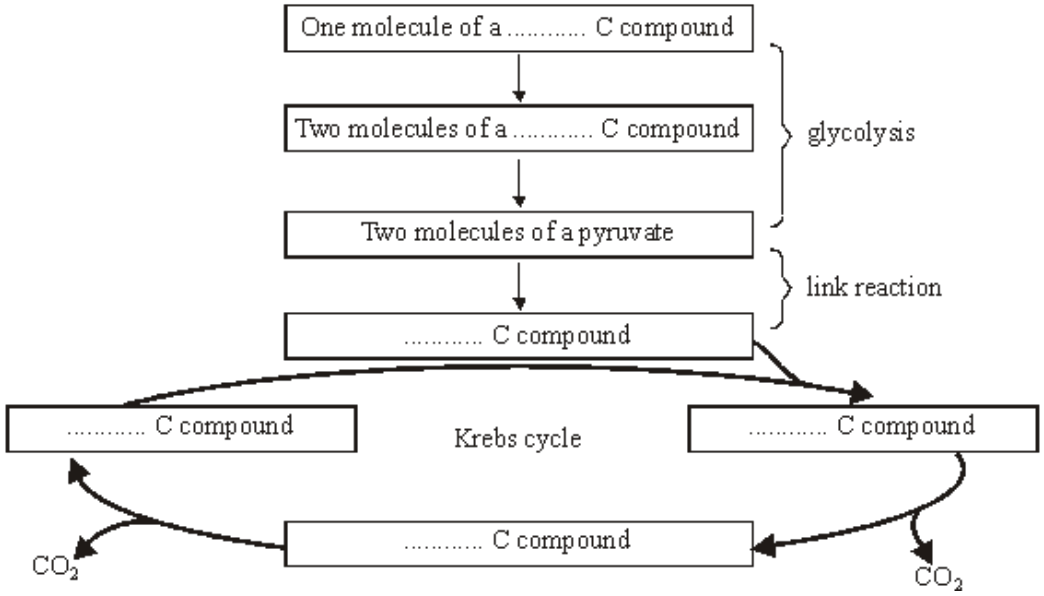
(3)

(Total 15 marks)

Q5. The boxes in the diagram represent substances in glycolysis, the link reaction and the Krebs cycle.



(a) Complete the diagram to show the number of carbon atoms present in **one** molecule of each compound.

(2)

(b) Other substances are produced in the Krebs cycle in addition to the carbon compounds shown in the diagram. Name **three** of these other products.

1 .....

2 .....

3 .....

(3)
(Total 5 marks)

Q6. (a) The table contains some statements relating to biochemical processes in a plant cell. Complete the table with a tick if the statement is true or a cross if it is not true for each biochemical process.

Statement	Glycolysis	Krebs cycle	Light-dependent reaction of photosynthesis
NAD is reduced			
NADP is reduced			
ATP is produced			
ATP is required			

(4)

(b) An investigation was carried out into the production of ATP by mitochondria. ADP, phosphate, excess substrate and oxygen were added to a suspension of isolated mitochondria.

(i) Suggest the substrate used for this investigation.

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(1)

(ii) Explain why the concentration of oxygen and amount of ADP fell during the investigation.

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(2)

(iii) A further investigation was carried out into the effect of three inhibitors, **A**, **B** and **C**, on the electron transport chain in these mitochondria. In each of three experiments, a different inhibitor was added. The table shows the state of the electron carriers, **W–Z**, after the addition of inhibitor.

Inhibitor added	**Electron carrier**			
	W	**X**	**Y**	**Z**
A	oxidised	reduced	reduced	oxidised
B	oxidised	oxidised	reduced	oxidised
C	reduced	reduced	reduced	oxidised

Give the order of the electron carriers in this electron transport chain. Explain your answer.

Order ....

Explanation .....

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(2)
(Total 9 marks)

Q7. (a) Describe the part played by the inner membrane of a mitochondrion in producing ATP.

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(3)

(b) A scientist investigated ATP production in a preparation of isolated mitochondria. He suspended the mitochondria in an isotonic solution and added a suitable respiratory substrate together with ADP and phosphate. He bubbled oxygen through the preparation.

(i) Why was the solution in which the mitochondria were suspended isotonic?

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(1)

(ii) Explain why the scientist did **not** use glucose as the respiratory substrate.

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(2)

(iii) Explain why the oxygen concentration would change during this investigation.

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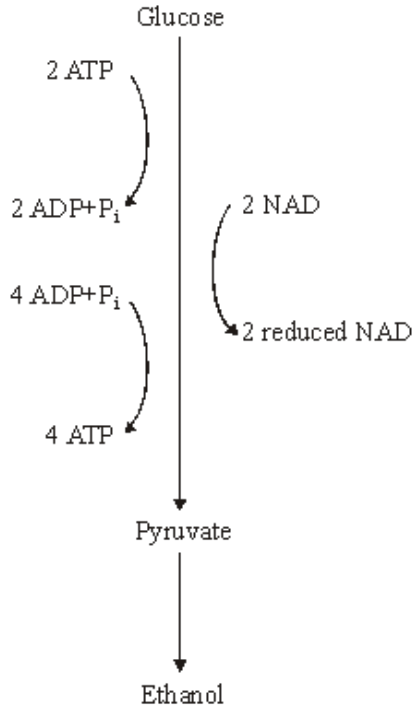
(1)

(Total 7 marks)

Q8. The diagram summarises the process of anaerobic respiration in yeast cells.



(a) (i) In anaerobic respiration, what is the net yield of ATP molecules per molecule of glucose?

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(1)

(ii) Give **two** advantages of ATP as an energy-storage molecule within a cell.

1 .....

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2 .....

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(2)

(b) Describe how NAD is regenerated in anaerobic respiration in yeast cells.

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(1)

(c) The respiratory quotient (RQ) for yeast respiring aerobically and using glucose as a substrate is 1.0. However, some students found the RQ of yeast respiring glucose to be 1.6. Assuming that their technique was correct, explain how this is possible.

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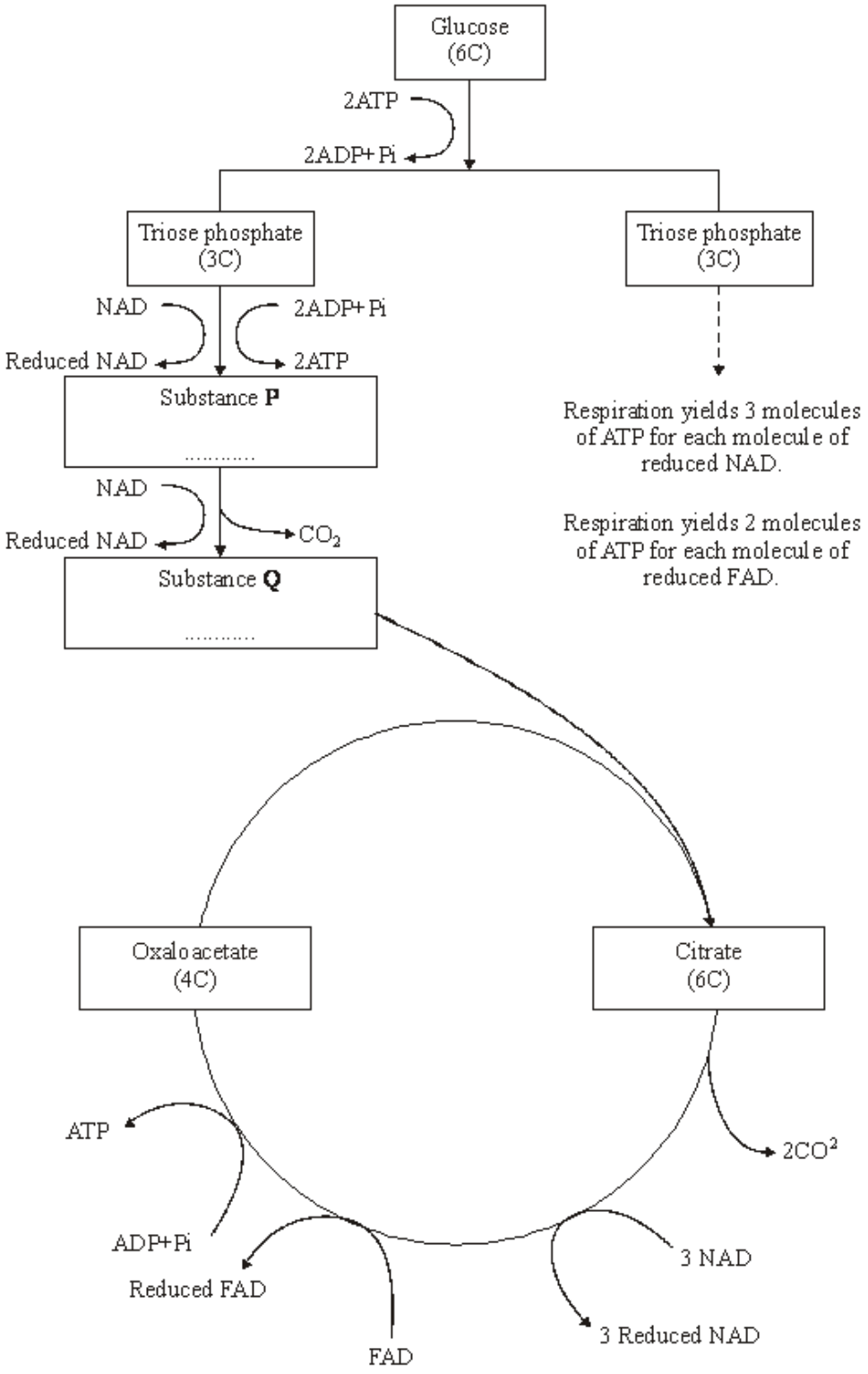
(2)
(Total 6 marks)

Q9. (a) The flow chart shows the main stages in aerobic respiration.



(i) Complete the flow chart by writing, in the appropriate boxes, the number of carbon atoms in substance **P** and the name of substance **Q**.

(2)

(ii) Some ATP is formed in the cytoplasm and some in the mitochondria. Use the information given to calculate the number of molecules of ATP formed in a mitochondrion from one molecule of glucose in aerobic respiration. Show how you arrived at your answer.

Answer.....

(2)

(iii) In the presence of oxygen, respiration yields more ATP per molecule of glucose than it does in the absence of oxygen. Explain why.

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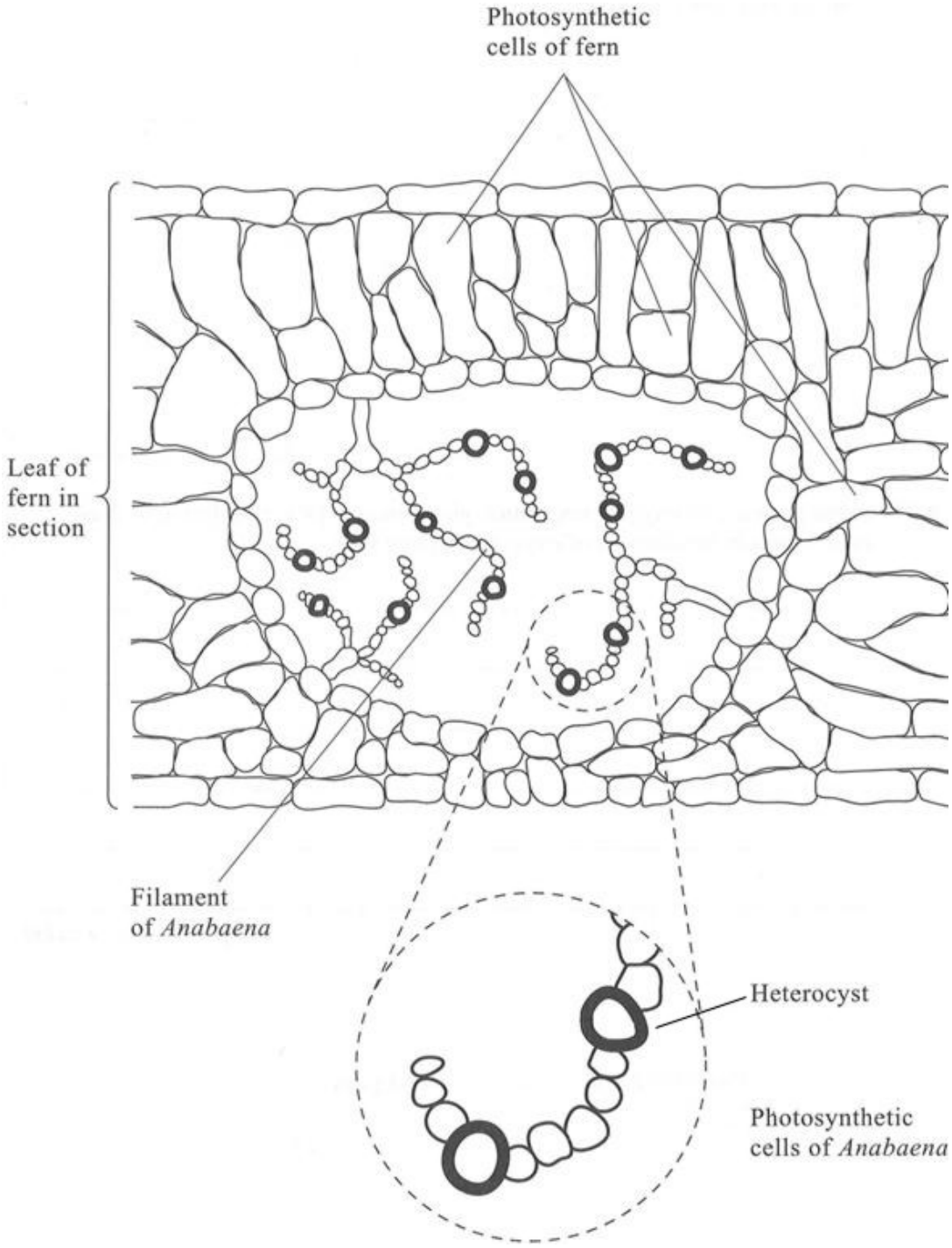
(3)

(b) Anabaena is a prokaryote found inside the leaves of a small fern. Anabaena can produce ammonia from nitrogen (nitrogen fixation). This reaction only takes place in the anaerobic conditions found in cells called heterocysts. Heterocysts are thick-walled cells that do not contain chlorophyll. The drawing shows the relationship between *Anabaena* and the fern.



(i) Suggest how the features of the heterocysts improve the efficiency of the process of nitrogen fixation.

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(3)

(ii) In China, the fern is cultivated and ploughed into fields to act as an organic fertiliser. Explain how ploughing the fern plants into the soil results in an improvement in the growth of the rice crop grown in these fields.

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(5)
(Total 15 marks)

Q10. (a) The biochemical pathway of aerobic respiration involves a number of different steps.

Name **one** step in which carbon dioxide is produced.

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(1)

In an investigation, scientists transferred slices of apple from air to anaerobic conditions in pure nitrogen gas. They measured the rate of carbon dioxide production.

(b) The scientists kept the temperature constant throughout the investigation. Explain how a decrease in temperature would affect the rate of carbon dioxide production.

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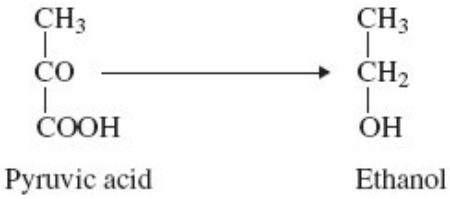
(2)

(c) When the apple slices were transferred to nitrogen, the following biochemical pathway took place.



Pyruvic acid Ethanol

Use this pathway to explain the part played by reduced NAD when the apple slices were transferred to nitrogen.

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(2)

(d) The rate of carbon dioxide production was higher when the apple slices were in nitrogen than when they were in the air. Explain why.

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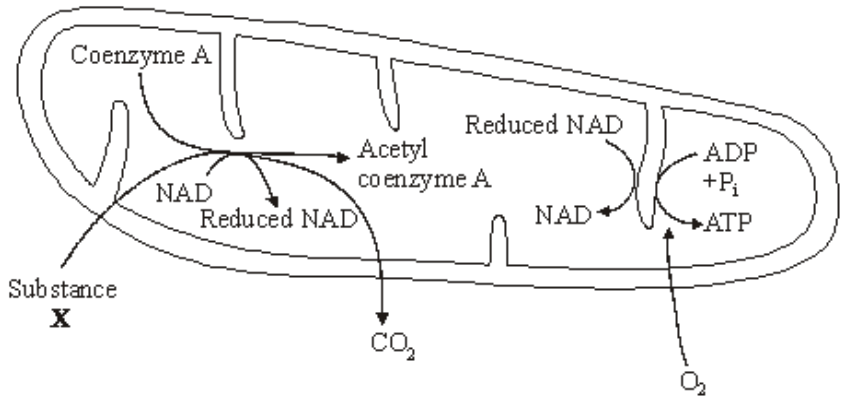
(3)

(Total 8 marks)

Q11. The diagram represents two of the stages of aerobic respiration that take place in a mitochondrion.



(a) Name substance **X**.

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(1)

(b) Which stage of aerobic respiration takes place inside a mitochondrion and is **not** represented on the diagram?

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(1)

(c) Explain why oxygen is needed for the production of ATP on the cristae of the mitochondrion.

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(3)
(Total 5 marks)

Q12. Each of the following statements refers to a process that occurs either during photosynthesis or during respiration. A 6C compound refers to a compound whose molecules contain six carbon atoms, 5C refers to a compound with five carbon atoms, and so on.

For each statement, give as precisely as possible the stage of photosynthesis or respiration and the names of the compounds.

(a) A 6C compound is broken down into two 3C compounds.

Stage .....

6C compound .....

3C compound .....

(2)

(b) A 5C compound is combined with a 1C compound.

Stage .....

5C compound .....

1C compound .....

(2)

(c) 3C compounds are combined to form a 6C compound.

Stage .....

3C compound .....

6C compound .....

(2)

(Total 6 marks)

Q13. Roundabouts are common at road junctions in towns and cities. Ecologists investigated the species of plants and animals found on roundabouts in a small town.

(a) Ground beetles are large black insects. The mark-release-recapture method can be used to estimate the ground beetle population on a roundabout. Describe how.

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(5)

(b) The grass on the roundabouts was mown at different time intervals. The table shows the mean number of plant species found on the roundabouts.

Approximate interval between mowing/days	Mean number of plant species
7	15.8
14	21.2
40	30.6
365+	32.0

Mowing was also found to affect the number of insect species found on a roundabout. Use your knowledge of succession to explain how.

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(5)

(c) The carbon dioxide concentration was monitored at ground level in the centre of a small roundabout. The measurements were made on a summer day. Describe and explain how you would expect the concentration of carbon dioxide to fluctuate over the period of 24 hours.

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(5)

(Total 15 marks)

Q14. (a) Mitochondria in muscle cells have more cristae than mitochondria in skin cells. Explain the advantage of mitochondria in muscle cells having more cristae.

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(2)

(b) Substance **X** enters the mitochondrion from the cytoplasm. Each molecule of substance **X** has three carbon atoms.

(i) Name substance **X**.

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(1)

(ii) In the link reaction substance **X** is converted to a substance with molecules effectively containing only two carbon atoms. Describe what happens in this process.

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(2)

(c) The Krebs cycle, which takes place in the matrix, releases hydrogen ions. These hydrogen ions provide a source of energy for the synthesis of ATP, using coenzymes and carrier proteins in the inner membrane of the mitochondrion.

Describe the roles of the coenzymes and carrier proteins in the synthesis of ATP.

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(3)
(Total 8 marks)