

AQA, OCR, Edexcel

A Level

A Level Biology

Photosynthesis, Respiration Succession
and Nutrient Cycle Questions

Name:

M

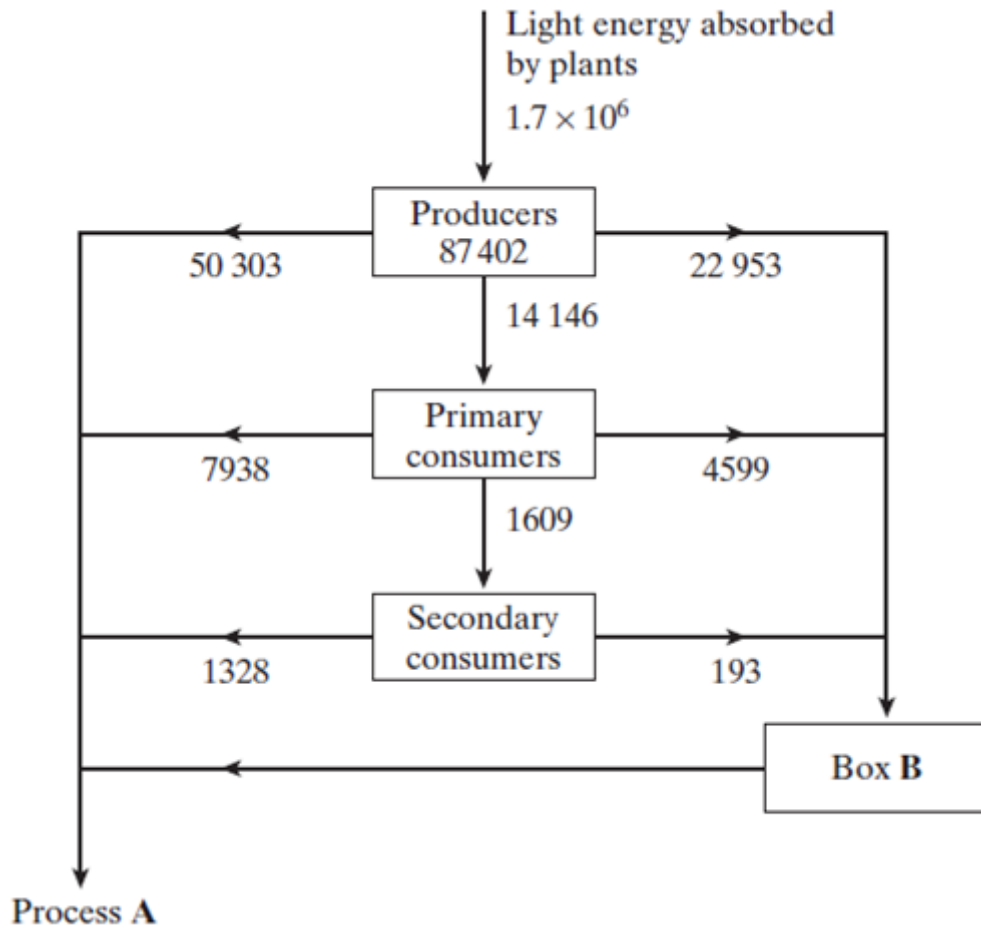
M

E

Mathsmadeeasy.co.uk

Total Marks:

Q1. The diagram shows the energy flow through a freshwater ecosystem. All units are $\text{kJ m}^{-2}\text{year}^{-1}$.



(a) Name

(i) process **A**;

.....(1)

(ii) the group of organisms represented by box **B**.

.....(1)

(b) Calculate the percentage efficiency with which light energy is transferred to energy in producers. Show your working.

Answer

(2)

S (c) Describe the effect of light energy in the light-dependent reaction of photosynthesis.

.....

(2)

S (d) If a plant is kept in the dark it is still able to produce carbohydrates, as long as it is provided with two products of the light-dependent reaction of photosynthesis. Give the name of these products and explain their function in the light-independent reaction of photosynthesis.

Name

Function

.....

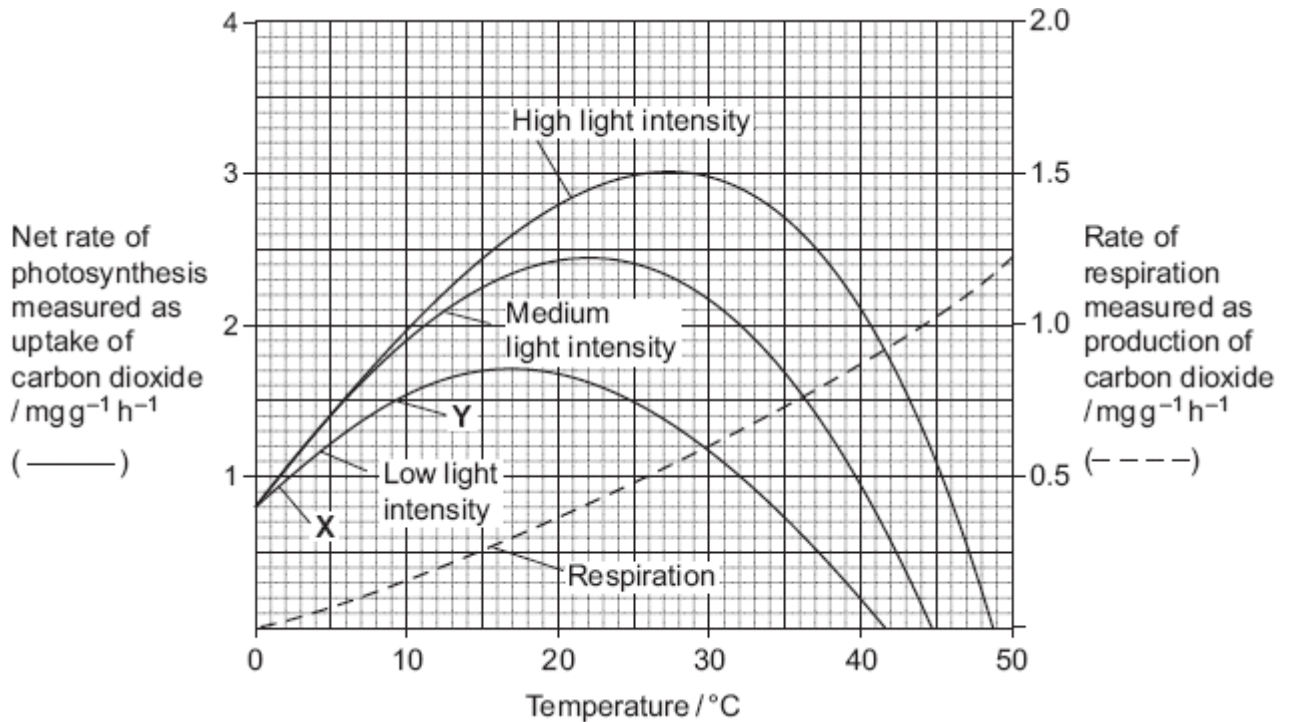
Name

Function

.....(4)

(Total 10 marks)

Q2. Scientists investigated the effects of temperature and light intensity on the rate of photosynthesis in creeping azalea. They investigated the effect of temperature on the net rate of photosynthesis at three different light intensities. They also investigated the effect of temperature on the rate of respiration. The graph shows the results.



(a) (i) Name the factors that limited the rate of photosynthesis between X and Y.

.....(1)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

(ii) Use information from the graph to explain your answer.

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

(b) Use information from the graph to find the gross rate of photosynthesis at 20°C and medium light intensity.

Answer

(1)

(c) Creeping azalea is a plant which grows on mountains. Scientists predict that in the area where this plant grows the mean summer temperature is likely to rise from 20 °C to 23 °C. It is also likely to become much cloudier. Describe and explain how these changes are likely to affect the growth of creeping azalea.

.....
.....
.....
.....
.....
.....(3)

(Total 7 marks)

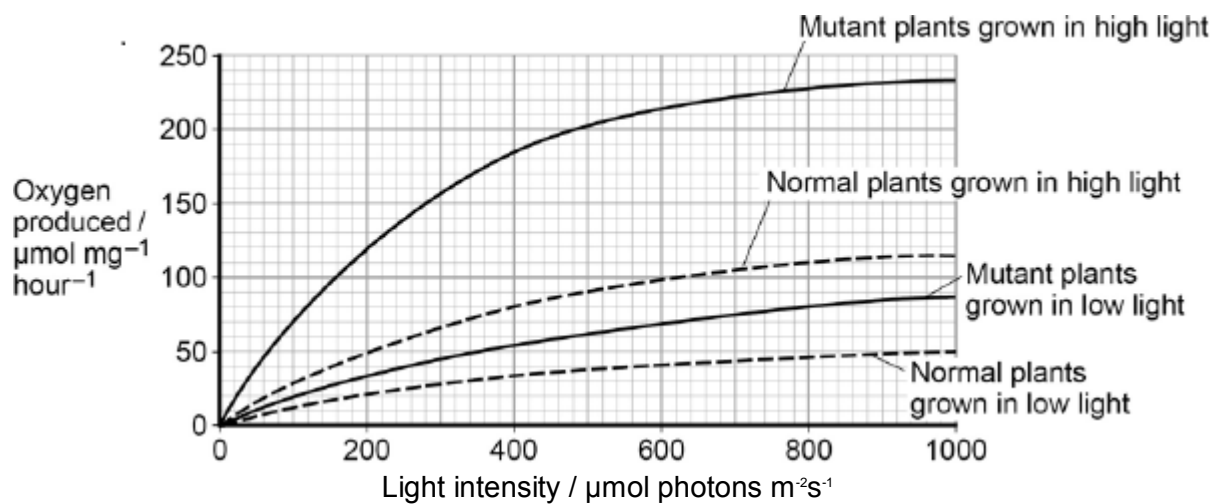
Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

Q3. Chloroplasts contain chlorophyll a and chlorophyll b. Scientists found tobacco plants with a mutation that caused them to make more chlorophyll b than normal tobacco plants. They investigated the effect of this mutation on the rate of photosynthesis.

The scientists carried out the following investigation.

- They grew normal and mutant tobacco plants. They grew some of each in low light intensity and grew others in high light intensity.
- They isolated samples of chloroplasts from mature plants of both types.
- Finally, they measured oxygen production by the chloroplasts they had isolated from the plants.

The figure below shows the scientists' results.



(a) Explain why the scientists measured the rate of production of oxygen in this investigation.

.....

.....

.....

.....(2)

In each trial, the scientists collected oxygen for 15 minutes.

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (b) Calculate the difference in the oxygen produced by the chloroplasts from mutant plants grown in low and high light intensities at a light intensity of $500 \mu\text{mol photons m}^{-2} \text{ s}^{-1}$.

Show your working.

Difference $\mu\text{mol O}_2 \text{ mg}^{-1} \text{ hour}^{-1}$ (2)

- (c) The scientists suggested that mutant plants producing more chlorophyll b would grow faster than normal plants in all light intensities.

Explain how these data support this suggestion.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(4)
(Total 8 marks)

Q4. (a) In respiration in cells,

- (i) where does glycolysis take place

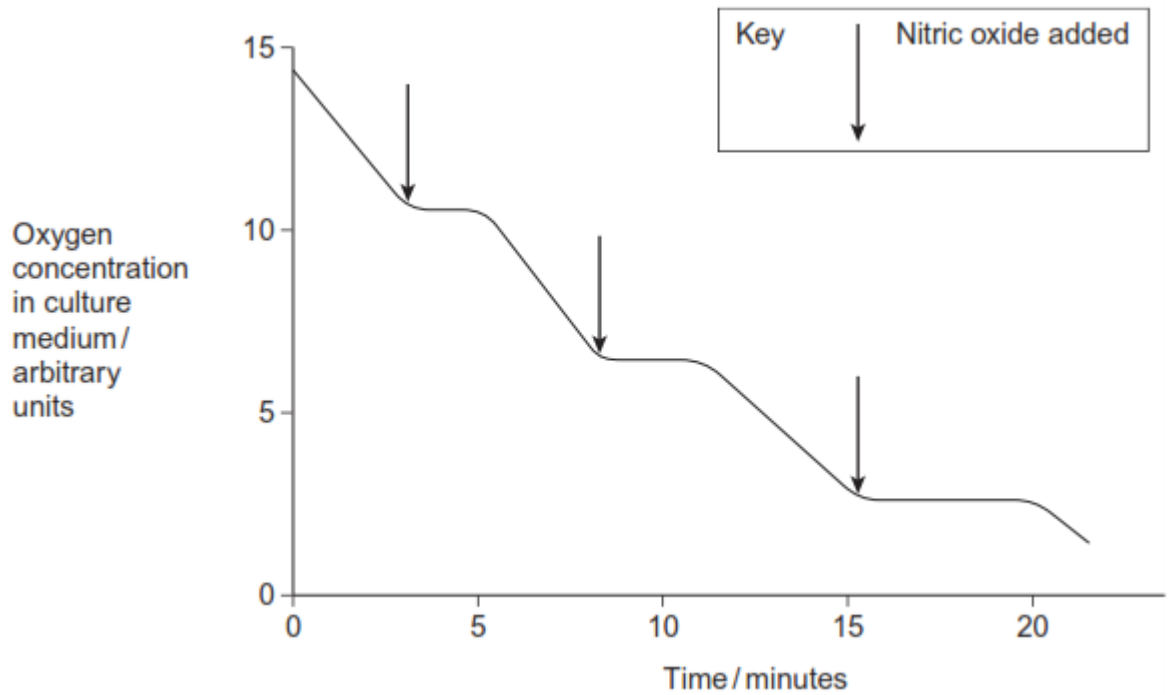
.....(1)

- (ii) where, exactly, is the electron transfer chain found?

.....(1)

- (b) Scientists kept kidney cells in a liquid culture. They investigated the effect of the gas nitric oxide on oxygen consumption by these cells. They recorded the oxygen concentration in the culture medium over a period of time. At intervals they added a small volume of nitric oxide to the culture medium. Nitric oxide affects the functioning of a protein in the electron transport chain.

The graph shows their results.



Explain the effect of nitric oxide.

.....

.....

.....

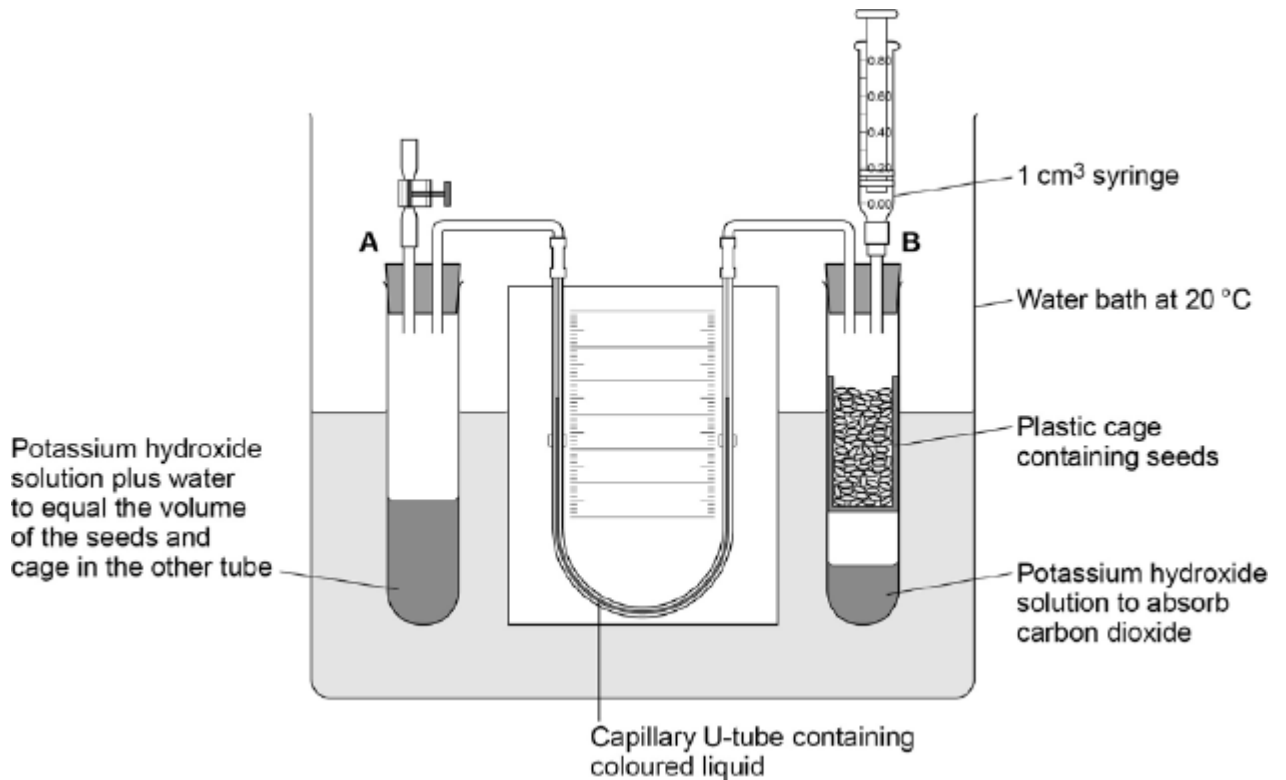
.....

.....

.....

(3)
(Total 5 marks)

Q5. The figure below shows the apparatus used for measuring the rate of oxygen consumption in aerobic respiration by seeds.



- (a) For the first 10 minutes, the tap attached to tube **A** was left open and the syringe from tube **B** was removed.

Suggest **three** reasons why the apparatus was left for 10 minutes.

- 1
-
- 2
-
- 3
-(3)

- (b) Suggest and explain why the chosen temperature was 20 °C for this experiment.

-
-
-
-(2)

After 10 minutes, the tap attached to tube **A** was closed and the syringe was attached to tube **B**. Every minute, the syringe plunger was moved until the levels in the U-tube were the same. The reading on the syringe volume scale was then recorded. The results are shown in the table below.

Time / minutes	Reading on syringe volume scale / cm ³
0	0.84
1	0.81
2	0.79
3	0.76
4	0.73
5	0.70
6	0.68
7	0.66
8	0.63
9	0.62
10	0.58

- (c) During the experiment, the coloured liquid in the tubing moved towards tube **B**. Explain what caused this.

.....
.....
.....
.....
.....
.....

(3)

- (d) The mass of the seeds was 1.6 g. Use the information in the table above to calculate the rate of oxygen consumption in cm³ g⁻¹ hour⁻¹ by the seeds.

Show your working.

Rate = cm³ g⁻¹ hour⁻¹

(2)

(Total 10 marks)

Q6.(a) Describe how acetylcoenzyme A is formed in the link reaction.

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

(b) In the Krebs cycle, acetylcoenzyme A combines with four-carbon oxaloacetate to form six-carbon citrate. This reaction is catalysed by the enzyme citrate synthase.

(i) Oxaloacetate is the first substrate to bind with the enzyme citrate synthase. This induces a change in the enzyme, which enables the acetylcoenzyme A to bind.

Explain how oxaloacetate enables the acetylcoenzyme A to then bind to the enzyme.

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

(ii) Another substance in the Krebs cycle is called succinyl coenzyme A. This substance has a very similar shape to acetylcoenzyme A.

Suggest how production of succinyl coenzyme A could control the rate of the reaction catalysed by citrate synthase.

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

- (c) In muscles, pyruvate is converted to lactate during anaerobic respiration.
- (i) Explain why converting pyruvate to lactate allows the continued production of ATP during anaerobic respiration.

.....

.....

.....

.....

.....(2)

- (ii) In muscles, some of the lactate is converted back to pyruvate when they are well supplied with oxygen. Suggest **one** advantage of this.

.....

.....

.....

.....(1)

(Total 9 marks)

Q7. A scientist investigated the uptake of radioactively labelled carbon dioxide in chloroplasts. She used three tubes, each containing different components of chloroplasts. She measured the uptake of carbon dioxide in each of these tubes. Her results are shown in the table.

Tube	Contents of tube	Uptake of radioactively labelled CO₂ / counts per minute
A	Stroma and grana	96 000
B	Stroma, ATP and reduced NADP	97 000
C	Stroma	4 000

- (a) Name the substance which combines with carbon dioxide in a chloroplast.
-(1)

- (b) Explain why the results in tube **B** are similar to those in tube **A**.
-
-
-(1)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (c) Use the information in the table to predict the uptake of radioactively labelled carbon dioxide if tube **A** was placed in the dark. Explain your answer.

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

- (d) Use your knowledge of the light-independent reaction to explain why the uptake of carbon dioxide in tube **C** was less than the uptake in tube **B**.

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

- (e) DCMU is used as a weed killer. It inhibits electron transfer during photosynthesis. The addition of DCMU to tube **A** decreased the uptake of carbon dioxide. Explain why.

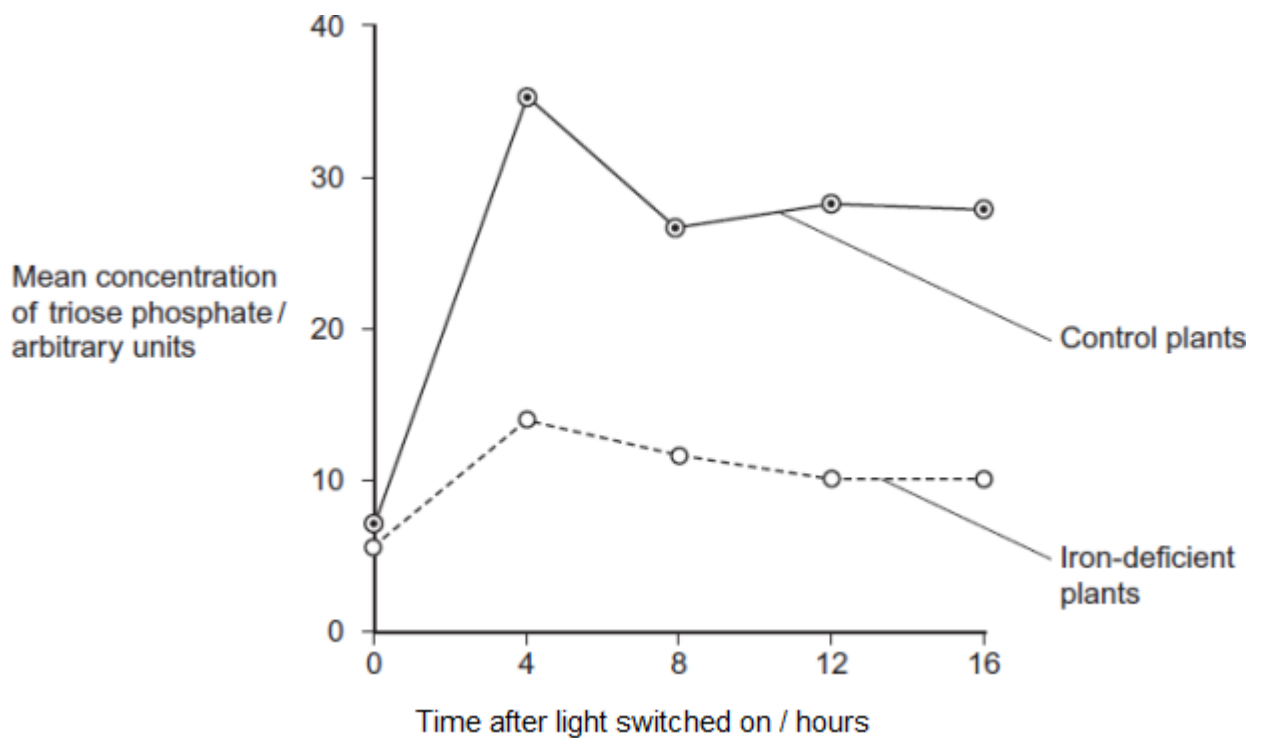
.....
.....
.....
.....
.....(2)

(2)
(Total 8 marks)

Q8. Scientists investigated the effect of iron deficiency on the production of triose phosphate in sugar beet plants. They grew the plants under the same conditions with their roots in a liquid growth medium containing all the necessary nutrients. Ten days before the experiments, they transferred half the plants to a liquid growth medium containing no iron. The scientists measured the concentration of triose phosphate produced in these plants and in the control plants:

- at the end of 6 hours in the dark
- then for 16 hours in the light.

Their results are shown in the graph.



- (a) (i) The experiments were carried out at a high carbon dioxide concentration. Explain why.

.....
.....
.....(1)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (ii) Explain why it was important to grow the plants under the same conditions up to ten days before the experiment.

.....
.....
.....(1)

- (iii) The plants were left in the dark for 6 hours before the experiment. Explain why.

.....
.....
.....(1)

- (b) Iron deficiency reduces electron transport. Use this information and your knowledge of photosynthesis to explain the decrease in production of triose phosphate in the iron-deficient plants.

.....
.....
.....
.....
.....
.....
.....
.....
.....(4)

- (c) Iron deficiency results in a decrease in the uptake of carbon dioxide. Explain why.

.....
.....
.....
.....(2)
(Total 9 marks)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

Q9. Scientists measured the rate of respiration in **three** parts of an ecosystem.

They did this by measuring carbon dioxide released into the air by:

- leaves of plants
- stems and roots of plants
- non-photosynthetic soil organisms.

The table below shows the scientists' results for these three parts of the ecosystem.

Part of ecosystem	Mean rate of carbon dioxide production / $\text{cm}^3 \text{ m}^{-2} \text{ s}^{-1}$	Percentage of total carbon dioxide production measured by the scientists
Leaves of plants	0.032	25.0
Stems and roots of plants	0.051	
Non-photosynthetic soil organisms	0.045	

(a) Complete the table to show the percentage of total carbon dioxide production by each part of the ecosystem. Show your working.

(2)

(b) A student who looked at the data in the table concluded that plants carry out more respiration than non-photosynthetic organisms in the ecosystem.

Use the information provided to suggest why these data may **not** support the student's conclusion.

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

(c) What measurements would the scientists have made in order to calculate the rate of carbon dioxide production?

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

- (d) The scientists calculated the mean rate of carbon dioxide production of the leaves using measurements of carbon dioxide release in the dark.

Explain why they did **not** use measurements taken in the light.

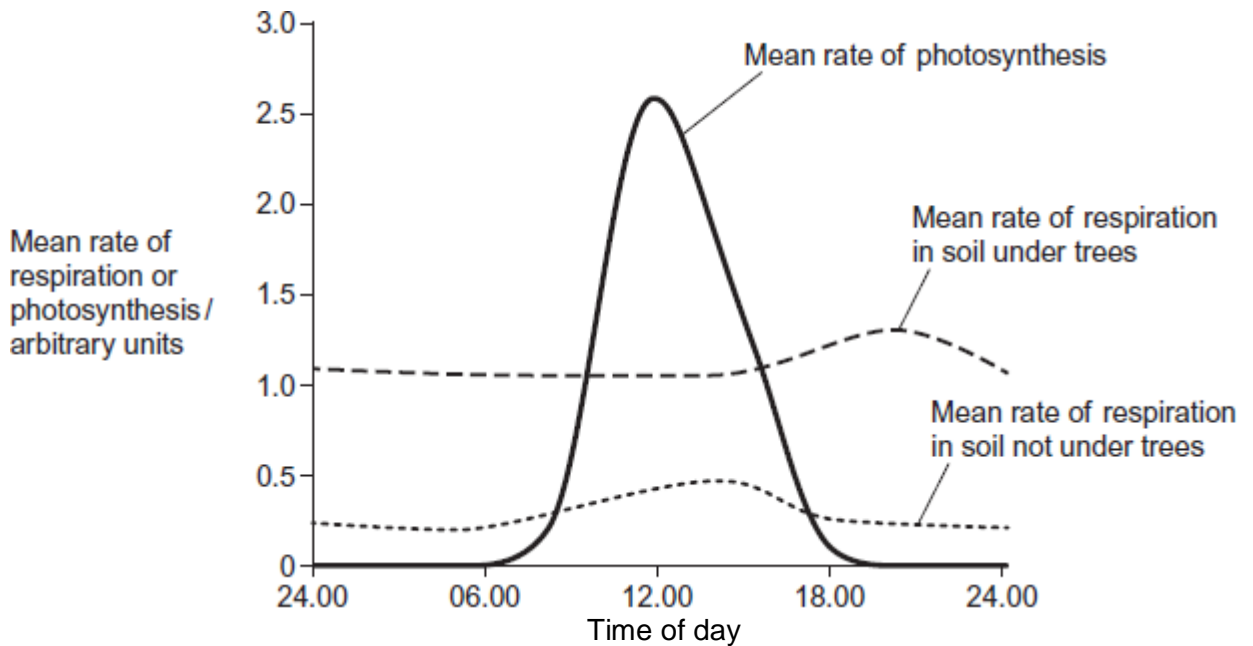
.....

.....

.....

.....(2)

Another group of scientists measured the mean rate of respiration in soil under trees and soil not under trees in the same wood. They also measured the mean rate of photosynthesis in the trees. They took measurements at different times of day during the summer. The figure below shows the scientists' results.



- (e) (i) Describe **two** ways in which the mean rate of respiration in soil under trees is different from soil not under trees.

1

.....

2

.....(2)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (ii) Suggest **one** explanation for the differences in the mean rate of respiration in soil under trees and soil not under trees between 06.00 and 12.00.

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

- (f) The scientists suggested that the rise in the mean rate of photosynthesis was the cause of the rise in the mean rate of respiration in soil under trees.

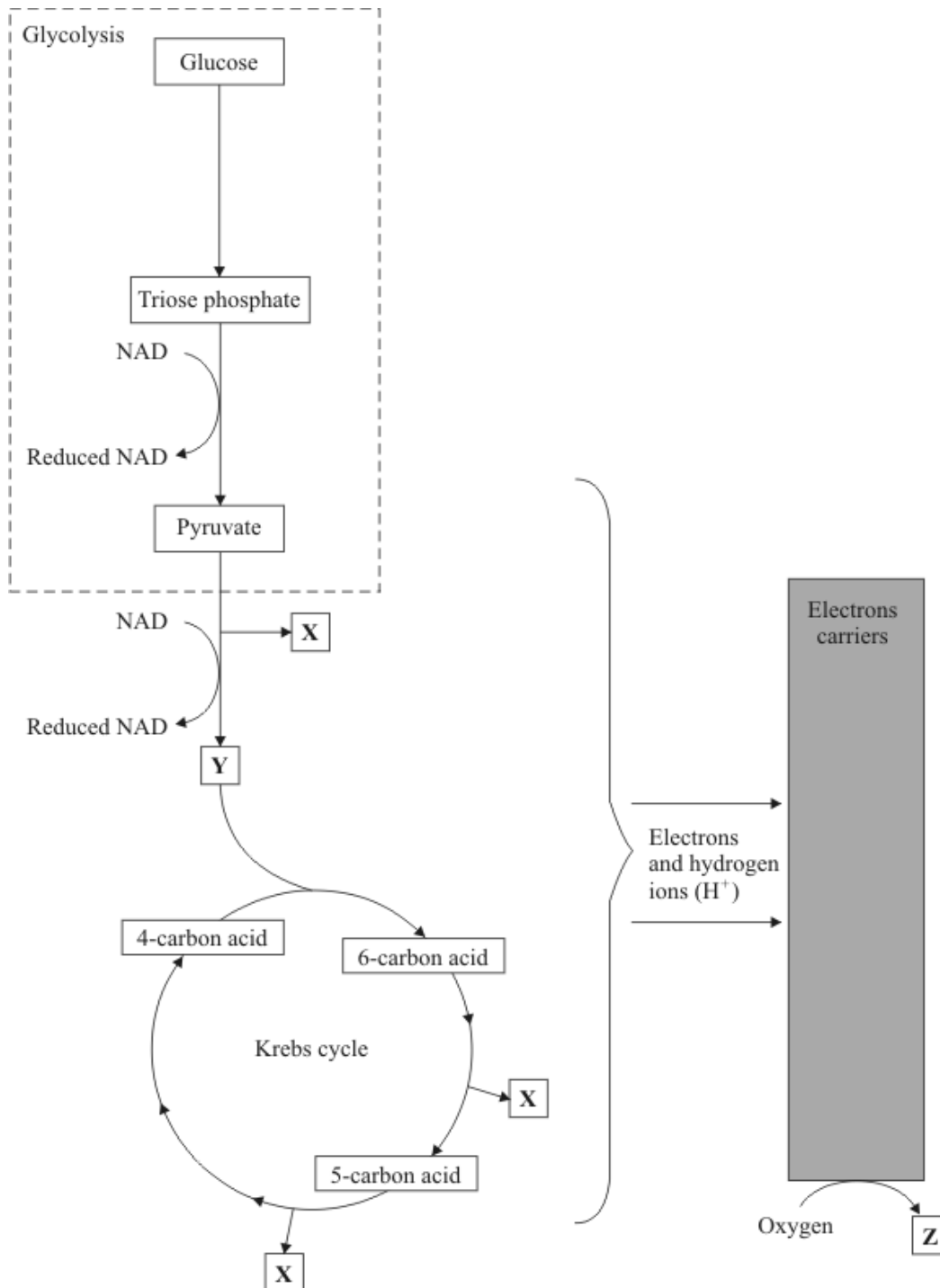
- (i) Suggest how the rise in the mean rate of photosynthesis could lead to the rise in the mean rate of respiration in soil under trees.

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

- (ii) Suggest why there is a delay between the rise in the mean rate of photosynthesis and the rise in the mean rate of respiration.

.....
.....(1)
(Total 15 marks)

Q10. 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.

.....

.....

.....

.....

.....

.....

.....

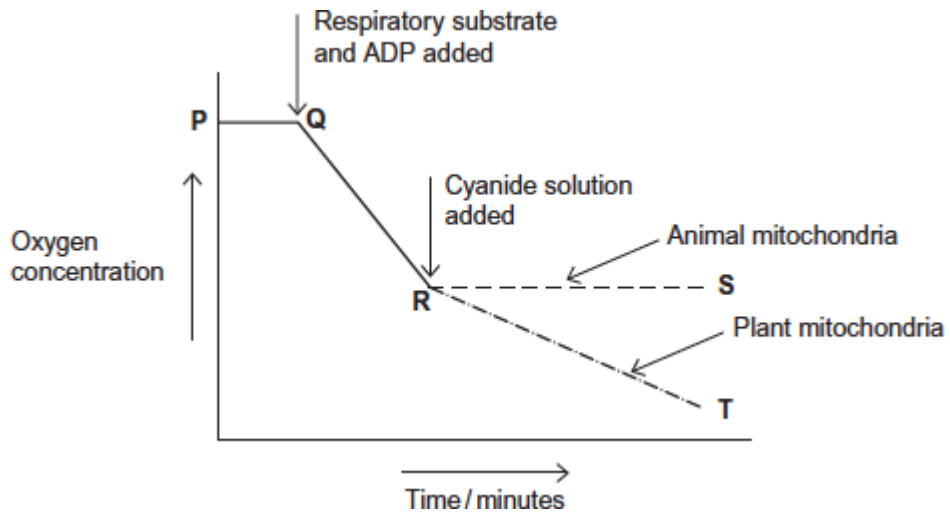
.....

(4)
(Total 15 marks)

Q11. Researchers investigated the effect of cyanide on oxygen uptake by mitochondria. They prepared a suspension of mitochondria from animal cells and a suspension of mitochondria from plant cells. They placed the suspensions in separate flasks containing isotonic solution, started the timer and began recording the concentration of oxygen in each flask.

- After 5 minutes, they added a respiratory substrate and ADP to each flask.
- After 13 minutes, they added cyanide solution to each flask.

The graph below shows their results. From **P** to **R** the curves for animal and plant mitochondria overlap.



(a) Explain the line between **P** and **Q**.

.....

.....

.....

.....

.....(2)

(b) (i) Explain the line between **Q** and **R**.

.....

.....

.....

.....(2)

(ii) The respiratory substrate and ADP added after 5 minutes (**Q**) were part of a buffered isotonic solution.

What other substance would the buffer or solution have to contain?

.....

.....(1)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (c) Describe and explain the difference between line **R to S** (animal mitochondria) and line **R to T** (plant mitochondria).

.....

.....

.....

.....

.....

.....

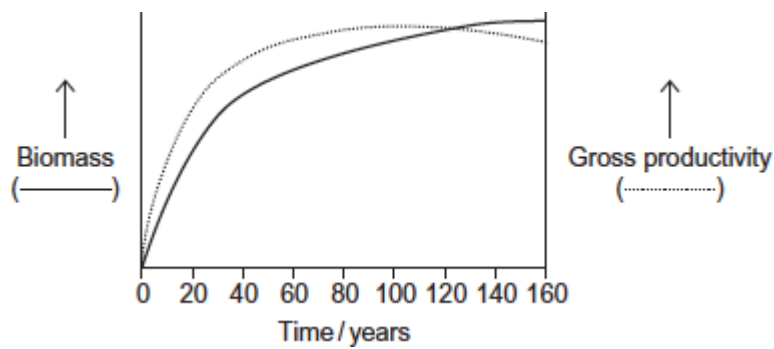
.....

.....

.....

(4)
(Total 9 marks)

Q12.The graph shows how gross productivity and biomass in an area changed with time in the succession from bare soil to mature woodland.



- (a) (i) Suggest appropriate units for gross productivity.

.....(1)

- (ii) Explain the decrease in gross productivity as the woodland matures.

.....

.....

.....

.....

.....

.....(2)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (b) Use your knowledge of succession to explain the increase in biomass during the first 20 years.

.....
.....
.....
.....
.....
.....
..... (3)

- (c) Use the information in the graph and your knowledge of net productivity to explain why biomass shows little increase after 100 years.

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

- (d) Suggest **one** reason for conserving woodlands.

.....
.....
..... (1)
(Total 9 marks)

Q13. When fertilisers are applied to fields next to a lake, nitrogen-containing substances from the fertilisers get into the lake.

- (a) (i) Describe how the nitrogen-containing substances get into the lake.

.....
.....
..... (1)

- (ii) It takes longer for the nitrogen-containing substances to get into the lake when an organic fertiliser is used than when an inorganic fertiliser is used. Explain why it takes longer when an organic fertiliser is used.

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

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (b) Describe how the presence of nitrates in a lake may eventually lead to the death of fish.

.....
.....
.....
.....
.....
.....
.....
.....

.....(4)
(Total 7 marks)

Q14. Scientists investigated the effect of a mycorrhizal fungus on the growth of pea plants with a nitrate fertiliser or an ammonium fertiliser. The fertilisers were identical, except for nitrate or ammonium.

The scientists took pea seeds and sterilised their surfaces. They planted the seeds in soil that had been heated to 85 °C for 2 days before use. The soil was sand that contained no mineral ions useful to the plants.

- (a) Explain why the scientists sterilised the surfaces of the seeds and grew them in soil that had been heated to 85 °C for 2 days.

.....
.....
.....
.....

.....(2)

- (b) Explain why it was important that the soil contained no mineral ions useful to the plants.

.....
.....

.....(1)

The pea plants were divided into four groups, **A**, **B**, **C** and **D**.

- **Group A** – heat-treated mycorrhizal fungus added, nitrate fertiliser
- **Group B** – mycorrhizal fungus added, nitrate fertiliser
- **Group C** – heat-treated mycorrhizal fungus added, ammonium fertiliser
- **Group D** – mycorrhizal fungus added, ammonium fertiliser

The heat-treated fungus had been heated to 120 °C for 1 hour.

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (c) Explain how groups **A** and **C** act as controls.

.....

.....

.....

.....

(2)

After 6 weeks, the scientists removed the plants from the soil and cut the roots from the shoots. They dried the plant material in an oven at 90 °C for 3 days. They then determined the mean dry masses of the roots and shoots of each group of pea plants.

- (d) Suggest what the scientists should have done during the drying process to be sure that all of the water had been removed from the plant samples.

.....

.....

.....

.....(2)

The scientists' results are shown in the table below.

Treatment	Mean dry mass / g per plant (standard deviation)	
	Root	Shoot
A – heat-treated fungus and nitrate fertiliser	0.40 (±0.05)	1.01 (±0.12)
B – fungus and nitrate fertiliser	1.61 (±0.28)	9.81 (±0.33)
C – heat-treated fungus and ammonium fertiliser	0.34 (±0.03)	0.96 (±0.26)
D – fungus and ammonium fertiliser	0.96 (±0.18)	4.01 (±0.47)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (e) What conclusions can be drawn from the data in the table about the following?

The effects of the fungus on growth of the pea plants.

.....
.....
.....
.....

The effects of nitrate fertiliser and ammonium fertiliser on growth of the pea plants.

.....
.....
.....
.....(4)

The scientists determined the dry mass of the roots and shoots separately. The reason for this was they were interested in the ratio of shoot to root growth of pea plants. It is the shoot of the pea plant that is harvested for commercial purposes.

- (f) Explain why determination of dry mass was an appropriate method to use in this investigation.

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

- (g) Which treatment gave the best result in commercial terms? Justify your answer.

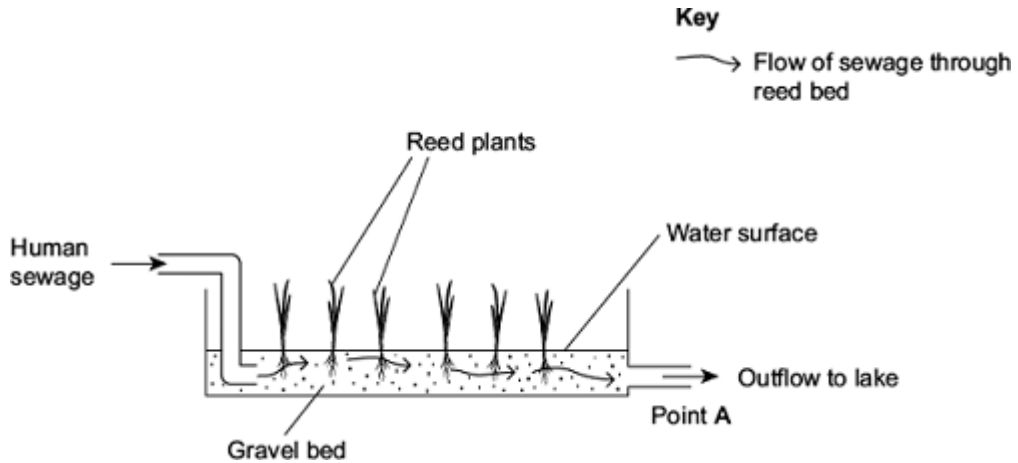
.....
.....
.....
.....(2)

(Total 15 marks)

Q15.(a) Name the process by which some bacteria oxidise ammonia to nitrate.

.....(1)

Reeds are plants that grow with their roots under water. A reed bed contains a large number of growing reeds. Reed beds may be used to absorb nitrates produced when bacteria break down human sewage. The diagram shows a reed bed.



(b) Reeds have hollow, air-filled tissue in their stems which supplies oxygen to their roots.
Explain how this enables the roots to take up nitrogen-containing substances.

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

(c) (i) There is an optimum rate at which human sewage should flow through the reed bed. If the flow of human sewage is too fast, the nitrate concentration at point A falls. Explain why.

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

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (ii) An increase in nitrate concentration in the water entering the lake could affect algae and fish in the lake. Explain how.

.....

.....

.....

.....

.....

.....

.....

(3)
(Total 8 marks)

Q16. Upwelling is a process where water moves from deeper parts of the sea to the surface. This water contains a lot of nutrients from the remains of dead organisms.

- (a) (i) Nitrates and phosphates are two of these nutrients. They provide a source of nitrogen and phosphorus for cells.

Give a biological molecule that contains:

1. nitrogen

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

- (ii) Describe the role of microorganisms in producing nitrates from the remains of dead organisms.

.....

.....

.....

.....

.....

.....

.....

(3)

- (b) Upwelling often results in high primary productivity in coastal waters. Explain why some of the most productive fishing areas are found in coastal waters.

.....

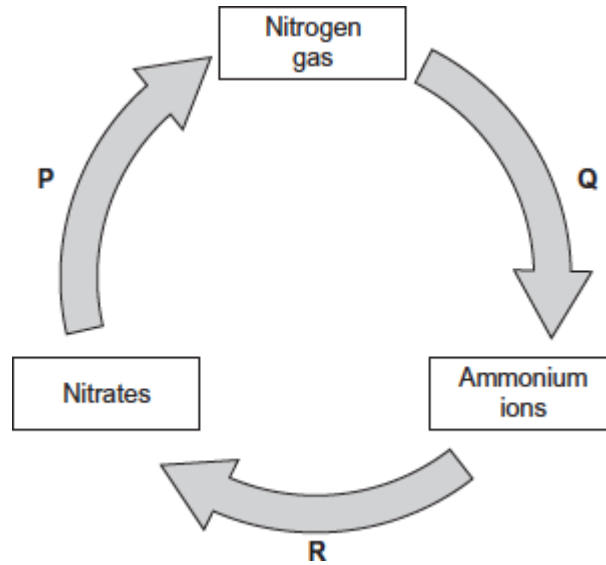
.....

.....

.....

(2)
(Total 7 marks)

Q17.The diagram shows part of the nitrogen cycle.



- (a) Which **one** of the processes **P**, **Q** or **R** involves nitrification?

(1)

- (b) The diagram above includes one process in which microorganisms add ammonium ions to soil. Describe another process carried out by microorganisms which adds ammonium ions to soil.

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

- (c) Denitrification requires anaerobic conditions. Ploughing aerates the soil. Explain how ploughing would affect the fertility of the soil.

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

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (d) One farming practice used to maintain high crop yields is crop rotation. This involves growing a different crop each year in the same field.

Suggest **two** ways in which crop rotation may lead to high crop yields.

1

.....

.....

2

.....

.....

(2)
(Total 7 marks)

[7]