PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 5: ENERGY FOR BIOLOGICAL PROCESSES

CORE PRACTICALS

SCORE	PERCENTAGE
/122	%

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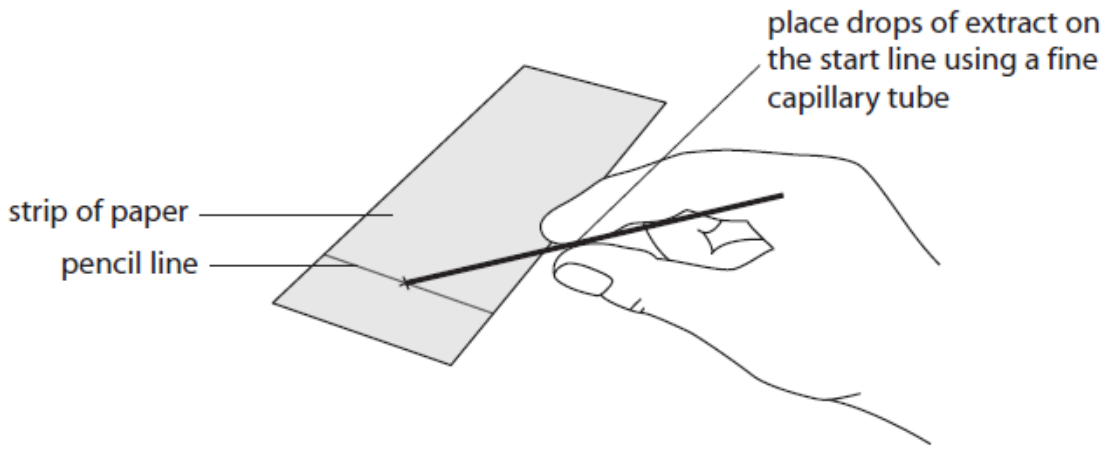
Q1.

Photosynthetic pigments in leaves can be separated by chromatography.

A leaf extract can be made by grinding up leaves in a solvent.

The diagram shows how the extract is applied to chromatography paper.

The extract is applied one drop at a time. The paper is dried before the next drop of extract is applied.



Explain why the paper is dried before the next drop of extract is applied.

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Q2.

Photosynthetic pigments are found in plant leaves.

Describe how you could use chromatography to separate these pigments.

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(Total for question = 3 marks)

Q3.

Last year, eight million Christmas trees were bought in the UK.

There are many Christmas tree farms that supply these trees.

The photograph shows young Christmas trees growing on a farm.



Christmas tree farmers remove the other plants (weeds) in order to increase tree growth.

A farmer investigated two methods of removing weeds:

- removing weeds by hand
- spraying herbicides that inhibit weed growth.

The table shows the mean height of Christmas trees using each method, over a five-year period.

Year	Mean height of trees / cm	
	Removing by hand	Using herbicide
0	20	20
1	50	60
2	70	100
3	90	130
4	110	160
5	130	200

A student read that some herbicides work by inhibiting electron transport in photosynthesis.

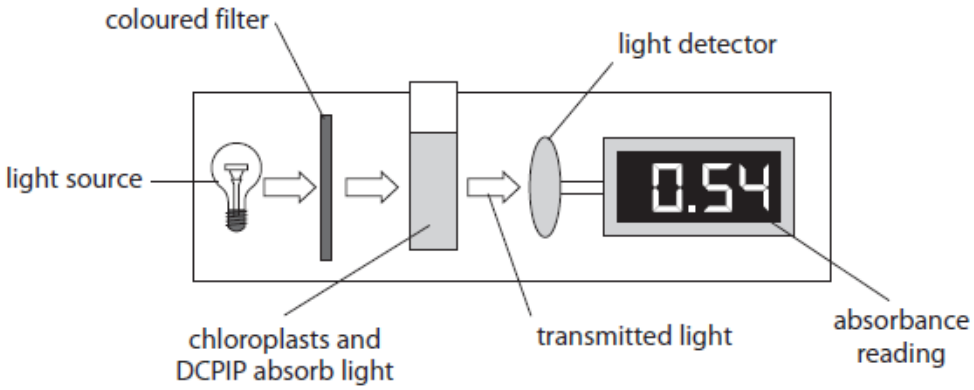
The student investigated this using the indicator DCPIP.

This indicator changes from blue to colourless when it is reduced.

The student used the following method:

- chloroplasts were suspended in two tubes, each containing a solution of DCPIP
- herbicide was added to one of the tubes and no herbicide was added to the other tube
- both tubes were exposed to light
- a colorimeter was used to measure the absorbance in each tube at five minute intervals for 20 minutes.

The diagram shows details of the workings of the colorimeter used by the student.



As DCPIP changes from blue to colourless, the absorbance of light decreases.

(i) Explain how the student used this method to collect valid data.

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The table shows the results.

Time / min	Absorbance / a.u.	
	With herbicide	Without herbicide
0	0.53	0.54
5	0.54	0.31
10	0.54	0.24
15	0.54	0.20
20	0.53	0.16

(ii) Analyse the data to explain the effect of this herbicide on the growth of weeds.

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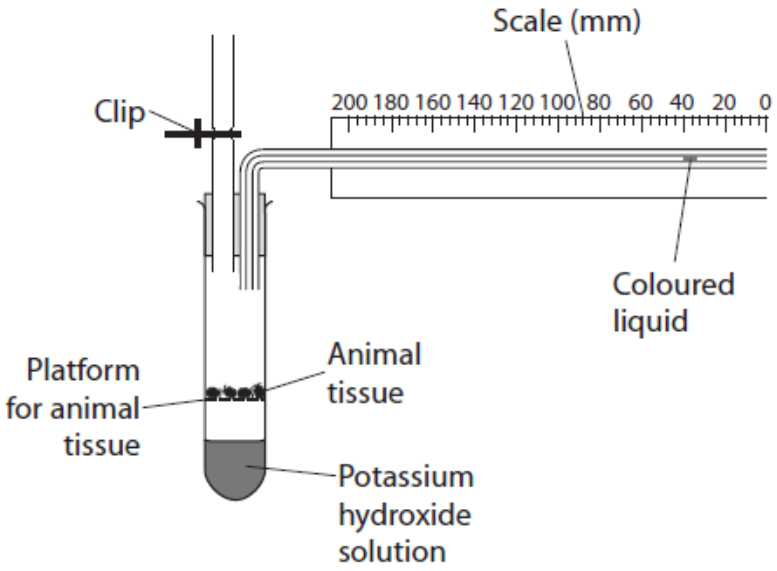
Q4.

The tissues of some animals can carry out anaerobic and aerobic respiration.

Three investigations were carried out to study respiration in an animal tissue, using the apparatus shown below.

The tissue used glucose as the respiratory substrate.

All other variables were kept constant.



The table below shows the three investigations that were carried out and the result for investigation 1.

Investigation	Type of respiration	Potassium hydroxide solution absent or present	Coloured liquid moved to the left	Coloured liquid moved to the right	Coloured liquid did not move
1	Anaerobic	Absent	☐	☐	☒
2	Aerobic	Absent	☐	☐	☐
3	Aerobic	Present	☐	☐	☐

(i) Complete the table by placing a cross in one box ☒ for each of investigations 2 and 3 to show the response of the coloured liquid.

(2)

(ii) Explain why the coloured liquid did not move in investigation 1.

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(iii) Reduced NAD (NADH + H^+) would be formed in investigations 2 and 3.

Describe the fate of reduced NAD in aerobic respiration.

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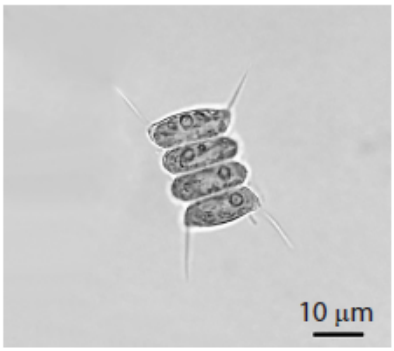
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Q5.

The green alga, *Scenedesmus quadricauda*, lives in fresh water.

Each cell has a single chloroplast.

The photograph shows some *Scenedesmus* cells.



Photosynthesis can be measured if these algae are placed in a solution containing hydrogen carbonate indicator.

When the carbon dioxide concentration is the same as that of atmospheric air, the hydrogen carbonate indicator is red.

As the carbon dioxide concentration decreases, the hydrogen carbonate indicator changes colour from red to pink and then to purple.

A student investigated the effect of light on the rate of photosynthesis in *S. quadricauda*.

He used different coloured filters to vary the wavelength of the light.

The algae were added to a solution of hydrogen carbonate indicator in a test tube.

The test tube was sealed and placed under a lamp with a red filter.

After 30 minutes, the student noted the colour of the hydrogen carbonate indicator.

He then shook the open test tube until the indicator returned to its original colour.

He repeated this procedure with yellow, green and blue filters, using the same algae and the same indicator solution.

The student's results are shown in the table.

colour of filter	wavelength of light / nm	colour of indicator after 30 minutes
red	640	reddish pink
yellow	580	pink
green	520	pinky purple
blue	460	dark purple

(i) Analyse the data to explain what conclusion may be drawn from these results.

(2)

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(ii) The student repeated the method using fresh hydrogen carbonate indicator and a new sample of *S. quadricauda*.

This time he used the blue filter first, then green, then yellow, then red.

The results are shown in the table.

colour of filter	wavelength of light / nm	colour of indicator after 30 minutes
blue	460	reddish pink
green	520	pink
yellow	580	pinky purple
red	640	dark purple

*Evaluate the student's investigation.

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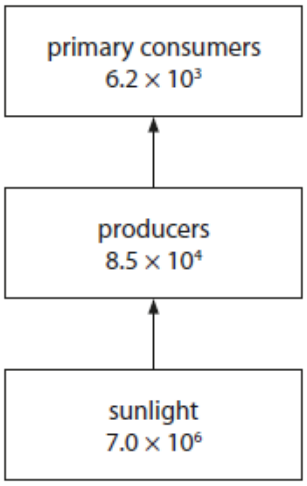
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Q6.

The diagram shows the flow of energy in an ecosystem.

The numbers represent the energy in kJ m^{-2} yr^{-1} in each category.



(i) Calculate the percentage efficiency of energy transfer from sunlight to the producers.

(2)

Answer ..... %

(ii) Give one reason why the energy transfer from sunlight to the producers is less than 100% efficient.

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(iii) Explain the energy difference between the producers and the primary consumers.

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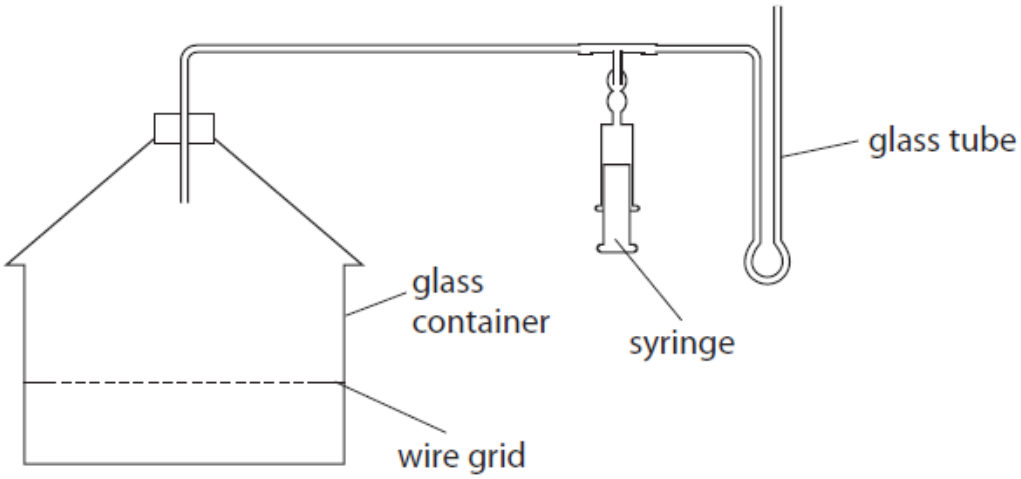
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(Total for question = 5 marks)

Q7.

The diagram shows a respirometer.



Explain how a student could modify this respirometer and use it to measure the mean oxygen consumption of a rat.

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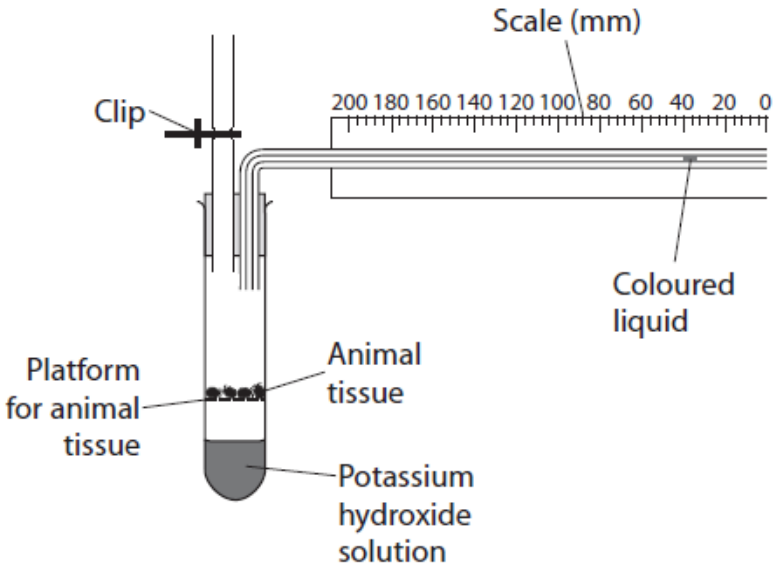
Q8.

The tissues of some animals can carry out anaerobic and aerobic respiration.

Three investigations were carried out to study respiration in an animal tissue, using the apparatus shown below.

The tissue used glucose as the respiratory substrate.

All other variables were kept constant.



The table below shows the three investigations that were carried out.

Investigation	Type of respiration	Potassium hydroxide solution absent or present
1	Anaerobic	Absent
2	Aerobic	Absent
3	Aerobic	Present

Explain how investigation 3, shown in the table, could be used to compare the rate of respiration of two different tissues.

(2)

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Q9.

Single-celled algae can be trapped in gel beads and used to study photosynthesis.

The beads are placed in a test tube of hydrogencarbonate indicator.

The table shows the colour of the indicator when it contains different concentrations of carbon dioxide.

Colour of indicator	Relative carbon dioxide concentration
yellow	highest
orange	higher than atmospheric air
red	same as atmospheric air
magenta	lower than atmospheric air
purple	lowest

A student used the following method to investigate the effect of light intensity on the rate of photosynthesis.

1. Set up five test tubes, each half-filled with red hydrogencarbonate indicator.

2. Add a teaspoon of gel beads containing single-celled algae to each test tube and close with a bung.

3. Place each test tube at a different distance from a lamp in a dark room.

4. Leave the tubes for 30 minutes.

5. Record the colour of the hydrogencarbonate indicator in each tube and the position of the gel beads.

The table shows the results.

Distance from lamp / cm	5	15	25	35	45
Colour of indicator after 30 minutes	purple	purple	red	orange	orange
Position of gel beads in tube after 30 minutes	half-way up	less than half-way up	bottom	bottom	bottom

(i) Describe two control tubes that should be used in this investigation.

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(ii) Explain the changes in colour of the hydrogencarbonate indicator in this investigation.

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(Total for question = 5 marks)

Q10.

Single-celled algae can be trapped in gel beads and used to study photosynthesis.

The beads are placed in a test tube of hydrogencarbonate indicator.

The table shows the colour of the indicator when it contains different concentrations of carbon dioxide.

Colour of indicator	Relative carbon dioxide concentration
yellow	highest
orange	higher than atmospheric air
red	same as atmospheric air
magenta	lower than atmospheric air
purple	lowest

A student used the following method to investigate the effect of light intensity on the rate of photosynthesis.

1. Set up five test tubes, each half-filled with red hydrogencarbonate indicator.

2. Add a teaspoon of gel beads containing single-celled algae to each test tube and close with a bung.

3. Place each test tube at a different distance from a lamp in a dark room.

4. Leave the tubes for 30 minutes.

5. Record the colour of the hydrogencarbonate indicator in each tube and the position of the gel beads.

The table shows the results.

Distance from lamp / cm	5	15	25	35	45
Colour of indicator after 30 minutes	purple	purple	red	orange	orange
Position of gel beads in tube after 30 minutes	half-way up	less than half-way up	bottom	bottom	bottom

The colour of the indicator and the position of the beads can be used to give a quantitative measure of the effect of light intensity.

Describe how the method could be modified to give valid, quantitative results.

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(Total for question = 3 marks)

Q11.

White clover plants provide a rich source of nitrogen for cattle when grown with grass plants in fields.

The photograph shows a clover plant growing in a field of grass.



A student noticed that the grass plants growing near patches of clover were a darker green than other grass plants.

Devise an investigation to show whether the presence of clover plants affects the concentration of the green pigment chlorophyll in grass plants.

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(Total for question = 6 marks)

Q12.

Mitochondria and chloroplasts in eukaryotic cells are thought to have originated millions of years ago by a process called endosymbiosis.

In endosymbiosis, free-living prokaryotic organisms were engulfed by their new host cells.

The table shows the lipid composition of the membranes of these two organelles.

Type of lipid	Percentage of total lipid composition of membranes (%)	
	In mitochondria	In chloroplasts
phosphatidyl A	43	0
phosphatidyl B	35	0
phosphatidyl C	6	1
phosphatidyl D	3	7
phosphatidyl E	13	0
monogalactosyldiacylglycerol F	0	55
digalactosyldiacylglycerol G	0	24
sulfolipid H	0	8

(i) Analyse the data and use your knowledge to explain why these two organelles are thought to have originated from different prokaryotic organisms.

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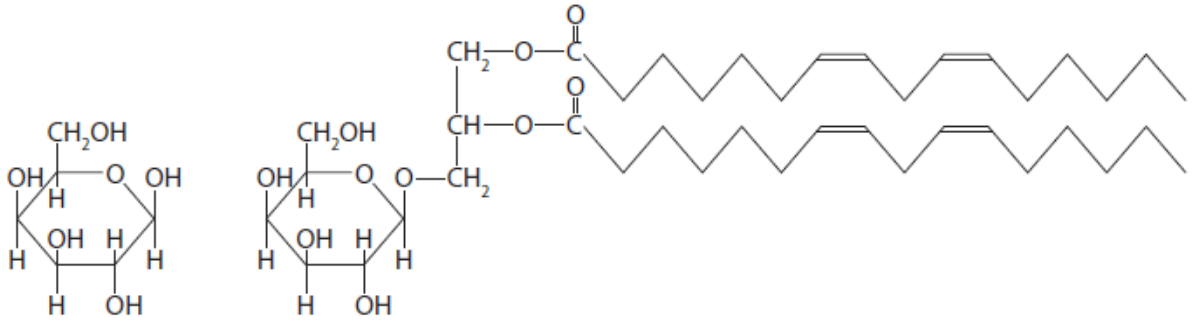
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(ii) Digalactosyldiacylglycerol (DGDG) is synthesised from galactose and monogalactosyldiacylglycerol (MGDG).

The galactose forms a 1,6 glycosidic bond with the MGDG.

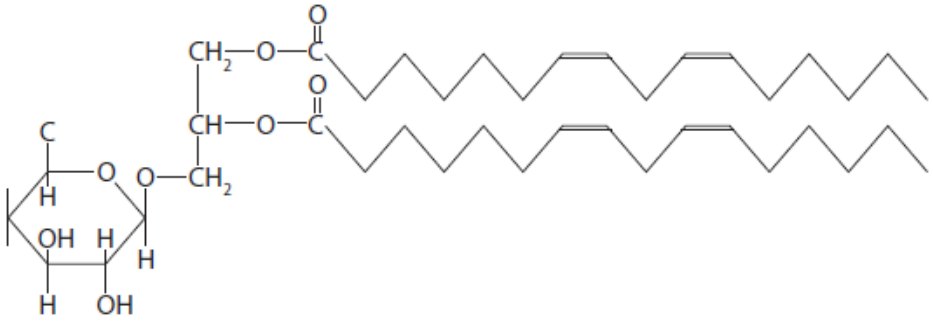
The diagram shows the structure of galactose and MGDG.



galactose MGDG

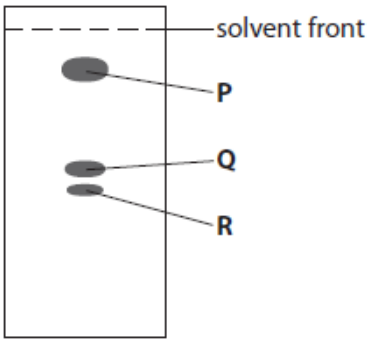
Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(3)



(iii) Chromatography can be used to separate MGDG, DGDG and sulfolipid extracted from chloroplasts.

The diagram shows the position of these three lipids, **P**, **Q** and **R**, on a chromatogram.



Which row in the table identifies the position of these three lipids in this chromatogram ?

(1)

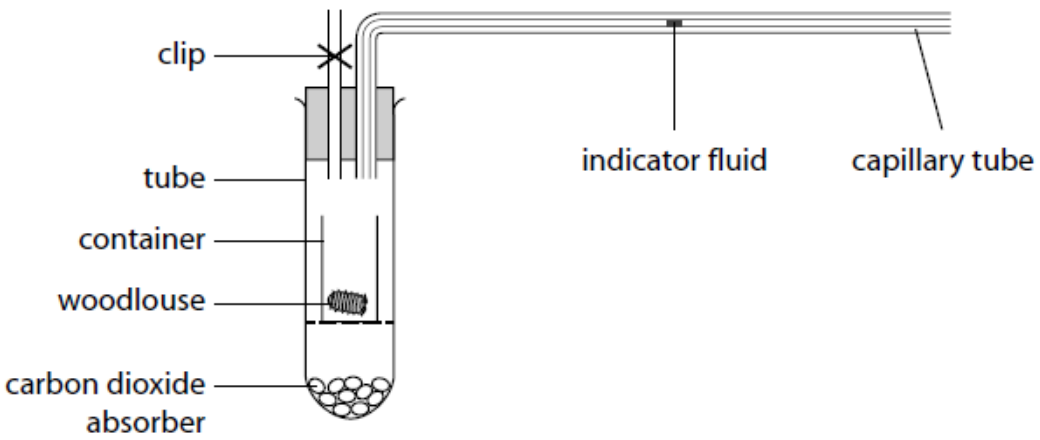
	Lipid in position P	Lipid in position Q	Lipid in position R
☒ **A**	DGDG	sulfolipid	MGDG
☒ **B**	MGDG	DGDG	sulfolipid
☒ **C**	sulfolipid	DGDG	MGDG
☒ **D**	sulfolipid	MGDG	DGDG

(Total for question = 7 marks)

Q13.

The diagram below shows a simple respirometer used by a student to measure the rate of respiration of a small invertebrate called a woodlouse.

The rate was measured by observing the distance the indicator fluid moved in a known time.



(a) Give one way in which the student could modify the procedure to obtain a better measurement of the rate of respiration.

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(b) Explain what would happen to the indicator fluid after five hours if a culture of green algae was added to the container and the tube was completely covered in light-proof paper.

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(c) (i) The student wanted to compare the rate of respiration of a mouse with that of a woodlouse.

Explain how you could modify the procedure used to measure the rate of respiration of the woodlouse so that it could be used to compare with the rate of respiration of a mouse.

Your answer should explain the reasons for the modifications and include reference to the ethical treatment of the animal, and show how you could produce valid results.

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(ii) Comment on how the results you would expect to obtain for a mouse would differ from the results for a woodlouse.

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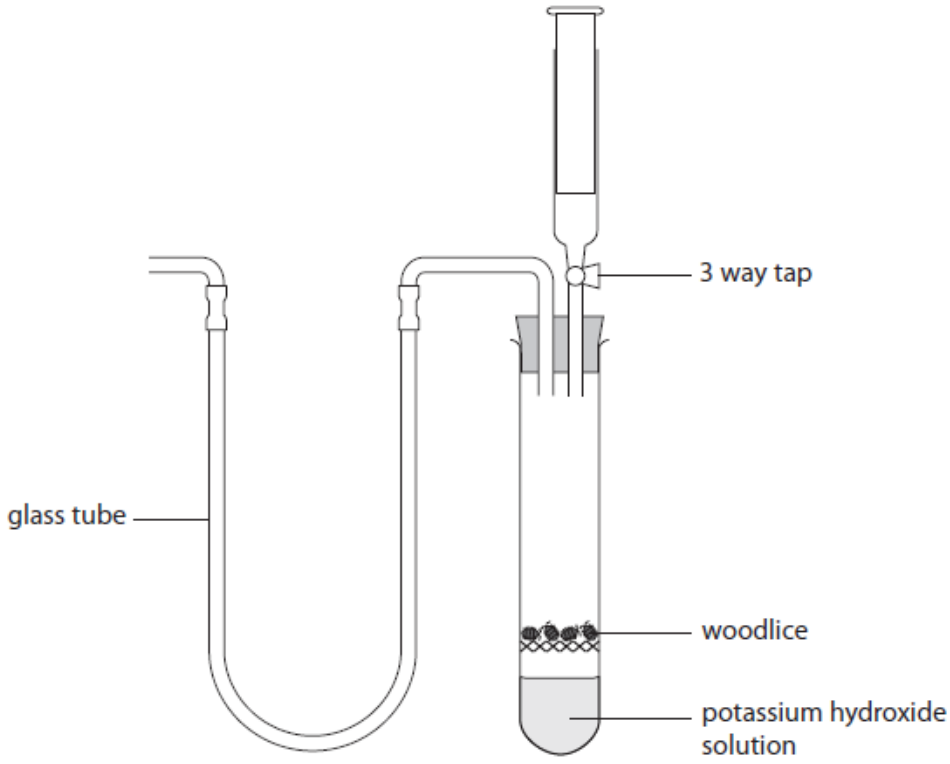
(Total for question = 12 marks)

Q14.

Fluoride ions reduce anaerobic respiration in yeast by inhibiting the action of the enzyme enolase.

Fluoride ions combine with magnesium ions and phosphate ions to resemble the substrate of enolase.

* The diagram shows some apparatus that can be used to measure the rate of respiration in small animals such as woodlice.



Discuss how you would modify this apparatus and use it to find out if fluoride ions have a significant effect on the rate of anaerobic respiration in yeast.

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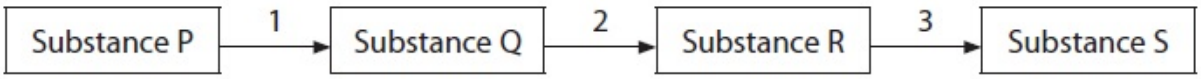
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(Total for question = 9 marks)

Q15. Respiration is a metabolic process which consists of many steps.

(a) The diagram below shows a metabolic process consisting of three steps.

Each letter represents a different substance and each number a different enzyme.



Describe and explain the functions of enzymes in this metabolic process.

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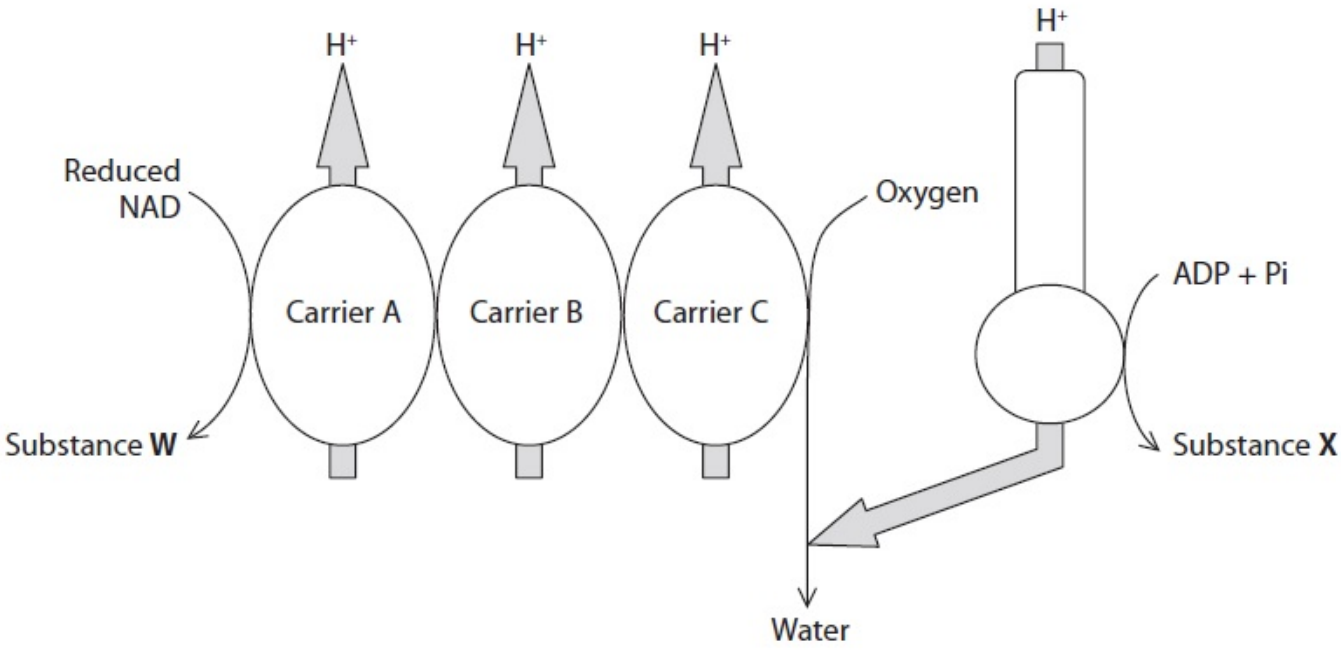
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(b) The diagram below shows the electron transport chain, which is part of aerobic respiration.



(i) Using the information in the diagram, name substance **W** and explain how it is formed.

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(ii) Name substance **X**.
Explain the link between the formation of substance **X** and the H^+ shown on the diagram.

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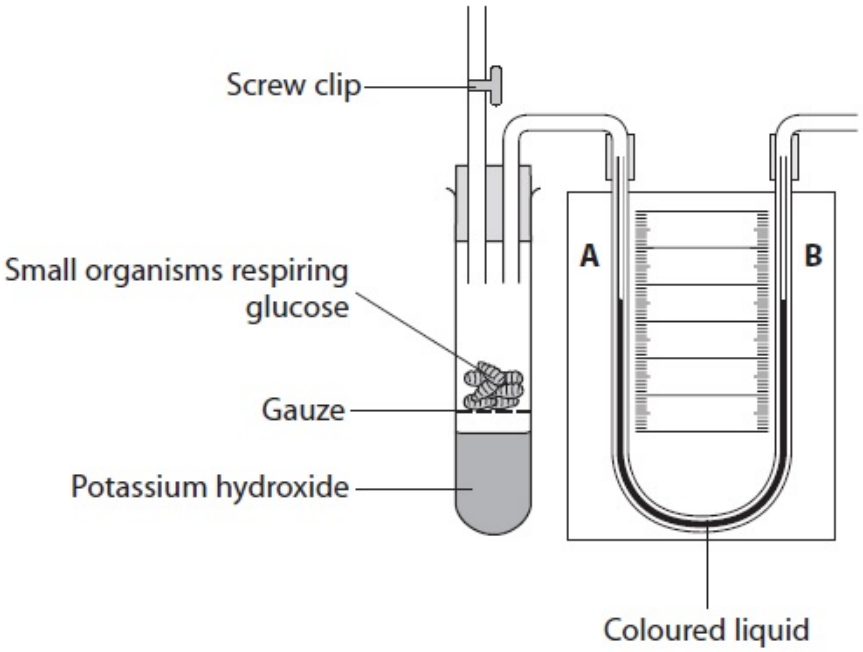
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(c) The diagram below shows a respirometer used to measure the rate of aerobic respiration in small organisms.



Potassium hydroxide absorbs carbon dioxide.
The table below describes three different situations.
Place a cross in the box ☒ that correctly shows the movement of the coloured liquid in the U-shaped tube for each situation.

(3)

Situation	Movement of coloured liquid		
	towards A	towards B	does not move
Screw clip is open	☐	☐	☐
Screw clip is closed	☐	☐	☐
Potassium hydroxide is replaced with water and screw clip is closed	☐	☐	☐

(Total for Question = 13 marks)

Q16. Respiration is a metabolic process which consists of many steps.

(a) The diagram below shows three steps in respiration.

Each box represents a different substance and each step involves an enzyme.



Describe and explain the functions of enzymes in this metabolic process.

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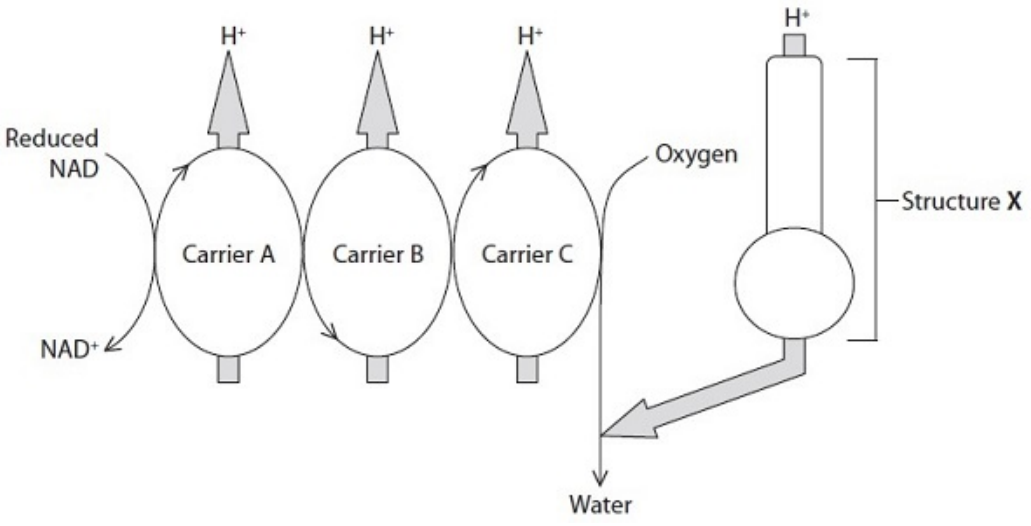
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(b) The diagram below shows the electron transport chain, which is part of aerobic respiration.



(i) Using the diagram and your own knowledge, describe the role of carrier B.

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(ii) Name structure **X** and explain its role in aerobic respiration.

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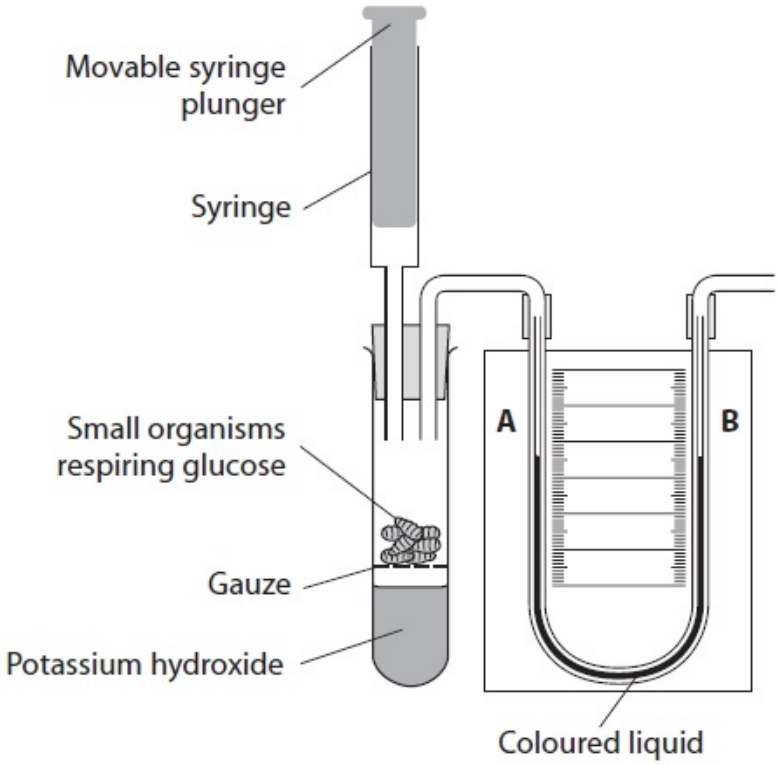
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(c) The diagram below shows a respirometer used to measure the rate of aerobic respiration in small organisms.



Potassium hydroxide absorbs carbon dioxide.

The table below describes three different situations.
Place a cross ☒ in the box that correctly shows the movement of the coloured liquid in the U-shaped tube for each situation.

(3)

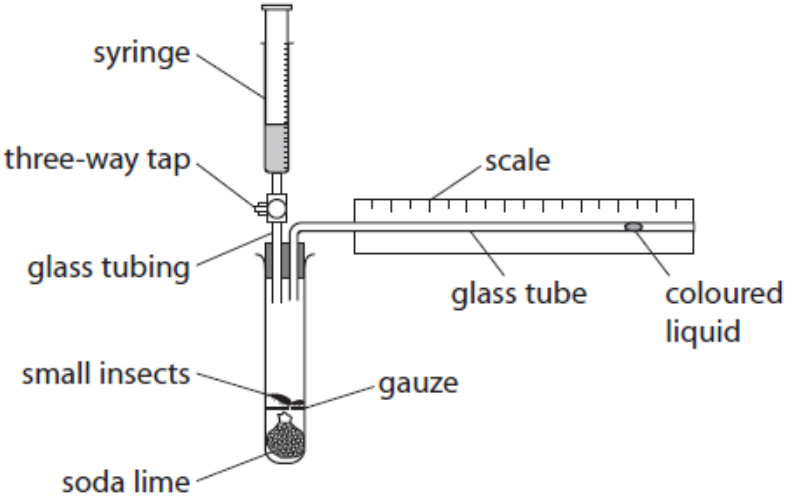
Situation	Movement of coloured liquid		
	towards A	towards B	does not move
Syringe plunger pulled upwards	☒	☒	☒
Syringe plunger not moved	☒	☒	☒
Potassium hydroxide is replaced with water and syringe plunger not moved	☒	☒	☒

(Total for Question = 13 marks)

Q17.

A respirometer was used to compare the rate of aerobic respiration of two species of insect.

The diagram shows the respirometer.



(i) Give the units for a valid comparison of the rate of respiration of these two species of insect.

(1)

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(ii) Other factors may affect the results from this respirometer.

Describe how one named factor could be controlled when using this respirometer.

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(iii) Explain why the soda lime in the tube must be replaced when the other species of insect is placed in the respirometer.

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(Total for question = 5 marks)

Q18.

Macroalgae and microalgae are photosynthetic organisms.

Seaweeds are macroalgae that live attached to rock in coastal areas.

Some seaweeds are green, some are brown and some are red.

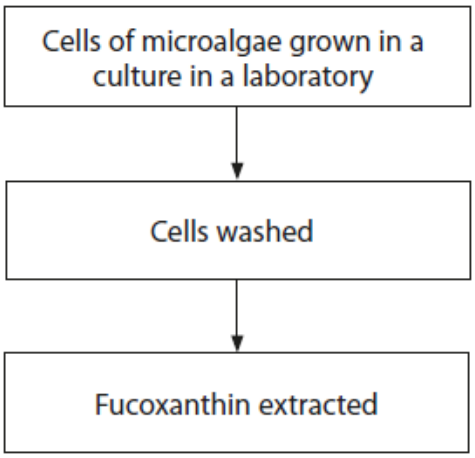
The colour of seaweeds depends on the photosynthetic pigments contained in their cells.

Green seaweeds contain chlorophyll, brown seaweeds contain chlorophyll and fucoxanthin and red seaweeds contain chlorophyll and phycoerythrin.

Fucoxanthin is found in both macroalgae and microalgae.

Fucoxanthin has anti-inflammatory, anti-tumour, anti-diabetes, anti-malarial and anti-obesity activity in humans.

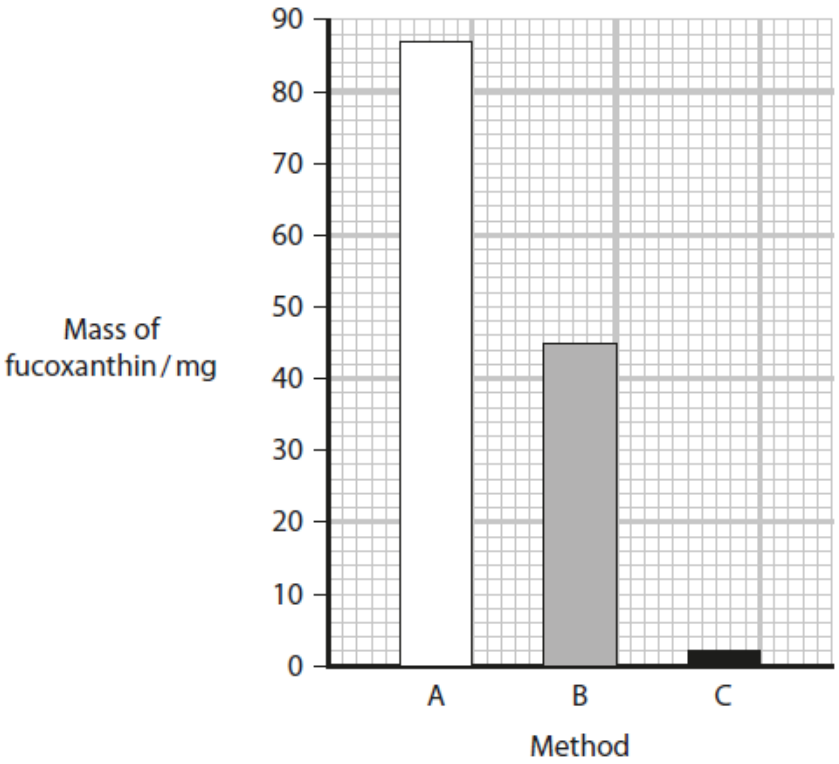
The diagram outlines the steps taken to extract fucoxanthin from microalgae.



The table shows three methods used for washing the cells and extracting the fucoxanthin.

Method	Liquid used for washing cells	Chemical used to extract fucoxanthin
A	water	ethanol
B	culture media	ethanol
C	culture media	water

The graph shows the mass of fucoxanthin extracted from 1 dm^3 of cell culture.



(i) Calculate how many times more fucoxanthin was extracted using method A compared with method B.

(1)

Answer .....

(ii) Explain why different masses of fucoxanthin were extracted using these three methods.

(3)

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(Total for question = 4 marks)