

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 5: ENERGY FOR BIOLOGICAL PROCESSES
CORE PRACTICALS

SCORE

/122

PERCENTAGE

%

STEMUP

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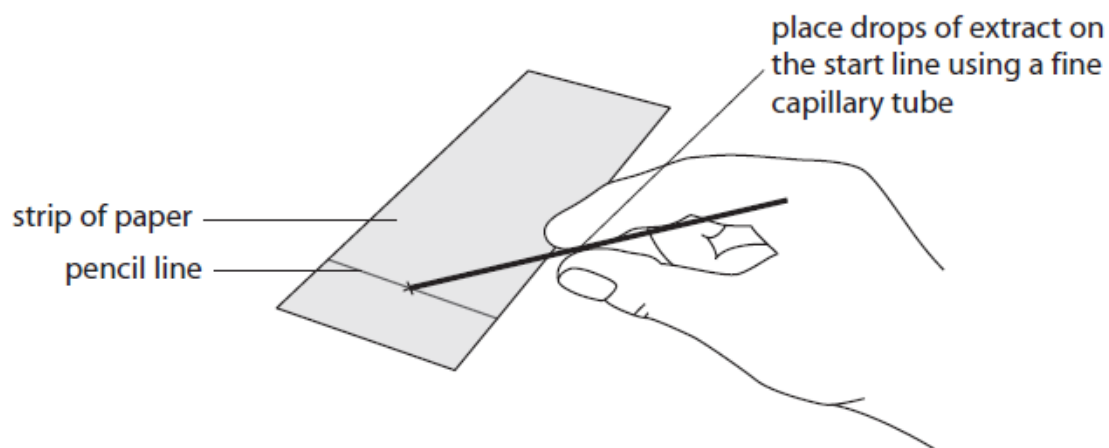
Q1.

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.

(3)

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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.

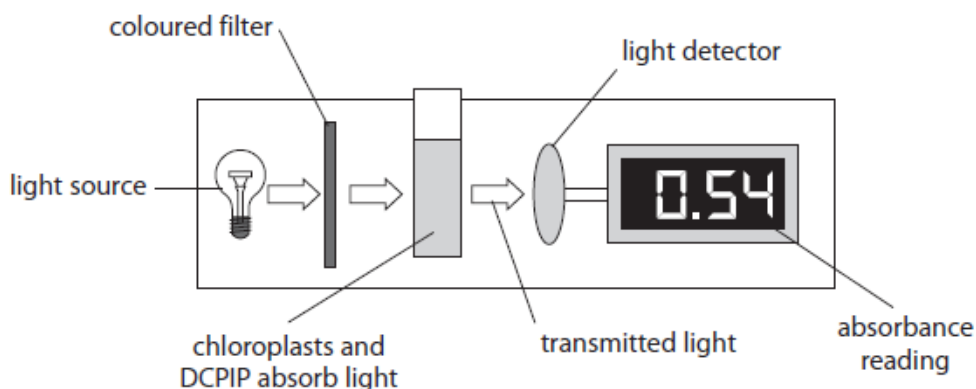
The student investigated this using the indicator DCPIP.

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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(Total for question = 8 marks)

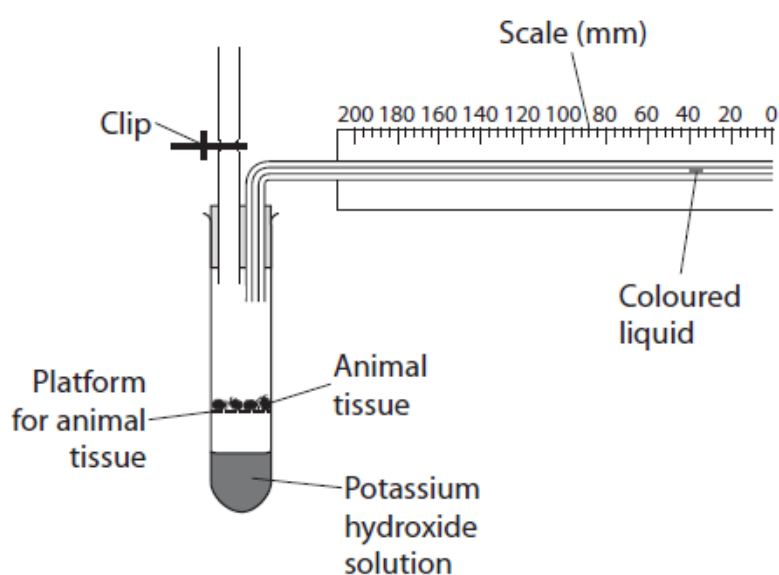
Q4.

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.

(3)

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(iii) Reduced NAD ($\text{NADH} + \text{H}^+$) would be formed in investigations 2 and 3.

Describe the fate of reduced NAD in aerobic respiration.

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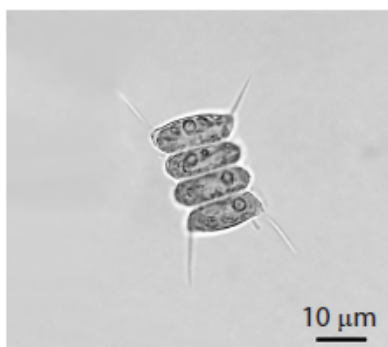
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Q5.

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.

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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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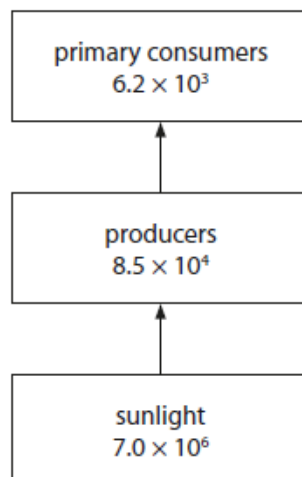
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Q6.

The diagram shows the flow of energy in an ecosystem.

The numbers represent the energy in $\text{kJ m}^{-2} \text{yr}^{-1}$ 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.

(1)

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

(2)

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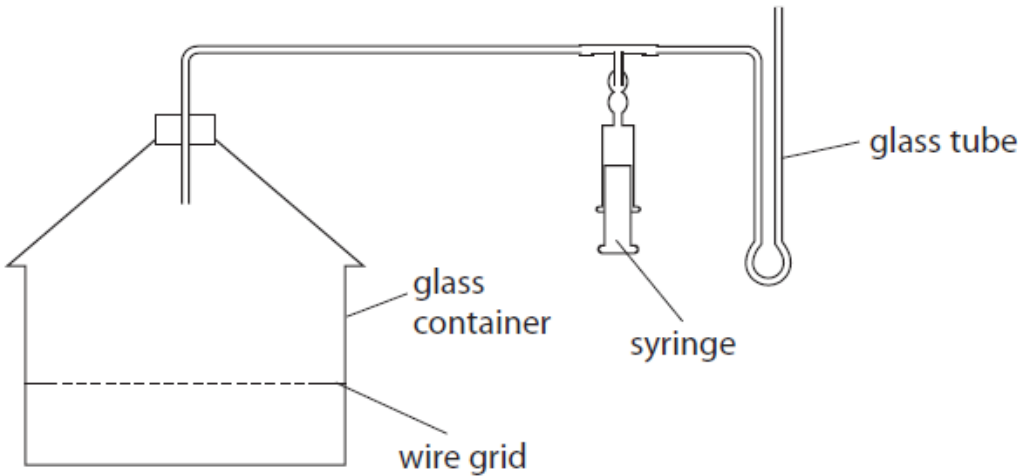
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(Total for question = 5 marks)

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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(Total for question = 4 marks)

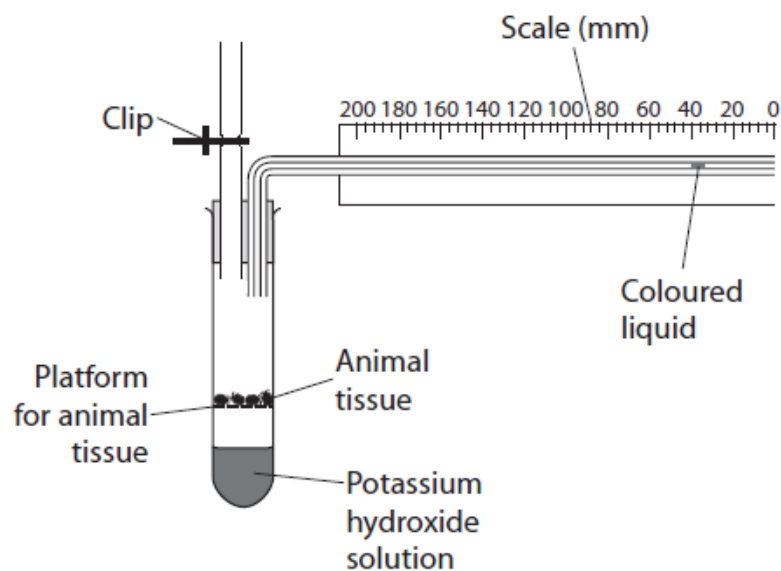
Q8.

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.

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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.

(2)

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(ii) Explain the changes in colour of the hydrogencarbonate indicator in this investigation. (3)

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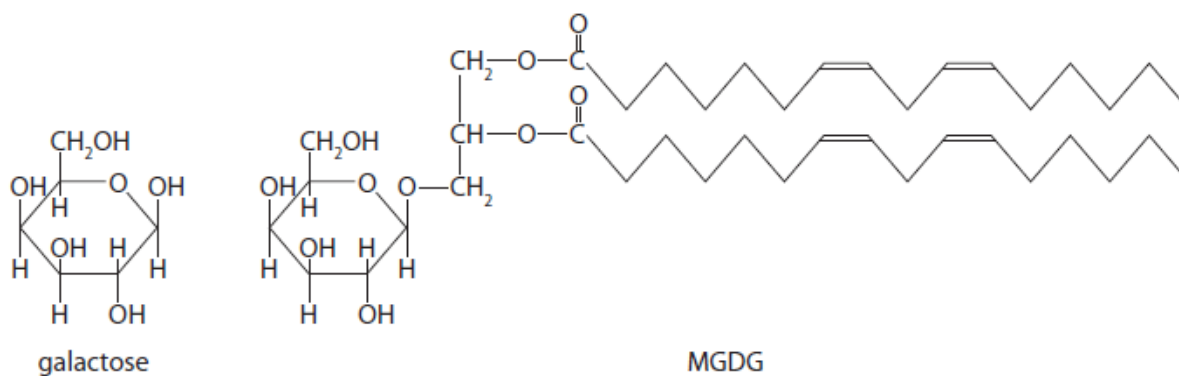
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(ii) Digalactosyldiacylglycerol (DGDG) is synthesised from galactose and monogalactosyldiacylglycerol (MGDG).

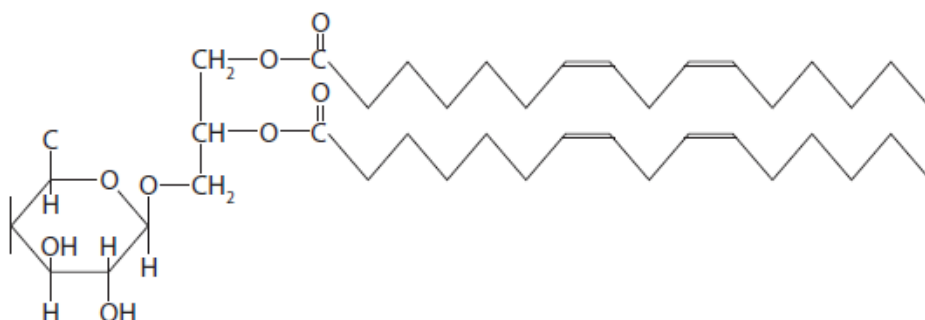
The galactose forms a 1,6 glycosidic bond with the MGDG.

The diagram shows the structure of galactose and MGDG.



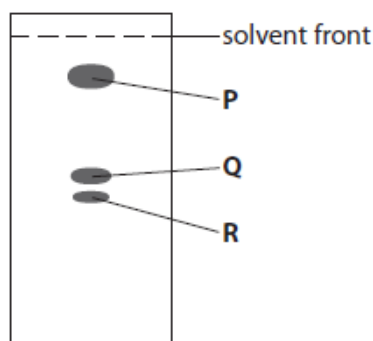
Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(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)

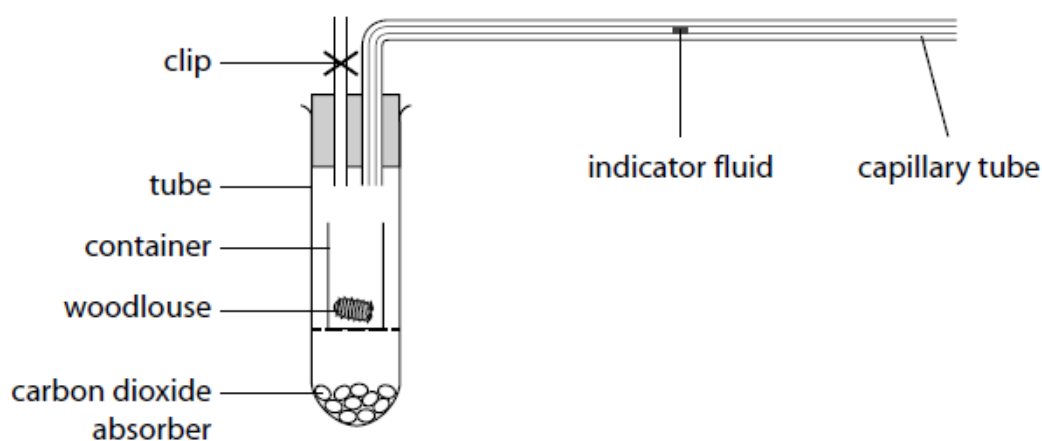
	Lipid in position P	Lipid in position Q	Lipid in position R
☒ A	DGDG	sulfolipid	MGDG
☒ B	MGDG	DGDG	sulfolipid
☒ C	sulfolipid	DGDG	MGDG
☒ D	sulfolipid	MGDG	DGDG

(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.

(1)

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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.

(4)

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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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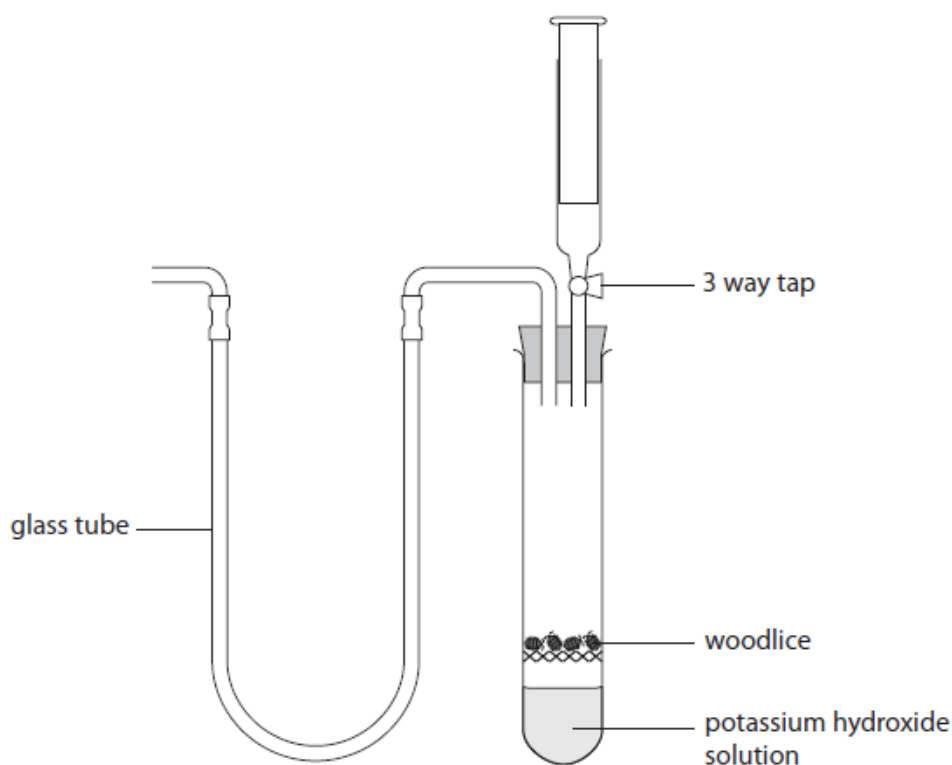
(Total for question = 12 marks)

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.

(9)

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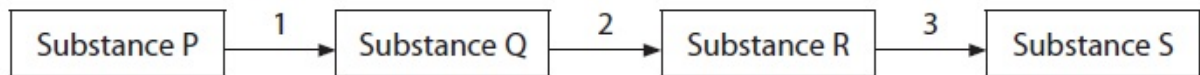
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(Total for question = 9 marks)

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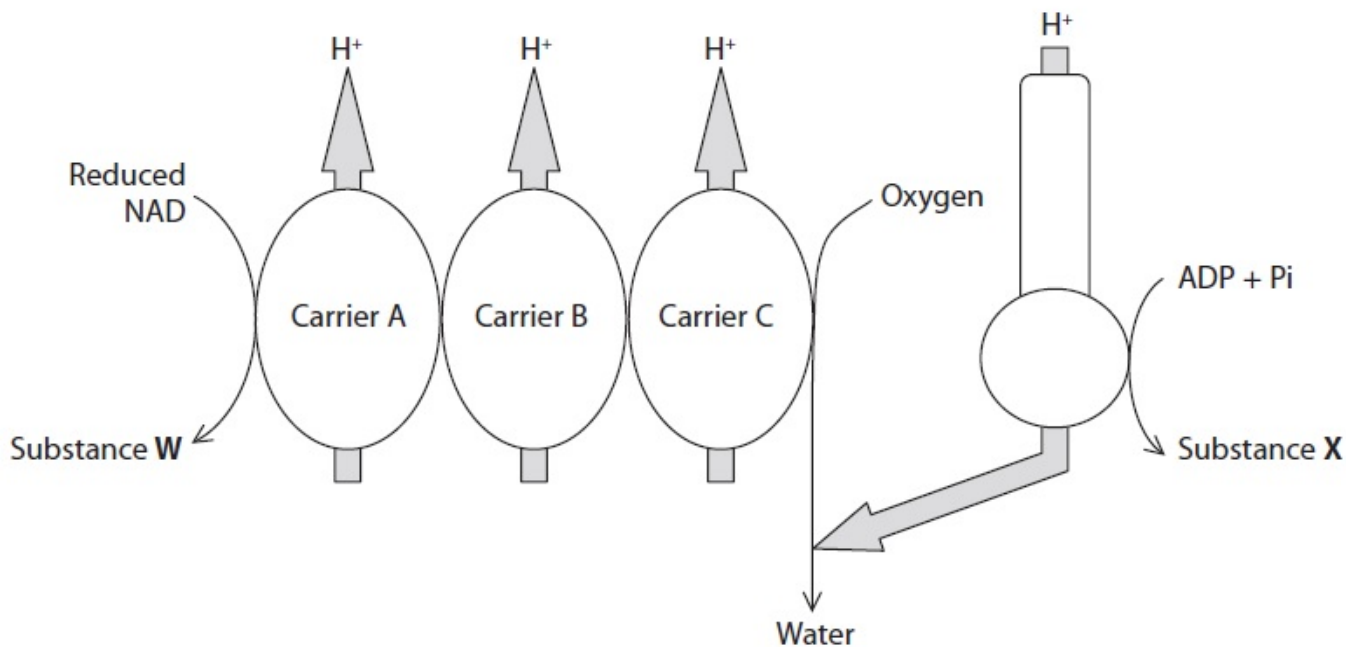
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(b) The diagram below shows the electron transport chain, which is part of aerobic respiration.



(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.

(3)

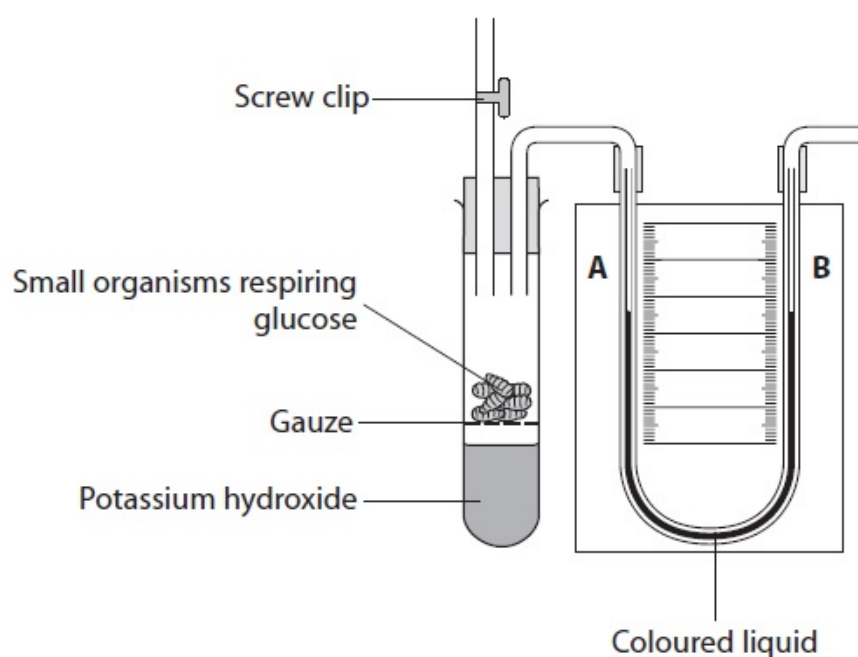
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(c) The diagram below shows a respirometer used to measure the rate of aerobic respiration in small organisms.



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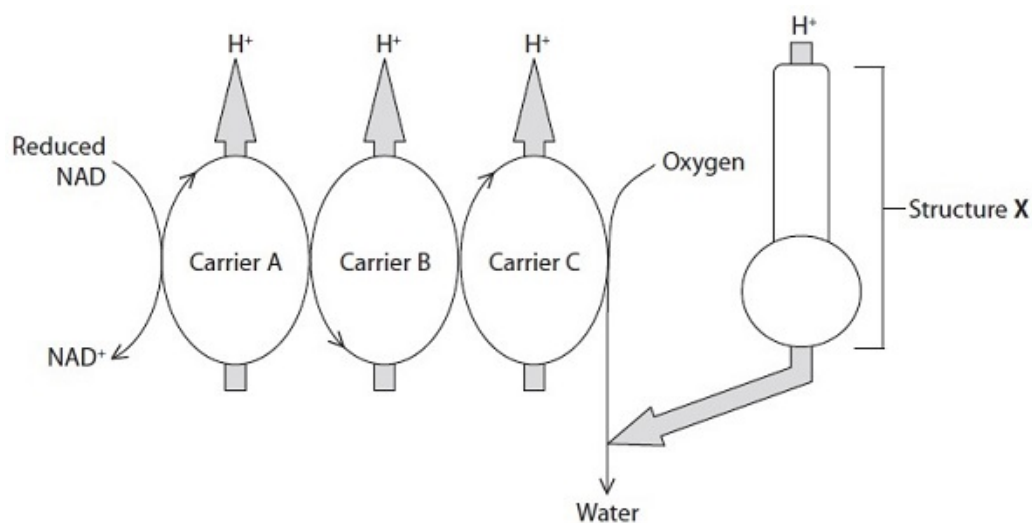
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(b) The diagram below shows the electron transport chain, which is part of aerobic respiration.



(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.

(3)

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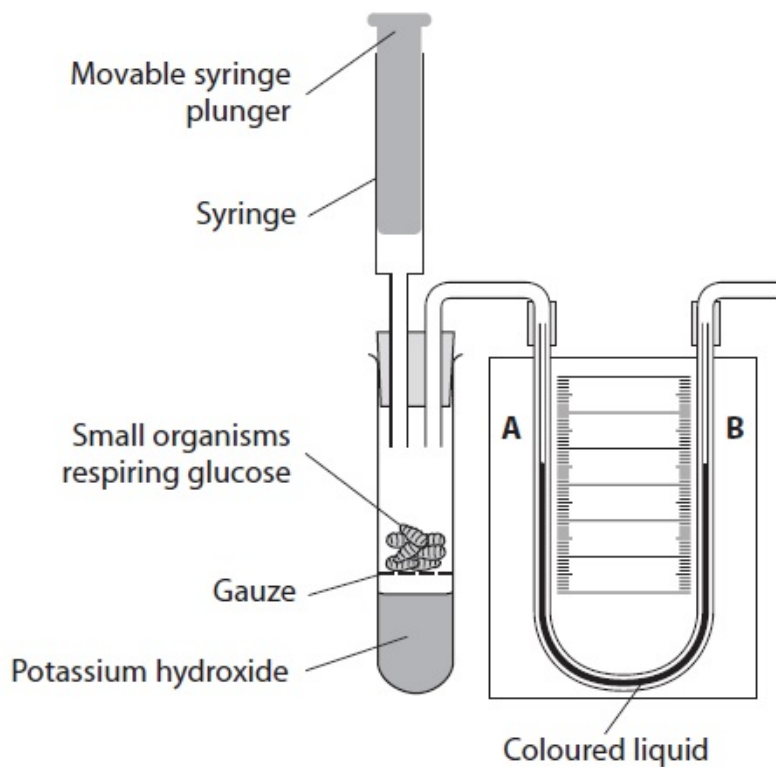
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(c) The diagram below shows a respirometer used to measure the rate of aerobic respiration in small organisms.



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)

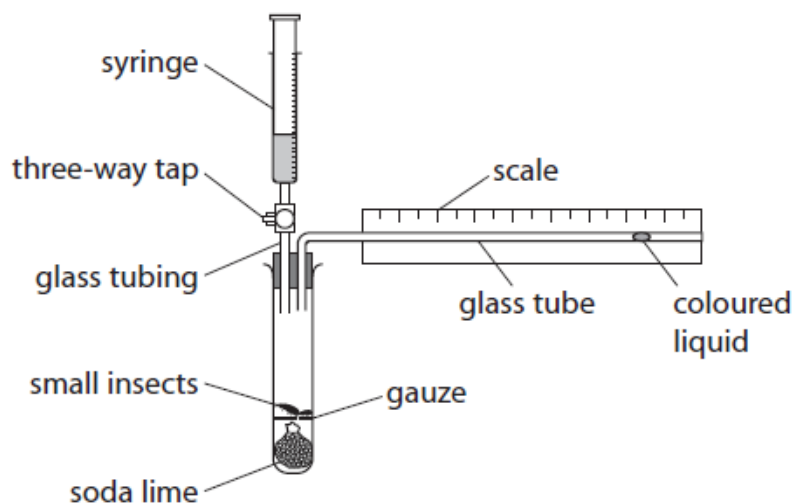
Situation	Movement of coloured liquid		
	towards A	towards B	does not move
Syringe plunger pulled upwards	☒	☒	☒
Syringe plunger not moved	☒	☒	☒
Potassium hydroxide is replaced with water and syringe plunger not moved	☒	☒	☒

(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.

(2)

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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.

(2)

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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.

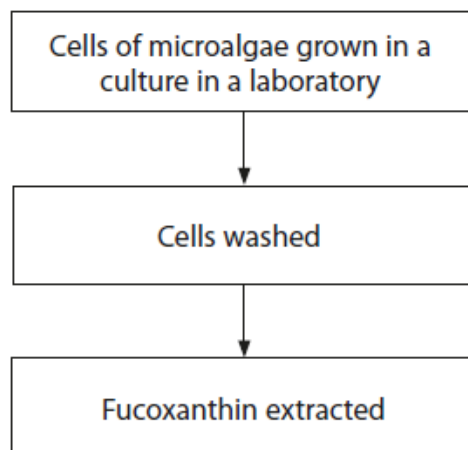
The colour of seaweeds depends on the photosynthetic pigments contained in their cells.

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.

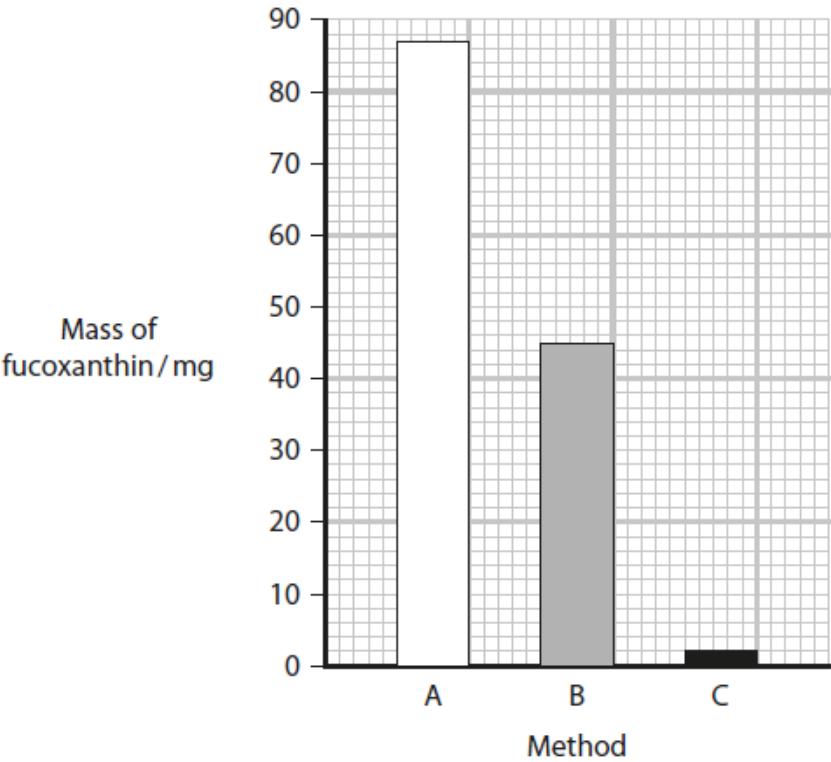
The diagram outlines the steps taken to extract fucoxanthin from microalgae.



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 dm³ 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)

Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following:		
	• drying evaporates the solvent (1)		
	• so that a small concentrated spot of extract can build up (1)		
	• in order to prevent extract spreading out (1)		(3)

Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • add {extract / pigment} to (start) line (1) • (concentrate spot by) dry and repeat (1) • place paper in named solvent (1) • obtain solvent front / place paper so line or spot above solvent / until reaches near top (1)	e.g. propanone / ethanol / petroleum ether DO NOT ACCEPT water	(3)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • use same light intensity (1) • use red filter (1) • use tube {with clean sides / no scratches / holding opaque side} (1) • use a control tube with water to {calibrate / obtain zero absorbance} (1) • same {concentration / volume} of {chloroplasts / DCPIP} (1)	DO NOT ACCEPT same lamp / same bulb / same power / same distance	(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • with herbicide DCPIP not {decolourised / reduced / stays blue} (1) • no electrons available / reduced electron transport (1) • less {reduced NADP / NADPH} (1) • therefore less ATP (1) • because the {Calvin cycle / light independent stage} are affected (1)	ACCEPT converse DO NOT ACCEPT absorbance does not change DO NOT ACCEPT if from ETC implies respiration	(4)

Q4.

	Answer					Mark
(i)						
	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	☒ ;	☒	☒
						(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. (as anaerobic) no O ₂ absorbed / eq ; 2. no CO ₂ produced / eq ; 3. so no change in {volume/pressure} (so liquid does not move) ; 4. since for each 6C glucose respired, 2x3C lactate formed / eq ;	1. ACCEPT No oxygen used	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	1. (reduced NAD from glycolysis) enters mitochondria/ moves through outer mitochondrial membrane / eq ; 2. moves to inner membrane of mitochondrion / eq ; 3. becomes {oxidised / NAD / NAD⁺} ; 4. as {electrons / eq} transferred to {electron transport chain / eq} / eq ; 5. fate of hydrogen ions described e.g. pumped into membrane space ; 6. (NAD) returns to {Krebs cycle/ matrix / eq} ;	2. ACCEPT crista for inner mitochondrial membrane 6. ACCEPT cytoplasm, glycolysis	(4)

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • (as) wavelength of light decreases, rate of photosynthesis increases (1) • because the data show a greater colour change at shorter wavelengths of light, indicating faster CO₂ uptake (by alga) (1)	ACCEPT converse throughout	(2)

Question Number	Indicative content
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. - the trend of the results is opposite in the two repeats: results are not reliable - variables such as organism and indicator are controlled whereas variables such as temperature and light intensity are not controlled - colour changes judged by eye are qualitative and not precise - fastest rate is seen with the last filter used, therefore temperature may be responsible for change in rate - experiment left for 30 minutes, other additional times would give extra information about the rate - coloured indicator may affect the wavelengths of light reaching the algae - the algae will be respiring and producing CO₂, which complicates measurement of the rate of photosynthesis - rate of respiration is assumed to be constant, but this may not be the case - changes in temperature or pH may alter the activity of the enzymes responsible for photosynthesis - conclusion that the experiment is invalid / not measuring effect of wavelength on photosynthesis

Level	Marks	Descriptor
Level 0	0	No awardable content
Level 1	1-3	Limited scientific judgement made with a focus on mainly one aspect. A few strengths or weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but supported with limited evidence.
Level 2	4-6	Scientific judgements are made through the application of relevant evidence, referring to both methods and trends in results. Both strengths and weaknesses are identified. A conclusion is made with reference to more than one piece of evidence, demonstrating links to biological knowledge and understanding.
Level 3	7-9	Scientific judgements are made through detailed analysis and interpretation of relevant evidence including trends in results and several aspects of methodology. Both strengths and weaknesses are identified in both methods and results. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding and drawing upon several strands of evidence.

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: divide energy in producers by energy in sunlight (1) multiply by 100 (1)	$85\,000 \div 7\,000\,000$ $\times 100 = 1.21$ Correct answer gains full marks, with no working shown.	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to one of the following: - light reflected (from leaf) (1) - light misses {chloroplast / chlorophyll} (1) - only certain wavelengths absorbed (1)	Accept transmitted / not absorbed by {chloroplast / chlorophyll} Accept limiting factors eg lack of CO₂, water etc may reduce rate	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: - because some of the energy is lost through {respiration / heat / movement} (1) - some of the producers not eaten (1) - some of the producers not digested (1)		(2)

Q7.

Question Number	Answer	Mark
	An explanation that makes reference to four of the following: • use {soda lime / KOH / NaOH} to absorb carbon dioxide (1) • put {water / dye / ink} (1) • use ruler / scale to measure distance (1) • use {syringe / cross sectional area multiplied by distance / use $\pi r^2 d$} to measure volume of oxygen (1) • use {syringe / 3-way tap} to reset / do repeats (1) • control temperature using water bath (1)	(4)

Q8.

Question Number	Answer	Additional Guidance	Mark
	1. same mass of each tissue / eq ; 2. idea of time being recorded for {a set distance travelled by coloured liquid OR distance coloured liquid travelled in a set time} ;	1. IGNORE amount	(2)

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes the following: - tube with no gel beads (tube containing hydrogencarbonate indicator in light) (1) - tube (containing hydrogencarbonate indicator and gel beads) in light-proof cover (1)	Accept tube containing gel beads without algae (tube containing hydrogencarbonate indicator in light) / no algae Accept tube (containing hydrogencarbonate indicator and gel beads) in the dark	Exp (2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that includes three of the following: {at 5cm and 15cm / at high light intensity / close to lamp} (indicator is purple) there is more photosynthesis, so carbon dioxide being taken in (1) (at 5 and 15cm) more photosynthesis than respiration so net uptake of carbon dioxide (1) - at 25cm (indicator is red) the carbon dioxide used in photosynthesis equals the carbon dioxide produced in respiration (1) {at 35 or 45cm / at low light intensity / far from lamp} (indicator is orange) there is more respiration than photosynthesis, so carbon dioxide released (1)	Allow ref to LDR or carbon fixation for photosynthesis Accept at 5 and 15 cm light is not a limiting factor for photosynthesis, so carbon dioxide is taken in. Accept converse Mp2 may also get mp1 Accept reference to compensation point Accept rate of photosynthesis equals rate of respiration Accept there is less light for photosynthesis so less carbon dioxide is used than is produced in respiration Accept net increase in carbon dioxide	Exp (3)

Q10.

Question Number	Answer	Additional Guidance	Mark
	An answer that includes three of the following: • two examples of standardisation (2) and a maximum of two from: • set up a reference set of solutions at different carbon dioxide concentrations (1) • compare by {colour matching / using a colorimeter} (1) • time taken for algal balls to rise {a known distance / to the surface of the tube} (as oxygen is being produced in photosynthesis) (1)	eg equal volume of sodium hydrogen carbonate indicator / equal number of algal balls in each tube / mass of algae / mass or volume of beads / same temperature Accept measurement of position of / distance moved by algal beads in tube	Exp (3)

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to six of the following: - grass taken from in or near clover and from an area without clover (1) - standardised mass of grass plants collected (1) - use of known volume of (named) solvent to extract pigment from (known mass of) grass (1) - absorbance measured in colorimeter (1) - red filter used to measure absorbance of green chlorophyll (1) - colorimeter zeroed with solvent (1) - replicates taken and means calculated (1) - t test used to look for significant difference (1) - other relevant factor monitored (1)	Allow lab-based experiment where grass is grown with and without clover Allow use of {sand / pestle and mortar/food mixer} to grind up grass Allow extract filtered Allow details of chromatography if carried out as an alternative with area or intensity of green spots measured Allow compare standard deviation	(6)

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: - because different types of lipid are found in the mitochondria and chloroplasts (1) - because mitochondria are associated with { respiration / oxidative phosphorylation} whereas chloroplasts are associated with {photosynthesis / light-dependent reactions / photophosphorylation} (1) - because mitochondria contain {electron transport proteins / cytochromes / cristae / stalked particles} whereas chloroplasts contain {grana / chlorophyll / photosystems / carotenoids} (1)	Accept a description of the differences e.g. a lipid high in mitochondria is low in chloroplast, only two of the lipids are found in both organelles Do not accept a list of values from the table without some sort of comparison Accept any other membrane difference	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	A diagram that shows the following: - a glycosidic bond between C 1 on galactose and C 6 on MGDG (1) - rest of molecules complete (1) - water molecule (1)	ecf if glycosidic bond drawn between C1 and C 4 Accept H₂O / water	(3)

Question Number	Answer	Mark
(iii)	The only correct answer is B A is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot C is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot D is not correct because sulfolipid is the smallest quantity so will be the smallest spot	(1)

Question Number	Correct Answer	Additional guidance	Mark
(a)	An answer that makes reference to the following: • measure volume by use of {formula / three way tap and syringe} (1)		(1)

Question Number	Correct Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • the indicator fluid movement would move to the left (1) • because there is lower pressure (1) • because there is respiration but no photosynthesis (1) • therefore the pressure is reduced because the carbon dioxide produced is absorbed (1)		(4)

Question Number	Correct Answer	Additional guidance	Mark
(c)(i)	An explanation that makes reference to five of the following: • use of a larger container because mice are bigger (1) • need to use more carbon dioxide absorber to ensure all carbon dioxide is absorbed (1) • convert readings into units per gram for each animal (1) • attach a syringe to enable {repeat measurements / volume measurements}(1) • abiotic variables such as light / temperature to be same as in the woodlouse experiment (1) • barrier to protect mouse from carbon dioxide absorber / do not leave mouse in the container for a long time (1)		(5)

Question Number	Correct Answer	Additional guidance	Mark
(c)(ii)	An answer that makes reference to the following: • mouse rate of respiration greater than woodlouse (1) • because mice are endotherms / metabolic rate greater / need to maintain body temperature because of heat loss (1)		(2)

Q14.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. <u>Modify:</u> - uses yeast - provide glucose to yeast - remove potassium hydroxide / remove gauze - coloured liquid put into tubing - scale / ruler - add oil on top of yeast / glucose mixture / use boiled glucose solution <u>'Use' Method:</u> - use apparatus to measure the carbon dioxide released - use range concentrations of fluoride / plus and minus fluoride - replication carried out - use of control - control species of yeast / mass of yeast / volume of mixture / temperature - allow yeast to acclimatise with the three-way tap open - wait for lag phase to finish before measuring rate of reaction <u>'Significant' - Analysis:</u> - use statistical analysis - t test - volume divided by time / distance divided by time - calculate volume from tube diameter - plot graph of respiration against fluoride concentration - use error bars / calculate standard deviation - calculate mean

Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. Covers up to 3 ideas with no analysis Uses woodlice means Level 1 max
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. Covers from 4 to 6 ideas including at least 1 analysis Inappropriate method eg. yeast and photosynthesis / aerobic respiration / Benedict's / keeping KOH means Level 2 and maximum of 5 marks
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. Covers 7 or more ideas including at least 2 analysis Max 8 if no statistical analysis

Q15.

Question Number	Answer	Additional guidance	Mark
(a)	- Idea an enzyme converts a named substrate into named product e.g. enzyme 1 converts P to Q ; - idea that this product becomes the substrate of next step ; - idea of specificity ; {controls / eq} the conversion / eq ; - speeds up the conversion / eq ; - by reducing activation energy / eq ; - credit reference to control of whole process ;	ACCEPT answers in context of respiration ACCEPT 1 - ref to an enzyme converting one named intermediate to the next e.g. {enzyme/ named enzyme} used to convert hexose to phosphorylated hexose ACCEPT 3 - description of specificity e.g. active site of enzyme 1 only accepts substance P or in context of named respiratory intermediate ACCEPT 4 – regulates ACCEPT 5 - catalysis / enzyme acts as a catalyst ACCEPT 7 - end product inhibition or description	(4)

Question Number	Answer	Additional guidance	Mark
(b)(i)	- W = {NAD / NAD⁺ / NAD_{ox} / eq} ; Any two of the following: (due to) reduced NAD {releasing/eq} {electrons / eq} ; - Idea of electrons go to {carrier A / ETC / eq} ; - idea of H⁺ moved into inter-membranal space ;	ACCEPT 2 – being oxidized Releasing hydrogen (atoms), H⁺/protons ACCEPT 3 – 1st electron carrier/correctly named carrier	(3)

Question Number	Answer	Additional guidance	Mark
(b)(ii)	- substance X is ATP ; Any two of the following : - due to H⁺ pass through {stalked particle / ATP synthase} ; (H⁺ passes) down an electrochemical gradient ; (sufficient) energy is {released / eq} ; - to join ADP and {Pi / eq} ; - reference to chemiosmosis ;	ACCEPT 2 –ATPase ACCEPT 3 - description of electrochemical gradient ACCEPT 5 – phosphorylation of ADP	(3)

Question Number	Answer	Additional guidance	Mark																			
(c)	<table border="1"> <tr> <th rowspan="2">Situation</th><th colspan="3">Movement of coloured liquid</th></tr> <tr> <th>towards A</th><th>towards B</th><th>does not move</th></tr> <tr> <td>Screw clip is open</td><td></td><td></td><td>☒</td></tr> <tr> <td>Screw clip is closed</td><td>☒</td><td></td><td></td></tr> <tr> <td>Potassium hydroxide is replaced with water and screw clip is closed</td><td></td><td></td><td>☒</td></tr> </table>	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			☒		(3)
Situation	Movement of coloured liquid																					
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Potassium hydroxide is replaced with water and screw clip is closed			☒																			

Q16.

Question Number	Answer	Additional Comments	Mark
(a)	1. idea of a different enzyme for each step ; 2. (which) converts one intermediate into the next e.g. enzyme 1 converts DHAP to 2-PG / eq ; 3. idea that this product becomes the substrate of the next {stage/enzyme} ; 4. Idea of specificity ; 5. {controls/regulates/ eq} the conversion / eq ; 6. {speeds up / catalyses} the conversion / eq ; 7. by lowering the activation energy // eq ; 8. idea that pyruvate only produced if all enzymes active ;	1. Accept 3 enzymes are involved 2. Accept correctly named enzyme 4. Accept description of specificity	(4)

Question Number	Answer	Additional Comments	Mark
(b)(i)	1. direction of electron movement described / eq ; 2. reference to oxidation / reduction ; 3. idea of releasing energy ; 4. idea that this is used to pump the {H ⁺ / hydrogen ions/protons} ; 5. from the matrix / into the space between the inner and outer mitochondrial membrane ;	1. Accept electron picked up from A or passed on to C 2. Ignore ref to energy lost 4. Not hydrogen unqualified	(3)

Question Number	Answer	Additional Comments	Mark
(b)(ii)	1. structure X is { stalked particle / ATP synthase / eq } ; Any two of the following: 2. reference to {H ⁺ flows through {structure X / eq} / chemiosmosis} / eq ; 3. down electrochemical gradient / eq ; 4. (sufficient) energy is {released / eq} to ; 5. allow {ADP + Pi to join / ATP to form} ;	1. Accept , ATP <u>synthetase</u> , ATPase 3. Accept H ⁺ concentration gradient 4. Not energy produced 5. Accept phosphorylation of ADP Not reference to phosphorus, P	(3)

Question Number	Answer	Additional Comments	Mark																			
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Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	{mm/cm/mm ³ /cm ³ } min ⁻¹ g ⁻¹		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: - named factor (1) - how controlled (1)	e.g. temperature, {size / mass / age} of insect e.g. thermostatically controlled water bath / water bath set at a constant temperature / ac room choose equal { size / mass / age } of insect	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: - it has already absorbed the maximum amount of carbon dioxide / no more carbon dioxide can be absorbed (1) (therefore) coloured liquid {would not move / would move less} / readings {are an underestimate / will not be valid} (1)	Accept it is able to absorb less carbon dioxide (for the second insect) Accept (it is replaced) so that coloured liquid will move / so that readings will be valid	(2)

Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	2.0 / 1.9 / 1.93 (times / x)	DO NOT ACCEPT 1.93 recurring	(1)
(ii)	An explanation that makes reference to three of the following: - water is more effective than culture media for washing (1) {water is not the solvent / ethanol is the solvent} for fucoxanthin(1) - ethanol {increases permeability of / disrupts} (cell / vacuole)membrane (1) - more fucoxanthin extracted in method A (compared with methodB) because water enters the seaweed {by osmosis / causing the cells to burst} (1)	ACCEPT more fucoxanthin extracted in A because washed with water	(3)