

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES
INORGANIC IONS

SCORE

/35

PERCENTAGE

%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at [qualifications.pearson.com](https://www.pearson.com/qualifications) before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Chemical control in plants is brought about by plant growth substances such as auxins.

Auxins cause elongation of cells.

Auxins weaken the bonds between molecules found in cell walls. Molecules found in cell walls include cellulose and hemicellulose.

(i) Which of the following statements about cellulose molecules is correct?

(1)

- ☐ **A** they are branched polymers
- ☐ **B** they contain α -glucose
- ☐ **C** they are bonded to each other by hydrogen bonds
- ☐ **D** they contain 1,6 glycosidic bonds

(ii) The following statements relate to calcium pectate:

1. found in the middle lamella
2. cell walls together
3. prevents the movement of water

Which of the following is correct for calcium pectate?

(1)

- ☐ **A** statement 1 and statement 2
- ☐ **B** statement 1 and statement 3
- ☐ **C** statement 2 only
- ☐ **D** statement 3 only

(Total for question = 2 marks)

Q2.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer

with a cross ☒.

Transpiration moves water and mineral ions from the roots to the leaves of plants.

Which box in the table shows the mineral ions needed to make an amino acid and which box shows those needed to make DNA?

(2)

Molecule	Mineral ions needed to make the molecule			
	nitrate ions only	phosphate ions only	both nitrate and phosphate ions	neither nitrate nor phosphate ions
amino acid	☐	☐	☐	☐
DNA	☐	☐	☐	☐

(Total for question = 2 marks)

Q3.

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.



Clover plants have bacteria living in root nodules.

These bacteria convert atmospheric nitrogen (N_2) to ammonia (NH_3) using the enzyme nitrogenase.

(i) State one organic molecule containing nitrogen atoms which is found in plant cells.

(1)

.....

(ii) Nitrogen is a relatively unreactive gas that forms 80% of the atmosphere.

The enzyme nitrogenase catalyses the reaction shown:



The activation energy for this reaction is very high.

Analyse the information to explain how the enzyme nitrogenase is involved in the energy changes required for this reaction.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Q4.

The photograph shows a glacier that is melting. As the glacier gradually melts, it leaves behind bare rock.



(Source: © CHARLES D. WINTERS/SCIENCE PHOTO LIBRARY)

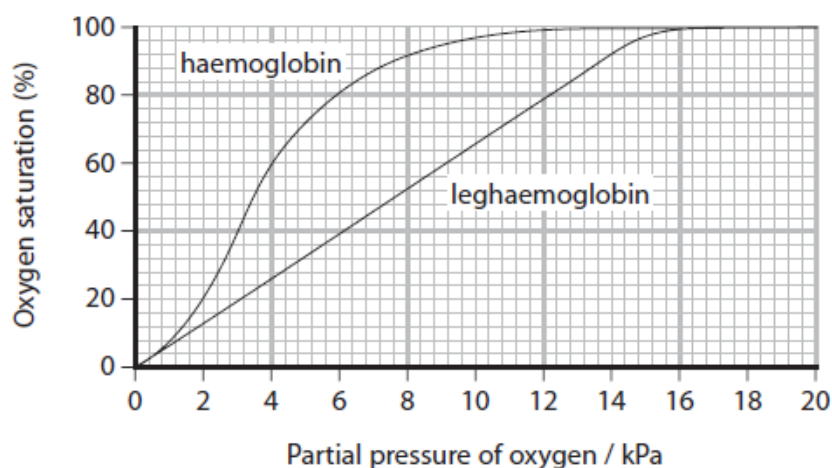
Scientists sampled the soil from areas that had been uncovered for different lengths of time after the glacier ice had melted.

The table shows the results from the samples.

Length of time since glacier melted / years	Soil depth / cm	Mass of nitrate in soil / mg m^{-2}	Mass of leaf litter that falls to ground each year / $\text{g m}^{-2} \text{yr}^{-1}$
5	5.2	3.8	1.5
15	6.4	4.1	1.7
40	7.0	5.3	12.8
100	9.2	21.8	277.0
150	10.8	35.4	335.0
200	15.1	53.3	277.0
250	16.2	61.4	261.0

The roots of some of the plants growing around the glacier were found to contain an oxygen binding protein called leghaemoglobin.

The graph shows the oxygen dissociation curve for leghaemoglobin and the oxygen dissociation for haemoglobin.



(i) Leghaemoglobin is a protein that is similar in structure to myoglobin. Both of these proteins have one subunit.

Explain how the oxygen dissociation curve shows that the structure of leghaemoglobin is more similar to myoglobin than to haemoglobin.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Explain how leghaemoglobin enables these plants to grow in waterlogged and compact soils.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q5.

Plants require mineral ions from the soil for healthy growth.

(i) Describe how mineral (inorganic) ions are taken up by active transport.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Describe the function of a named mineral ion that is vital for the growth of plants.

(2)

Mineral ions

.....

Function

.....

.....

.....

.....

(Total for question = 5 marks)

Q6.

Soya beans are an important crop for the production of food and oil.

A study of the nutritional content of soya beans from non-transgenic soya bean plants and from transgenic soya beans plants was carried out in two regions of Brazil.

The regions were Ponta Grossa and Londrina.

Tables 1 and 2 show the results of this study.

Table 1

Type of plant	Region	Mean mineral content / mg per 100 g dried soya beans		
		Iron	Copper	Manganese
Non-transgenic	Ponta Grossa	3.34	0.76	1.38
Transgenic	Ponta Grossa	3.44	0.86	1.40
Non-transgenic	Londrina	4.59	1.35	2.20
Transgenic	Londrina	4.15	1.25	2.02

Table 2

Type of plant	Region	Mean organic content / mg per 100 g dried soya beans		
		Protein	Lipid	Carbohydrate
Non-transgenic	Ponta Grossa	38.61	21.09	23.88
Transgenic	Ponta Grossa	38.80	21.19	23.41
Non-transgenic	Londrina	41.68	18.56	25.74
Transgenic	Londrina	40.62	19.87	25.26

* (i) Analyse the data to assess the nutritional content of soya beans from transgenic and from non-transgenic soya bean plants grown in these two regions.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

[illegible]

(ii) The soil in Londrina is more fertile than the soil in Ponta Grossa. Londrina has higher temperatures and rainfall during the growing season.

Explain the differences in the nutritional content of soya beans grown in these two regions.

(5)

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(iii) Explain why this study also analysed the types of fatty acid found in soya beans from transgenic plants and from non-transgenic plants.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 13 marks)

Q7.

Water is needed for the transport of mineral ions through a plant.

Farmyard manure contains many mineral ions.

(i) Calcium ions in manure promote the growth of plants by increasing

(1)

- ☐ **A** amino acid synthesis
- ☐ **B** the production of chlorophyll
- ☐ **C** the strength of the middle lamella between cells
- ☐ **D** water loss by the leaves

(ii) Which of the following is the mechanism by which these calcium ions are transported from soil water into plants?

(1)

- ☐ **A** active transport
- ☐ **B** exocytosis
- ☐ **C** osmosis
- ☐ **D** transpiration

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	The only correct answer is C (they are bonded to each other by hydrogen bonds) A is not correct because cellulose molecules are not branched polymers B is not correct because cellulose molecules do not contain α - glucose, they contain β - glucose D is not correct because cellulose molecules do not contain 1,6 glycosidic bonds, they contain 1,4 glycosidic bonds		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	The only correct answer is A (statement 1 and statement 2) B is not correct because calcium pectate does not prevent the movement of water C is not correct because calcium pectate is also found in the middle lamella D is not correct because calcium pectate does not prevent the movement of water		(1)

Q2.

Question Number	Answer	Additional Guidance	Mark																			
			(2)																			
	<table><tr><th rowspan="2">Molecule</th><th colspan="4">Mineral ions used</th></tr><tr><th>nitrate ions only</th><th>phosphate ions only</th><th>both nitrate and phosphate ions</th><th>neither nitrate nor phosphate ions</th></tr><tr><td>amino acid</td><td>X</td><td>☐</td><td>☐</td><td>☐</td></tr><tr><td>DNA</td><td>☐</td><td>☐</td><td>X</td><td>☐</td></tr></table>	Molecule	Mineral ions used				nitrate ions only	phosphate ions only	both nitrate and phosphate ions	neither nitrate nor phosphate ions	amino acid	X	☐	☐	☐	DNA	☐	☐	X	☐		
Molecule	Mineral ions used																					
	nitrate ions only	phosphate ions only	both nitrate and phosphate ions	neither nitrate nor phosphate ions																		
amino acid	X	☐	☐	☐																		
DNA	☐	☐	X	☐																		

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: (the nitrogen can be incorporated into) protein (1)	Allow {DNA / RNA / organic base / amino acid / named protein / ATP /chlorophyll}	(1)
(ii)	An explanation that makes reference to the following: - enzyme lowers the activation energy (for the reaction) (1) - a large number of ATP molecules is used (1) - because the reaction needs a lot of energy (1) - to compensate for nitrogen being unreactive (1)		(4)

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following points: • (leghaemoglobin / myoglobin) is not S shaped / is linear / is a straight line (1) • because (leghaemoglobin / myoglobin) affinity for oxygen does not alter (1) • because (with leghaemoglobin) there is no cooperative binding (1) • (leghaemoglobin) binds to one molecule (of oxygen) (1)	Accept converse for haemoglobin Accept converse for haemoglobin Accept converse for haemoglobin Accept shape change to subunits / conformation change Accept (leghaemoglobin / myoglobin) has only one oxygen binding site Accept haemoglobin has four binding sites / binds to four molecules of oxygen	3 exp

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following points: • (waterlogged soil has) little / low / less / no oxygen (1) • (leghaemoglobin) provides oxygen for respiration (1) • which enables active uptake of mineral ions / named mineral ion (1) • such as (calcium) to make calcium pectate / (nitrate) to make amino acids / (magnesium) to make chlorophyll (1)	Accept binds to / stores oxygen for respiration Accept other correct active processes e.g. synthesis of amino acids / protein synthesis / mitosis Accept other correct examples of minerals with functions	3 exp

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes three of the following: • moved {across membrane / into cell / into root} by carrier proteins (1) • against a concentration gradient (1) • using ATP (1)	Accept protein pumps Ignore channel proteins Accept from a low to a high concentration	Exp (3)

Question Number	Answer	Additional Guidance	Mark
(ii)	• suitable mineral ion named (1) • appropriate function given (1)	Mp2 can be given if suitable mineral not named eg nitrogen for nitrate eg nitrate / (ammonium) – formation of amino acids / proteins / enzymes / nucleic acids / nucleotides / DNA / RNA / chlorophyll phosphate – formation of nucleotides / nucleic acids / DNA / RNA / ATP / ADP / amino acids calcium – formation of middle lamella / calcium pectate magnesium – formation of chlorophyll Accept other correct mineral ions with correct functions potassium, sodium, iron etc	Exp (2)

Q6.

Question Number	Indicative content
* (i)	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>Indicative content</u> Table 1 • Ponta Grossa: transgenic plants have higher mineral content than non-transgenic plants • Londrina: transgenic plants have lower mineral content than non-transgenic plants • Transgenic plants: plants grown in Ponta Grossa have lower mineral content than plants grown in Londrina • Non-transgenic plants: plants grown in Ponta Grossa have lower mineral content than plants grown in Londrina • Londrina: both types of soybean have more mineral content than both types in Ponta Grossa

	Table 2 • Ponta Grossa: transgenic plants have higher protein and lipid but lower carbohydrate content than non-transgenic plants • Londrina: transgenic plants have higher lipid but lower protein and carbohydrate content than non-transgenic plants • Transgenic plants: plants grown in Ponta Grossa have higher lipid but lower protein and carbohydrate content than plants grown in Londrina • Non-transgenic plants: plants grown in Ponta Grossa have higher lipid but lower protein and carbohydrate content than plants grown in Londrina • Londrina: both types of soybean have more protein and carbohydrate but lower lipid than both types in Ponta Grossa Examples of Conclusions • Londrina soybeans are (generally) the most nutritious • In Londrina, non-transgenic soybeans are more nutritious
--	--

		• In Ponta Grossa, transgenic soybeans are more nutritious • Very little difference in nutritional content overall
Level 0	Marks	No awardable content
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. 2 / 3 comparisons / conclusions
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure. 4 / 5 comparisons / conclusions
Level 3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. 6 / more comparisons and conclusions

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to five of the following: - Londrina (has a more fertile soil therefore the) soya beans will have a higher {mineral / mineral ion / ion / named mineral ion} content (1) - Londrina (has a more fertile soil therefore the) soya beans will have a higher protein content as there will be more nitrates (1) - Londrina has a higher temperature so {photosynthesis / Calvin cycle / carbon fixation} will be faster (1) - as {enzymes / RUBISCO} will {increase rate of reactions / have more kinetic energy} (1) - therefore making more {organic molecules / carbohydrate / named carbohydrate / protein} (1) - Londrina has a higher rainfall therefore more water for {photolysis / transport of minerals} (1)	ACCEPT {photosynthesise faster as more magnesium ions for chlorophyll / be stronger as more calcium ions for cell walls / more phosphate for ATP or nucleic acid synthesis} ACCEPT greater activity / work faster ACCEPT light-dependent reactions	(5)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: - to compare the fatty acids in the two types of soya bean (1) - so that {the (transgenic) soybeans will be less likely to increase the risk of heart disease / oxidation is less likely} (1)	ACCEPT to see if there were less saturated fatty acids / less linoleic acid / more oleic acid ACCEPT converse less likely to go rancid oleic acid less likely to oxidise than linoleic acid	(2)

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	C (the strength of the middle lamella between cells)		(1)

Question Number	Answer	Additional guidance	Mark
(ii)	A (active transport)		(1)