Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in A Level Biology

Topic 5: Energy for Biological Processes

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

Mitochondria can be extracted from liver cells.

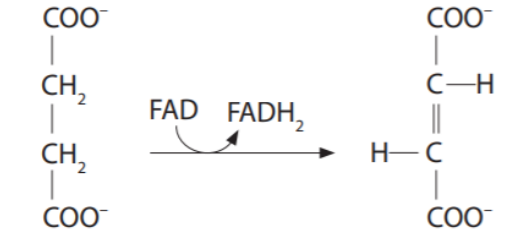
In order to monitor the purification of a sample of mitochondria, a protein concentration : enzyme activity ratio can be determined.

(a) Describe the structure of a globular protein.

(2)

(b) The enzyme used to monitor the purification of mitochondria is succinate dehydrogenase.

This enzyme is involved in the Krebs cycle and converts succinate into fumarate in this reaction.



Succinate Fumarate

(i) When succinate is converted into fumarate, succinate is

(1)

- ☒ **A** hydrolysed
- ☒ **B** oxidised
- ☒ **C** phosphorylated
- ☒ **D** reduced

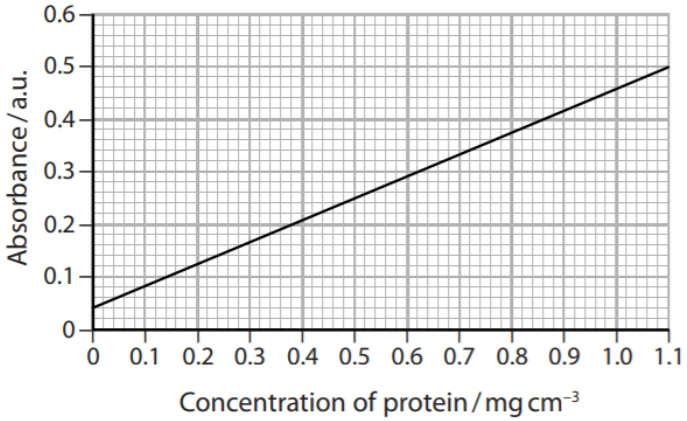
(ii) Explain the role of the Krebs cycle.

(4)

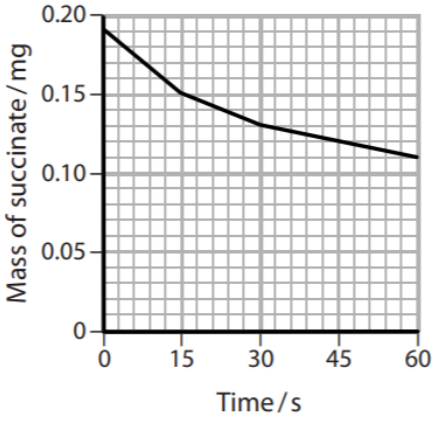
(c) Protein concentrations can be determined by using a calibration curve, shown in graph 1.

The initial rate of activity of succinate dehydrogenase, from a sample of mitochondria, can be determined using graph 2.

Graph 1



Graph 2



(i) This sample of mitochondria had an absorbance of 0.28 when the protein concentration was measured.

Determine the protein concentration of this sample of mitochondria.

(1)

Answer .....

(ii) Determine the initial rate of enzyme activity to obtain the protein : enzyme activity ratio for this sample of mitochondria.

(2)

Ratio .....

2

Photosynthetic pigments are found in plant leaves.

(a) Describe how you could use chromatography to separate these pigments.

(3)

(b) A scientist investigated the effect of lead pollution by cars on the chlorophyll content of plant leaves.

Quadrat sampling was used to collect leaves from a plant species.

Leaf samples were collected from an area with little car traffic and from an area with heavy car traffic.

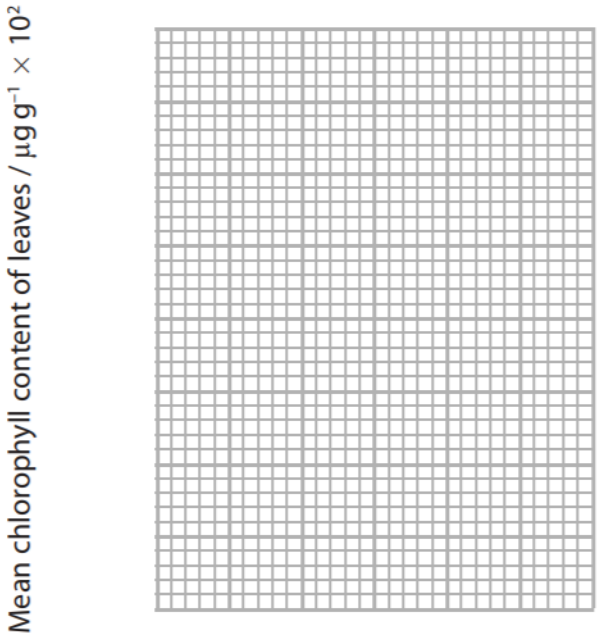
The leaf samples were tested for lead content and chlorophyll content.

The table shows the results of this investigation.

Area	Mean lead content of leaves / $\mu g\, g^{-1}$	Mean chlorophyll content of leaves / $\mu g\, g^{-1} \times 10^2$
Little traffic	1.28 ± 0.64	64.00 ± 4.00
Heavy traffic	3.11 ± 0.31	22.50 ± 3.00

(i) Plot a graph to show the data for mean chlorophyll content.

(2)



(ii) Explain how the quadrat sampling should have been carried out.

(3)

(iii) The scientist concluded that lead pollution from cars reduces the photosynthesis of plants.

Criticise the validity of this conclusion.

(2)

3

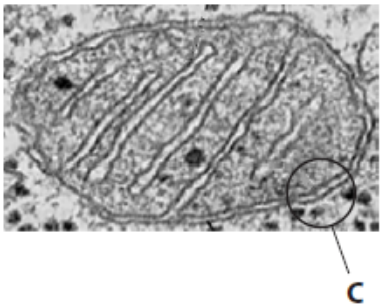
(a) Photographs **P** and **Q** are electron micrographs of mitochondria.

Each photograph was taken using a different electron microscope.

Photograph **P**

Sourced from: http://book.bionumbers.org/how-big-are-mitochondria/

Photograph **Q**



Source: Cellupedia

(i) What is the structure labelled **S**?

(1)

- ☒ **A** crista
- ☒ **B** matrix
- ☒ **C** stroma
- ☒ **D** thylakoid

(ii) Explain the difference in appearance of the parts labelled **C** using the two different electron microscopes.

(2)

*(b) The table shows the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

Membrane of mitochondrion	Protein : lipid ratio
inner	3:2
outer	1:1

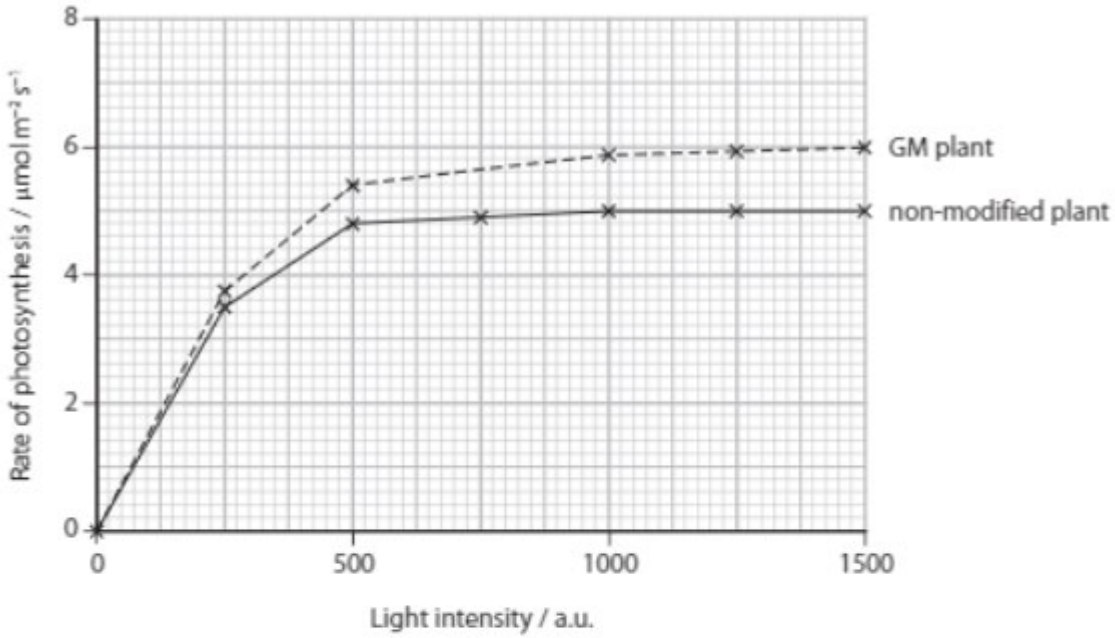
Explain the difference in the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

(6)

4

(b) An investigation was carried out to compare the effect of light intensity on the rate of photosynthesis in GM plants with the effect in non-modified plants.

The graph shows the results of this investigation.



(i) The rate of photosynthesis is expressed as $\mu mol\, m^{-2} s^{-1}$.

Describe what was measured to find the rate of photosynthesis.

(3)

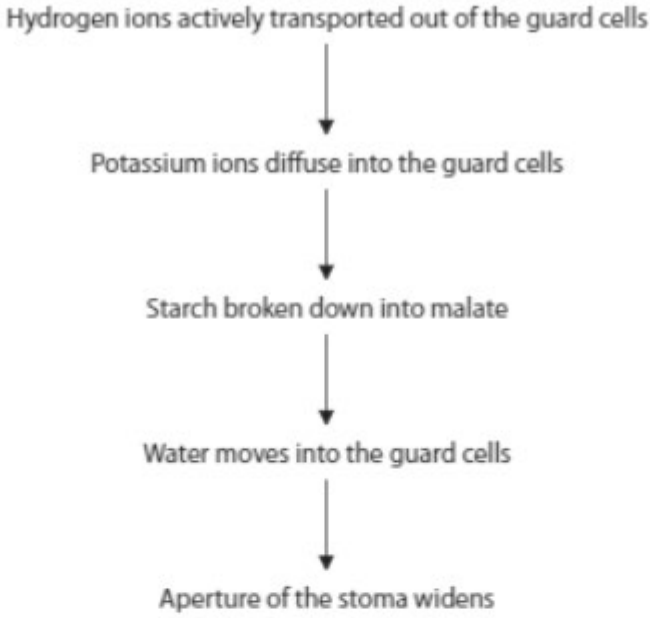
(ii) Explain the results of this investigation.

(3)

(c) Explain why the wider stomata in GM crop plants could increase their yield.

(3)

(d) The flow chart shows some of the steps involved in opening the aperture of a stoma.



(i) What happens when hydrogen ions are actively transported out of the guard cells?

(1)

☐ **A** ADP and phosphate ions are converted into ATP by a hydrolysis reaction

☐ **B** ADP and phosphate ions are converted into ATP by a condensation reaction

☐ **C** ATP is broken down into ADP and phosphate ions by a condensation reaction

☐ **D** ATP is broken down into ADP and phosphate ions by a hydrolysis reaction

(ii) Which of the following explains why water moves into the guard cells?

(1)

☐ **A** malate lowers the water potential of the cytoplasm

☐ **B** malate raises the water potential of the cytoplasm

☐ **C** starch lowers the water potential of the cytoplasm

☐ **D** starch raises the water potential of the cytoplasm

(iii) Which of the following explains why the aperture of the stoma widens?

(1)

☐ **A** The guard cells become smaller and the inner wall of the guard cell is more flexible than the outer wall

☐ **B** The guard cells become smaller and the inner wall of the guard cell is less flexible than the outer wall

☐ **C** The guard cells become larger and the inner wall of the guard cell is more flexible than the outer wall

☐ **D** The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall

5

Plant pigments are involved in photosynthesis.

The action spectrum of chloroplasts and the absorption spectrum of the pigments can be determined.

(a) (i) State the difference between an action spectrum and an absorption spectrum.

(1)

(ii) State how an action spectrum and an absorption spectrum show that chlorophyll is used in photosynthesis.

(1)

(b) Cadmium is an environmental pollutant that affects the synthesis of plant pigments.

A scientist investigated the effect of cadmium on the synthesis of chlorophyll and carotenoid pigments in plants.

The scientist used the following steps in the method.

Step 1: plants were grown in darkness for one week to produce yellow leaves

Step 2: leaf discs of the same diameter were taken from the first pair of these leaves

Step 3: a total of 25 discs was put into tubes containing different cadmium chloride concentrations

Step 4: these tubes were kept at 27 °C and exposed to the same source of light

The table shows information about the pigments chlorophyll a and chlorophyll b and the carotenoids present in the leaf discs after 48 hours.

Cadmium chloride concentration / a.u.	Mean concentration of chlorophyll / mg kg^{-1}	Mean concentration of carotenoid / mg kg^{-1}	Ratio of chlorophyll a : b	Ratio of carotenoid : chlorophyll
0.0	384 ± 4.2	444 ± 6.2	1.23	1.15
0.1	204 ± 4.9	270 ± 4.5	1.00	1.32
1.0	180 ± 3.6	207 ± 5.2	0.83	1.15
3.0	146 ± 4.1	140 ± 3.1	0.81	0.95
5.0	126 ± 2.7	91 ± 1.0	0.56	0.71
10.0	102 ± 1.9	64 ± 1.1	0.80	0.63

(i) Analyse the data to deduce the effect of cadmium on the synthesis of plant pigments.
(3)

Total for test = 46 marks