Pearson Edexcel

Additional Assessment Materials
Summer 2021

# Pearson Edexcel GCE in AS Biology

## Topic 1: Biological Molecules

## (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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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** Short sequences of nucleotides are being developed as potential drugs.

They act by binding to selected sites on DNA or RNA molecules and prevent the synthesis of a specific protein associated with a disease.

Two types of drug to treat genetic disorders are:

- antisense drugs, which are RNA nucleotides that bind to mRNA
- triplex drugs, which are DNA nucleotides that bind to DNA forming a three-stranded helix.

(a) (i) The type of bonds that hold the two strands of a DNA molecule together in a double helix are

(1)

☐ **A** glycosidic bonds

☐ **B** hydrogen bonds

☐ **C** phosphodiester bonds

☐ **D** peptide bonds

(ii) Antisense drugs inhibit protein synthesis by interfering with

(1)

☐ **A** protein folding

☐ **B** replication

☐ **C** transcription

☐ **D** translation

(iii) Triplex drugs inhibit protein synthesis by interfering with

(1)

☐ **A** protein folding

☐ **B** replication

☐ **C** transcription

☐ **D** translation

(b) The table shows the sequence of bases in part of an mRNA molecule.

Complete the table to show the base sequence of **each** of the following:

(i) the corresponding coding strand of DNA that produced this mRNA sequence

**(1)**

(ii) the base sequence of an antisense drug that will bind to this mRNA.

**(1)**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Base sequence on the DNA coding strand** | | | | | | | | | | | | |
| **Base sequence on mRNA** | C | A | U | G | C | A | U | A | U | C | G | G |
| **Base sequence of antisense drug** | | | | | | | | | | | | |

(iii) State the number of amino acids that would be coded for by the part of mRNA shown in this table.

**(1)**

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(c) Which of the following statements is true for the total number of bases in a double-stranded DNA molecule?

**(1)**

☐ **A** $\frac{A+T}{C+G}=1$

☐ **B** $\frac{A}{T}=\frac{C}{G}$

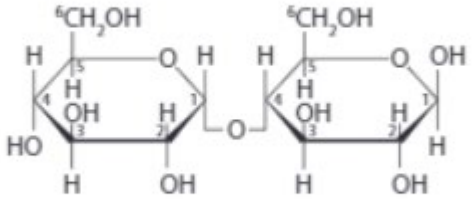
☐ **C** $A \times T = C \times G$

☐ **D** $\frac{A}{C}=\frac{G}{T}$

**2**

Enzymes are involved in a wide range of metabolic reactions.

(a) The diagram represents the structure of a maltose molecule.




Draw a diagram to show the hydrolysis of maltose.

(3)

(b) Catalase is an enzyme found in potato cells.

It catalyses the breakdown of hydrogen peroxide.

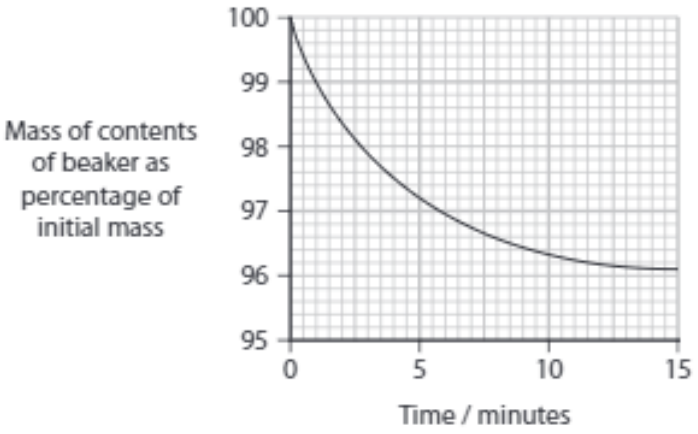
$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water} + \text{oxygen}$$

In an investigation, cylinders of potato were cut with a cork borer.

The cylinders were then sliced into discs with the same thickness and put into a small beaker containing 50 $cm^3$ of hydrogen peroxide.

The mass of the beaker and its contents was recorded over a period of 15 minutes.

The graph shows the results of the experiment.



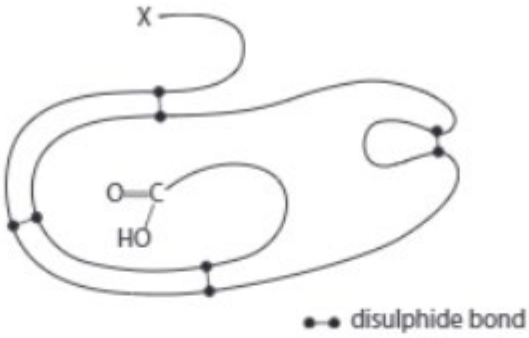

Explain the relationship shown in the graph.

**(4)**

(c) Explain how a gene mutation can prevent the production of catalase in potato cells.

**(3)**

**3** The diagram shows the tertiary structure of a molecule of the enzyme RNase.




(a) (i) Which chemical group is found at position X?

(1)

- ☐ **A** amino
- ☐ **B** carboxyl
- ☐ **C** hydroxyl
- ☐ **D** nitrate

(ii) Give the meaning of the term tertiary structure of a protein.

(2)

**4**

Polyphenol oxidase is an enzyme found in many plant cells.

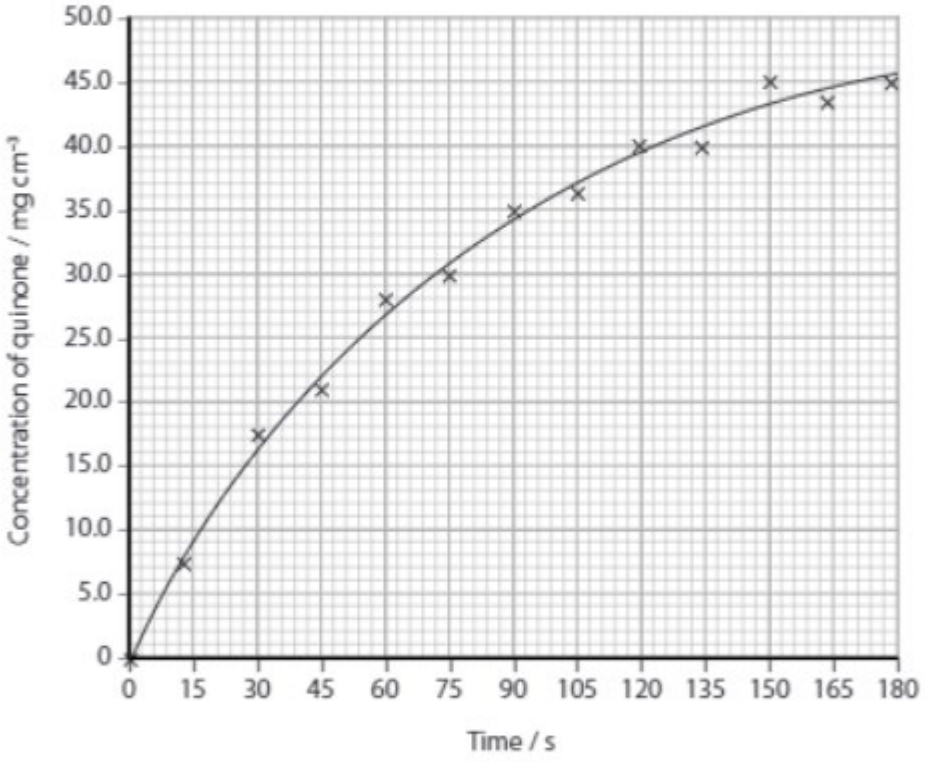
This enzyme catalyses the following reaction

monophenol (colourless) + oxygen ⟶ quinone (brown)

This reaction causes cut fruit to turn brown when exposed to air.

(a) A student carried out an investigation into the rate at which grape juice produced quinone.

The graph shows the results of this investigation.




(i) Calculate the initial rate of this reaction.

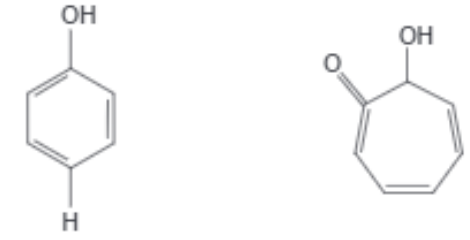
(3)

(ii) Explain why adding citric acid to cut fruit reduces the rate at which the fruit turns brown.

**(2)**

(iii) The diagram shows the structures of monophenol and a molecule called tropolone.

Tropolone can be added to grape juice to slow the rate at which the juice turns brown.




monophenol tropolone

Explain how tropolone affects the rate at which the grape juice turns brown.

**(2)**

(b) Plant breeders have developed a grape variety that produces inactive polyphenol oxidase.

The bonding in this enzyme is changed and this prevents the juice from turning brown.

(i) Which of the following bonds are used to form the tertiary structure of enzymes?

(1)

- ☒ **A** hydrogen, glycosidic and ester
- ☒ **B** hydrogen, ionic and disulfide
- ☒ **C** ionic, glycosidic and disulfide
- ☒ **D** ionic, disulfide and ester

(ii) The base sequence of this polyphenol oxidase gene is different in this grape variety.

Explain how this leads to the production of inactive enzyme.

(3)

**5**

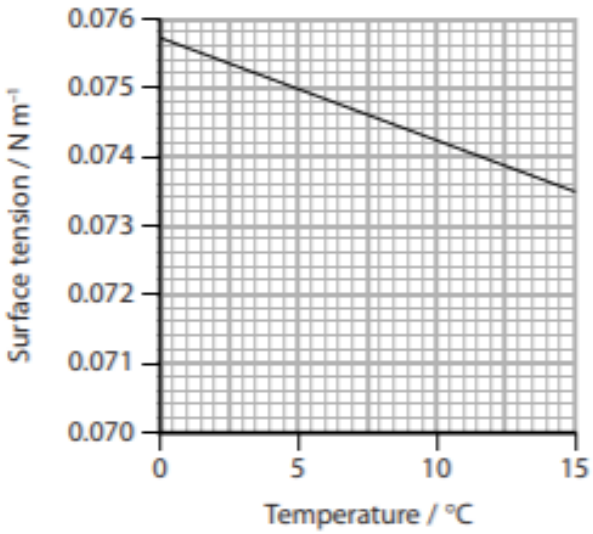
Pond skaters are insects. They can move on the surface of water due to the high surface tension of water.

The photograph shows four pond skaters on the surface of water.

(a) Explain how the properties of water molecules result in surface tension.

**(3)**

(b) The graph shows the effect of temperature on the surface tension of water.




A pond skater has a mass of 0.02 g and has a length of 20 mm in contact with the surface of the water.

The force that this pond skater exerts on the surface of the water can be calculated using the equation:

force in newtons = mass in kilograms × 9.8

(i) Calculate the force exerted by the pond skater for each millimetre length of contact with the surface of the water.

Give your answer in standard form.

(3)

Answer .....

(ii) This pond skater can stay on the surface of water even on a hot day in summer.

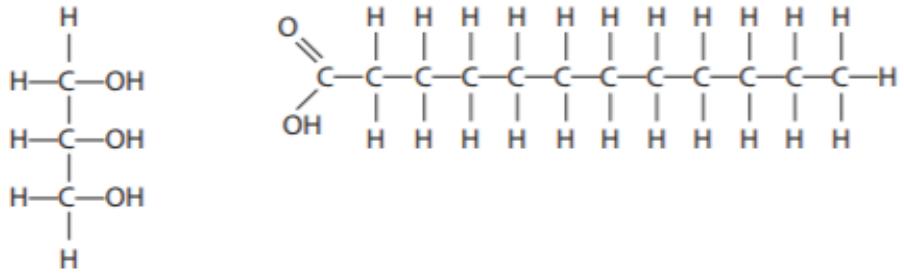
Use your calculated value and the graph to explain why this pond skater can stay on the surface of water.

**(3)**

**6**

Glycerol molecules and fatty acid molecules are used in the synthesis of cell membranes.

The diagram shows a molecule of glycerol and a molecule of a fatty acid.



(a) Which of the following describes the reaction when these two molecules are joined together?

(1)

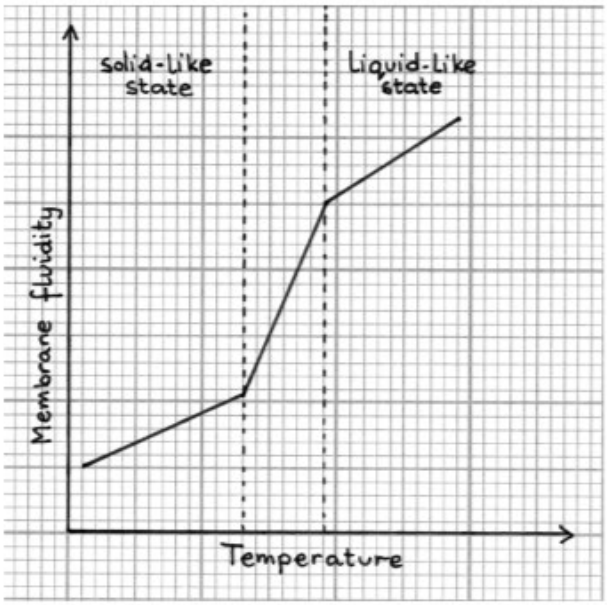
☒ **A** condensation reaction forming an ester bond

☒ **B** condensation reaction forming a glycosidic bond

☒ **C** hydrolysis reaction forming an ester bond

☒ **D** hydrolysis reaction forming a glycosidic bond

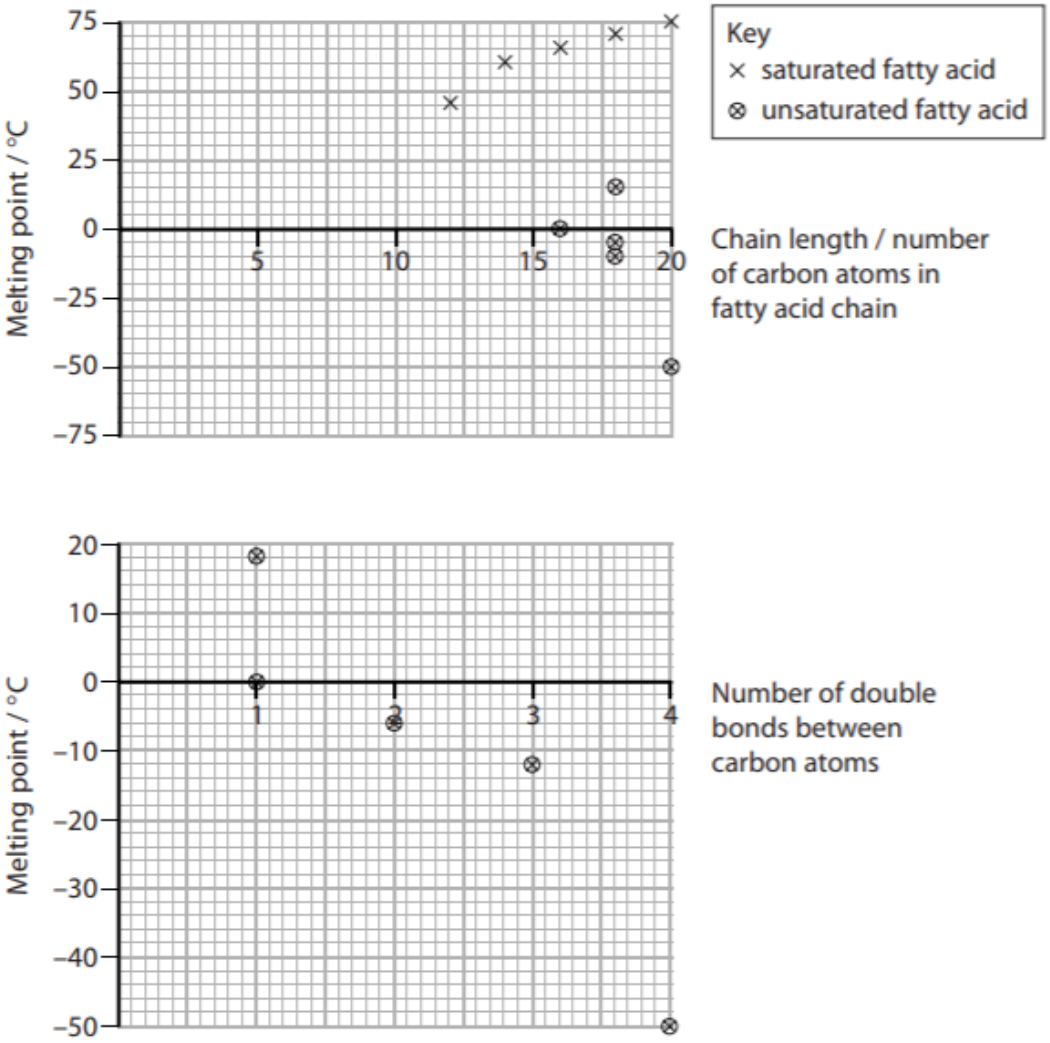
(b) This graph was sketched by a student to show how membrane fluidity changes with temperature.




(i) Describe the relationship between membrane fluidity and temperature as shown by this graph.

**(2)**

(ii) The student found two graphs about the structure of lipids and their melting points.



The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

**(4)**