



Additional Assessment Materials  
Summer 2021

Pearson Edexcel GCE in AS Biology

Topic 4: Exchange and Transport

(Public release version)

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)



## General guidance to Additional Assessment Materials for use in 2021

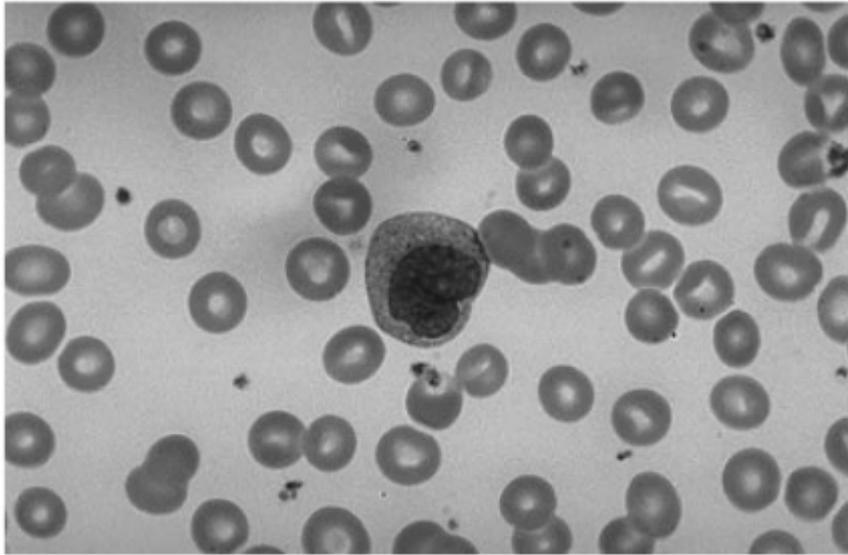
### Context

- 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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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 The photograph shows blood cells as seen using a light microscope.



Source: Library.med.utah.edu

(a) Explain how the structures of erythrocytes and monocytes are related to their functions.

(3)

erythrocytes do not have a nucleus which means they have more space for haemoglobin molecules to carry oxygen and are also able to squeeze through narrow blood vessels due to their biconcave shape. Monocytes are large and have a nucleus so they are able to engulf and digest pathogens by phagocytosis, and can also move from the blood into tissues. Monocytes also contain lysosomes which contain digestive enzymes to digest pathogens engulfed.

(b) Blood is able to clot and prevent further blood loss from a cut.

Give **one** other function of blood clotting.

(1)

prevents the entry of pathogens from the environment

(c) Doctors can measure the effectiveness of the clotting process using the prothrombin time test (PTT).

This test measures **how long it takes for a sample of blood to clot**.

Two groups of adults had their PTT recorded.

One group had liver disease and the other group was a healthy control.

The results are shown in the table.

Group	Mean PTT / seconds	Standard deviation / seconds
with liver disease	20.1	0.3
control	13.5	0.1

Analyse the data to deduce whether PTT is a useful indicator of liver disease.

(3)

The time taken for a sample of blood to clot in the control was 6.6 seconds less than for the group with liver disease; the standard deviations do not overlap hence the difference is significant. This suggests that the blood clotting process is working well in the control but not the group with liver disease. However, the liver is responsible for many other processes in addition to blood clotting, so other tests need to be done to make sure the liver is working properly, not just the clotting time of blood.

2 Substances move into and out of cells by different mechanisms.

(a) (i) Which of these mechanisms moves substances against a concentration gradient? (1)

- A active transport
- B diffusion
- C facilitated diffusion
- D osmosis

(ii) Which of these mechanisms enables non-polar molecules to pass through cell membranes? (1)

- A diffusion
- B facilitated diffusion
- C osmosis
- D transpiration

(b) Which of the following is usually found in a greater concentration in lymph than in blood? (1)

- A fatty acids
- B glucose
- C haemoglobin
- D oxygen

(c) The size of an animal can affect gas exchange.

As animals increase in size, their

- A surface area decreases and volume increases
- B surface area to volume ratio decreases
- C surface area to volume ratio increases
- D surface area to volume ratio remains constant

(d) Explain the features of gas exchange surfaces that are common to both insects and mammals.

(4)

Both insects and mammals have a trachea and tracheoles which gases diffuse through to enter the body. Both insects and mammals have a large surface area to allow the rapid exchange of gases into and out of cells. Insects have lots of tracheoles which are very thin, creating a short diffusion distance, and mammals have lots of tiny alveoli which have cell walls which are one cell thick, providing a large surface area and short diffusion distance. Mammals and insects both get their oxygen from the air. In both insects and mammals, the oxygen gets used up quickly and so there is a huge concentration gradient between the air and the blood (in mammals) and muscle tissues (in insects).

3

Increased blood pressure is one risk factor associated with atherosclerosis.

A study investigated the effect of aspirin on the risk of having a heart attack or a stroke.

In the study, which lasted 10 years, 12 000 adults with one or more risk factors for atherosclerosis were used.

The adults were split into two equal sized groups.

Each adult in one group was given 100 mg of aspirin every day and each adult in the other group was given a placebo.

The list shows the results of this study:

- 4.29% of the people who received aspirin died
- 4.48% of the people who received the placebo died
- there was no effect on the incidence of strokes
- people who took the aspirin experienced twice the bleeding into the digestive system compared with people in the placebo group
- the numbers of people with bleeding into the digestive system in both groups was low.

(a) (i) Explain how increased blood pressure increases the risk of atherosclerosis.

(4)

increased blood pressure leads to an increased risk of damage to the endothelium of the arteries. Damage to the endothelium exposes collagen fibres and increases the risk of blood clotting and causes an inflammatory response, and white blood cells move to the site of damage.

Over time, white blood cells, calcium salts, cholesterol and fibres build up and harden, leading to plaque formation. The build up of plaque narrows the arteries and restricts blood flow, therefore increasing blood pressure and leading to further damage to the endothelium.

(ii) Describe how **three** factors, other than increased blood pressure, can increase the risk of atherosclerosis.

(3)

Smoking can damage the walls of the arteries which is caused by the nicotine and carbon monoxide in tobacco smoke. Increased cholesterol levels are another risk factor because this leads to an increased risk of plaque formation if the arterial wall becomes damaged. The risk of atherosclerosis increases with age as the arteries become narrower and less elastic, and so cannot transport blood as efficiently.

(iii) Calculate the total number of people who died in this study.

(2)

$$12000 \div 2 = 6000 \text{ in each group}$$

aspirin : 4.29% of 6000 = 257.4 died due to aspirin.  
deaths

placebo : 4.48% of 6000 = 268.8

Answer 526

$$257.4 + 268.8 = 526.2$$
$$\approx 526$$

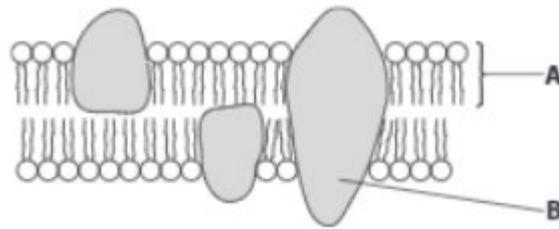
(b) Discuss whether patients at risk of a heart attack or stroke should take a 100mg dose of aspirin every day.

(5)

From the data provided by the study, aspirin does not seem to decrease the risk of stroke, but there's no data on the risk of heart attack. 257.4 people who took aspirin died, and a similar number (268.8) who took the placebo died, showing that there's almost no difference in number of deaths in the group with aspirin compared to placebo. Also, aspirin caused twice the bleeding into the digestive system compared to the placebo group, although the number of people bleeding into the digestive system was low. In conclusion, it can be said from the data provided that the risks of taking aspirin far outweigh the benefits as there was no effect on risk of stroke. However, more data needs to be collected, for example assessing the effect of aspirin on heart attack risk.

4

The diagram shows the structure of a cell membrane.



(a) Name the parts labelled A and B.

(1)

A = phospholipid

B = trans-membrane protein

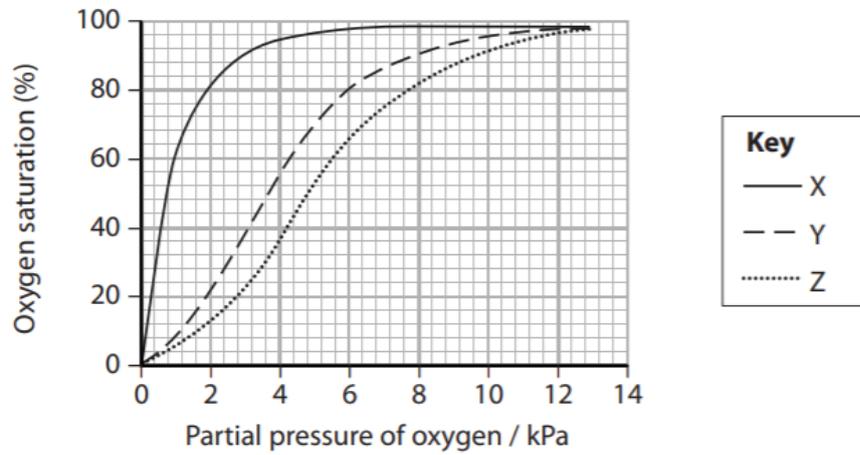
(b) Explain how the structure of the membrane controls the transport of polar molecules.

(4)

Polar molecules have to travel across the membrane by facilitated diffusion using protein channels and ATP. The protein channels span across the entire length of the membrane and open in the presence of a charged or polar molecule. The molecule then travels across the membrane and the protein channel closes. The membrane is fluid, meaning the phospholipids and proteins are free to move and aid in the transport of molecules across the membrane.

(b) Northern elephant seals have a high concentration of haemoglobin in their blood.

The graph shows the oxygen dissociation curves for myoglobin, adult haemoglobin and fetal haemoglobin.



Which of the rows correctly matches each curve with myoglobin, adult haemoglobin and fetal haemoglobin?

(1)

	Myoglobin	Adult haemoglobin	Fetal haemoglobin
<input type="checkbox"/> A	X	Y	Z
<input checked="" type="checkbox"/> B	X	Z	Y
<input type="checkbox"/> C	Y	Z	X
<input type="checkbox"/> D	Z	X	Y

- (c) Northern elephant seals are able to dive to great depths and hold their breath for up to two hours.

The tables show data for four diving mammals.

Species	Maximum time holding breath / min	Maximum diving depth / m	Mass of animal / kg
bottlenose dolphin	5	20	200
harbour seal	17	19	24
Weddell seal	82	400	400
Northern elephant seal	119	437	400

Species	Volume of oxygen in body / $\text{cm}^3 \text{kg}^{-1}$	Concentration of haemoglobin in blood / $\text{g dm}^{-3}$	Total blood volume / $\text{cm}^3 \text{kg}^{-1}$	Percentage of stored oxygen in different body tissues		
				lungs	blood	muscle
bottlenose dolphin	36	14	71	34	27	39
harbour seal	57	21	132	13	54	33
Weddell seal	87	210	173	5	66	29
Northern elephant seal	97	216	207	4	71	25

- (i) Calculate the total mass of haemoglobin in a Northern elephant seal.

(3)

$$\text{mass of seal} = 400 \text{ kg}$$

$$[\text{Hb}] = 216 \text{ g dm}^{-3}$$

$$\begin{aligned} \text{total blood volume} &= 207 \text{ cm}^3 \text{ kg}^{-1} \times 400 \\ &= 82800 \text{ cm}^3 = 82.8 \text{ dm}^3 \end{aligned}$$

$$\begin{aligned} \text{mass of Hb} &= 82.8 \times 216 \text{ g dm}^{-3} \\ &= 17884.8 \text{ g} \end{aligned}$$

$$\approx 17885 \text{ g}$$

Answer 17 885 g

\*(ii) Analyse the data to explain how marine mammals are adapted for diving.

(6)

The greater the mass of the mammal, the greater the volume of oxygen in their body, as seen with the Weddell seals and Northern elephant seals. This also means there's a greater concentration of haemoglobin in the blood which can carry the oxygen. An increase of 200kg as seen from bottlenose dolphins to Weddell seals increases the haemoglobin concentration by  $196 \text{ g dm}^{-3}$ . The greater the mass of the animal the more oxygen that is stored in the blood as opposed to the muscle or lungs e.g. in Weddell seals 66% of the oxygen is stored in the blood as opposed to 27% (39% difference) in bottlenose dolphins. This leads to an increase in maximum holding breath in larger marine mammals as there's more oxygen stored in the blood and so more can be transported around the body to the tissues and organs that need it (such as the heart and muscle tissue). There is a positive correlation between maximum depth and maximum time holding breath. Aerobic respiration requires oxygen to release energy, so diving deeper requires a larger oxygen storage. All mammals must possess myoglobin to act as an oxygen store in muscle, and bottlenose dolphins and harbour seals have more myoglobin.

TOTAL FOR TEST = 44 MARKS