



GCE Biology

S21-A400U30-1

Assessment Resource 25

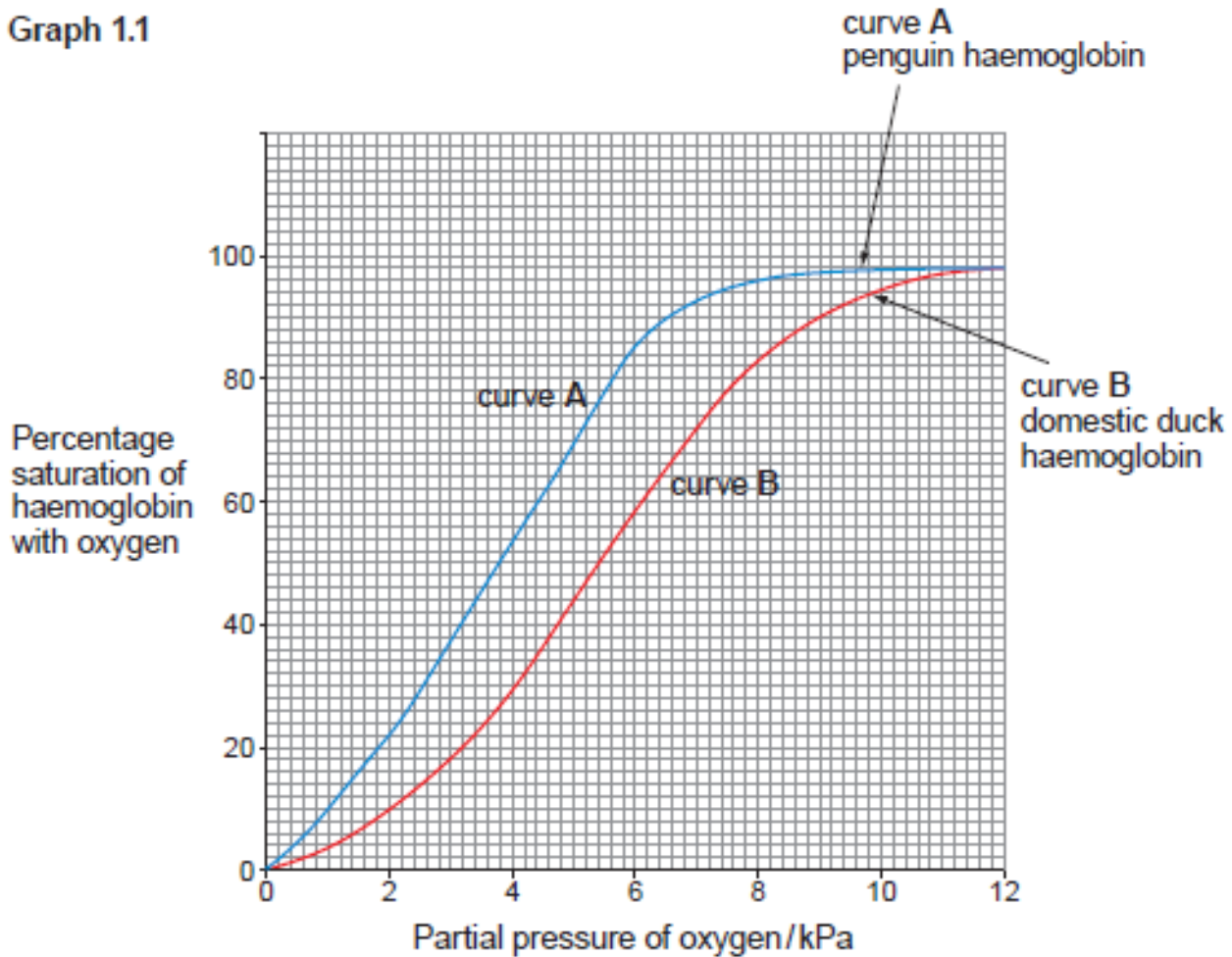
Requirements for Life G

Answer all questions.

1. Emperor penguins live in the Antarctic. They hunt for fish and can dive for 25 minutes at a time when they are looking for food.

Graph 1.1 shows the oxygen dissociation curve for emperor penguin haemoglobin and domestic duck haemoglobin.

Graph 1.1



- (a) Explain the advantage to the penguin of having the haemoglobin dissociation curve as shown on graph 1.1. [3]

.....

.....

.....

.....

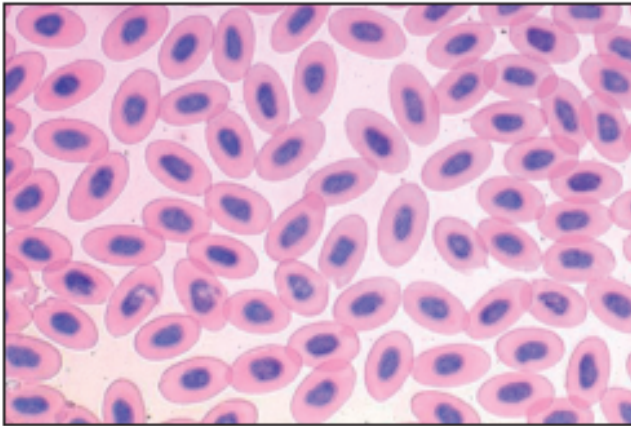
.....

.....

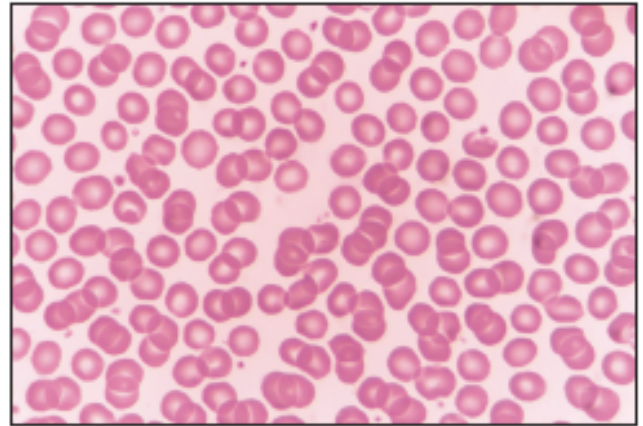
(b) Image 1.2 shows penguin and human red blood cells.

Image 1.2

Penguin red blood cells



Human red blood cells



(i) Explain why blood is considered to be a tissue.

[1]

.....

.....

(ii) Describe two differences between a red blood cell of a human and a red blood cell of a penguin, as seen in image 1.2.

[2]

.....

.....

.....

.....

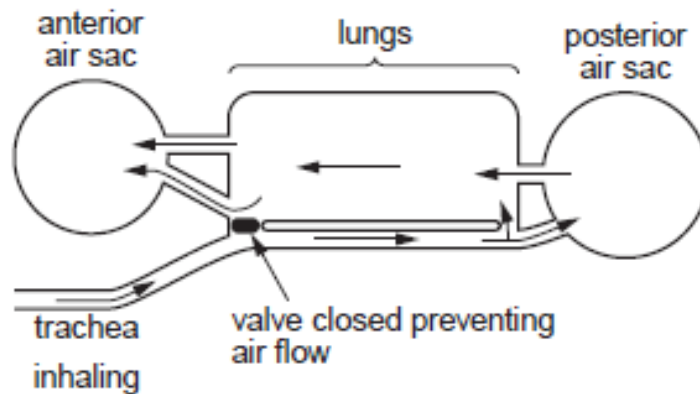
- (c) (i) As the penguin breathes in, the air passes over bony plates which have capillaries very close to the surface.

Suggest how this helps to warm the inspired air.

[1]

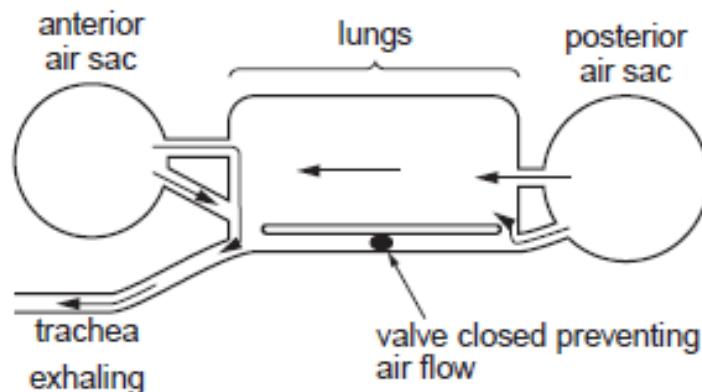
When the penguin inhales, air passes down the trachea and into the posterior air sacs. The anterior air sacs also expand and draw air through the lungs. This is shown in image 1.3.

Image 1.3



When the penguin exhales, the posterior air sacs force air through the lungs. The anterior air sacs force air out through the trachea. This is shown in image 1.4.

Image 1.4



- (ii) With reference to images 1.3 and 1.4, explain two features of the gas exchange system of the penguin that make it far more efficient than the gas exchange system of a human. [3]

.....

.....

.....

.....

.....

.....

In the lungs, gas exchange takes place in structures called parabronchi. Image 1.5 shows the direction of air flow in a parabronchus and the direction of blood flow in the capillaries that surround them.

Image 1.5



- (iii) Explain how the direction of blood flow in the capillaries further increases the efficiency of gas exchange. [3]

.....

.....

.....

.....

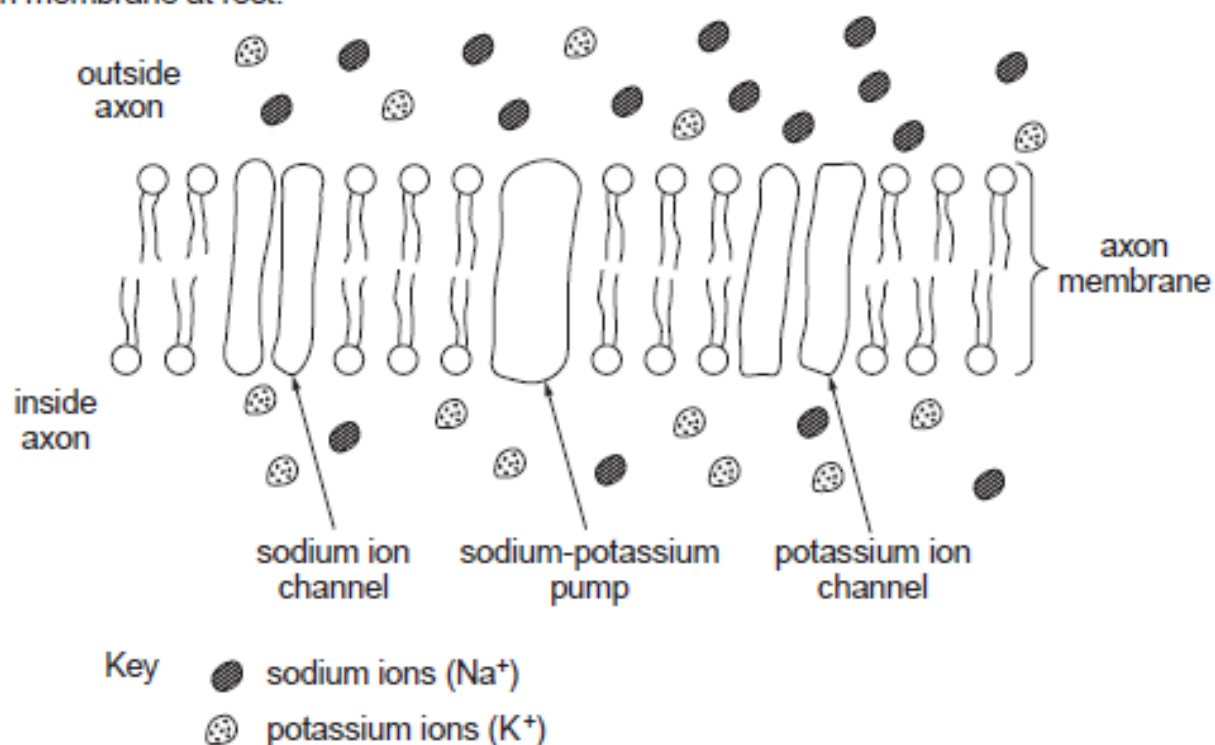
.....

.....

2. Image 2.1 shows a diagram of an axon membrane that a student found in a textbook.

Image 2.1

Axon membrane at rest.



(a) (i) Describe and explain the distribution of sodium ions (Na⁺) across the membrane at rest. [3]

.....

.....

.....

.....

.....

.....

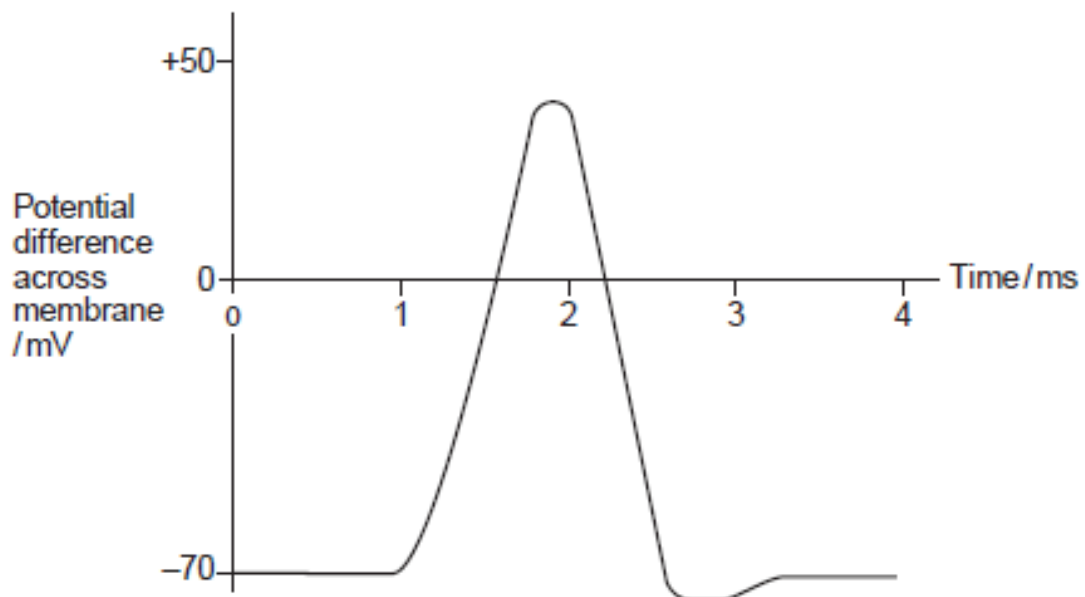
(ii) Explain why the sodium ions do not diffuse across the phospholipid bilayer despite the concentration gradient. [1]

.....

.....

Image 2.2 shows a typical action potential of an axon.

Image 2.2



The drug tetraethylammonium (TEA) blocks gated potassium channels in the axon membrane.

- (b) Describe how the drug TEA would affect the action potential trace. Explain the cause of this effect. [3]

.....

.....

.....

.....

.....

.....

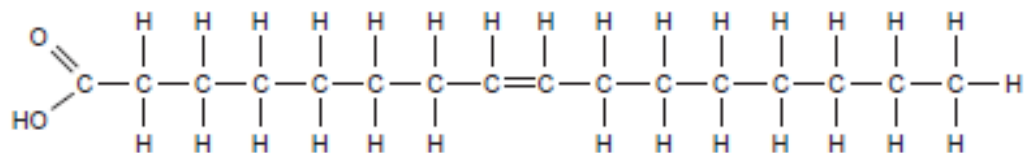
.....

3. The fat in cow's milk consists of triglycerides with different fatty acid chains.

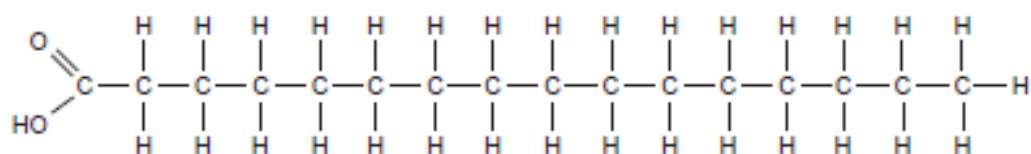
Two fatty acid chains, A and B, are shown in image 3.1.

Image 3.1

Chain A



Chain B



- (a) (i) Identify which of these chains would have a more negative effect on human health. Explain your answer. [1]

.....
.....

- (ii) Explain why triglycerides are not regarded as polymers. [1]

.....
.....

Lipase enzymes are released by the pancreas.

- (b) (i) State the term given to enzymes which work outside cells. [1]

.....
.....

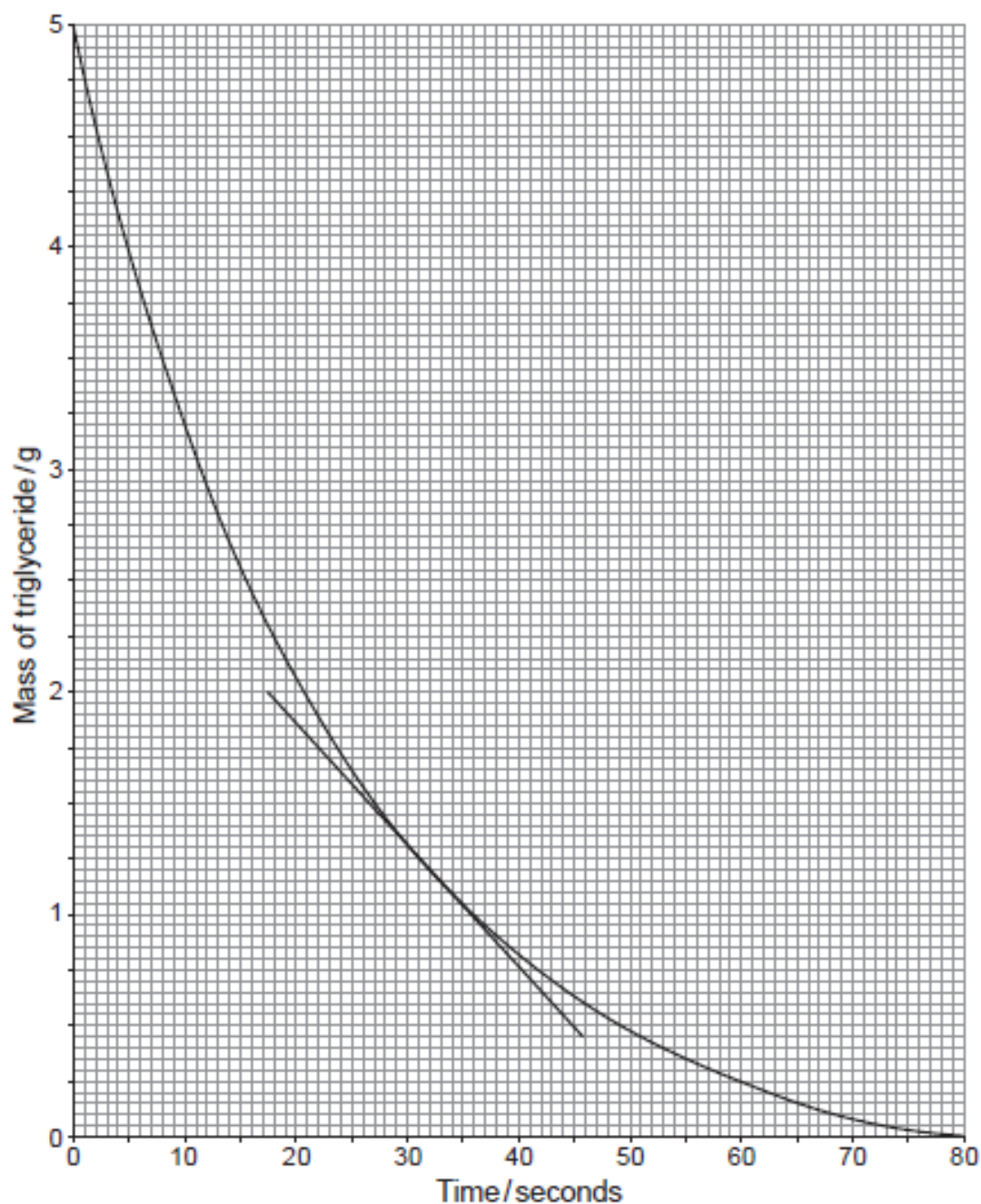
- (ii) Explain why several different types of lipase enzymes are released by the pancreas. [2]

.....
.....
.....
.....

- (c) A scientist determined the mass of fat in a 100 cm^3 sample of cow milk. He added lipase and measured the mass of triglyceride present over a period of time.

Graph 3.2 shows the result of this experiment.

Graph 3.2



- (i) A tangent has been drawn at 30 seconds, use this tangent to calculate the rate of digestion per second at that time. Give your answer in standard form. [3]

Rate = gs^{-1}

- (ii) Describe how the shape of the curve on the graph would be different if the scientist had added bile salts to the milk before the start of the experiment. Explain your answer. [3]

.....

.....

.....

.....

.....

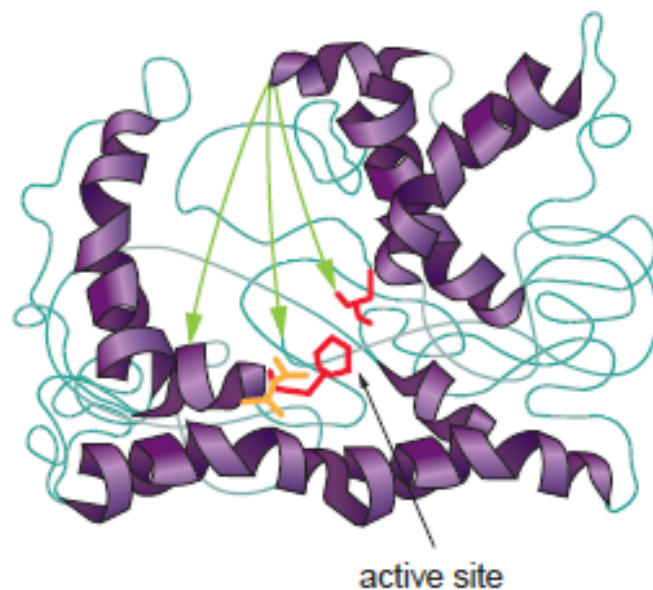
- (iii) Suggest why carnivores such as lions and tigers have gall bladders, whereas many herbivores such as deer do not have a gall bladder. [1]

.....

.....

- (d) Image 3.3 shows a ribbon diagram of one type of lipase.

Image 3.3



This lipase enzyme is a globular protein with the active site labelled. When the substrate enters the active site, it changes shape to accommodate the lipid. If it did not, the enzyme would not be able to reduce the activation energy needed to hydrolyse the lipid.

State the name of this model of enzyme action. [1]

.....

- (e) A student decided to time how long it takes lipases to digest lipids. She used the indicator phenolphthalein. Phenolphthalein is pink at pH10. When the pH drops below 8.3 it becomes colourless.

When the triglycerides in milk are hydrolysed they form glycerol and fatty acids. The fatty acids reduce the pH to below 8.3.

The student carried out the following procedure:

- 0.5 cm^3 of phenolphthalein was added to 5 cm^3 of milk in a test tube. 7 cm^3 of sodium carbonate (pH10) was added.
- 1 cm^3 of 5% lipase was added to a separate test tube.
- Both tubes were placed in a thermostatic water bath set at 30°C for 5 minutes.
- The contents of the tubes were combined and then put back in the water bath.
- The time taken for the indicator to become colourless was recorded.
- The procedure was repeated a further four times using the same type of milk.

The results are shown in table 3.4.

Table 3.4

Repeat	Time taken for indicator to become colourless/s
1	65
2	53
3	72
4	58
5	68

- (i) Explain why the solutions were left in the thermostatic water bath for 5 minutes before combining. [1]

.....
.....

- (ii) Suggest two sources of inaccuracy in this experimental method that could account for the variation within these results. For each suggestion give one way by which the method could be improved. [4]

Inaccuracy 1

.....
.....

Inaccuracy 2

.....
.....