Biological Membranes

Model Answers 2

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Biological Membranes
Booklet	Model Answers 2

Time allowed: **30 minutes**

Score: **/22**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

Which option, **A** to **D**, describes the role of cholesterol in cell surface membranes in the human body?

A. Cholesterol binds to phospholipid phosphate heads, increasing the packing of the membrane, therefore reducing the fluidity of the membrane.

B. Cholesterol binds to phospholipid fatty-acid tails, reducing the packing of the membrane, therefore increasing the fluidity of the membrane.

C. Cholesterol absorbs ATP, preventing active transport across the membrane.

D. Cholesterol binds to phospholipid fatty-acid tails, increasing the packing of the membrane, therefore reducing the fluidity of the membrane.

[1]

Cholesterol decreases fluidity and increases rigidity by binding to fatty acid tails and increasing the packing of the membrane

Question 2

Membranes are found within and surrounding cells.

Which of the statements, **A** to **D**, is **not** a role of membranes in cells?

A. acts as a barrier between areas

B. cell signalling

C. provides support for cell

D. site of chemical reactions

[1]

If you think about it, the electron transport chain, chemiosmosis, photophosphorylation all take place in membranes. They do not provide any support as they are too thin.

Question 3

Amoeba proteus is a single-celled organism that lives in freshwater habitats. Fig. 1.1 is a drawing of *A. proteus*.

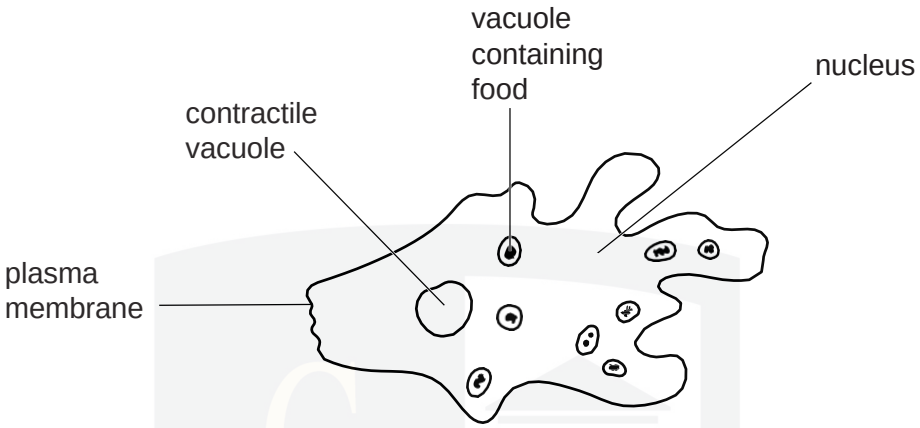


Fig. 1.1

(a) Explain why an *Amoeba* does **not** need a specialised surface for gaseous exchange. **[2]**

An Amoeba does not need a specialised exchange system because:

- It is one cell, which is very small (i.e. has a large surface area to volume ratio)
- Therefore there would be a short diffusion pathway
- So diffusion would be sufficiently fast to supply all the needs of the cell

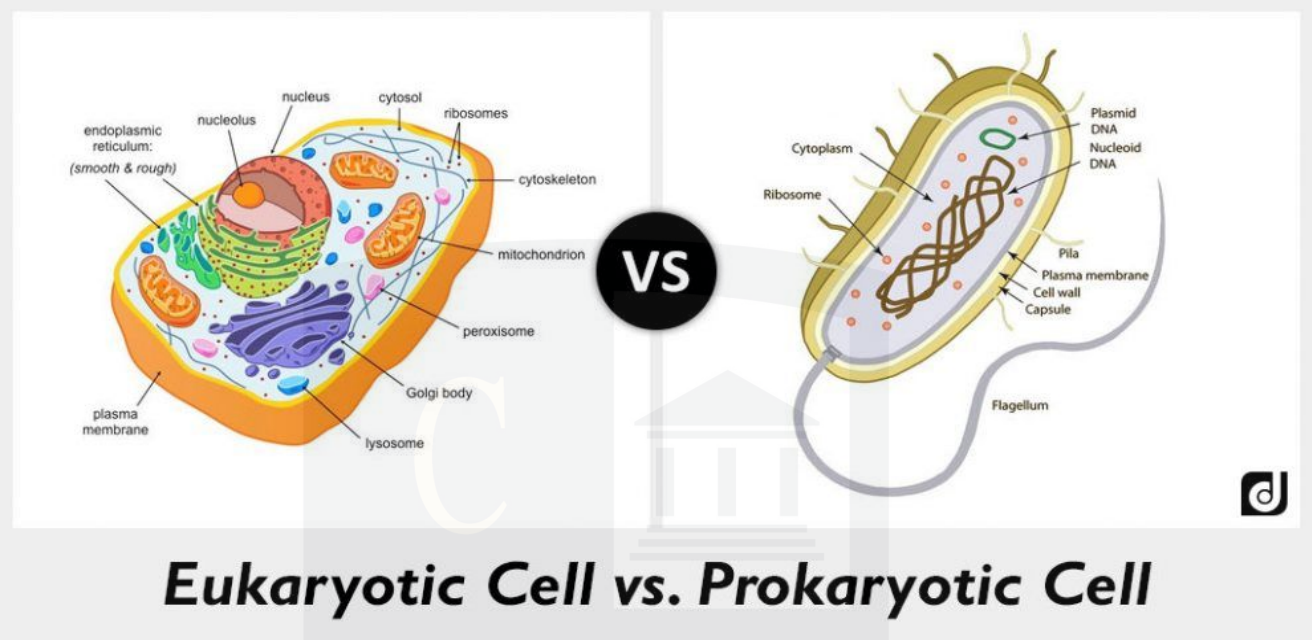
(b) State **one** feature shown in Fig. 1.1 that would **not** be present in a prokaryotic cell. **[1]**

One feature that would not be found in a prokaryote would be:

- Nucleus
- Food vacuole

There are many differences between eukaryotic and prokaryotic cells. Make sure in this question you only mention the features that can be seen inside the Amoeba cell.

Diagram to show differences between eukaryotic and prokaryotic cells:



(c) One role of the plasma membrane is to act as a barrier between the cell and its surroundings.

(i) Which component of the plasma membrane acts as a barrier to mineral ions entering the cell?

[1]

The component of the plasma membrane which acts as a barrier to mineral ions is:

- The phospholipid bilayer

(ii) Describe **two other** roles of membranes in an *Amoeba*. **[2]**

Two other roles of membranes in Amoeba are (any two of):

- control what enters / leaves the organelles
- it contains receptors to detect changes in environment
- compartmentalisation
- as a site for enzymes
- creating concentration gradients
- to form pseudopodia

Tip: here you need to think of all the different functions of membranes in cells that you know about. Which of these would you see in an Amoeba?

Pseudopodia are temporary extensions of the plasma membrane, for movement and feeding.

(d) Water continually enters an *Amoeba* from its surroundings. The contractile vacuole is an organelle that collects water from inside the cell and expels it from the cell. The contractile vacuole expands as it collects water and then fuses with the plasma membrane to release the water from the cell.

(i) Name the process by which water is expelled from the *Amoeba*. **[1]**

The process by which Amoeba expel water is called:

- exocytosis

From the question, it describes water being expelled on mass, via the plasma membrane. This is a form of bulk transport, known as exocytosis (as the water is going **out** of the cell).

(ii) What would happen to an *Amoeba* if it had no contractile vacuole? **[1]**

If the Amoeba did not have a contractile vacuole:

- it would burst

The role of the contractile vacuole is to take in water, so that excess water is taken out of the cytoplasm and therefore does not upset the water potential of the cell. If this was not present, water would enter the cell, causing it to swell. Because there is no cell wall present, this would place too much pressure on the membrane, causing it to lyse or burst.

(e) A student investigated the activity of the contractile vacuole when an *Amoeba* was placed in solutions of different water potential.

The student placed the *Amoeba* in each solution and counted the number of times the contractile vacuole filled and emptied in the first minute. The results are shown in Table 1.1.

Water potential surrounding *Amoeba* (kPa)	**Number of times the contractile vacuole filled and emptied in the first minute**
0	19
–100	14
–200	9
–300	5
–400	2
–500	0

Table 1.1

Explain why the contractile vacuole emptied more frequently when the water potential surrounding the *Amoeba* was –100 kPa compared to when the water potential was –400 kPa.

[2]

At -100kPa the contractile vacuole was emptied more regularly because:

- the water potential of the -100kPa is higher than the solution at -400kPa
- and at -100kPa, the water potential gradient is steeper
- therefore, at -100kPa, water enters the Amoeba more quickly

Water will enter faster when the difference between the water potentials either side of the membrane is the greatest (i.e. the gradient is the steepest).

[Total: 10]

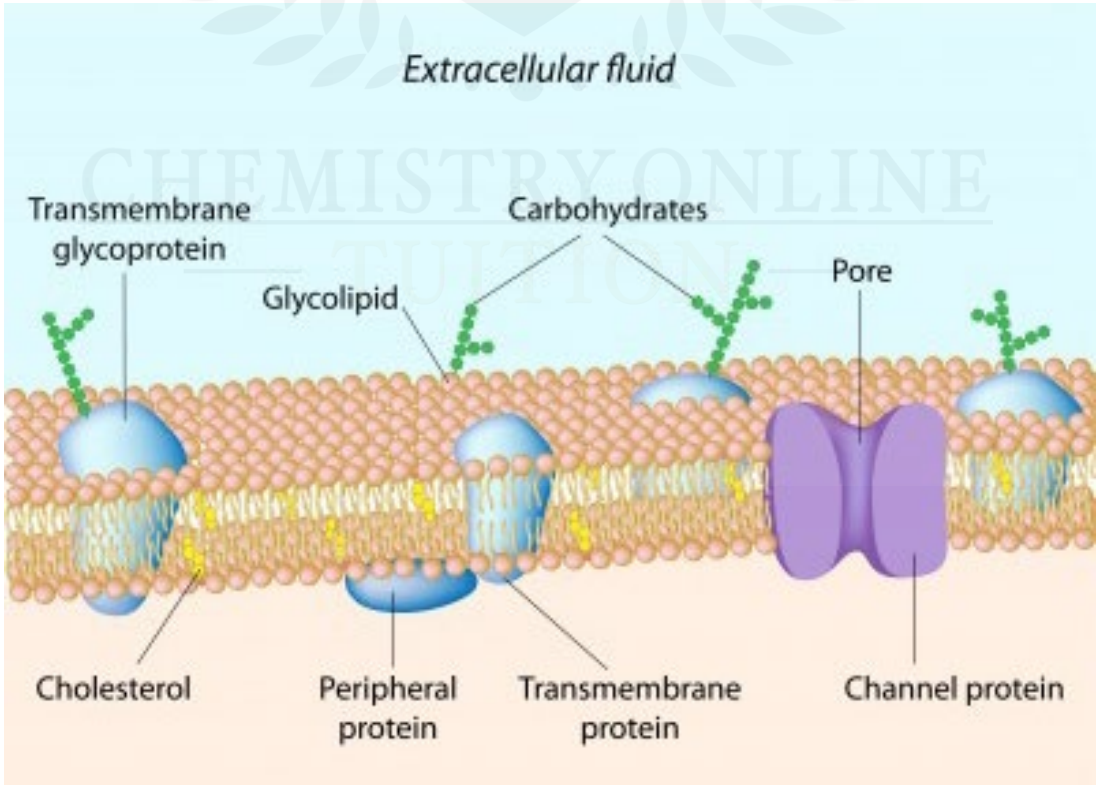
Question 4

(a) Describe the structure of a plasma (cell surface) membrane. **[6]**

- The plasma membrane is primarily made of a **phospholipid bilayer that contain proteins**
- These proteins are both **intrinsic** (transmembrane) and **extrinsic** (surface)
- The **hydrophilic** heads of the lipids **face outwards** while the hydrophobic tails face inwards
- The plasma membrane also contains **cholesterol** in between the phospholipids
- and **glycoproteins** that stick out of the bilayer

***Exam tip**: Ensure that you are specific about where all the different components of the membrane can be found.*

Diagram to show the components in the phospholipid bilayer:



(b) A student investigated the movement of substances through the cell surface membrane of yeast cells using an indicator.

- The student was supplied with a suspension of yeast cells in a slightly alkaline solution.
- The indicator used is yellow in alkaline conditions but turns red in acidic conditions.

The student mixed the indicator with the yeast suspension and labelled the tube containing this suspension **A**. The suspension was red/pink in colour.

(i) The student took a small sample from tube **A** and centrifuged this sample.

After centrifuging, the student observed that the liquid portion was colourless but the cells at the bottom were red/pink.

Suggest the mechanism by which the indicator enters the cells and suggest the component of the membrane involved.

mechanism **active transport**

component **carrier/ transport proteins** **[2]**

Note: this must be active transport (rather than facilitated diffusion) as all the indicator entered the cells. Do not confuse carrier proteins with channel proteins.

(ii) The student took a small sample from suspension **A** and added alkaline ammonia solution. There was no colour change.

What could the student conclude about the permeability of the yeast plasma membrane?

[1]

- This suggests that the yeast plasma membrane is **impermeable to ammonia.**

If ammonia was able to get across the membrane then a colour change would be seen from red (acidic) to yellow (alkaline).

(iii) The student then took another sample from suspension **A** and boiled it. When this boiled suspension was centrifuged the liquid portion was yellow and the cells at the bottom were red/pink.

The student suggested that the liquid in the suspension was yellow because boiling the yeast had damaged the plasma membrane, allowing the indicator out of the cells.

Describe the effect of high temperature on the structure of the yeast cell membranes.

In your answer you should use appropriate technical terms, spelled correctly.

[4]

- High temperatures cause the **phospholipids** in the yeast plasma membrane to have more **kinetic energy** and therefore vibrate more
- This increase in kinetic energy increases the size of the gaps in the plasma membrane between the phospholipids
- This causes the **bilayer** to become more fluid
- High temperatures may also **denature** the proteins and glycoproteins in the plasma membrane

Exam tip: to gain marks in this question, you need to include all your key terminology, shown here in bold.

[Total: 10]