Full Name:	Civics group: 21S	Index no.:	Date:

Core Idea 1: The Cell and Biomolecules of Life
Membranes & Protein Trafficking
Tutorial 3

MCQ

1	2	3	4	5	6	7	8	9	10

1 The structure of phospholipids includes the following:

1 glycerol linked to fatty acids
2 hydrophobic fatty acid chains
3 ester bonds
4 phosphate group attached to glycerol

Which structure(s) enable formation of a lipid bilayer in cell surface membranes?

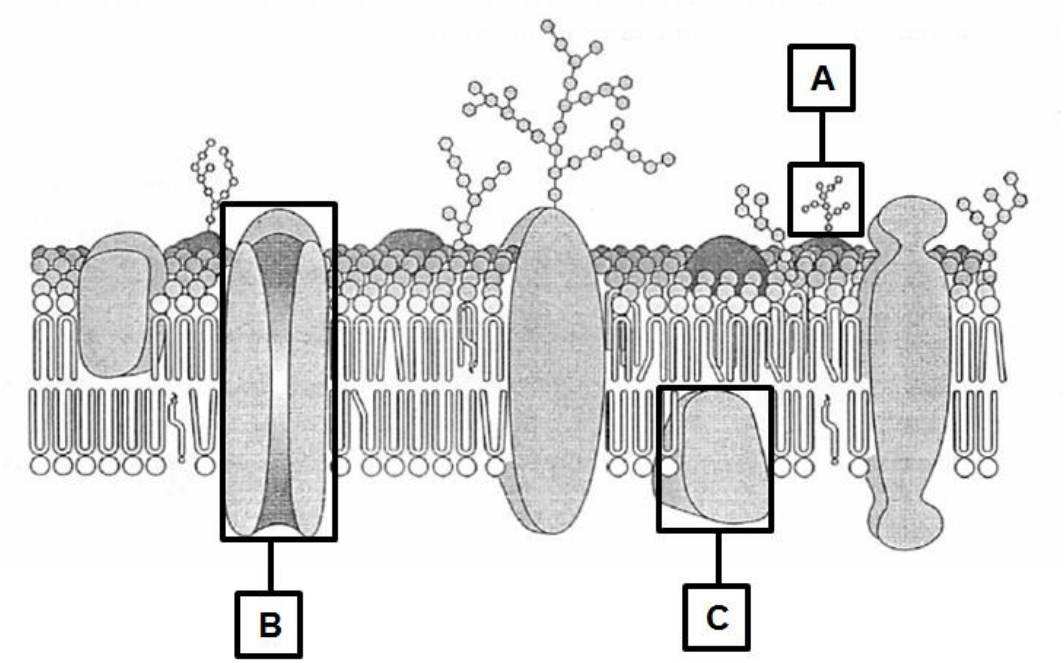
A 1 and 3
B 2 and 3
C 2 and 4
D 1, 2 and 4

2 The cell surface membrane structure is described as a 'fluid mosaic'.

Which statement describes the 'mosaic' part of the cell surface membrane?

A the different patterns that are obtained by the moving phospholipid molecules
B the random distribution of cholesterol molecules within the phospholipid bilayer
C the regular pattern produced by the phospholipid heads and membrane proteins
D the scattering of the different proteins within the phospholipid bilayer

3 The diagram below shows a section of a cell surface membrane.



Which of the following statements are correct?

1 Structure **A** is found only on the extracellular surface of the membrane.
2 Structure **B** may contain a channel that is hydrophilic to allow ions to move across the membrane.
3 Structure **C** allows transport of substances across the membrane only in the presence of ATP.
4 Structure **C** is found only on one surface of the membrane.

A **1**, **2** and **4**
B **2**, **3** and **4**
C **1** and **2**
D **2** and **3**

4 The cell surface membranes of plants adapted to cold conditions change as the weather gets colder, allowing the plants to carry out exocytosis.

Which change occurs?

A a decrease in the ratio of proteins to saturated phospholipids
B a decrease in the ratio of unsaturated phospholipids to saturated phospholipids
C an increase in the ratio of proteins to unsaturated phospholipids
D an increase in the ratio of unsaturated phospholipids to saturated phospholipids

5 The cell membrane of an African desert rat and that of the Arctic red fox are compared to investigate their composition. Which of the following is the most probable makeup of the respective membranes?

	Amount of saturated fatty acids		**Amount of cholesterol**	
	Arctic red fox	**Desert rat**	**Arctic red fox**	**Desert rat**
A	Low	High	Low	High
B	High	Low	Low	Low
C	Low	High	High	High
D	High	Low	High	Low

6 What are the features of facilitated diffusion?

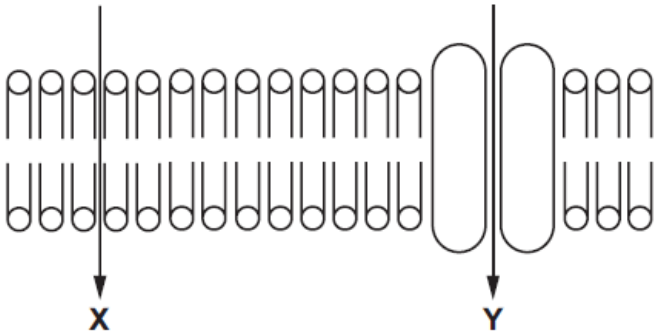
	uses proteins in membrane	uses ATP molecules	move down a concentration gradient
A	√	√	√
B	x	√	√
C	√	x	√
D	√	√	x

7 Which statements about the components of the cell surface membrane are correct?

1 Diffusion can take place through lipids and protein pores.
2 Endocytosis only involves lipids.
3 Facilitated diffusion only involves proteins.
4 Osmosis only involves proteins.

A 1, 2, 3 and 4
B 1, 3 and 4
C 1 and 3
D 2 and 4

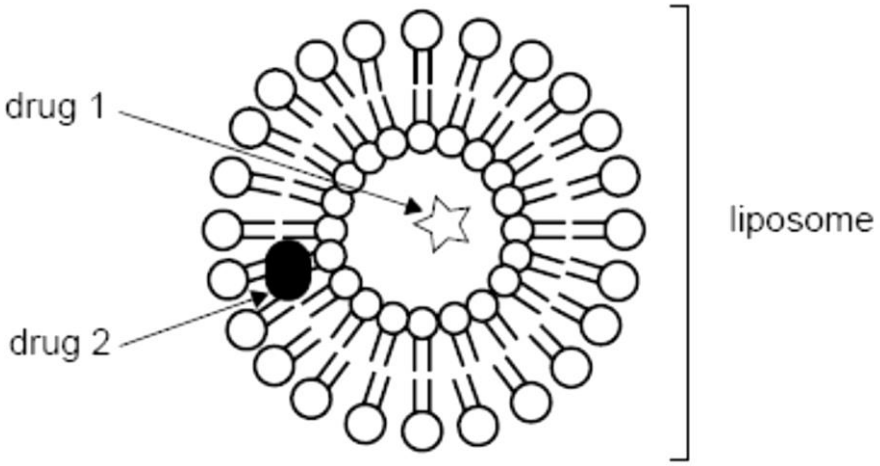
8 The diagram shows two pathways, X and Y, through which molecules can diffuse across a cell surface membrane.



Which row correctly shows possible pathways for lipids, water and glucose?

	lipids	water	glucose
A	X only	X and Y	Y only
B	X only	Y only	Y only
C	X and Y	X only	X and Y
D	X and Y	X and Y	X only

9 Liposomes are spherical vesicles consisting of a phospholipid bilayer. They can be designed to carry pharmaceutical drugs into cells. The figure below shows the structure of a liposome and two potential drugs, drug 1 and drug 2, that it can carry.



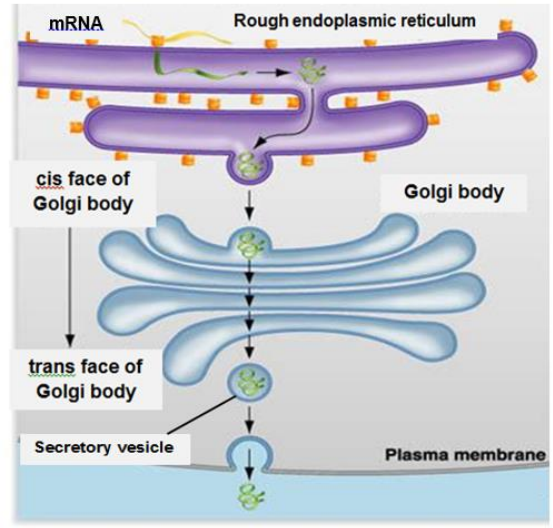
Which of the following statements are true?

1 Liposomes can carry both hydrophobic and hydrophilic drugs.
2 The centre of the liposome is aqueous.
3 Liposomes are able to fuse with the cell surface membrane of a cell.
4 Liposome-based membranes have a rigid structure.

A 1 and 2 only
B 1, 2, and 3 only
C 2 and 3 only
D 2, 3, and 4 only

10 Two chemicals, Brefeldin A and Monensin, are inhibitors of certain cellular processes:

- Brefeldin A inhibits the transport of substances from the rough endoplasmic reticulum to the Golgi apparatus.
- Monensin inhibits the formation of post-Golgi vesicles.



Researchers tested several samples of cells that produce a particular protein called APRIL with the above named inhibitors. The results are shown in the table below.

Sample	Functional Protein formation	Secretion
1	Functional Protein APRIL formed	Protein APRIL not secreted from the cells
2	Functional Protein APRIL not formed	Protein APRIL not secreted from the cells
3	Functional Protein APRIL formed	Protein APRIL secreted from the cells

From this information, which treatment was each sample subjected to?

A Sample 1 was treated only with Brefeldin A.
B Sample 3 was treated only with Monensin.
C Sample 2 was treated with Brefeldin A and Monensin.
D Sample 2 was treated only with Monensin.

STQ
QUESTION 1

(a) The passage of most molecules through membranes is regulated by proteins. Fig. 1.1 is a diagram showing the four main steps in the release of insulin from beta cells, which involves three types of transmembrane proteins.

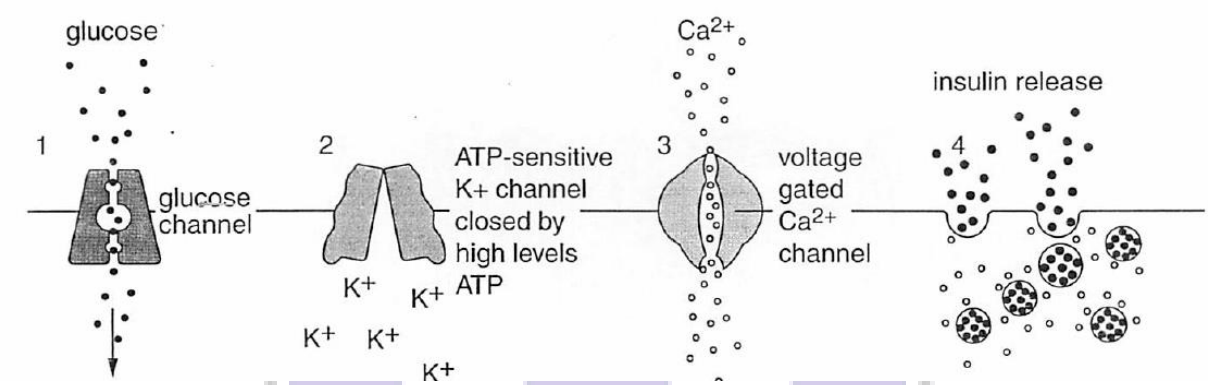


Fig. 1.1

Explain why transmembrane proteins are necessary for glucose, potassium ions and calcium ions to pass through cell surface membrane.

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Describe the properties of the phospholipid bilayer and the aquaporin channels in relation to the movement of water across the cell surface membrane.

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Suggest why there are no channels for insulin release across the membrane.

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Describe how transmembrane proteins are embedded in the membrane.

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(b) Fig. 1.2 is an electron micrograph showing release of insulin from a β (beta) cell in the pancreas.

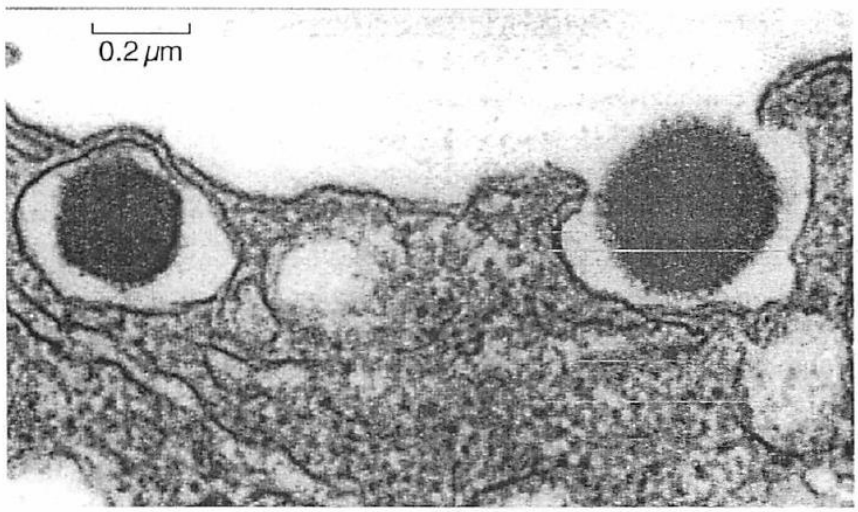

Fig. 1.2

Describe how this release across the membrane occurs.

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QUESTION 2

(a) Milk contains lipids, carbohydrates, proteins and glycoproteins. These components are synthesised in special milk-secreting cells in mammary glands and, together with water, are then secreted into cavities within the mammary glands to form milk.

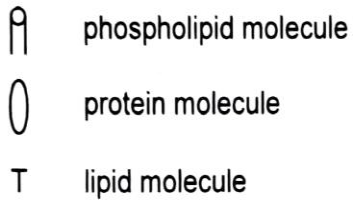
(i) Milk lipids are synthesised in the cisternae of the smooth endoplasmic reticulum (smooth ER) within the milk-secreting cells.

These milk lipids collect in between the two layers of phospholipids that make up the phospholipid bilayer of the smooth ER membrane.

The outer phospholipid layer of the bilayer pinches off to from a droplet. The droplet consists of a single layer of phospholipids with some membrane proteins and contains milk lipids.

Sketch the arrangement of molecules in one complete droplet.

You should use the following symbols in your sketch. [3]



The droplet moves through the cytoplasm to reach the surface of the cell, where it is secreted as a milk fat globule into a cavity within a mammary gland.

Fig. 2.1 shows the stages in this process.

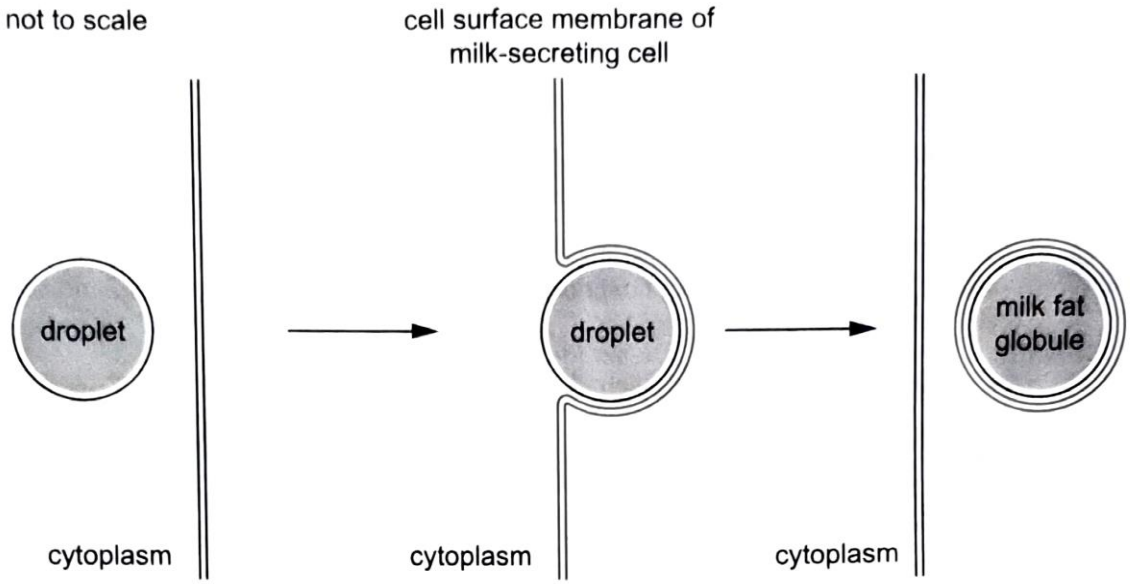


Fig. 2.1

The secreted milk fat globule has a unique membrane that has an outer phospholipid bilayer (approximately 7nm thick), then a layer of cytoplasm (approximately 15nm in thickness) and inside that a single phospholipid layer.

(ii) State the approximate thickness of the unique membrane of a milk fat globule.[1]

Thickness: _____

Glycoproteins in milk are also synthesised in milk-secreting cells and then secreted.

(iii) State the site of synthesis of glycoproteins in cells such as milk-secreting cells.
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(iv) Explain how newly synthesised glycoprotein molecules in the milk-secreting cells reach the cavities within the mammary gland.

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(v) Milk-secreting cells secrete lipids and glycoproteins at the same time. This helps the cells to maintain a constant cell surface membrane area.

Suggest why secreting lipids and glycoproteins at the same time helps to maintain a constant cell surface membrane area.

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(b) Liposomes are small spheres, about 100nm in diameter, that are surrounded by a phospholipid bilayer.

Liposomes can be used to enclose a variety of drugs and transport these around the body in the blood.

It is possible to manufacture pH-sensitive liposomes that release their contents below specific pH values. Cancer cells in some tumours can be targeted using pH-sensitive liposomes containing anti-cancer drugs.

Tumours can form in many different tissues, including bone and muscle, and are often poorly supplied with blood.

Use this information to suggest why cancer cells in some tumours can be targeted using pH-sensitive liposomes containing anti-cancer drugs.

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QUESTION 3

An experiment was carried out to determine what happens to amino acids after they are absorbed by animal cells. The cells were incubated for 5 minutes in a medium containing radioactively labelled amino acids. The radioactive amino acids were then washed off the cells' surface and the cells were incubated in a medium containing only non-radioactive amino acids.

Samples of the cells were removed from the medium every five minutes for 40 minutes. For each sample, the levels of radioactivity in three different membranous organelles, **P**, **Q** and **R**, were determined.

The results of the experiment are shown in Fig. 3.1 below.

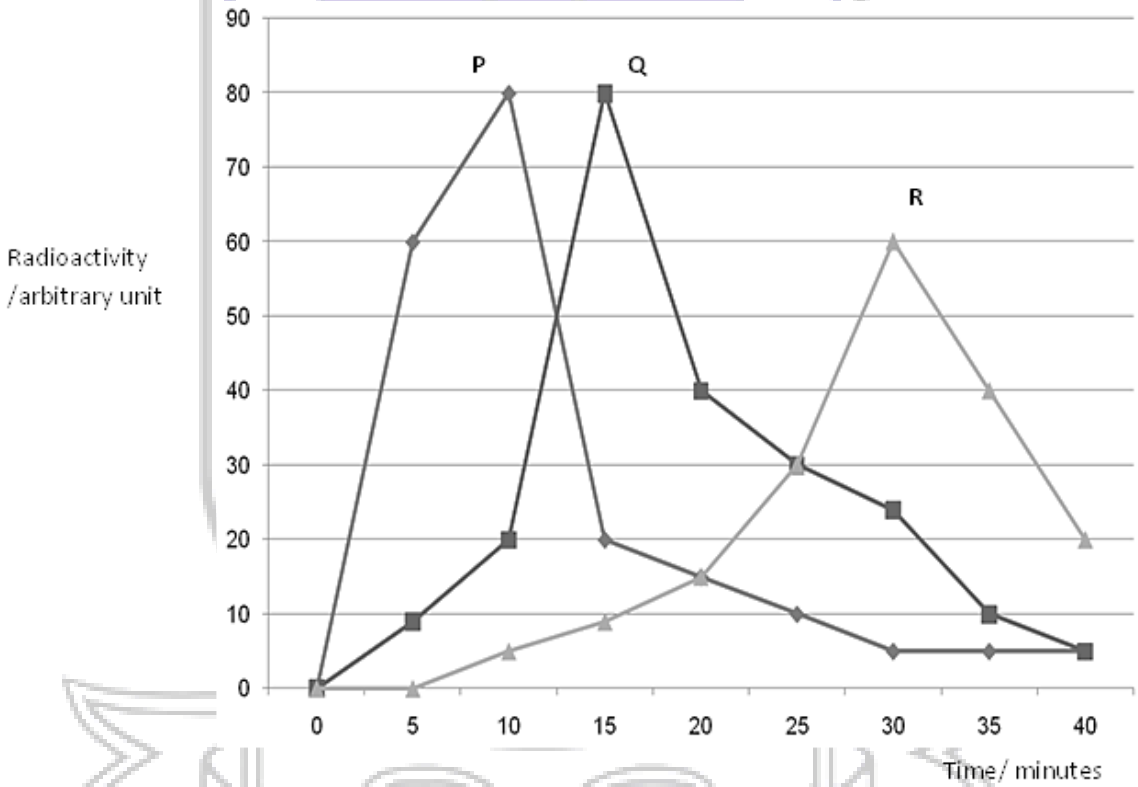

Fig. 3.1

(a) Identify the organelles **P**, **Q** and **R**

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(b) With reference to Fig. 3.1, explain the changes in the level of radioactivity of the three organelles with time.

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(c) Suggest what will happen to the level of radioactivity in the cell after 40 minutes. Explain your answer.

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[Total: 7]

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Core Idea 1: The Cell and Biomolecules of Life

Membranes & Protein Trafficking

Marked Assignment

Peptic cells from the lining of the mammalian stomach secrete the enzyme precursor pepsinogen. Some of these cells were isolated and maintained in a culture solution containing radioactively labelled amino acids. Samples of the cells were taken at regular intervals and prepared for electron microscopy.

Fig. 1 shows a drawing from an electron micrograph of a peptic cell. The right axis of the drawing indicates the **time taken**, in minutes, **for radioactivity to be detected** in the various cell organelles viewed under the electron micrograph.

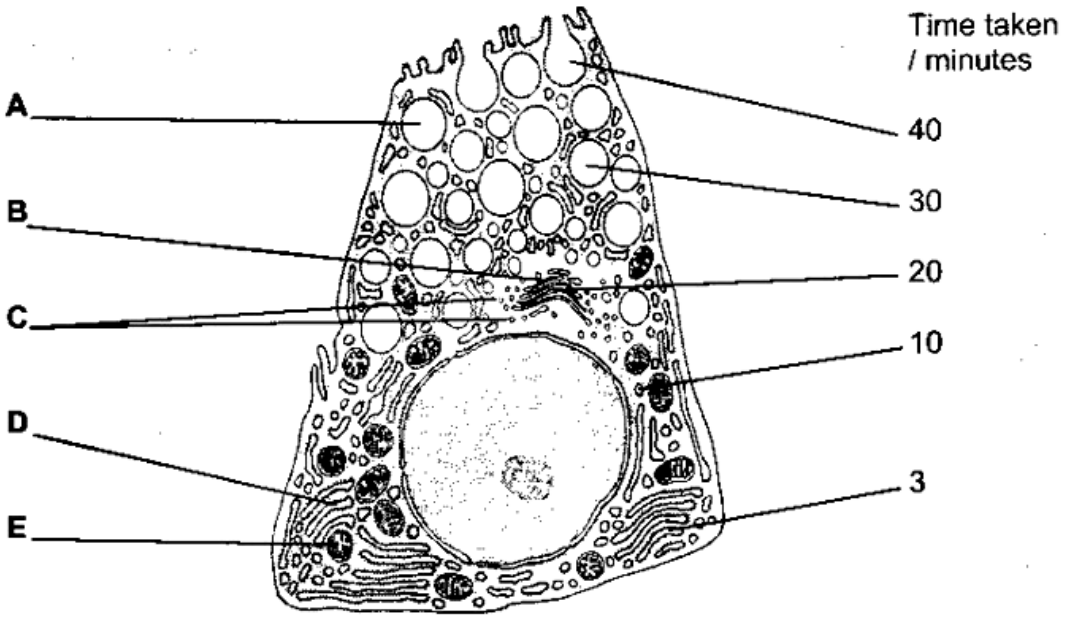

Fig. 1

(a) Identify the organelles labelled **A** to **D,** as shown in Fig. 1.

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(b) With reference to Fig. 1, explain why radioactivity was detected in various organelles at different times.

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(c) Describe how the enzymes in organelle **A** is secreted out of the cell.

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(d) Explain why large numbers of organelle **E** are required in cells synthesizing and secreting proteins.

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[Total: 13]