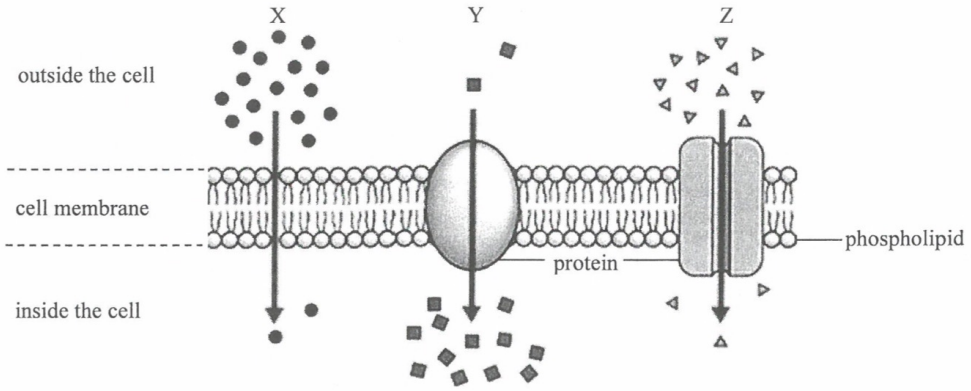
2022

1. The diagram below shows three different ways by which substances pass through a cell membrane:



Which of the following combinations correctly matches the substances with their corresponding ways of passing through the cell membrane?

	X	*Y*	*Z*
A.	oxygen	glucose	water
B.	glucose	water	oxygen
C.	water	oxygen	glucose
D.	water	glucose	oxygen

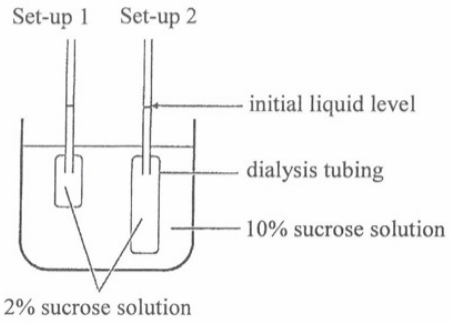
Directions: Questions 13 and 14 refer to the table below, which shows the effect of different substrates on the rate of anaerobic respiration of yeast:

Substrate	Average amount of carbon dioxide produced after 10 min (ppm)
Glucose	395.2
Maltose	345.8
Sucrose	222.2
Fructose	198.2

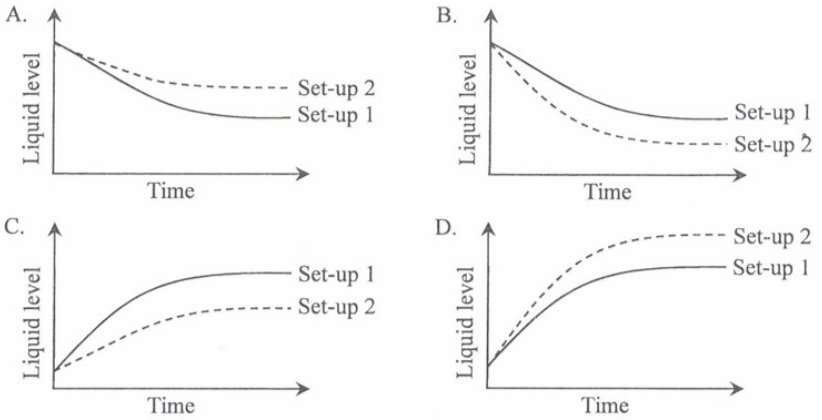
14. In this investigation, which part of the yeast cell produces carbon dioxide?

A. cytoplasm
B. cell membrane
C. matrix of mitochondria
D. inner membrane of mitochondria

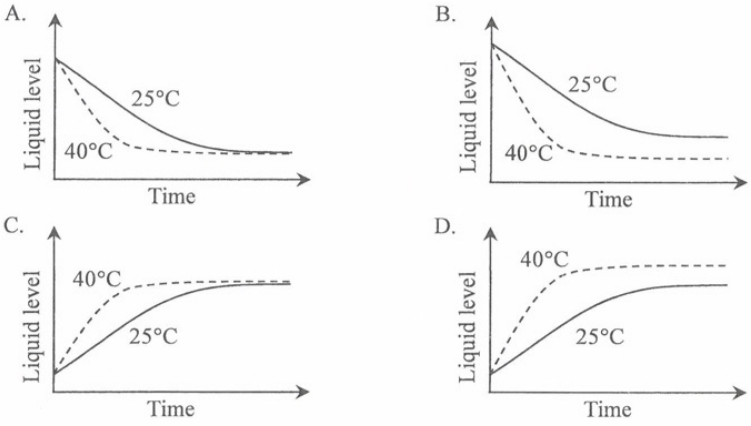
Directions: Questions 35 and 36 refer to the diagram below, which shows two set-ups used for investigating osmosis. Two dialysis tubings of different lengths were filled with 2% sucrose solution and then submerged in 10% sucrose solution. All solutions were kept at 25°C.



35. Which of the following graphs correctly shows the change in the liquid levels of set-ups 1 and 2?



36. If the experiment was repeated with the same setting except that the solutions were kept at 40°C, which of the following graphs correctly shows the change in the liquid levels of set-up 1 at different temperatures?



Answer **ALL** questions. Write your answers in the spaces provided.

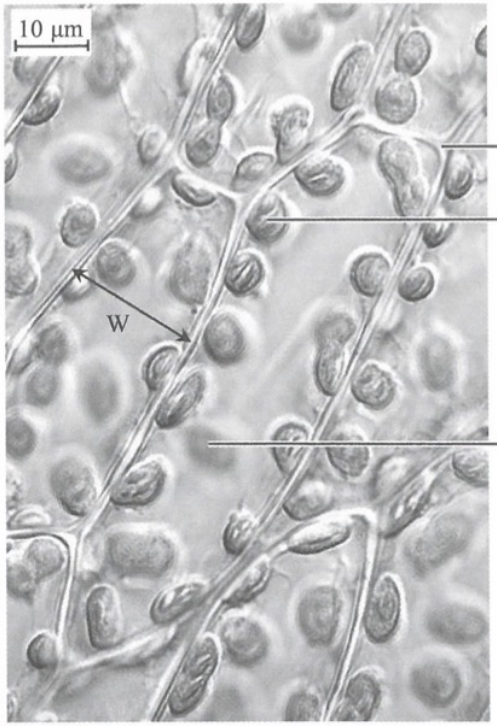
1. The following are some life processes in humans:

Egestion (A)
Excretion (B)
Feeding (C)
Growth (D)
Respiration (E)

(a) Use the letters to construct an equation showing the relationship of these processes in energy flow. (1 mark)

☐ = ☐ – ☐ – ☐ – ☐

3. The photomicrograph below shows some unstained plant cells:



(a) Label structure M. (1 mark)

(b) What is the actual length of W shown in the photomicrograph? (1 mark)

(c) Chloroplast 1 appears sharp in this photomicrograph while chloroplast 2 appears blurred. To obtain a sharper image of chloroplast 2, how should you operate the microscope? (1 mark)

(d) Some structures of chloroplast cannot be distinguished in this photomicrograph. State ***one*** of these structures. (1 mark)

(e) Give ***one*** equipment that can be used to observe the structure stated in (d). (1 mark)

DSE M.C. Questions - Cell and membrane transport
(sort by difficulty)

Challenging

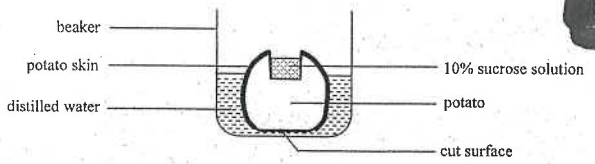
2012 Q.2 (33%)

Plants carry out photosynthesis to produce glucose which is required for the formation of

(1) cellulose
(2) protein
(3) starch

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1),(2) and (3)

Directions: Questions 23 to 25 refer to the diagram below, which shows an experiment on osmosis using a potato tuber. A washed potato was cut to form a base. After that, a cavity was made and a 10% sucrose solution was added into the cavity. The whole potato was then placed into a beaker containing some distilled water. After 1 day, the level of the sucrose solution rose.



2013 Q.25 (24%)

Which of the following treatments will lead to a higher final level of the sucrose solution after 1 day?

(1) using 5% sucrose solution instead of 10% sucrose solution
(2) using 20% sucrose solution instead of 10% sucrose solution
(3) peeling off all the potato skin instead of just cutting the bottom of the potato

A. (1) only B. (2) only C. (1) and (3) only D. (2) and (3) only

2013 Q.26 (33%)

Which of the following nutrients enter the epithelial cells of the small intestine mainly by simple diffusion?

A. amino acids B. fatty acids C. monosaccharides D. nucleotides

Challenging

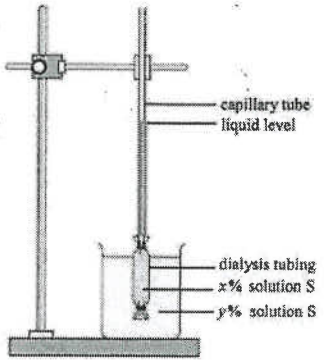
2014 Q.2 (32%)

Which of the following events ***does not*** involve the functioning of membrane proteins?

A. Transmission of nerve impulses across a synapse
B. Absorption of glucose in the small intestine
C. Transport of oxygen by haemoglobin
D. Recognition of pathogens

2016 Q.24 (36%)

Directions: Questions 24 and 25 refer to the diagram below, which shows an experimental set-up for studying osmosis:



After three hours, the liquid level has risen. What can be deduced from this result?

(1) Solution S diffuses into the dialysis tubing.
(2) Value of x is larger than that of y.
(3) Solute of solution S cannot pass through the dialysis tubing.

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1), (2) and (3)

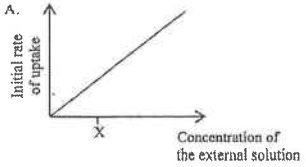
Challenging

2019 Q.11 (23%)

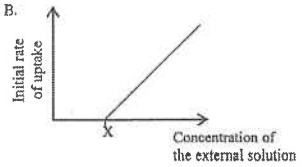
Solutions of different concentrations of a solute with a small molecular size were prepared and some plant cells were immersed in each of the solutions. Which of the following graphs shows the initial rate of uptake of the solute by means of diffusion?

(Note: X is the concentration of the solute inside the plant cells)

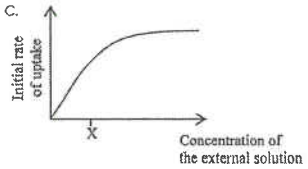
A.



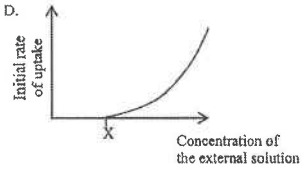
B.



C.



D.



Average

2012 Q.1 (73%)

Which of the following tissue types has the greatest number of mitochondria?

A. the wall of an air sac
B. the wall of a capillary
C. the inner wall of a lymph vessel
D. the inner wall of the small intestine

Directions : Question 1 to 3 refer to the table below, which shows the relative amountsof the mitochondria, chloroplasts and endoplasmic reticulum in four cell types P,Q,R and S:

Cell type	*Relative amount of the sub-cellular structure*		
	Mitochondrion	*Chloroplast*	*Endoplasmic reticulum*
P	+	++	+
Q	+++	-	+
R	+++	-	+++
S	+	-	-

Key: number of '+' indicates the relative amount of the sub-cellular structure
'-' indicates the absence of the sub-cellular structure

2013 Q.1 (54%)

Which cell type is found in the lining of the air sacs in the lungs?

A. P B. Q C. R D. S

2013 Q.3 (72%)

Which of the following carbohydrate(s) is/are likely to be found in cell type P?

(1) Starch
(2) Glucose
(3) Glycogen

A. (1) only B. (2) only C. (1) and (2) only D. (2) and (3) only

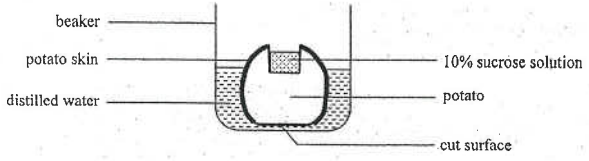
2013 Q.5 (41%)

Which of the following descriptions of the function of membrane proteins is ***incorrect***?

A. Some membrane proteins serve as antigens for cell recognition.
B. Some membrane proteins serve as enzymes for cellular metabolism.
C. Some membrane proteins act as barriers which prevent the entry of some substances.
D. Some membrane proteins act as carriers which transport some substances across the membrane.

Average

Directions: Questions 23 to 25 refer to the diagram below, which shows an experiment on osmosis using a potato tuber. A washed potato was cut to form a base. After that, a cavity was made and a 10% sucrose solution was added into the cavity. The whole potato was then placed into a beaker containing some distilled water. After 1 day, the level of the sucrose solution rose.



2013 Q.23 (48%)

The level of sucrose solution inside the cavity rose because osmosis has taken place, which means that

A. water was drawn mainly from the cells in contact with the sucrose solution.
B. water was initially drawn from the cells in contact with the distilled water.
C. water moved from the distilled water along the cell wall of the potato cells to the cavity.
D. water moved from the distilled water through the cell membrane of the potato cells to the cavity.

2013 Q.24 (65%)

The diagram shows the appearance of a cell in contact with distilled water in the beaker at the beginning of the experiment:

Which of the following diagrams correctly shows the appearance of the same cell at the end of the experiment?

A.

B.

C.

D.

Average

2014 Q.1 (64%)

Which of the following is a catabolic process?

A. Conversion of glucose to glycogen
B. Absorption of glucose
C. Emulsification of fat
D. Digestion of starch

Directions: Questions 3 to 5 refer to the following study:

A study wants to use an ordinary light microscope to observe the binary fission of a photosynthesizing protist under high magnification. A temporary mount of the protist is placed on the stage of the microscope.

2014 Q.3 (59%)

Below are some steps in using a light microscope:

(1) Focus with 10X objective
(2) Focus with 40X objective
(3) Search the field with 10X objective
(4) Search the field with 40X objective
(5) Move the slide until the protist is located in the centre of the field
(6) Adjust light intensity if necessary

Which of the following is the most reasonable sequence of steps for the above study?

A. (1), (3), (5), (6)
B. (2), (6), (4), (5)
C. (1), (2), (4), (5), (6)
D. (1), (3), (5), (2), (6)

2014 Q.5 (41%)

Which of the following structures would be observable in the above study?

A. Ribosome B. Chloroplast C. Mitochondrion D. Endoplasmic reticulum

2014 Q.23 (61%)

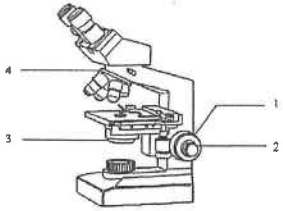
Which of the following cell types has the highest density of mitochondria?

A. Root hair cell
B. Leaf epidermal cell
C. Spongy mesophyll cells
D. Palisade mesophyll cells

Average

2015 Q.1 (49%)

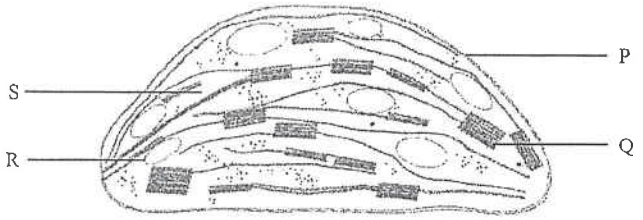
Which of the following parts of the microscope should be adjusted to obtain a clear and sharp image when you switch from low-magnification to high-magnification observation?



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

2015 Q.5 (74%)

Directions: Questions 4 and 5 refer to the schematic diagram below, which shows the structures of a chloroplast:



Which of the following kingdoms contain organisms that possess the above organelle?

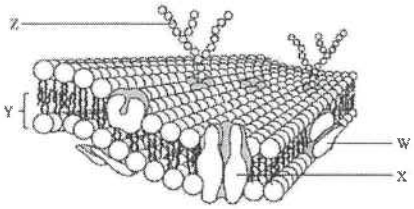
(1) Eubacteria
(2) Protista
(3) Plantae

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Average

Directions:

Questions 1 and 2 refer to the schematic diagram, which shows the structure of a cell membrane:



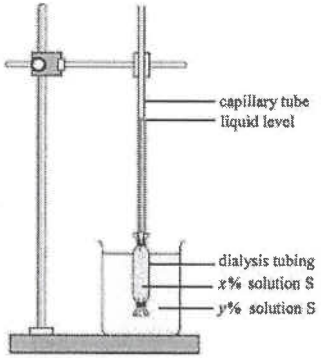
2016 Q.2 (69%)

If the membrane is located at the inner surface of the small intestine, the absorption of amino acids is likely to be achieved via

A. W B. X C. Y D. Z

2016 Q.25 (58%)

Directions: Questions 24 and 25 refer to the diagram below, which shows an experimental set-up for studying osmosis:



Which of the following modifications will result in a faster rise in the liquid level?

A. use a smaller volume of x% solution S
B. use a larger volume of y% solution S
C. use a shorter capillary tube
D. use a longer piece of dialysis tubing

Average

2018 Q.36 (66%)

Which of the following processes mainly involves osmosis?

A. movement of water along the xylem in plants
B. movement of water vapour out of stomata in plants
C. movement of water from tissue fluid lo capillaries in humans.
D. movement of water from tissue fluid to lymph capillaries in humans

2019 Q.8 (73%)

According to the requirements of various methods of transport across the cell membrane,

which of the following combinations is correct?

	Requirements		
	Energy input	***Membrane protein***	***Concentration gradient***
A.	phagocytosis	active transport	osmosis
B.	diffusion	osmosis	active transport
C.	active transport	phagocytosis	phagocytosis
D.	osmosis	diffusion	diffusion

Easy

2013 Q.2 (76%)

Directions : Question 1 to 3 refer to the table below, which shows the relative amountsof the mitochondria, chloroplasts and endoplasmic reticulum in four cell types P,Q,R and S:

Cell type	*Relative amount of the sub-cellular structure*		
	Mitochondrion	*Chloroplast*	*Endoplasmic reticulum*
P	+	++	+
Q	+++	-	+
R	+++	-	+++
S	+	-	+

Key: number of '+' indicates the relative amount of the sub-cellular structure
'-' indicates the absence of the sub-cellular structure

Which cell type would you expect to be insulin-producing cells in the pancreas?

A. P B. Q C. R D. S

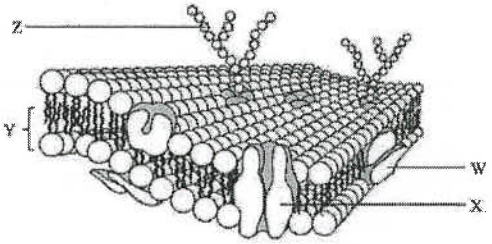
2015 Q.2 (78%)

Which of the following processes requires metabolic energy?

A. glucose moves across the epithelium of the ileum
B. carbon dioxide moves across the wall of air sacs
C. oxygen moves into mesophyll cells
D. water moves along the xylem

2016 Q.1 (85%)

Directions: Questions 1 and 2 refer to the schematic diagram below, which shows the structure of a cell membrane:



Which of the following molecules contributes to the fluidity of the cell membrane?

A. W B. X C. Y D. Z

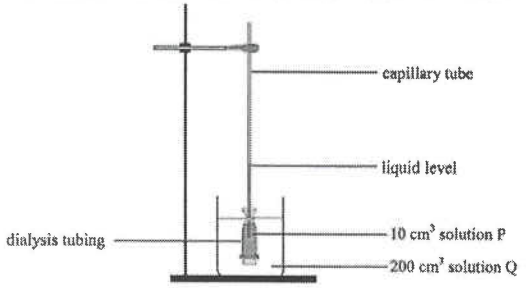
2020 Q.1

1. Which of the following sub-cellular structures can be found in a prokaryotic cell?

A. cell wall, ribosome, cell membrane
B. ribosome, cell membrane, chloroplast
C. cell wall, cell membrane, mitochondria
D. cell membrane, chloroplast, mitochondria

2020 Q.2

Directions: Questions 2 and 3 refer to the diagram below, which shows a set-up for investigating the permeability of dialysis tubing. 10 cm^3 of solution P was added to the dialysis tubing, with one end tied and the other end connected to a capillary tube. The dialysis tubing was then placed in a beaker with 200 cm^3 of solution Q. When solutions P and Q are mixed, a blue colour will be observed.



2. At the end of the investigation, the liquid level inside the capillary tube had risen and only the solution inside the dialysis tubing became blue. Which of the following conclusions can be drawn from the results?

(1) Solute of solution P can pass through the dialysis tubing.
(2) Solute of solution Q can pass through the dialysis tubing.
(3) There is a net movement of water into the dialysis tubing.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

2020 Q.3

3. If the investigation is repeated with water instead of solution Q, which of the following results will be obtained?

A. The liquid level in the capillary tube will not rise at all.
B. The liquid level in the capillary tube will rise to a lower level.
C. The liquid level in the capillary tube will rise to a higher level.
D. The liquid level in the capillary tube will rise to the same level.

2020 Q.9

9. The electron micrograph below shows an organelle P:

Which of the following are possibly produced by organelle P in the cells of the pancreas?

(1) amylase
(2) insulin
(3) lipase

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

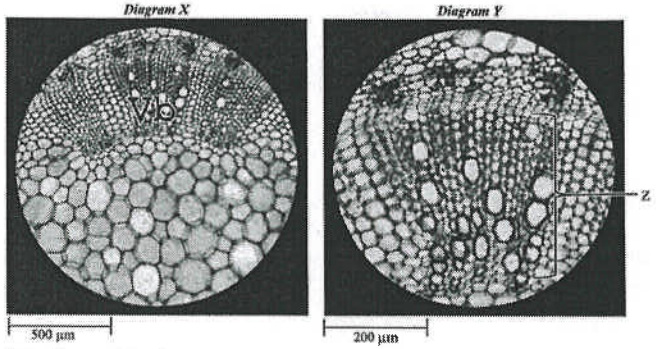
2020 Q.14

14. Which of the following combinations correctly matches the water movement in the human body with its major driving force?

	Water movement	*Major driving force*
A.	water in tissue fluid enters lymph vessels	osmosis
B.	water in blood leaves capillaries at the arterial end	hydrostatic pressure
C.	water in tissue fluid enters capillaries at the venous end	active transport
D.	water enters capillaries from the lumen of the small intestine	diffusion

2020 Q.22

Directions: Questions 22 to 24 refer to the photomicrographs below, which show the stem section of a plant observed under a microscope. Diagram Y shows a higher magnification of the vascular bundle (Vb) in Diagram X:



Key: Vb = vascular bundle

22. Which of the following combinations shows the correct steps for using the microscope in order to obtain the image in Diagram Y from that of Diagram X?

	Step 1	*Step 2*
A.	Move the slide towards the observer so that Vb is in the centre of the field of view.	Change the objective from 4X to 10X and adjust the focus.
B.	Change the objective from 10X to 40X and adjust the focus.	Move the slide towards the observer so that Vb is in the centre of the field of view.
C.	Move the slide away from the observer so that Vb is in the centre of the field of view.	Change the objective from 4X to 10X and adjust the focus.
D.	Change the objective from 10X to 40X and adjust the focus.	Move the slide away from the observer so that Vb is in the centre of the field of view.

2020 Q.24

24. Which of the following structures is commonly found in all the cells shown in Diagram Y?

A. vacuole
B. cell wall
C. cytoplasm
D. cell membrane

2021 Q.24

8. Which of the following combinations correctly lists the requirements of both osmosis and diffusion?

	Concentration gradient	*Energy supply*	*Selectively permeable membrane*
A.	Yes	No	Yes
B.	Yes	No	No
C.	No	Yes	Yes
D.	No	Yes	No

Answers

Challenging

2012	2013	2014	2016	2019
2 [D]	25 [B] 26 [B]	2 [C]	24 [C]	11 [B]

Average

2012	2013	2014	2015	2016	2018	2019
1 [D]	1 [D] 3 [C] 5 [C] 23 [D] 24 [A]	1 [D] 3 [D] 5 [B] 23 [A]	1 [D] 5 [C]	2 [B] 25 [D]	36 [C]	8 [A]

Easy

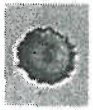
2013	2015	2016
2 [C]	2 [A]	1 [C]

2020
1[A]
2[C]
3[C]
9[D]
14[B]
22[C]
24B]

Past Questions -- Cell and membrane transport

CE - 2003

1. (b) A student carried out a study on the effect of two different sodium chloride solution on red blood cells. He added a drop of citrated mammalian blood to 2 cm^3 of each solution in separate test tubes, A and B. After five minutes, the mixtures in both tubes appeared light red in colour. He then examined a drop of each mixture under the microscope. After repeated examinations, he found that intact red blood cells were present in tube B only and they were in two different forms as shown below:


Wrinkled


Smooth

The results are recorded in the table below:

Tube	Concentration of solution (%)	Average number of different forms of intact red blood cells	
		Wrinkled	Smooth
A	0.3	0	0
B	1.5	15	5

Note : All observations were done under the same magnification.

(i) (1) In tube B, some red blood cells became wrinkled. How would you explain this? (3)
(2) Both forms of red blood cells were observed in tube B. Give a reason for this.(1)

(ii) How could the student be sure that the red blood cells in tube B had reached equilibrium with the surrounding solution at the time when he made the observation? (2)

(iii) Account for the absence of intact red blood cells in the mixture in tube A and the light-red appearance of the mixture. (4)

CE - 2007

1. **Three** samples of specimen were examined in a laboratory. The results are shown below:

Feature of specimen	Sample 1	Sample 2	Sample 3
Size(mm)	0.0002	0.003	100
Cell wall	-	+	+
Mitochondrion	-	-	+
Nucleus	-	-	+
Deoxyribonucleic Acid(DNA)	+	+	+

Key: '+'means present '-'means absent

The following paragraph summarizes the report about the three samples. Complete the paragraph with suitable word(s). (4 marks)

With reference to the results, the groups that samples 1 and 2 belong to are (a)_____ and (b)_____ respectively. For sample 3, it remains unclassified. It could belong to one of the following groups: plants, (c)_____ or (d)_____.

CE - 2007

2. One day, when Keith and Jane walked past a fresh fruit juice shop, Keith noticed that some pears were cut into pieces and stored in a tank of water before use.

(a) Keith thought that the shopkeeper stored the cut pears in water in order to extract more juice. Explain the biological principle behind Keith's idea. (3 marks)

(b) Jane disagreed with Keith because she found that the shopkeeper also stored whole pears in water tanks. Explain why this observation provides Jane with evidence to oppose Keith's idea. (2 marks)

(c) Suggest one possible hygienic problem of storing the cut pears in water tanks. (1 mark)

CE - 2008

4. Read the passage below and answer the questions that follow.

The Discovery of Cells

Most cells are too small to be observed with the naked eye. Thus the existence of cells remained unnoticed until the 17th century. In 1665, Robert Hooke studied a thin section of cork under his self-made compound microscope. He found that the cork was made up of many units which he named 'cells'. According to his observation, a cell is an empty space bounded by a thick wall. At that time, Antonie van Leeuwenhoek, using the single-lens microscope he made, discovered single-celled organisms.

(a) Single-celled organisms can be classified into different kingdoms. Name ***two*** kingdoms that include single-celled organisms. (2)

(b) Later, scientists found that living cells are made up of many cellular structures. State ***two*** cellular structures present in all living cells. (2)

(c) The following table shows some steps of preparing a temporary slide of onion epidermis and the purpose behind each step. Complete the table. (2)

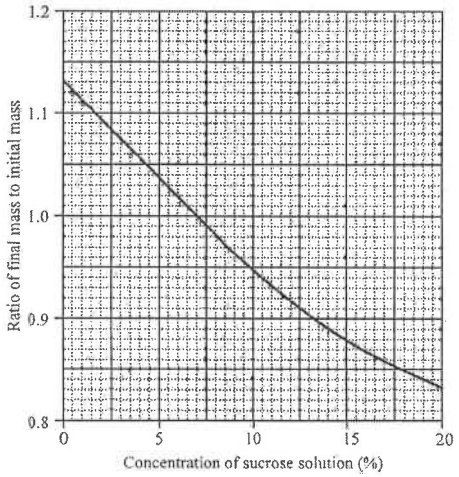
Step	Purpose
Peeling of epidermis	Separate a thin tissue for observation
Staining with iodine solution	(i)
Adding a drop of water	Reduce the refraction of light
(ii)	Flatten the tissue

CE - 2009

4. A student carried out an investigation to determine the water potential of potato tissue. He immersed five identical potato strips separately into five beakers containing sucrose solution of different concentrations for one hour. The masses of the potato strips before and after the immersion were measured and recorded. He then made the following calculation for each potato strip:

$$\text{Ratio of final mass to initial mass} = \frac{\text{mass of strip after immersion}}{\text{mass of strip before immersion}}$$

The graph below shows the results of the investigation:



(a) (i) 'When the ratio of final mass to initial mass is 1.0, the potato tissue has the same water potential as the corresponding sucrose solution.' Explain the biological principle behind this statement. (3 marks)

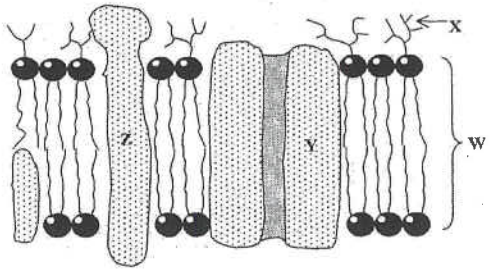
(ii) Based on the statement in (i), the student should be able to conclude that the water potential of the potato tissue is equal to the water potential of_____ sucrose solution. (1 mark)

(b) Describe the state of the potato strip after being immersed in 10 % sucrose solution for one hour. Explain your answer. (3 marks)

(c) What would be the change in water potential of a fresh potato after it has been stored for a long time? Explain your answer. (2 marks)

AL - 2003 2A

1. The following diagram is a model illustrating the structure of a plasma membrane:

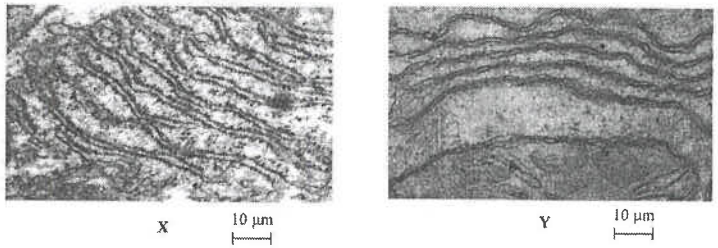


(a) Name this model. Give *two* features that justify such a name. (3)

(b) Explain how the nature and arrangement of molecules at W are related to the permeability of the membrane. (4)

AL - 2005 1A

7. The electron micrographs below show two types of organelles:



Complete the following table :

	X	Y
Name of organelle	(a)	(b)
Product	(c)	Testosterone (male sex hormone)

(3)

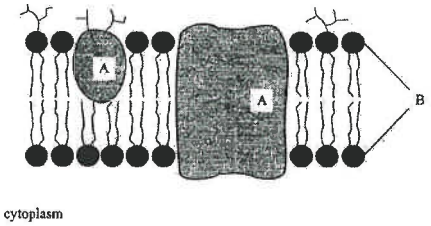
AL - 2005 2A

3. (a) It has been proposed that both the mitochondrion and the chloroplast might have been prokaryotic organisms such as an aerobic bacterium and a photosynthetic bacterium respectively. They had been engulfed by a larger eukaryotic cell and then evolved to establish a relationship of mutualism with the eukaryotic cell.

(i) Use ***labelled*** diagrams to illustrate the process of a bacterium being engulfed by a eukaryotic cell and subsequently becoming a part of the cell.(4)

AL - 2006 1A

9. The diagram below shows a model of the cell membrane:



Complete the following paragraph with suitable words: (4)

The membrane is composed of proteins which are labelled as A in the diagram and (a)..... molecules labelled as B. The layer of molecules B makes the membrane impermeable to (b)..... . The proteins on the membrane serve important functions; one example is (c)..... Carbohydrates are also found on the membrane. Sugar units attached to the proteins act as (d)..... on the membrane surface for recognition by other cells.

AL - 2008 1A

2. The following is a schematic diagram of an animal cell:

(a) In the secretory cells of the salivary glands, some of the organelles shown above work together for the production of salivary amylase. The table below lists three of these organelles and their functions in amylase production. Complete the table.

Structure	Name of the organelle	Function in salivary amylase production
E	rough endoplasmic reticulum	(i)
A	nucleus	(ii)

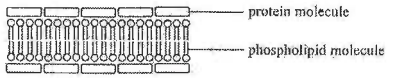
(b) Other than salivary amylase, name one secretory substance produced by the cells of the salivary glands and state its function. (2)

AL - 2008 2B

4. (a) Models have been used to explain the structure and function of biological systems such as membranes in cells. With reference to the current membrane model, discuss how phospholipids contribute to membrane properties and thereby lead to various membrane functions in cells. (6)

AL - 2010 1A

7. The table below lists some historical events in the research into the molecular structure of the cell member (based on models proposed by scientists):

Time	Scientist	Historical event
1925	E. Gorter and F. Grendel	Extracted phospholipid molecules from the cell membrane of red blood cells and spread them into a thin layer on the surface of water. It was found that the area of the thin layer was double that of the surface area of red blood cells.
1935	H. Davson and J. Danielli	Proposed the 'sandwich model' to illustrate the structure of the cell membrane. 
1972	S. Singer and G. Nicolson	Proposed the 'fluid mosaic model' to illustrate the structure of the cell membrane.

(a) How did Davson and Danielli make use of the findings of Gorter and Grendel to build the 'sandwich model'? (1 mark)

(b) In the space below, draw a labeled 2D-diagram to show the molecular arrangement of the 'fluid mosaic model'. (3 marks)

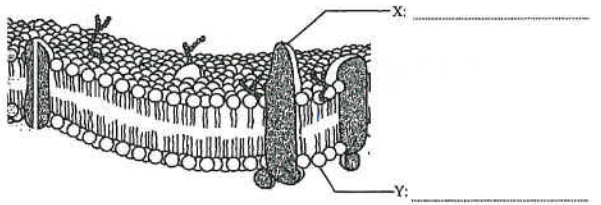
(c) Based on the 'fluid mosaic model', describe the importance of three key features of the cell membrane in cell functions. (3 marks)

HKDSE 2013 1B

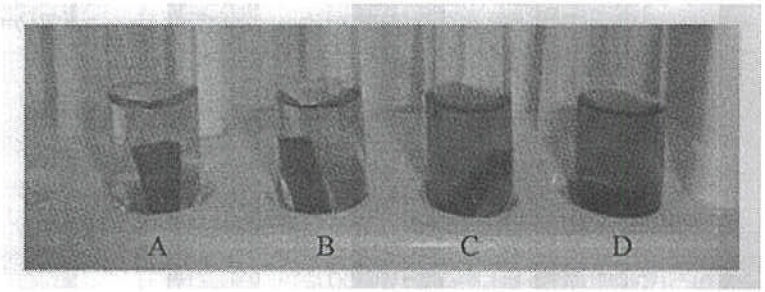
10. Proteins serve different functions in our body and their functional role is closely related to their conformation (shape). Describe how protein molecules can have different conformations and explain how the different conformations enable them to carry out different functions. (11marks)

HKDSE 2014 1B

7. (a) The following is a schematic diagram of a cell membrane. In the spaces provided, label membrane components X and Y. (2 marks)



(b) The vacuoles of beetroot cells contain a red pigment which will be released from the cells if the cell membrane and vacuole membrane are damaged. In an investigation, Gary placed identical cylinders of beetroot tissues into four test tubes. Each tube contained the same volume of alcohol at different concentrations. The following photograph shows the appearance of the solutions bathing the beetroot cylinders after 30 minutes:



(i) From the result of the above investigation, deduce which test tube contained the highest concentration of the alcohol. (4 marks)

(ii) After three hours, Gary found that the colour intensity of the solutions of all the test tubes became the same. Suggest an explanation for this. (2 marks)

HKDSE – 2015 1B

6. The table below lists some historical developments about the discovery of the structure of cell membrane:

Year	*Scientists*	*Historical events*
1895	Overton	Discovered that lipid-soluble substances could penetrate cells easily
1917	Langmuir	Discovered that the major component of cell membrane exhibited both water-loving and water-hating properties
1925	Gorter & Grendal	Extracted lipids from the cell membrane of red blood cells and spread the lipids in a single layer on a water surface; found that the area of the layer was double the surface area of the cell membrane
1972	Singer & Nicolson	Proposed the Fluid Mosaic Model to explain the structure of cell membranes

(a) What is the major component noted by Overton and Langmuir? (1 mark)

(b) Gorter and Grendal proposed that the major component identified in (a) existed as a bilayer (Bilayer Model). With reference to the observation of Langmuir, suggest how this major component is oriented and arranged in the cell membrane. Explain your answer. (3 marks)

(c) (i) The Bilayer Model proposed by Gorter and Grendal did not mention another major component of the cell membrane. What is this component? (1 mark)

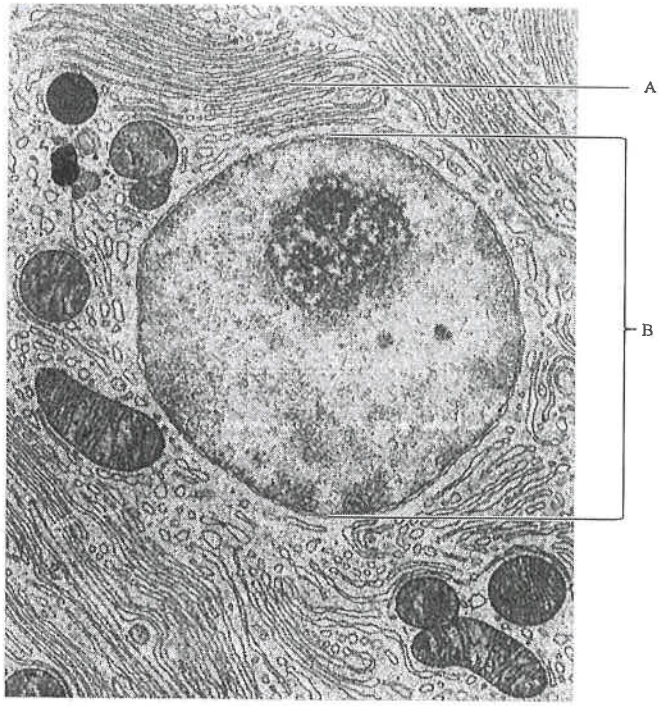
(ii) With reference to the Fluid Mosaic Model, briefly describe the orientation of this component in the cell membrane. (2 marks)

(d) Models are often used by scientists to explain their findings. Complete the following table to elaborate on the aspects of the nature of science involved in the use of scientific models. (2 marks)

Nature of science	*Elaboration*
Science is evidence based	
	Models are used to simulate an invisible structure or illustrate a theory.

HKDSE - 2017 1B

4. The electron micrograph on the opposite page shows some structures of a human cell.



a. Label A and B. (2 marks)

b. Which stage of the cell cycle is shown in this photomicrograph? Give a reason to support your answer. (2 marks)

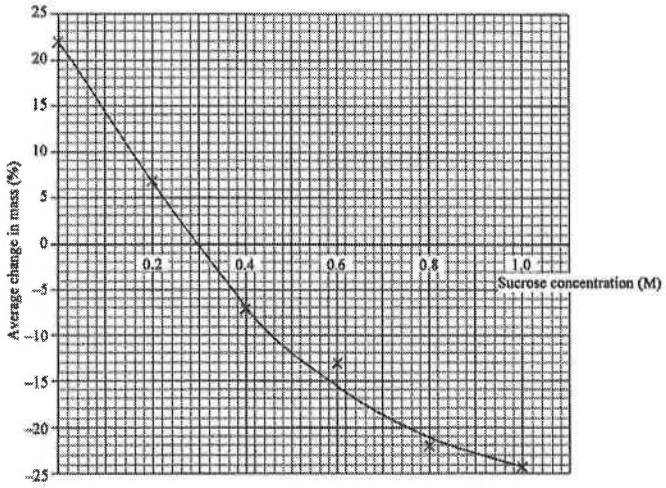
c. The cell was obtained from the pancreas. How do A and B work together such that this cell can perform its function? (4 marks)

HKDSE - 2019 1B

6. Johnny conducted an experiment to determine the water potential of potato tuber cells. He measured the masses of fresh potato cylinders before and after immersing them in sucrose solutions at different concentrations (0M, 0.2M, 0.4M, 0.6M, 0.8M, and 1.0M). Below shows the major steps in the experiment:

Step 1: Cut potato tubers into cylinders
Step 2: Blot dry the surface of the potato cylinders
Step 3: Weigh the potato cylinders (initial mass)
Step 4: Immerse three potato cylinders in each concentration of sucrose solution for two hours
Step 5: Remove and blot dry the surface of the potato cylinders
Step 6: Reweigh the potato cylinders (final mass)
Step 7: Calculate the average percentage change in mass of the potato cylinders in each solution

The results are shown in the graph below:



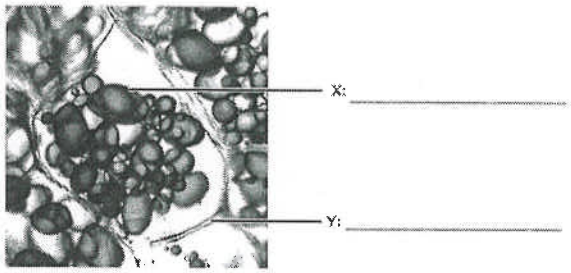
(a) With reference to the graph, which sucrose solution concentration has the same water potential as the potato cells? Explai your answer. (3 marks)

(b) If Johnny skipped step 2 by mistake for all samples, how would this affect th curve and the deduced value of the concentration of the sucrose solution in (a)? Sketch a curve on the graph on the facing page to show the effect. (1 mark)

(c) In terms of experimental design, what is the importance of putting three potato cylinnders in each concentration of sucrose solution? (1 mark)

HKDSE - 2019 1B

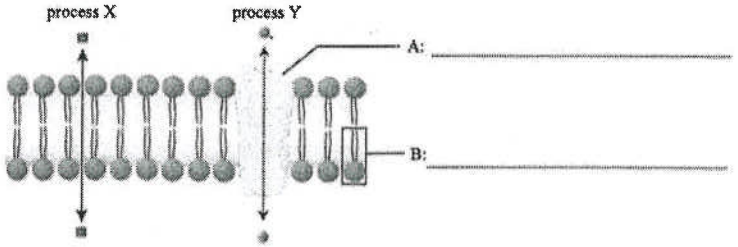
6. (d) Johnny prepared a slide of freshly sectioned potato cylinder and stained it with iodine solution. The photomicrograph below shows the section. Label structure X and Y. (2 marks)



(e) In the middle of the 19th century, there was a severe attack on potato ccrops by a pathogen in Ireland. As the potato was the major staple food at that time, many Irish people died of starvation. Vegatative propagation of potatoes was blamed for the high vulnerability of the potato crops. Explain the rationale for this claim. (2 marks)

HKDSE - 2020 1B

4. The following diagram's shows a cell membrane and the movement of some substance across it:



(a) Label structures A and B. (2 marks)

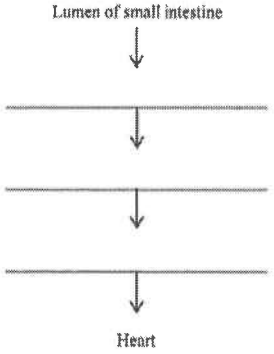
(b) X and Y represent two different processes by which substances pass through the cell membrane.

(i) Give ***one*** digested product which is absorbed through process X in the human body. (1 mark)

(ii) Give one digested product which is absorbed through process Y in the human body. (1 mark)

HKDSE - 2020 1B

4. (b) (iii) The digested products absorbed through process X are transported from the small intestine to the heart. Complete the following flowchart to show the vessels involved in the transport. (3 marks)



Past Papers Marking Scheme – Cell and membrane transport

CE - 2003 Q.1 (b)

(i) (1) The water potential of the red blood cells was higher than that of the surrounding solution 1
As a result, the cells shrank and became wrinkled 1
(2) Because the water potential of some red blood cells was higher than, while that of others was equal to /lower than the water potential of the surrounding solution 1

(ii) Observe the red blood cells again after some time 1
The proportion of the two forms should remain the same if they had reached equilibrium in the previous observation. 1

(iii) The water potential of the red blood cells was lower than that of the surrounding solution 1
Water entered the cells 1
The red blood cells expanded and burst 1
Releasing the haemoglobin to the solution, thus making it red 1

CE - 2007 Q.1

(a) virus 1
(b) prokaryotes 1
(c) fungi / protoctist 1
(d) Protoctist / fungi 1

CE - 2007 Q.2

(a) The water outside has a higher water potential than the cells of pears 1
water moves into the cells 1
increasing the volume of the cell content / water content of the cell 1
As a result, more fruit juice can be extracted

(b) The skin of the fruit acts as barrier to water 1
Little / no water movement will occur 1

(c) The water / pear may be contaminated with pathogens / lead to food poisoning 1

CE - 2008 Q.4

(a) * Prokaryotes / prokaryotae
* Protoctists / protoctista / protista
* Fungi
} any two 1, 1

(b) Cell membrane, cytoplasm 1, 1
(c) (i) Make cell structure / nucleus / cell wall / cell more distinct 1
(ii) Cover the tissue with a cover slip 1

CE - 2009 Q.4

(a) (i) When the ratio is 1.0, there is no change in the mass of the potato strip before and after the treatment 1
This shows that there is no net gain or loss of water throughout the investigation 1
by osmosis 1
(ii) 7 % 1

(b) The potato strip became flaccid 1
due to a net loss of water by osmosis 1
because the water potential of potato tissue is higher than that of the 10% sucrose solution 1

(c) After storing the potato for a long time, the water potential if the potato will become lower 1
because of evaporation of water during storage 1

2003 2A

1. (a) • *fluid mosaic model (1) 3
• fluidity: lateral movement of protein (1) / phospholipid molecules (accept alternative expression)
• mosaic: protein molecules interspersed among phospholipid molecules (1) (accept: a mosaic of protein and phospholipid molecules)

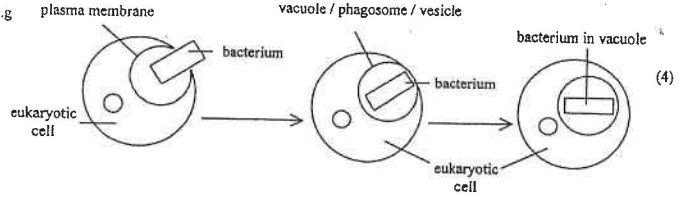
(b) Structural-functional relationships: max. 4
• W consists of 2 layers of phospholipid molecules (1) / phospholipid bilayer; allows lipid soluble substances to go through (1) as they dissolve in it
• hydrophobic tails of the phopholipid molecules point inwards (1); form an inner hydrophobic zone (1); make the membrane impermeable to charged molecules (1)

AL - 2005 1A

7. (a) Rough endoplasmic reticulum (1) / RER 3
(b) Smooth endoplasmic reticulum (1) / SER
(c) Insulin (1) / Glucagon

AL - 2005 2A

3. (a) (i)



(4)

AL - 2006 1A

9. (a) phospholipids (1) 4
(b) ions (1) / polar or charged molecules such as glucose, amino acids, proteins, water
(c) acting as ion channels (1) / trans-membrane carriers / electron carriers / enzymes / receptors / maintaining structural integrity of membrane
(or state the function of proteins e.g. for active transport across cell membrane)
(d) antigens (1) / recognition markers

AL - 2008 1A

2. (a) (i) • as the site of formation of the polypeptide / for transporting the polypeptide (1) / modification of the polypeptide
(ii) • as the site of formation of the mRNA of amylase (1) / as the site of transcription / contains genetic information coding for amylase
(iii) • (B) (1)
(iv) • *Golgi apparatus (1)
(b) • *mucin (1) / mucus
• for lubricating the swallowing of food (1) / sticking food particles together

AL - 2008 2B

4. (a)

- the phospholipids molecules in the membrane are capable of slight lateral movements (1), giving fluidity (1) to the membrane
  - this allows the membrane to invaginate (1) / carry out endocytosis / bud off vesicles from ER and Golgi apparatus
  - also allows membrane fusion (1), thus supporting the export of materials contained in vesicles by exocytosis (1), and the intracellular vesicular transport of materials (1) e.g. transport of proteins in vesicles from RER to the Golgi apparatus

} max.4

- due to the hydrophobic nature (1) of the fatty acid chains, phospholipids molecules spontaneously form a bilayer (1) in aqueous surroundings
  - the bilayer makes the membrane a good physical barrier for compartmentalization (1) and can help restrict the entry / exit of ions and polar molecules (1), thus establishing gradients of charges / concentration across membranes
  - the bilayer also forms a matrix / structural framework for the embedment of proteins (1) so that they can exert their respective functions

} max. 4

(max. 6)

AL - 2010 1A

7. (a) · cell membrane consists of two layers of phospholipid (1) (1)

(b) · correct drawing showing integral proteins (1) and asymmetrical arrangement of peripheral proteins (1) (max. 3)
· title and labels (2)

(c) · (transmembrane) integral proteins serve as ion channel/ carrier protein for transport of materials across membrane(1)
· peripheral proteins serve as antigen for cell recognition/ receptor site for receiving chemical messenger (1) (3)
· fluid nature of the lipid bilayer allows phagocytosis/ pinocytosis (1)/ permeability

HKDSE - 2013 1B

10. Factors determining the different conformations of protein molecules (S)

- amino acid sequence:
  - ✓ proteins are built from 20 different amino acids (1)
  - ✓ held / joined together to form a polypeptide (1)
  - ✓ the amino acids sequence determines the final conformation of protein molecule (1)
  - ✓ this amino acid sequence is encoded by the base sequence of a gene / code / nucleotide on DNA (1)

S=max. 3

- folding of the polypeptide:
  - ✓ the polypeptide chains then coil / fold up (1)
  - ✓ while some polypeptide chains bind together (1) to form a molecule with specific conformation

The unique shape of each protein allows different proteins to perform different functional roles in our body, e.g. it gives rise to (R)

- enzymes with unique active sites / substrate binding sites (1) that fit with specific substrates for controlling cellular metablism (1)
- receptors with binding sites for neurotransmitters (1) that allows transmission of nerve impulses across synpase (1)
- antibodies which allow recognition of antigens / pathogens (1) for body defence (1)
- haemoglobin with binding site (1) for carrying oxygen (1)

R=max. 5

C=max. 3
11 marks

HKDSE - 20141B

7. (a) X: * protein (1)
Y: * phospholipid (1) (2)

(b) (i)
- tube D should have the highest concentration of alcohol (1)
- the amount of pigment released to the bathing solution would be the highest, as indicated by the highest colour intensity (1)
- this is because the phospholipids of the membrane dissolve in alcohol (1)
- the cell membrane and vacuole membrane of the beetroot tissue bathing in the test tube with highest concentration of alcohol would be most damaged (1)

(4)

(ii)
- when the cell membrane and vacuole membrane are damaged, the pigment leaks out of the vacuole by diffusion (1)
- as time passes, it allows the diffusion of the red pigment in all 4 tubes to reach an equilibrium state at which the same concentration of red pigment are found in the bathing solutions / the bathing solution becames saturated with the same amount of red pigment in all 4 tubes, i.e. same colour intensities (1)

(2)

8 marks

HKDSE – 2015 1B

6. (a) phospholipids 1

(b) the water-loving parts of phospholipids point outward while the water-hating parts point inward (1)
both the medium inside and the medium outside the cell are aqueous solutions (1)
hence, only the water-loving part of the phospholipids is in contact with the cell sap and extracellular fluid (1) 3

(c) (i) protein 1
(ii) proteins are interspersed in the bilayer / a mosaic pattern (1)
in an asymmetric manner (1) 2

(d)

Nature of science	*Elaboration*
-	Scientific models / theory are built based on experimental findings / observations (1)
Doing science requires imaginations / creativity (1)	-

2

HKDSE – 2017 1B

4. (a) • A: endoplasmic reticulum* (1) [accept rough endoplasmic reticulum/ smooth endoplasmic reticulum] (2)
• B: nucleus* (1)

(b) • interphase / resting stage (1) / (1+1)
Accept G1, S or G2 (whole set must be given, if candidates answered either one, no mark for 1st point but continue to mark 2nd point, i.e. 0+1)
• because DNA is in the format of chromatin / the chromosomes are invisible (NOT accept no chromosomes) (1) [no mark will be given with wrong stage of the cell cycle]

(c) • B carries the genetic materials [accept DNA/ genes/ chromatin/ chromosome] (1)coding for the hormone / digestive enzymes*
• transcription takes place in B to produce mRNA(1)^
• which is transported to A for translation/ protein synthesis (1)^*@ (4)
• to produce protein hormones# / digestive enzymes#(1)for discharge / secretions

^ Some candidates may mix up the terms transcription and translation yet with correct descriptions; candidates will be only penalised once for such mixing up.
** No mark will be given if candidates mix up A and B.*
 # Accept if suitable examples are given (e.g. insulin, glucagon, trypsin, chymotrypsin, protease, amylase, lipase).
@No mark will be given if the candidate fails to indicate/imply the functional link between B and A.

8 marks

HKDSE – 2018 1B

2. (a) • vacuole (1) (1)

(b) Any ***two*** of the following:
• the cell membrane / cytoplasm of the leaf cells has detached from the cell wall / the leaf cell is plasmolysed (1)
• chloroplasts condense to the centre of the cell (1) (2)
• the vacuole / X has shrunk (1)

(c) • sucrose solution has a lower water potential than the cell content (1)
• there is a net movement of water from the cell content to the bathing solution by osmosis (1) (2)

5 marks

HKDSE – 2019 1B

6. (a) • 0.3 M sucrose solution (1) *[accept ± 0.01]*
• there was no change of mass at this concentration (1)
• this shows that there was no net movement of water [accept no osmosis] in or out of the cells (1) (3)
i.e. the bathing solution had the same water potential as the potato cells

(b) • the curve would shift downward (1) / to the left (1)

(c) • this can increase the reliability of the results by minimizing the individual differences of the cylinders (1) / can help to spot the presence of experimental error when there is inconsistent data (1). [discard inconsistent data (x)] (1)

(d) • X: starch granule / starch grain / amyloplast (1) [x starch] (2)
• Y: cell wall (1)

(e) • offspring produced will have the same genetic makeup as parents / low (no) genetic variation (1) (2)
• this provides limited raw materials for the selection of resistant strain (1) / if parent genotype [accept parent / one of the offspring] is susceptible to the pathogen attack, the whole population will be susceptible (1)

9 marks