

Name: _____

Questions in Cell Biology

Directions: The following questions are taken from previous IB Final Papers on the subject of cell biology. Answer all questions. This will serve as a study guide for the next quiz on Monday 11/21.

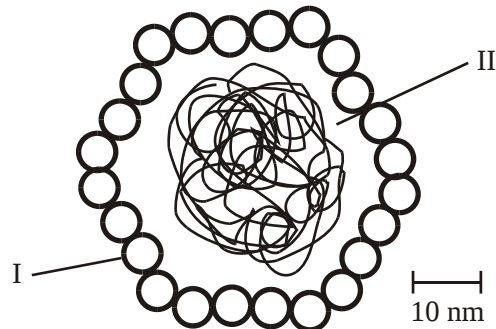
1. Outline the process of endocytosis.

(Total 5 marks)

2. Draw a labelled diagram of the fluid mosaic model of the plasma membrane.

(Total 5 marks)

3. The drawing below shows the structure of a virus.



- (a) Identify structures labelled I and II.

I:

II:

(2)

- (b) Use the scale bar to calculate the maximum diameter of the virus. Show your working.

Answer:

(2)

- (c) Explain briefly why antibiotics are effective against bacteria but not viruses.

.....

.....

.....

.....

.....

.....

.....

(3)

- (d) Explain how antibiotic resistance develops in bacteria.

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 10 marks)

4. (a) State **one** type of secondary structure of a protein.

.....

(1)

- (b) Outline the differences between globular and fibrous proteins, giving a named example of each.

.....

.....

.....

.....

.....

.....

.....

(3)

- (c) Explain the significance of polar amino acids for membrane proteins.

.....

.....

.....

.....

.....

(2)
(Total 6 marks)

5. Explain how vesicles are used in cells, including the way in which they form and are reabsorbed.

(Total 8 marks)

6. Draw a labelled diagram of a prokaryotic cell as seen in electron micrographs.

(Total 6 marks)

7. Describe passive transport across a biological membrane.

(Total 5 marks)

8. Compare, with the aid of a diagram, the structure of generalised prokaryotic and eukaryotic animal cells.

(Total 8 marks)

9. (a) An organelle is a discrete structure within a cell with a specific function. In the table below, identify the missing organelles and outline the missing functions.

Name of organelle	Structure of organelle	Function of organelle
Nucleus	Region of the cell containing chromosomes, surrounded by a double membrane, in which there are pores.	Storage and protection of chromosomes
Ribosome	Small spherical structures, consisting of two subunits.	
.....	Spherical organelles, surrounded by a single membrane and containing hydrolytic enzymes.	Digestion of structures that are not needed within cells.
.....	Organelles surrounded by two membranes, the inner of which is folded inwards.	

(2)

- (b) The table above shows some of the organelles found in a particular cell. Discuss what type of cell this could be.

.....

.....

.....

.....

.....

(2)

(Total 4marks)

10. (a) Distinguish between diffusion and osmosis.

.....

.....

.....

(1)

- (b) Explain how the properties of phospholipids help to maintain the structure of the cell surface membrane.

.....

.....

.....

.....

(2)

- (c) State the composition and the function of the plant cell wall.

.....

.....

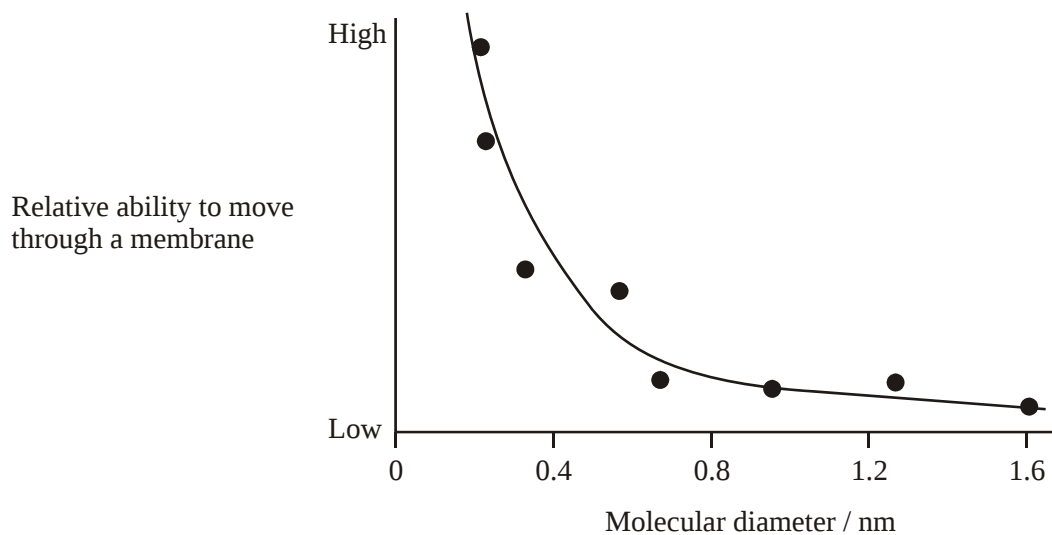
.....

.....

(2)

(Total 5 marks)

11. A study was carried out to determine the relationship between the diameter of a molecule and its movement through a membrane. The graph below shows the results of the study.



[Source: Knox, *et al.*, *Biology*, Mcgraw Hill, Sydney, 1994, page 65]

- (a) From the information in the graph alone, describe the relationship between the diameter of a molecule and its movement through a membrane.

.....

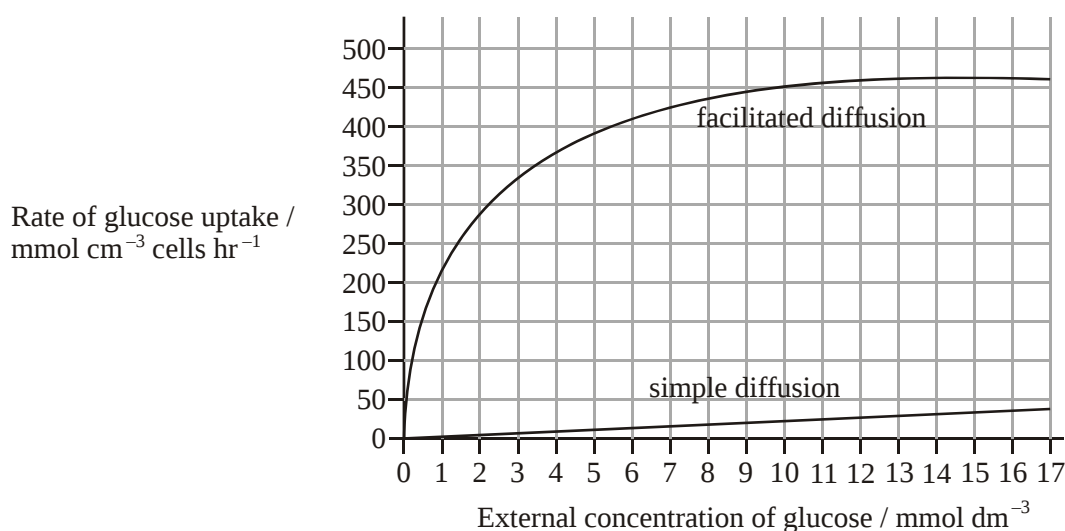
.....

.....

.....

(2)

A second study was carried out to investigate the effect of passive protein channels on the movement of glucose into cells. The graph below shows the rate of uptake of glucose into erythrocytes by simple diffusion and facilitated diffusion.



- (b) Identify the rate of glucose uptake at an external glucose concentration of 4 mmol dm⁻³ by

(i) simple diffusion.

(1)

(ii) facilitated diffusion.

(1)

- (c) (i) Compare the effect of increasing the external glucose concentration on glucose uptake by facilitated diffusion and by simple diffusion.

.....

.....

.....

.....

.....

.....

(3)

- (ii) Predict, with a reason, the effect on glucose uptake by facilitated diffusion of increasing the external concentration of glucose to 30 mmol dm^{-3} .

.....

.....

.....

.....

(2)

(Total 9 marks)

12. Outline the advantages of using light microscopes in comparison with electron microscopes.

(Total 3 marks)

13. Explain how the structure and properties of phospholipids help to maintain the structure of cell membranes.

(Total 9 marks)

14. Distinguish between the structure of plant and animal cells.

(Total 6 marks)

1. (Annotated diagram illustrating the process may be used to gain some or all the marks.)
the mechanism whereby cells take in solids and / or solutions;
involves the formation of vesicles;
infolding of cell membrane;
called phagocytosis when solids / organisms are engulfed;
phagocytosis is called feeding in some unicellular organisms;
called pinocytosis when solutions are taken in
(vesicles are much smaller);
may be receptor-mediated (e.g. HIV);
requires energy / active process;

[5]
-
2. Award [1] for each of the following structures clearly drawn and labelled correctly in a diagram of a plasma membrane.
phospholipid bilayer;
protein channels / integral (intrinsic) membrane proteins;
peripheral (extrinsic) proteins associated with the membrane;
cholesterol embedded in the membrane;
glycoproteins / receptor proteins on the outside;
hydrophobic and hydrophilic portions of membrane indicated; (both needed for [1])

[5]
3.
 - (a) I: protein coat / capsid / capsomere;
II: DNA/nucleic acid / RNA / genetic material;

2
 - (b) $\text{size} = \frac{\text{diameter of drawing}}{\text{length of size bar}} \times 10\text{mm} / \text{equivalent working shown}$
52 nm (± 5 nm); (units required)

2
 - (c) antibiotics block specific metabolic pathways /
cell production in bacteria;
viruses reproduce using the host cell metabolic pathways;
(host cell) pathways are not affected by antibiotics;
viruses do not have metabolic pathways;

3 max
 - (d) some bacteria are resistant to an antibiotic /
variation within bacterial populations includes antibiotic resistance;
genes for antibiotic resistance originate as
mutations (not caused by antibiotics);
transfer of resistance genes (can occur) from strain /
species to species;
bacteria that are resistant survive when an antibiotic is used and others die;
resistant bacteria pass on their genes for resistance to offspring;
proportion of resistant bacteria increases in each
generation in the population/species;
natural selection for bacteria that are resistant;

3 max

[10]
4.
 - (a) beta sheet / alpha helix

1

- (b) fibrous proteins have a long and narrow shape,
 globular protein have rounded shape;
 fibrous mostly insoluble in water, globular protein soluble in water
 fibrous in secondary structure, globular in tertiary structure
 fibrous: collagen / myosin / silk / keratin / other fibrous protein;
 Globular: immunoglobulin / hemoglobin /
 catalase / named enzyme /
 other globular protein; 3 max
- (c) polar amino acids are hydrophilic / "water loving";
 polar amino acids form hydrophilic proteins / channels;
 allow hydrophilic / polar /
 charged particle substances through the membrane;
 controls shape / function / location of the protein in the membrane;
 polar amino acids on the surface proteins make them water soluble; 2 max
*Accept any of the above points if clearly explained using a
 suitable diagram*

[6]

5. vesicle is made by pinching off a piece of membrane;
 fluidity of membrane allows this;
 vesicles can be used to transport material around inside cells;
 proteins are transported in vesicles;
 from the rough endoplasmic reticulum to the Golgi apparatus;
 from the Golgi apparatus to the plasma membrane;
 formation of vesicle from plasma membrane allows material to be taken in;
 endocytosis / pinocytosis / phagocytosis / phagolysosome is absorption of material
 using a vesicle;
 fusion of vesicle with plasma membrane allows material to be secreted/passed out;
 exocytosis is secretion of material using a vesicle;
 named example of endocytosis or exocytosis;

[8]

6. Award [1] for each of the following structures clearly drawn and labelled
 correctly in a diagram of a generalized prokaryotic cell.

size stated: 1 to 10 μm ;
 cell wall;
 cytoplasm;
 flagella / flagellum;
 mesosome;
 plasma membrane;
 ribosomes;
 nucleoid region / DNA not enclosed in nuclear membrane;
 plasmid;
 pili;
 capsule / slime layer; 6 max
Deduct [1] for each eukaryotic feature included, up to [3 max].

[6]

7. passive transport requires no energy;
 molecules move down a concentration gradient;
 water moves by osmosis;
 from lower solute concentration to higher solute concentration / high water concentration to low water;
 small uncharged molecules move by diffusion;
 between phospholipid molecules;
 charged molecules move by facilitated diffusion;
 requires a protein channel;

[5]

8. labelled diagram of generalised prokaryotic (P) and generalised eukaryotic (E) animal cell 2 max
(Marks must be awarded if the following comparisons are made as either annotations to the diagram or in narrative/table form.)
 P is usually smaller in size, E is larger;
 both have cytoplasm / protoplasm;
 P has no nucleus / nucleoid region, E has (membrane-bound) nucleus;
 P has one chromosome / circular, E has two or more chromosomes;
 P has DNA only, E has DNA with protein (histones);
 P has no membrane-bound organelles, E has some membrane-bound organelles;
 E has mitochondria, P does not;
 E has other example of organelle, P does not;
 both can have a flagellum / flagella;
 if flagella then E has 9+2 fibrils, P does not;
 P can have pili / slime layer / capsule, E does not;
 P can have plasmids, E does not;
 both have ribosomes;
 P has small ribosomes, E has larger ones;
 both have cell membrane;
 P has cell wall, E has no cell wall;
 E has centriole, P has no centriole;

[8]

-

9. (a) translates RNA into/synthesises polypeptides/proteins;
 lysosomes; mitochondria;
 aerobic respiration / production of ATP;
Do not accept production of energy. 4
- (b) eukaryotic;
 membrane bound organelles/nucleus (as reason for being a eukaryote)
 could be plant or animal;
 probably animal because of the lysosomes; 2 max

[6]

10. (a) *Must have both for [1].*
 diffusion is the movement of molecules from an area of high concentration to an area of low concentration;
 osmosis is the diffusion of water across a partially permeable membrane;

1

- (b) hydrophilic head groups point outward;
hydrophobic tails form a lipid bilayer;
forms a (phospholipid) bilayer;
ions and polar molecules cannot pass through
hydrophobic barrier;
helps the cell maintain internal concentration
and exclude other molecules; 2 max
- (c) cellulose;
structural support / protection / maintain turgor pressure; 2

[5]

11. (a) as the diameter of the molecule increases the permeability / relative ability
to move decreases (*accept converse*);
the relationship is logarithmic / non-linear / negative;
for molecules above 0.6 (± 0.1) nm relative ability to move changes little /
for molecules below 0.6 (± 0.1) nm relative ability to move changes rapidly; 2 max
- (b) "U-1" rule applies.
- (i) 10 mmol cm⁻³ cells hr⁻¹ (*accept values within ± 5*); 1
- (ii) 370 mmol cm⁻³ cells hr⁻¹ (*accept values within ± 10*); 1
- (c) (i) glucose uptake in facilitated diffusion levels out whereas uptake in simple
diffusion does not level out / continues to rise;
glucose uptake increases in both;
glucose uptake is higher in facilitated diffusion (than in simple diffusion);
glucose uptake in simple diffusion is constant / linear whereas in
facilitated diffusion uptake increases rapidly at the beginning / increase
is not constant; 3 max
- (ii) little / no change in glucose uptake;
most / all (protein) channels in use; 2

[9]

12. easy to prepare a sample for;
living material can be viewed / living processes (*e.g.* cytoplasmic streaming) can be seen;
colour images can be seen;
relatively portable;
relatively cheap;
larger field of view;

[3]

13. *phospholipid structure*
hydrophobic tail / hydrophilic head;
head made from glycerol and phosphate;
tail made from two fatty acids;
saturated / unsaturated fatty acid (in tail);
- arrangement in membrane*
phospholipids form a bilayer;
heads face outside the membrane / tails face inside the membrane /
hydrophobic interior / hydrophilic exterior of membrane;
- A suitable annotated diagram may incorporate all or many of the above points.*
Award [5 max] for a suitable diagram that is labeled correctly.
phospholipids held together by hydrophobic interactions;

phospholipids layers are stabilized by interaction of hydrophilic heads and surrounding water;
 phospholipids allow for membrane fluidity / flexibility;
 fluidity / flexibility helps membranes to be (functionally) stable;
 phospholipids with short fatty acids / unsaturated fatty acids are more fluid;
 fluidity is important in breaking and remaking membranes (*e.g.* endocytosis / exocytosis);
 phospholipids can move about / move horizontally / "flip flop" to increase fluidity;
 hydrophilic / hydrophobic layers restrict entry / exit of substances;
 (*Plus up to [2] for quality*)

9 max

[9]

14. Award [1] per difference,
plant cells:

have cell walls, animal cells do not;
 have plastids / chloroplasts, animal cells do not;
 have a large central vacuole, animal cells do not;
 store starch, animal cells store glycogen;
 have plasmodesmata, animal cells do not;

animal cells:

have centrioles, plant cells do not;
 have cholesterol in the cell membrane, plant cells do not;
 plant cells are generally have a fixed shape / more regular whereas animal cells are more rounded;

[6]