

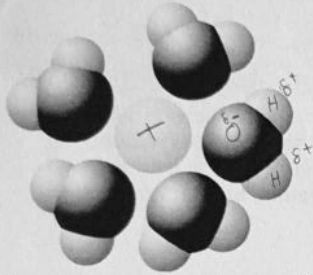
Select only the single best answer. Please transfer your answers, in pencil, to the Scantron sheet provided – we will not transfer answers

- 1) Which of the following is a major cause of the size limits for certain types of cells?
- A. limitation on the strength and integrity of the plasma membrane as cell size increases
 - B. the difference in plasma membranes between prokaryotes and eukaryotes
 - C. evolutionary progression in cell size; more primitive cells have smaller sizes
 - D. the need for a surface area of sufficient area to support the cell's metabolic needs
 - E. rigid cell walls that limit cell size expansion
- 2) When biologists wish to study the membrane structure of the microvilli on the outer surface of intestinal epithelial cells, they should use ...
- A. a phase-contrast light microscope.
 - B. a scanning electron microscope.
 - C. a transmission electronic microscope.
 - D. a confocal fluorescence microscope.
 - E. a super-resolution fluorescence microscope.
- 3) The evolution of eukaryotic cells most likely involved
- A. endosymbiosis of an aerobic bacterium in a larger host cell—the endosymbiont evolved into mitochondria. ✓
 - B. anaerobic archaea taking up residence inside a larger bacterial host cell to escape toxic oxygen—the anaerobic bacterium evolved into chloroplasts.
 - C. an endosymbiotic fungal cell evolved into the nucleus.
 - D. acquisition of an endomembrane system, and subsequent evolution of mitochondria from a portion of the Golgi.
 - E. two sequential endosymbiotic events; first the engulfment of a photosynthetic bacterium and later an aerobic bacterium.
- 4) If you added a fluorescent dye which labels deoxyribonucleic acid to a culture of rapidly growing bacterial cells, what part of the cells would you expect to be labeled?
- DNA
- A. nucleus
 - B. cytoplasm
 - C. nucleoid
 - D. ribosomes
- 5) Tay-Sachs disease is a human genetic abnormality that results in cells being unable to breakdown lipids which leads them to become clogged with very large and complex lipids. Which cellular organelle must be involved in this condition?
- A. smooth endoplasmic reticulum
 - B. lysosome
 - C. central vacuole
 - D. peroxisome

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- 6) Why isn't the mitochondrion classified as part of the endomembrane system?
- A. It is a static structure.
 - B. Its structure is not derived from the ER or Golgi.
 - C. It has too many vesicles.
 - D. It is not involved in protein synthesis.
 - E. It is not attached to the outer nuclear envelope.

- 7) Which of the following statements is *true* about buffer solutions?
- A. They maintain a constant pH when bases are added to them but not when acids are added to them.
 - B. They maintain a constant pH when acids are added to them but not when bases are added to them.
 - C. They maintain a relatively constant pH when either acids or bases are added to them.
 - D. They are found only in living systems and biological fluids.



- 8) Based on your knowledge of the polarity of water molecules, which surround the solute molecule depicted above, the depicted solute molecule is most likely
- A. positively charged.
 - B. negatively charged.
 - C. without charge.
 - D. hydrophobic.
 - E. Nonpolar.

- 9) Which of the following is *not* considered to be a weak molecular interaction?

- A. a covalent bond ✓
- B. a van der Waals interaction *weak*
- C. an ionic bond in the presence of water
- D. a hydrogen bond
- E. both a hydrogen bond and a covalent bond

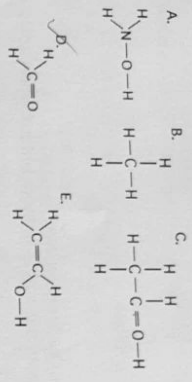
covalent > hydrogen.

- 10) Why are human sex hormones (e.x. estradiol and testosterone) considered to be lipids?

- A. They are essential components of cell membranes.
- B. They are synthesized from cholesterol. ✓
- C. They are made of fatty acids.
- D. They are hydrophilic compounds.
- E. They contribute to atherosclerosis.

B

Use the following figure to answer the questions 11 and 12 below.



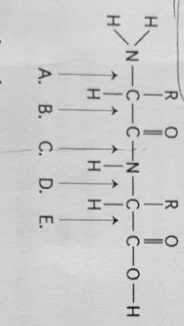
11) In which of the structures illustrated above are the atoms bonded by ionic bonds?

- A. A
- B. B
- C. C
- D. C, D, and E only
- E. none of the structures

12) Which of the structures illustrated above contain(s) a carbonyl functional group?

- A. A
- B. C and D
- C. C
- D. D
- E. C and E

13) Referring to the diagram below, at which bond would water need to be added to achieve hydrolysis of the peptide, back to its component amino acids?



- A. A
- B. B
- C. C
- D. D
- E. E

14) All of the following contain amino acids except

- A. hemoglobin.
- B. cholesterol.
- C. antibodies.
- D. enzymes.
- E. insulin.

15) According to the fluid mosaic model of cell membranes, which of the following is a true statement about membrane phospholipids?

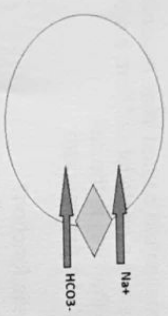
- A. They can move laterally along the plane of the membrane.
- B. They frequently flip-flop from one side of the membrane to the other.
- C. They occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane.
- D. They are free to depart from the membrane and dissolve in the surrounding solution.
- E. They have hydrophilic tails in the interior of the membrane.

16) Which of the following is one of the ways that the membranes of winter wheat are able to remain fluid when it is extremely cold?

- A. by increasing the percentage of unsaturated phospholipids in the membrane
- B. by increasing the percentage of saturated phospholipids in the membrane
- C. by decreasing the number of hydrophobic proteins in the membrane
- D. by cotransport of glucose and hydrogen
- E. by using active transport

17) An animal cell lacking oligosaccharides on its plasma membrane would likely be impaired in which function?

- A. transporting ions against an electrochemical gradient
- B. cell-cell recognition
- C. maintaining fluidity of the phospholipid bilayer
- D. attaching to the cytoskeleton
- E. establishing the diffusion barrier to charged molecules

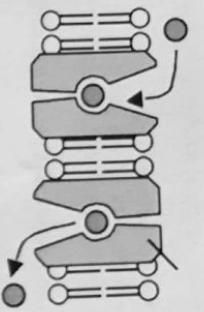


18) The transport protein shown in the figure above is a ...

- A. symporter
- B. antiporter
- C. uniporter
- D. channel protein

19) What kinds of molecules pass through a cell membrane most easily?

- A. large polar
- B. ionic
- C. monosaccharides such as glucose
- D. large and hydrophobic
- E. small and hydrophobic



20) The figure above depicts which type of transport across the cell membrane?

- A. Diffusion
- B. Facilitated diffusion
- C. Endocytosis
- D. Exocytosis
- E. Pinocytosis

21) Celery stalks that are immersed in fresh water for several hours become stiff and hard. Similar stalks left in a 0.15 M salt solution become limp and soft. From this we can deduce that the cells of the celery stalks are

- A. hypotonic to both fresh water and the salt solution.
- B. hypertonic to both fresh water and the salt solution.
- C. hypertonic to fresh water but hypotonic to the salt solution.
- D. hypotonic to fresh water but hypertonic to the salt solution.
- E. isotonic with fresh water but hypotonic to the salt solution.

22) Which of the following membrane activities require energy from ATP hydrolysis?

- A. facilitated diffusion of chloride ions across the membrane through a chloride channel
- B. movement of water into a cell
- C. Na^+ ions moving out of a mammalian cell bathed in an isotonic NaCl solution
- D. movement of glucose molecules into a bacterial cell from a medium containing a higher concentration of glucose than inside the cell
- E. movement of carbon dioxide out of a paramecium

23) In plant cells, how does the middle lamella function?

- A. allows adjacent cells to adhere to one another
- B. prevents dehydration of adjacent cells
- C. maintains the plant's circulatory system
- D. allows for gas and nutrient exchange among adjacent cells
- E. cell structure and support

24) Researchers tried to explain how vesicular transport occurs in cells by attempting to assemble the transport components. They set up microtubular tracks along which vesicles could be transported, and they added vesicles and ATP (because they knew transport process requires energy). Yet, when they put everything together, there was movement or transport of vesicles. What were they missing?

- A. an axon
- B. contractile microfilaments
- C. endoplasmic reticulum
- D. motor proteins
- E. intermediate filaments

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25) The extracellular matrix is thought to participate in the regulation of animal cell behaviour by communicating information from the outside to the inside of the cell via which of the following?

- A. gap junctions
- B. the nucleus
- C. DNA and RNA
- D. integrins
- E. plasmodesmata

Part B - Written Answers - total 50 marks
Please answer only in the space provided below, answers outside of those areas will not be marked. Answers in point form and/or those accompanied by diagrams will be accepted so long as they are complete.

1. Fill in the blank to complete each of the following sentences. (1 mark each - total 7 marks)

- a) The smallest collection of matter that can be considered alive is the cell.
- b) Proteins modified with covalently linked carbohydrates are called glycoproteins.
- c) A contractile vacuole pumps excess water out of cells; a process which allows some organisms to carry out osmoregulation.
- d) The process by which some cells can engulf another cell forming a food vacuole is known as phagocytosis.
- e) Molecules which contain both a hydrophobic and a hydrophilic region, such as phospholipids, are also known as amphipathic molecules.
- f) A type of transport protein that generates voltage across a membrane is also known as a electrogenic (Na⁺/K⁺) pump.
- g) Carbohydrates are the class of macromolecules which consist of both monosaccharides and the polymers built from them.

2. Fill in the blank to complete each of the following sentences. (1 mark each - total 3 marks)

In their journey through the endomembrane system, vesicles destined for the plasma membrane bud off of the trans face of the Golgi apparatus. An integral membrane protein internal → which will be exposed only on the cytoplasmic side of the plasma membrane, would be embedded in internal external leaflet of the lipid bilayer of the vesicle shuttling it to the plasma membrane. These vesicles merge with the plasma membrane where they release their content into the extracellular space in a type of bulk transport known as exocytosis.

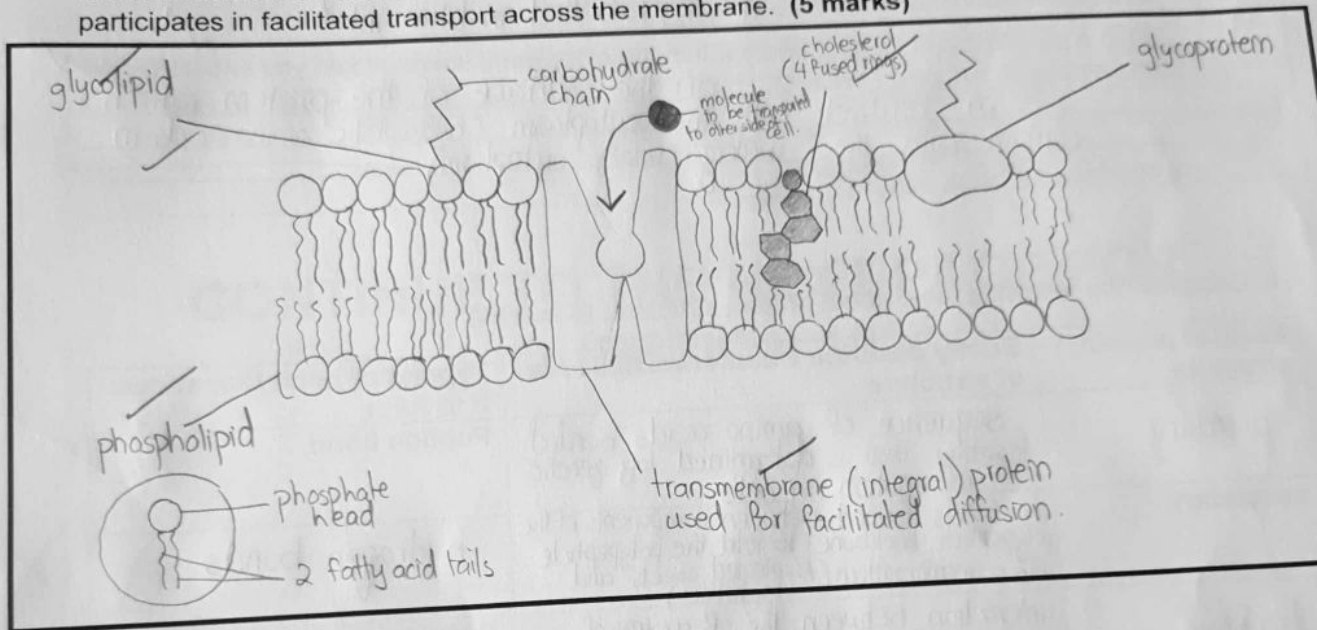
3. Identify 2 pieces of evidence biologist use to support the endosymbiotic theory. (2 marks)

- Chloroplasts and mitochondria have their own genetic material and they reproduce independent of the cell in which they are present, following prokaryotic reproduction mechanisms.
- Chloroplasts & mitochondria have a similar size to prokaryotes.
- Chloroplasts & mitochondria have free ribosomes inside of them for synthesis of their own proteins.

4. Name one trace element and using a specific example describe why it is necessary for life. (2 marks)

Iron - it is used in the prod part of the heme group which is used (or is a component) of hemoglobin which is the substance found in red blood cells that binds to oxygen and so carries oxygen which is used for respiration.)

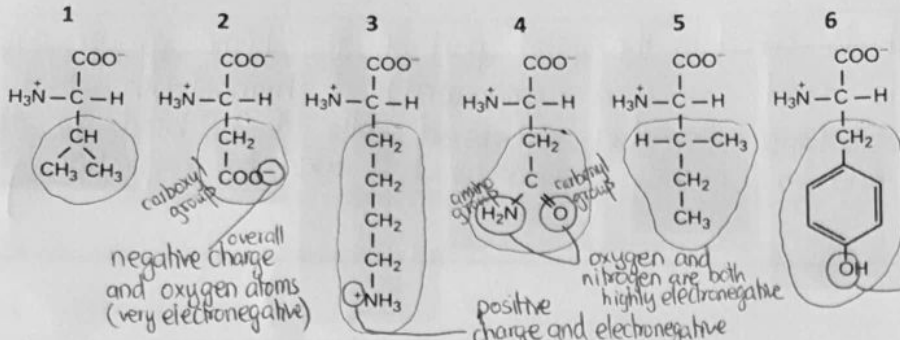
5. Draw a small patch of the plasma membrane which includes; all types of lipids commonly found in animal cell membranes, one glycolipid, and one integral membrane protein which participates in facilitated transport across the membrane. (5 marks)



6. The plasmodesmata of plant cells are most similar to which type of intercellular junction found in animal cells? Provide a brief justification for your answer. (2 marks)

Gap junctions because when open, ~~these~~ this intercellular intercellular junction allows for passage of ions and small molecules between two cells (the connexons of each adjacent cell should both be open) just like the plasmodesmata's function. ~~(the only diff)~~ Desmosomes and tight junctions do not allow for passage of molecules/ions between cells

7. Compare the following amino acids:



i) List those that you determine to be polar. (2 marks) 2, 3, 4, 6 ✓2

ii) Draw/label directly on the polar molecules what contributes to their polarity to justify your choice above. (2 marks) * drawn / labelled in blue ink * ✓1

iii) In a protein found floating freely within the cytoplasm, where would you expect to find these polar molecules. (1 mark) on the surface of the protein which is in contact with the cytoplasm (hydrophilic amino acids in contact with the watery (polar) cytoplasm). ✓1

8. Complete the following table about protein structure. (8 marks)

Level of protein structure	Briefly describe what forms this level of structure	Type(s) of bond that allows it to form
primary	sequence of amino acids bonded together that is determined by genetic information in cells.	Peptide bond
secondary	H bonds formed between components of the polypeptide backbone to fold the polypeptide into a regular pattern (β -pleated sheets and α helices)	hydrogen bonds
tertiary	interaction between the R groups of amino acids to give a 3D structure.	Name two types - disulfide bridges - ionic bonds
quaternary	combination combination of two or more polypeptide chains.	NOT AVAILABLE

9. Which of these associations are a correct match? Justify your answer in each case. (6 marks)

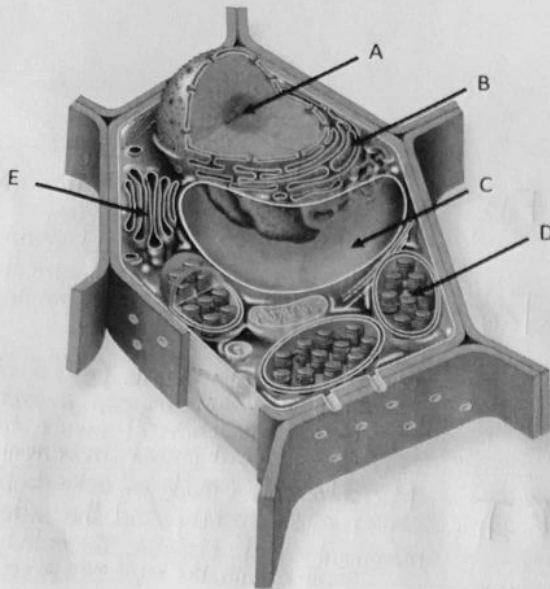
Association	True (T) or False (F)	Justify briefly your answer
Microfilaments and the nuclear lamella or 'cage'	False	It is the intermediate filaments that fix organelles into 'cages' & that form the nuclear lamina.
Microtubules and chromosome separation during mitosis	True	Microtubules separate to form the mitotic spindle that separates chromosomes during mitosis.
Intermediate filaments and myosin	False	Micro Microfilaments (made of actin subunits) work with myosin in order to cause contraction of muscle fibres and bring about muscle movement.
Microfilaments and <u>flagellar motion</u>	False	Microfilaments (made of actin double chain) allow motility and the sideways movement of flagella. The motility is possible with the help of motor proteins.

4.5

CONTINUE TO THE NEXT PAGE FOR QUESTION 10

4.5

10. Complete the table below using the following figure: (10 marks)



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Label	Name the structure	Briefly describe the role/function of the structure
A	nucleus	synthesis of ribosomal RNA and the assembly of ribosomes.
B	Rough endoplasmic reticulum.	packages & modifies and packages proteins (folds them into secondary/tertiary structures) and packages them into vesicles.
C	Vacuole	Stores nutrients (carbohydrates & proteins) and water for later use.
D	Chloroplast	Photosynth Captures light energy for photosynthesis and fixation of CO ₂ in glucose.
E	Golgi apparatus	modifies proteins and lipids and packages them into transport vesicles to be transported either to the outside of cell by exocytosis or to remain in vesicles.

9

BONUS QUESTION

Connect the cell part to the disease in which it is dysfunctional (you must get all 4 correct to be awarded **2 marks**)

Structures	Disorder (write the letter corresponding to the associated structure)
A. flagella	<u>D</u> Alzheimer's Disease
B. mitochondria	<u>A</u> male factor infertility
C . vacuoles	<u>B</u> Congenital Lactic Acidosis
D. cytoskeleton	<u>C</u> Danon's disease

2