

1. You are completing VERSION A. Bubble in "A" beside #1 on your scantron. THIS QUESTION IS NOT WORTH A MARK BUT NEEDS TO BE COMPLETED TO BE GRADED.

A. Pick this one!

- B.
- C.
- D.

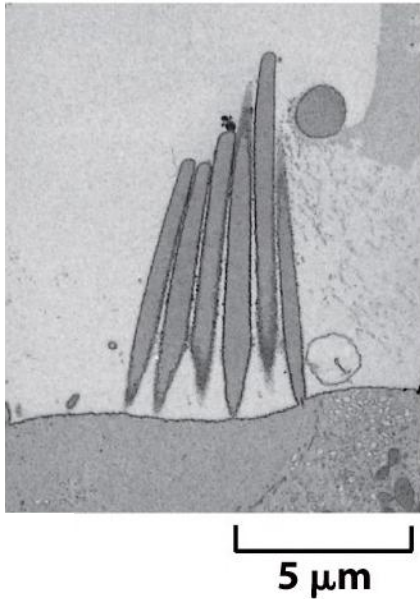
2. What is one major difference between transmission electron microscopy (TEM) and scanning electron microscopy (SEM)?

- A. TEM can only be used with dead cells, but SEM can be used to visualize living cells.
- B. TEM uses a shorter wavelength of light than SEM.

C. TEM can reveal internal structures of cells but SEM can only show the external surfaces

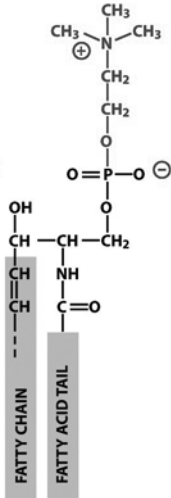
- D. TEM is a good technique to use with coloured specimens but SEM can reveal structure inside transparent specimens

3. What type of microscopy was used to visualize the cell below?



- A. Brightfield microscopy
- B. Phase contrast microscopy
- C. Scanning electron microscopy
- D. Transmission electron microscopy
- E. Dark-field microscopy

4. Which microscopy technique would be best for looking at a live, transparent, unstained mammalian cell in culture?
- A. Bright field microscopy
 - B. Phase contrast microscopy
 - C. Fluorescence microscopy
 - D. Transmission electron microscopy
 - E. Scanning electron microscopy
5. Which of the following is an advantage of using a primary cell culture?
- A. Primary cultures retain their differentiated characteristics.
 - B. Primary cultures divide indefinitely and so can be studied for a long time.
 - C. Primary cell cultures can be stored easily in liquid nitrogen.
 - D. All of the above
6. Which of the following statements about fluorescence microscopy is (are) TRUE?
- A. The excitation light and emitted light are exactly the same wavelength.
 - B. In a fluorescence microscope, the excitation light passes through the specimen using the same path that light takes in a bright field microscope.
 - C. Antibodies carrying a fluorescent tag can be used to visualize specific proteins in cells.
 - D. A and C.
 - E. B and C.
7. You would not be able to use ion sensitive indicators to measure the concentration of
- A. glucose
 - B. sodium
 - C. calcium
 - D. chloride
8. Which of the following is NOT a technique that is used with fluorescence microscopy?
- A. Dyes such as DAPI.
 - B. Staining with heavy metals.
 - C. Fusion proteins.
 - D. Tagged antibodies.
9. You are investigating the function of a membrane protein in epithelial cells and you have labeled it with a fluorescent tag such as YFP. While observing it under the fluorescence microscope, you carry out a FRAP (Fluorescence Recovery after Photobleaching) experiment by bleaching a patch of your labeled proteins with a high-powered laser and then watching what happens. What do you predict would happen if your protein is a component of the tight junctions that are found between epithelial cells?
- A. The fluorescence would not recover because the protein mobility is restricted.
 - B. The fluorescence would recover very quickly because fresh YFP-labeled proteins would insert into the membrane from the cytosol.
 - C. The fluorescence would recover quickly because unbleached YFP-labeled proteins would diffuse into the patch from surrounding membrane areas and replace the bleached proteins.
 - D. The fluorescence would not recover because the lipid membrane is much less fluid in that region.

10. Identify the molecule below.

- A. Phosphatidylethanolamine
- B. Phosphatidylserine
- C. Phosphatidylcholine
- D. Sphingomyelin**
- E. Cholesterol
- F. Glycolipid

11. The lab you are working in conducts research on a protein that is known to localize on the lateral plasma membrane. Why would you not find the protein on the apical membrane?

- A. The protein is rapidly degraded within the cell before it can reach the apical membrane.
- B. Tight junctions prevent the proteins from moving between the apical and lateral membranes.**
- C. Protein movement is limited by the presence of multiple lipid rafts in the plasma membrane.
- D. The protein has a beta barrel structure instead of an alpha helical structure and so associates more closely with the lateral membrane.

12. The glycocalyx refers to

- A. the layer of carbohydrates on the cell surface.**
- B. the hydrophilic amino acids of the lipid bilayer.
- C. the cell wall of plants.
- D. the cytoskeleton of human red blood cells.

13. Which of the following are found in the extracellular portion of the phospholipid bilayer of red blood cells?

- A. Phosphatidylethanolamine and phosphatidylserine
- B. Phosphatidylethanolamine and phosphatidylcholine
- C. Phosphatidylcholine and phosphatidylserine
- D. Phosphatidylcholine and sphingomyelin**
- E. Phosphatidylethanolamine and sphingomyelin
- F. Phosphatidylserine and sphingomyelin

14. Where would you likely NOT find glycolipids?

- A. On the outer surface of bacterial plasma membranes.
- B. On the outer surface of animal cell plasma membranes.
- C. On the outer surface of animal cell organellar membranes.
- D. On the outer surface of plant cell plasma membranes.
- E. All of the above; glycolipids are not found in ANY of these locations.

15. Which of the following is NOT an important function of membranes in animal cells?

- A. Act as a barrier to water-soluble molecules.
- B. Provide a rigid structure to maintain the shape of the cell.
- C. Maintain the differences between the cytosol and the extracellular environment.
- D. Maintain ion gradients that can be used for energy conversion.
- E. Contains proteins that act as receptors to transmit signals.
- F. None of the above; they are ALL important membrane functions.

16. What is the correct order of permeability across a lipid bilayer for the following solutes (most permeable to least permeable)?

- A. O₂, H₂O, glucose, Na⁺
- B. H₂O, O₂, glucose, Na⁺
- C. Na⁺, glucose, O₂, H₂O
- D. Na⁺, glucose, H₂O, O₂

17. Suppose in your laboratory you make an artificial membrane using all the lipids normally found in a liver cell plasma membrane, and you make a second membrane with the same lipids but you leave out the cholesterol. What might you expect to find about the second membrane without cholesterol?

- A. The membrane would be less permeable to small molecules.
- B. The membrane lipids would be more likely to pack together and crystallize.
- C. The membrane lipids would be more likely to form lipid rafts.
- D. All of the above
- E. None of the above

18. If you grew a culture of the bacterium *S. aureus* in a warm incubator at 37°C and then shifted it to room temperature (22°C), what would you expect to happen to the lipid composition of the bacterial plasma membrane after you shifted it?

- A. Nothing. The lipid composition is genetically determined and does not change with changes in the environment.
- B. The fatty acid composition would change so there were more saturated fatty acids.
- C. The fatty acid composition would change so there were more unsaturated fatty acids.
- D. More cholesterol would be found in the membrane.
- E. Less cholesterol would be found in the membrane.

19. Which of the following statements about transmembrane proteins is (are) TRUE?

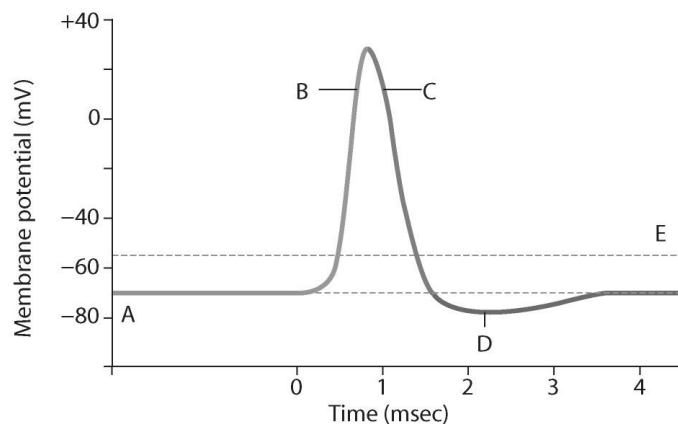
- A. All transmembrane proteins are integral membrane proteins.
- B. A particular transmembrane protein is always oriented in the membrane in only one unique direction.
- C. All transmembrane proteins have an alpha helix region that crosses the membrane.
- D. A and B only**
- E. A and C only
- F. All of the above

20. Which of the following statements is TRUE about the Na^+ - K^+ ATPase in the plasma membranes of animal cells?

- A. Energy from ATP is directly used to move sodium and potassium.**
- B. It is a symporter.
- C. It contributes about 90% of the membrane potential.
- D. A and B are true.
- E. A and C are true.
- F. B and C are true.

21. Why do Na^+ ions enter the cell when voltage-gated Na^+ channels are opened in neurons?

- A. Because the Na^+ concentration is much lower outside the cell than it is inside.
- B. Because the Na^+ ions are attracted to the negatively charged interior.**
- C. Because the Na^+ ions are actively transported by the sodium-potassium pump into the cell.
- D. Both A and B.
- E. Both A and C.

22. The figure below represents an action potential. Which letter corresponds to the membrane being hyperpolarized?

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

- 23. If you experimentally increase the concentration of K^+ inside a cell while maintaining other ion concentrations as they were, what would happen to the cell's membrane potential?**
- A. The membrane potential would become more negative.
 - B. The membrane potential would become less negative.**
 - C. The membrane potential would remain the same.
- 24. What causes Na^+ channels to open at the neuromuscular junction?**
- A. Voltage-gated Ca^{2+} channels open in the muscle cell plasma membrane and the influx of Ca^{2+} causes Na^+ channels to open.
 - B. Acetylcholine binds to ligand-gated Na^+ channels in the muscle cell plasma membrane.**
 - C. Membrane depolarization causes ligand-gated Na^+ channels to open in the muscle cell plasma membrane
 - D. Acetylcholine binds to voltage-gated Na^+ channels in the neuron axon terminal
- 25. Why does an action potential move in one direction only? Why does it not move backwards?**
- A. Sodium channels become refractory after opening**
 - B. Potassium channels become refractory after opening
 - C. Sodium potassium pumps close during an action potential
 - D. The neurotransmitter is not recycled or broken down
- 26. What is the most important function of the stereocilia of auditory hair cells?**
- A. They transduce chemical signals caused by sound into an electrical signal.
 - B. They convert a mechanical signal from sound waves into an electrical signal.**
 - C. Synapses at the tips of the stereocilia transmit the signal from sounds to the sensory neurons.
 - D. Synapses at the tips of the stereocilia receive chemical signals from sensory neurons and transmit the signals as action potentials.
- 27. Which of the following is (are) TRUE about ABC transporters?**
- A. They can make ATP by using the H^+ gradient in the mitochondrial matrix.
 - B. They are often found pumping small molecules out of mammalian cells.
 - C. They contribute about 10% to the membrane potential of mammalian cells.
 - D. The amplification of an ABC transporter is responsible for the development of chloroquine resistance in the malarial parasite *Plasmodium falciparum*.
 - E. A and D.
 - F. B and D.**
- 28. Which of the following is an example of a F-type transporter?**
- A. The Na^+-K^+ pump in the animal cell plasma membrane
 - B. The Na^+ -glucose transporter in epithelial cells
 - C. The multidrug resistance transporter (MDR)
 - D. The ATP synthase in chloroplasts**

29. Which of the following is NOT required for the gated transport of a protein into the nucleus?

- A. Energy from the hydrolysis of GTP by Ran GTPase.
- B. A nuclear localization signal in the protein sequence.
- C. Nuclear transport receptors that bind to nucleoporins.
- D. None of the above; they are all required for gated transport.**

30. What is the molecular action of the botulinum toxin?

- A. It prevents the release of neurotransmitters at the neuromuscular junction**
- B. It enhances the effects of neurotransmitters on the receptors in the central nervous system
- C. It inhibits the breakdown of neurotransmitters at the neuromuscular junction
- D. It inhibits the re-uptake of neurotransmitters in the central nervous system

31. Which of the following is NOT required for the co-translational import of a soluble protein into the lumen of the endoplasmic reticulum?

- A. A signal-recognition particle
- B. A signal peptidase
- C. A start-transfer sequence
- D. A stop-transfer sequence**
- E. A protein translocator
- F. B and C only

32. Which of the following organelles is (are) connected to the Golgi through transport vesicles?

- A. Mitochondria
- B. Endosomes**
- C. Nucleus
- D. Chloroplasts
- E. All of the above
- F. B and C only

33. For a protein to be exported from the lumen of the Golgi to the outside of the cell, how many membranes must it cross before it finally leaves the cell?

- A. 0**
- B. 1
- C. 2
- D. 3
- E. 4

34. Which of the following anchors the nuclear pore complex to the nuclear envelope?

- A. Annular subunits
- B. Luminal subunits**
- C. Column subunits
- D. Ring subunits

35. The lipid composition of the plasma membrane is asymmetric. How is this asymmetry produced?

- A. A flippase at the plasma membrane catalyzes the flipping of specific lipids to the cytosolic leaflet.
- B. During synthesis of lipids, specific lipids are inserted into either the cytosolic or luminal leaflet of the membrane.
- C. A scramblase in the endoplasmic reticulum membrane catalyzes the flipping of specific lipids to one or the other leaflet.
- D. Specific lipids are inserted directly into the plasma membrane from the cytosolic side, and other specific lipids are inserted from the extracellular side.
- E. Vesicles carry lipids in an asymmetric distribution and this is preserved when the vesicles fuse with the plasma membrane.

36. In which molecule(s) might you find a nuclear import signal?

- A. Messenger RNA
- B. DNA polymerase
- C. Transfer RNA
- D. A and B only
- E. A and C only

37. The process of protein transport into chloroplasts shows some similarities to the process of protein transport into mitochondria. Why?

- A. Mitochondria and chloroplasts regularly fuse with each other inside cells and share proteins.
- B. Mitochondria and chloroplasts need to import exactly the same proteins and so they have evolved the same mechanisms.
- C. Mitochondria and chloroplasts both need to import proteins that are synthesized in the cytosol across membranes and into internal spaces so they have evolved similar mechanisms.
- D. All of the above.

38. Which of the following statements about integral membrane proteins is (are) true?

- A. A particular integral membrane protein can be inserted into the membrane in either orientation (amino end first or carboxy end first), depending on the ribosomes that translate it.
- B. A particular integral membrane protein will be inserted into the membrane in one orientation (amino end first or carboxy end first), but then its orientation will be randomized during vesicular transport.
- C. The asymmetry of integral membrane proteins at the plasma membrane is created when the proteins are co-translationally inserted into the endoplasmic reticulum membrane.
- D. None of the above statements are true.

39. What is the role of the TIM complex in mitochondria?

- A. To transfer proteins across the outer membrane
- B. To transfer proteins across the inner membrane
- C. To insert proteins into the outer membrane
- D. To insert proteins into the inner membrane
- E. A and C only
- F. B and D only

- 40. Which of these statements is (are) TRUE about protein translocation through the TOM complex of mitochondria?**
- A. The membrane potential across the inner mitochondrial membrane is required to translocate a protein through the TOM complex.
 - B. Chaperone proteins in the intermembrane space help pull the protein through the TOM complex.
 - C. The signal sequence at the N-terminal end of the protein binds to the import receptor associated with TOM.**
 - D. TOM cleaves off the signal sequence after the protein is translocated.
 - E. A and B only
- 41. A genetically altered protein has two conflicting signal sequences. A nuclear localization/import signal and an ER start-transfer signal. Where will the protein end up?**
- A. Mitochondria
 - B. Nucleus
 - C. ER**
 - D. It will remain in the cytosol.
- 42. What would happen to newly-synthesized proteins that would normally be inserted into the lumen of the endoplasmic reticulum and then exported in vesicles if the glycosyl transferase in the ER was not functional?**
- A. All newly-made proteins could be exported from the ER through the normal vesicular pathway whether or not they were properly folded, and this could cause aggregation of unfolded proteins that could disrupt cellular functions.**
 - B. All newly-made proteins could be exported from the ER whether or not they were properly folded, but this would probably not have any serious effect on cellular functions because unfolded or misfolded proteins will always be immediately degraded.
 - C. Unfolded or misfolded proteins would be exported out of the ER to be ubiquitinated and degraded in proteasomes, but correctly folded proteins would leave by the normal vesicular pathway.
 - D. No proteins could ever leave the ER by any pathway.
- 43. During nuclear export, a nuclear export receptor enters the cell and picks up (Test taken out of 41 instead of 42 marks because of this question. The question itself was not removed in case you got it right; the entire test was taken out of less).**
- A. Ran-GDP
 - B. Ran-GTP**
 - C. Ran-GAP
 - D. Ran-GEF

----- END OF TEST! -----