Sample Questions, Midterm 1, Biol 2021, Winter 2013

Each question has only one best answer. There are 35 questions and all questions are worth equal weight. Four figures are at the end. Answers are posted separately.

WARNING: This is not a complete study guide. These questions do not cover all of the topics that may be on the exam. This is only a sample of the kind of questions that may be asked. DO NOT use this as a study outline.

1. What technique was used to visualize the cell in Fig. A?
a. bright field light microscopy
b. transmission electron microscopy
c. scanning electron microscopy
d. phase contrast light microscopy
e. none of the above

2. Which of the following is NOT a technique that is used with fluorescence microscopy?
a. DNA-binding dyes such as DAPI
b. staining with heavy metals
c. fusion proteins
d. ion-sensitive indicators
e. tagged antibodies

3. Identify the molecule in Fig. B:
a. Phosphatidylethanolamine
b. Phosphatidylserine
c. Phosphatidylcholine
d. Sphingomyelin
e. Cholesterol
f. Glycolipid

4. Which of the following statements is TRUE about the common phospholipids found in animal cell membranes?
a. An input of energy is required to make phospholipids form a lipid bilayer in water because the process is not spontaneous.
b. Phospholipids are amphiphilic.
c. Phospholipids will usually form a cone-shaped micelle in water due to their shape.
d. The formation of a membrane depends more on the exclusion of phospholipid tails by water than on the mutual attraction of phospholipids for each other.
e. All of the above are TRUE.
f. b and d only are TRUE

5. Which of the following lipids is NOT commonly found in the plasma membranes of animal cells?
a. cardiolipin
b. cholesterol
c. glycolipids
d. phospholipids
e. none of the above – they are ALL commonly found in plasma membranes

6. If you grew a culture of the bacterium *E. coli* at room temperature (22°C) and then shifted it to a warm incubator at 30°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. More cholesterol would be found in the membrane.
c. Less cholesterol would be found in the membrane.
d. The fatty acid composition would change so there were more saturated fatty acids.
e. The fatty acid composition would change so there were more unsaturated fatty acids.

7. Which of the following statements about membranes is (are) TRUE?
a. Lipid rafts are found only on the outer leaflet of the plasma membrane.
b. Cholesterol is found only on the inner leaflet of the plasma membrane.
c. The asymmetry of the lipid composition of the plasma membrane is formed as lipids spontaneously and rapidly flip-flop to one side or the other.
d. The large amount of PtdSer normally found on the outer leaflet of the plasma membrane causes the outside of the cell to have a negative charge.
e. None of the above- all statements are FALSE.

8. Which of the following statements about beta barrel transmembrane proteins is (are) TRUE?
a. They can be found in bacteria.
b. The structure is stabilized by hydrogen bonding between amino acids four peptide bonds away in the same chain.
c. Some beta barrel proteins have only a single peptide chain passing through the membrane.
d. Some beta barrel proteins have many (8 or more) peptide strands passing through the membrane.
e. all of the above are true
f. a and d only are true

9. You are investigating the function of a membrane protein in epithelial cells and you have labeled it with a fluorescent tag such as GFP. 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 GFP-labelled proteins would insert into the membrane from the cytosol.
c. The fluorescence would recover quickly because unbleached GFP-labelled 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. Which of the following is NOT likely to be found on the exterior surface of a mammalian cell?
a. glycoproteins
b. disulfide bonds in the exterior domains of membrane proteins
c. proteoglycans
d. glycolipids
e. none of the above; they are ALL found on the exterior surface

11. In what way(s) are channel proteins NOT like enzymes?
a. Channels are not inhibited by small molecule inhibitors.
b. The rate of transport through channels does not saturate at high solute concentrations.
c. Channels do not have to undergo conformational changes every time something is transported.
d. Channels are not specific for transporting certain molecules.
e. all of the above
f. b and c only

12. What is the usual energy source for the transport protein in Fig. C?
a. light
b. ATP
c. the H^+ gradient
d. the Na^+ gradient
e. none of the above

13. Which of the following is TRUE about active transport?
a. Depending on the energy source, it may or may not reduce the total free energy of the universe.
b. It can only transport molecules down their electrochemical gradient.
c. It can use either channels or transporters.
d. It can use another ion gradient as an energy source.
e. b and c only
f. a and d only

14. During transcellular transport of glucose across epithelial cells, how does glucose exit the cell into the extracellular fluid?
a. by active transport in a Na^+/glucose symporter
b. by active transport in a Na^+/glucose antiporter
c. by active transport in a glucose uniporter
d. by passive transport in a glucose uniporter
e. by passive transport in a Na^+/glucose symporter

15. Which of the following is (are) TRUE about ABC transporters?
a. They can make ATP by using the H^+ gradient in mitochondria.
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 c only
f. b and d only

16. Which of the following is (are) TRUE about the K^+ leak channel in the plasma membrane of animal cells?
a. It allows K^+ to come to equilibrium across the plasma membrane.
b. It opens in response to a change in the membrane potential.
c. It is responsible for only about 10% of the membrane potential.
d. a and c only
e. b and c only

17. During the propagation of an action potential along the axon of a neuron, what is happening at the leading edge (the front) of the region of depolarization as it moves down the axon?
a. Ligand-gated Na^+ channels are opening.
b. Voltage-gated Na^+ channels are opening.
c. Ligand-gated K^+ channels are opening.
d. Voltage-gated Na^+ channels have become inactive and refractory.
e. Voltage-gated Na^+ channels are closing.

18. Chloride ion Cl^- is close to equilibrium across the plasma membrane of many neurons. What would happen to the membrane potential of a neuron if ligand-gated Cl^- channels opened at the same time that the ligand-gated Na^+ channels opened?
a. There would be no effect of the Cl^- channel opening and the membrane would depolarize normally.
b. The membrane potential would become more negative.
c. The depolarization would be suppressed and the membrane potential would depolarize less than normal.
d. The membrane potential would become more depolarized than normal.

19. How is Ca^{2+} involved in the events at the neuromuscular junction when a signal from a neuron causes a muscle to contract?
a. Voltage-gated Ca^{2+} channels open in the presynaptic neuron to cause the release of neurotransmitter into the synaptic cleft.
b. Voltage-gated Ca^{2+} channels open in the muscle cell plasma membrane.
c. Ca^{2+}-gated Ca^{2+} release channels open in the sarcoplasmic reticulum.
d. Ca^{2+} enters the muscle cell cytoplasm and causes muscle contraction.
e. all of the above
f. a and d only

20. What do the nerve gas Sarin and the antidepressant Prozac have in common?
a. They both act primarily on the central nervous system.
b. They both primarily cause muscle paralysis.
c. They both primarily affect the binding of neurotransmitters to ligand-gated ion channels.
d. They both primarily prevent the removal of neurotransmitters from the synaptic cleft.
e. They both primarily affect the release of neurotransmitters into the synaptic cleft.

21. Why are the endoplasmic reticulum, Golgi, endosomes and lysosomes considered to be members of the same family of organelles?
a. They are all connected to each other with aqueous pores.
b. They all evolved from endosymbiotic bacteria and have their own DNA and protein synthesis mechanisms.
c. They are all connected to mitochondria through transport vesicles.
d. They transport proteins between members of the family using vesicular transport.
e. They are topologically equivalent spaces.
f. d and e only
g. a and e only

22. Where would you find the structures shown in Fig. D?
a. nuclear envelope
b. mitochondria
c. chloroplasts
d. rough endoplasmic reticulum
e. smooth endoplasmic reticulum
f. plasma membrane

23. 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. binding of HSP70 to the protein during transport
c. a nuclear localization signal in the protein sequence
d. nuclear transport receptors that bind to nucleoporins
e. None of the above; they are all required for gated transport.

24. 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. none of the above
f. a and b only

25. How are proteins inserted into the inner membrane of mitochondria?
a. They are first transported into the matrix, allowed to fold into their final conformation, and then HSP70 proteins insert them into the inner membrane.
b. They are inserted into the SAM complex and then released into the membrane.
c. They are inserted across the outer membrane into the intermembrane space, allowed to fold, and then inserted into the inner membrane.
d. They are inserted through TOM and into TIM, the signal sequence is cleaved off, and a stop-transfer sequence stops transfer in the inner membrane.
e. They are transported through the OXA complex in the outer membrane and then inserted into the inner membrane.

26. If you genetically engineered a protein so that its sequence contained only a nuclear export signal and a stop-transfer signal, where would you be most likely to find the protein?
a. in the nucleus
b. in the lumen of the endoplasmic reticulum
c. in the cytosol
d. cycling repeatedly in and out of the nucleus
e. inserted into a membrane as a single-pass transmembrane protein
f. in the mitochondria

27. The process of protein transport into chloroplasts shows some similarities to the process of protein transport into mitochondria. Why?
a. Both mitochondria and chloroplasts came from the same endosymbiotic bacteria.
b. Mitochondria and chloroplasts regularly fuse with each other inside cells and share proteins.
c. Mitochondria and chloroplasts need to import exactly the same proteins and so they have evolved the same mechanisms.
d. 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.

28. What determines whether a particular mRNA will become bound to the endoplasmic reticulum (ER) during protein synthesis?
a. whether the mRNA has a particular RNA secondary structure that binds to a receptor in the ER membrane
b. whether there is a signal sequence on the protein being made
c. whether the mRNA is recognized by a special pool of membrane-bound ribosomes
d. whether the mRNA is exported into the ER when it leaves the nucleus
e. random chance

29. 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

30. Which of the following statements is TRUE about the synthesis of a multipass transmembrane protein?
a. It must have at least one start-transfer sequence and one stop-transfer sequence.
b. Depending on the protein, the N-terminus of the protein could end up either in or out of the ER lumen.
c. The signal recognition particle will bind to the start-transfer sequence shortly after the sequence is translated.
d. all of the above
e. a and c only
f. none of the above

31. Which of the following statements about vesicular transport is (are) TRUE?
a. Cargo molecules must pass across several membranes on their route from the endoplasmic reticulum to the Golgi.
b. The cargo molecules carried by vesicles are all water-soluble molecules carried in the lumen.
c. Cargo receptors are always degraded after they reach their target and can never be re-used.
d. all of the above
e. a and c only
f. none of the above

32. Where are you most likely to find COPI coated vesicles?
a. moving from the endoplasmic reticulum to the cis-Golgi
b moving from the endoplasmic reticulum to the trans-Golgi
c. moving between Golgi compartments
d. moving from the plasma membrane to endosomes
e. moving between the trans-Golgi and endosomes

33. When a vesicle fuses with its target during vesicular transport, where does the energy come from to fuse the two membranes?
a. from the binding of Rab protein to its effector protein
b. from the SNARE proteins snapping together
c. from ATP hydrolysis by HSP70 proteins
d. from GTP hydrolysis by Arf1
e. from GTP hydrolysis by dynamin

34. Which of the following statements about Sar1 GTPase is (are) TRUE?
a. When GTP hydrolyzes to GDP the Sar1-GDP pops out of the membrane and causes the coat to fall apart after a coated vesicle has formed.
b. The GDP-bound form is the active form of Sar1 and helps recruit coat proteins to a vesicle as it forms.
c. The hydrolysis of GTP bound to Sar1 must be activated by another membrane protein.
d. The phosphate group from Sar1-GTP can be transferred to phospholipids in the membrane to regulate the formation of vesicles.
e. a and c only

35. Imagine you have identified one of the enzymes that carries out one particular step in the oligosaccharide processing pathway by which the complex oligosaccharides attached to proteins are made. You have made a fusion gene with the GFP gene fused to the gene for your enzyme and you have expressed this fusion protein in animal cells. If you now observe the cells in the fluorescence microscope, what is the most likely pattern of distribution you might see for your protein?
a. mostly concentrated in a few particular Golgi cisternae
b. mostly in lysosomes
c. distributed evenly throughout both endoplasmic reticulum and Golgi
d. mostly in secretory vesicles
e. evenly distributed throughout all Golgi cisternae but completely absent from the endoplasmic reticulum

Fig. A

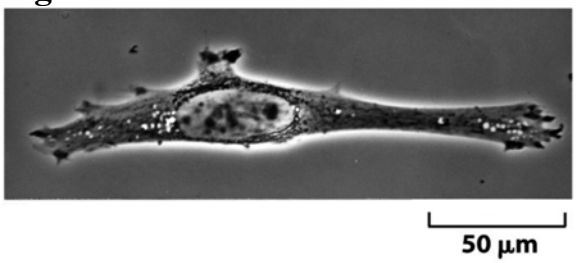

Fig. B

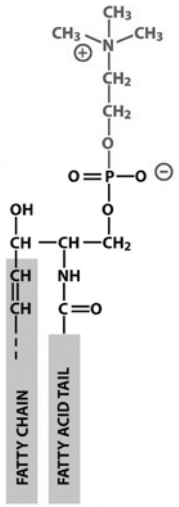

Fig. C

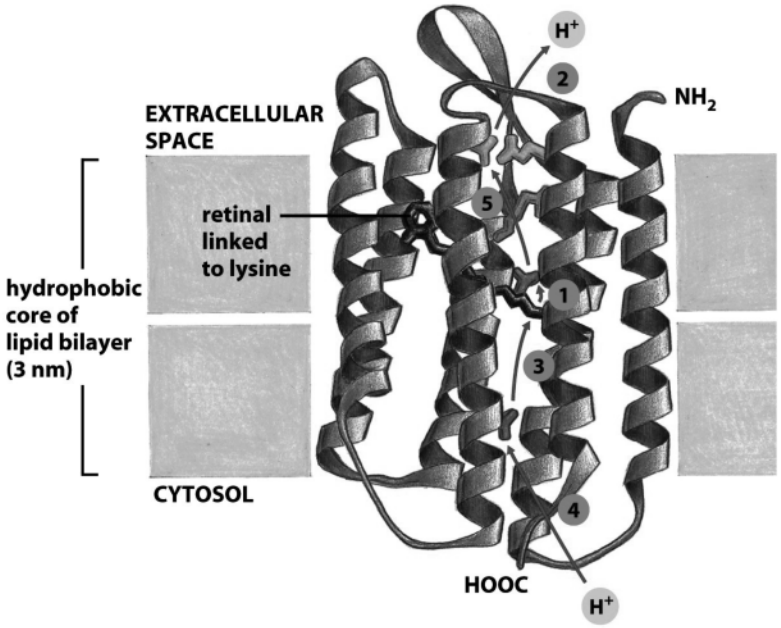

Fig. D