Examples of examination questions for BIOL 266

Final exam:

Questions for Part A (Multiple choice questions):
Circle clearly ONE correct answer per question.

Q1. In paracrine signaling, the extracellular signaling molecules released by a signaling cell act on:

A. other signaling cells
B. target cells in the close proximity to the signaling cell
C. target cells distant from the signaling cell
D. target cells in direct membrane-to-membrane contact with the signaling cell
E. all of the above
F. none of the above

Q2. Which of the following is not considered a second messenger:

A. Ca^{2+}
B. diacylglycerol (DAG)
C. inositol 1,4,5-triphosphate (IP3)
D. cAMP
E. GTP
F. phosphatidylinositol 3,4,5-triphosphate (PIP3)

Q3. Adrenaline-induced activation of adenylate cyclase depends on:

A. phospholipase C (PLC)
B. calmodulin (CaM)
C. receptor tyrosine kinase
D. Ras protein
E. MAP kinase
F. none of the above

Q4. The β isoform of phospholipase C (PLC-β) is activated by:

A. protein kinase C
B. MAP kinase
C. Ras protein
D. calmodulin (CaM)
E. heterotrimeric Go protein
F. none of the above

Q5. The Ca^{2+}- and DAG-activated form of protein kinase C phosphorylates and inactivates:

A. MAP kinase
B. CREB protein
C. glycogen phosphorylase
D. the γ isoform of phospholipase C (PLC-γ)
E. all of the above
F. none of the above

Q6. Large heterotrimeric G proteins and small monomeric G proteins are involved in a variety of signal transduction pathways. Regardless of differences in structure, all G proteins are activated by:

A. ATP
B. cAMP
C. Ca^{2+}
D. GDP
E. inositol 1,4,5-triphosphate (IP3)
F. none of the above

Q7. Glycogen phosphorylase catalyzes the breakdown of glycogen to glucose. This enzyme is activated by:

A. glycosylation
B. GTP
C. phosphorylation
D. phosphatidylinositol 3,4,5-triphosphate (PIP3)
E. dephosphorylation
F. none of the above

Q8. Detergents and phospholipids have similar property in that they both:

A. form bilayer in water
B. form micelles in water
C. are shaped like cones
D. have two hydrocarbon tails
E. are amphipathic
F. none of the above

Q9. The excitation wavelength of fluorescein is 470 nm. The emission wavelength of fluorescein is 540 nm. If fluorescein is used as a reporter molecule for fluorescence microscopy, the second barrier filter in a fluorescence microscope:

A. lets through only the light with a wavelength between 520 nm and 560 nm
B. lets through only the light with a wavelength below 450 nm
C. lets through only the light with a wavelength between 450 nm and 490 nm
D. lets through only the light with a wavelength of 470 nm
E. lets through only the light with a wavelength above 560 nm
F. lets through only the light with a wavelength below 520 nm

Q10. COPII-coated secretory vesicles are involved in protein transport:

A. between Golgi cisternae
B. from the Golgi apparatus to the endoplasmic reticulum
C. from the endoplasmic reticulum to the Golgi apparatus
D. from the Golgi apparatus to the lysosome
E. all of the above
F. none of the above

Q11. Resolution in light microscopy can be improved by:

A. increasing the speed of light
B. decreasing the angular aperture
C. using light with longer wavelength
D. increasing the magnification of the lens
E. not using condenser lenses
F. increasing the angular aperture

Q12. The asymmetric distribution of sphingomyelin between the extracellular and cytosolic leaflets of the plasma membrane is due to:

A. synthesis of this lipid only by enzymes that are exposed to the ER lumen and exist only in the inner leaflet of the ER membrane
B. lack of flippases that can translocate this lipid between the leaflets of the plasma membrane
C. activity of flippases that move this lipid only from the cytosolic leaflet to the extracellular leaflet of the plasma membrane
D. activity of flippases that move this lipid only from the extracellular leaflet to the cytosolic leaflet of the plasma membrane
E. synthesis of this lipid only in the extracellular leaflet of the plasma membrane
F. synthesis of this lipid only in the cytosolic leaflet of the plasma membrane

Q13. Immunogold electron microscopy:

A. is used to detect a green fluorescence emitted by the green fluorescent protein
B. uses antibodies attached to a fluorescent molecule
C. observes the light that is scattered by various components of a living cell
D. is used to examine cytochemically stained samples
E. is used to determine the subcellular localization of proteins
F. uses a chemical stain that binds to basic amino acids to increase contrast

Q14. Protein import into the mitochondrial matrix requires:

A. chaperone Hsp70 in the mitochondrial matrix
B. ”contact sites” in which the outer and inner membranes are in close proximity
C. cytosolic chaperones
D. channel-linked receptors in the outer mitochondrial membrane
E. all of the above
F. none of the above

Q15. The nucleus communicates with the cytosol via:

A. the inner nuclear membrane
B. the smooth endoplasmic reticulum
C. nuclear pore complexes
D. the rough endoplasmic reticulum
E. the nucleolus
F. the nuclear lamina

Q16. The Ca^{2+}-bound form of calmodulin (CaM) activates kinases that phosphorylate:

A. myosin light chain
B. CREB protein
C. cAMP phosphodiesterase
D. all of the above
E. none of the above

Q17. The nucleolus is:

A. the site of phospholipid synthesis
B. the most prominent membrane-bound organelle in the nucleus
C. the site of protein synthesis
D. the assembly centre for chromatin
E. the assembly centre for ribosomes
F. the site of sphingolipid synthesis

Q18. Free ribosomes in the cytosol synthesize proteins for:

A. the endoplasmic reticulum
B. the cis-Golgi network
C. the trans-Golgi network
D. the nucleus
E. lysosomes
F. the plasma membrane

Q19. Inositol 1,4,5-triphosphate (IP3) causes Ca2+ to be released into the cytosol from:

A. peroxisomes
B. mitochondria
C. Golgi apparatus
D. lysosomes
E. all of the above
F. none of the above

Answers to questions for Part A (Multiple choice questions):

A1. B. target cells in the close proximity to the signaling cell

A2. E. GTP

A3. F. none of the above

A4. E. heterotrimeric Go protein

A5. F. none of the above

A6. F. none of the above

A7. C. phosphorylation

A8. E. are amphipathic

A9. A. lets through only the light with a wavelength between 520 nm and 560 nm

A10. C. from the endoplasmic reticulum to the Golgi apparatus

A11. F. increasing the angular aperture

A12. B. lack of flippases that can translocate this lipid between the leaflets of the plasma membrane

A13. E. is used to determine the subcellular localization of proteins

A14. E. all of the above

A15. C. nuclear pore complexes

A16. D. all of the above

A17. E. the assembly centre for ribosomes

A18. D. the nucleus

A19. F. none of the above

Questions for Part B (Short answers)

Q1. Name at least four features that clearly distinguish neuronal signaling from endocrine signaling.

Q2. The feature that clearly distinguishes paracrine signaling from autocrine signaling is:

Q3. Name three classes of cell-surface receptors that are involved in the primary signal transduction step.

Q4. The function of GTP in the adrenaline-induced cAMP signaling pathway is:

Q5. Name the isoform of the enzyme that catalyzes the synthesis of DAG (diacylglycerol) and IP3 (inositol 1,4,5–triphosphate) from PIP2 (phosphatidylinositol 4,5-bisphosphate) and is activated by growth factor-dependent receptor tyrosine kinases.

Q6. Why does the rise in the cytosolic Ca2+ increase the level of cAMP in the cytosol?

Q7. How does the binding of the epidermal growth factor (EGF) to its receptor activate the Ras protein?

Q8. You have purchased cytochrome c from a biotechnological company. Briefly describe how you would use this commercially available protein in order to determine the subcellular location of cytochrome c with the help of electron microscopy.

Q9. Name three glycerol and non-glycerol phospholipids that have polar heads with the net charge 0 (zero) at pH 7.

Q10. When placed in a hypertonic solution, the cells and organelles shrink. Why?

Q11. What are the two functions of a receptor for an extracellular signaling molecule in signal transduction and what are the two functions of the secondary signal transduction steps?

Q12. In light microscopy, placing oil between the specimen and the objective lens increases resolution. Why?

Q13. Name five functionally distinct compartments of the Golgi apparatus and briefly describe the function of the Golgi compartment that points towards the plasma membrane.

Q14. Name three features of transport vesicles that allow each organelle of the endomembrane system to maintain its own distinctive protein composition.

Q15. Briefly describe two functions of the Hsp70 protein in the ER lumen.

Q16. Name three proteins that assist in the final folding of polypeptides translocated across the membrane of the endoplasmic reticulum (ER) and in the assembly of these folded polypeptides into multimeric complexes within the ER lumen.

Answers to questions for Part B (short answers)

A1.
(1) The distance over which the signaling molecule acts; Neuronal signaling (NS): short distance; Endocrine signaling (ES): long distance
(2) The medium through which the signaling molecule s distributed; NS: axon + extracellular medium; ES: the bloodstream
(3) The speed with which the signal molecule is delivered; NS: 100 m/s; ES: much slower
(4) NS: electrical impulses involve; ES: electrical impulses don't involve

A2.
Paracrine signaling: signaling cells synthesize and release signaling molecules that then act on target cells having receptors for these signaling molecules. Autocrine signaling: signaling cells synthesize and release signaling molecules that then act on the same signaling cells because they have receptors for these signaling molecules

A3.
(1) G-protein-linked receptors
(2) ion-channel-linked receptors
(3) enzyme-linked receptors

A4.
When GTP binds to the sα subunit of the heterotrimeric Gs protein, the activated GTP-bound sα subunit dissociates from the β and γ subunits of the heterotrimeric Gs protein and then binds to and activates the adenylate cyclase enzyme

A5.
Phospholipase C-γ (PLC- γ)

A6.
Ca^{2+} binds to and activates calmodulin (CaM). The Ca^{2+}-bound, active CaM then binds to and activates the CaM-dependent protein kinase for cAMP phosphodiesterase. This CaM-dependent protein kinase then phosphorylates and inactivates cAMP phosphodiesterase, thereby increasing the level of cAMP in the cytosol

A7.
(1) EGF binding to the receptor tyrosine kinase causes its dimerization
(2) The receptor tyrosine kinase undergoes autophosphorylation
(3) The phosphorylated form of the receptor tyrosine kinase binds to the adapter protein Grb2
(4) Grb2 bins to the protein Sos, which then interacts with the inactive GDP-bound form of Ras
(5) Sos acts as a guanine nucleotide-exchange factor (GEF), which helps to convert the inactive GDP-bound form of Ras to its active GTP-bound form

A8.
(1) Use the purchased cytochrome c as an antigen molecule to create antibodies that interact only with cytochrome c
(2) Attach these antibodies to electron-dense colloidal gold particles

(3) Treat thin sections of glutaraldehyde-fixed cells with the gold-labeled anti-cytochrome c antibodies
(4) Use electron microscopy to determine the subcellular location of cytochrome c within these cells

A9.
Glycerol phospholipids:
Phosphatidylcholine (a glycerol phospholipid), phosphatidylethanolamine (a glycerol phospholipid), sphingomyelin (a non-glycerol phospholipid)

A10.
Because water flows out of cells until the ion concentration inside and outside of the cell is the same

A11.
Two functions of a receptor for an extracellular signaling molecule in signal transduction: (1) binds to the extracellular signaling molecule; (2) transduces (converts) extracellular signals into intracellular signals
Two functions of the secondary signal transduction steps: They amplify and distribute the intracellular signals within the target cell

A12.
Because it increases the value of refractive index (n), thereby decreasing the value of D (the minimum distance between two distinguishable objects)

A13.
The cis-Golgi network, cis-Golgi cisterna, medial cisterna, cis-Golgi cisterna and trans-Golgi network.
Trans-Golgi network points towards the plasma membrane; it is actively involved in sorting proteins into vesicles that then deliver these proteins to the lysosome, plasma membrane or extracellular medium

A14.
High selectivity of the processes of transport vesicle packaging, budding and fusion.

A15.
(1) Binds to the extending polypeptide chain in the ER lumen and uses the energy of ATP hydrolysis to pull the polypeptide chain into the lumen
(2) Act as a chaperone by using the energy of ATP hydrolysis to assist in the final folding of the translocated protein into its mature, functionally active confirmation

A16.
Hsp70, calnexin, calreticulin