

NAME: _____

STUDENT #: _____

BIO 1140 Introduction to cell biology

MIDTERM #1

February 9th, 2013

Dr. K.M. Gilmour

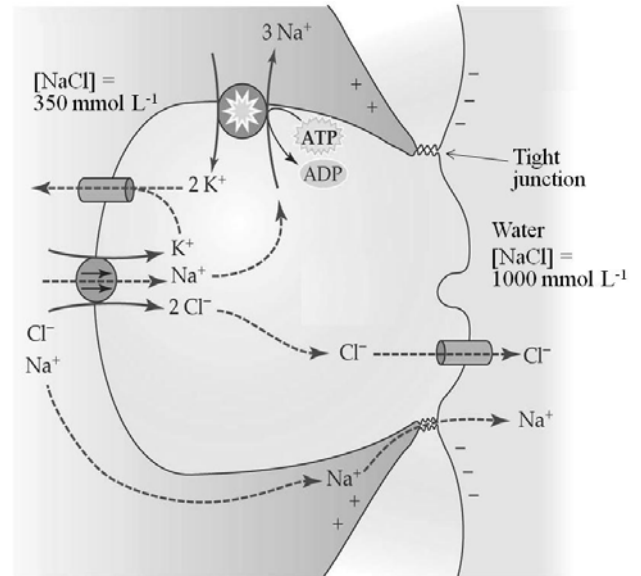
MULTIPLE CHOICE QUESTIONNAIRE GG

Instructions:

1. Make sure that you have a complete test package. You should have a set of multiple choice questions with a written-answer questionnaire, and a Scantron. Both components must be returned at the end of the midterm.
2. Fill in the Scantron with your name, student number and course code **BIO 1140 GG**.

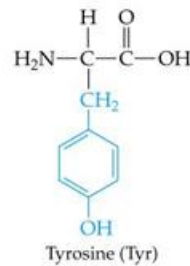
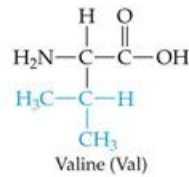
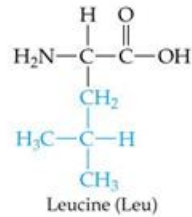
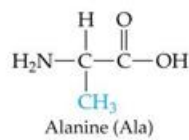
Answer the following 20 multiple choice questions **on the Scantron sheet** provided. Choose only one answer from among the choices. (20 marks)

1. Which one of the following is not a model organism?
 - a. *Drosophila melanogaster*
 - b. *Mus musculus*
 - c. *Ambystoma maculatum*
 - d. *Arabidopsis thaliana*
 - e. *Escherichia coli*
2. In the schematic at right, Cl^- enters the cell by means of...
 - a. A channel
 - b. An exchanger
 - c. A co-transporter
 - d. A uniporter



3. A voltage-gated ion channel...
 - a. Opens or closes in response to changes in the membrane potential of the cell.
 - b. Is an integral membrane protein receptor.
 - c. Contains one or more transmembrane domains rich in hydrophobic amino acid residues.
 - d. Is opened or closed by the binding of a water-soluble messenger molecule.
 - e. Both a and c are true of voltage-gated ion channels.

4. Which one of the amino acids below would you **not** expect to find in the transmembrane domain of an integral membrane protein?



- Alanine
 - Leucine
 - Valine
 - Tyrosine
5. Which one of the following statements about G proteins is correct?
- G proteins are heterotrimeric peripheral membrane proteins.
 - G proteins function as molecular switches – they are active when ATP is bound to the α subunit and inactive when this ATP is hydrolyzed to ADP.
 - When activated by a cell surface receptor, a G protein dissociates into an $\alpha\beta$ complex and a γ subunit.
 - All of a, b and c are true of G proteins.
 - None of a, b or c is true of G proteins.
6. In an aerobic bacterium, the enzymes that catalyze pyruvate oxidation and the citric acid cycle are located...
- On the inner mitochondrial membrane.
 - In the cytosol.
 - On the plasma membrane.
 - In the mitochondrial matrix.
 - On the outer mitochondrial membrane.
7. To investigate the nature of a membrane protein, you treat an isolated membrane with the enzyme phospholipase C and then probe the membrane with a fluorescent marker for the protein of interest. No fluorescence is detected. By contrast, membranes probed with the fluorescent marker after changes in solution pH or ionic strength show a strong fluorescent signal. Which one of the following conclusions is consistent with your observations?
- The protein of interest behaves like a peripheral protein.
 - The protein of interest is linked to the membrane by a glycosylphosphatidylinositol (GPI) anchor.
 - The protein of interest is anchored to the inner (cytosolic) leaflet of the lipid bilayer via a covalent interaction with a membrane fatty acid.
 - The protein of interest is an integral protein.
 - Both b and d are consistent with your observations.

8. The fluid mosaic model of the cell membrane was proposed by:
 - a. Virchow
 - b. Schwann and Schleiden
 - c. Gorter and Grendel
 - d. Singer and Nicolson
 - e. Ediden

9. You are attempting to characterize a novel receptor. You note that the receptor includes a ligand-binding domain and a single transmembrane domain, and that dimerization occurs when the receptor is activated. The novel receptor probably belongs to the family of...
 - a. G protein-coupled receptors
 - b. Steroid hormone receptors
 - c. Receptor tyrosine kinases
 - d. None of the above

10. Alcoholic fermentation...
 - a. Occurs in the skeletal muscle of anoxic goldfish.
 - b. Regenerates NAD^+ by transferring electrons from NADH to pyruvate.
 - c. Results in CO_2 production as the 3-C pyruvate is decarboxylated to a 2-C molecule of acetyl-CoA.
 - d. All of a, b and c are true of alcoholic fermentation.
 - e. None of a, b or c is true of alcoholic fermentation.

11. Which one of the following molecules would be equally distributed between the two leaflets of the cell membrane?
 - a. Cholesterol
 - b. Phosphatidylcholine
 - c. Glycolipids
 - d. Sphingomyelin
 - e. All of the above would be equally distributed between the two leaflets of the cell membrane.

12. Phosphodiesterase...
 - a. Is a membrane-associated enzyme that produces the second messenger cAMP.
 - b. Is an enzyme that catalyzes the transfer of a phosphate group from ATP to a protein.
 - c. Is a cytosolic enzyme that catalyzes the breakdown of the second messenger cAMP.
 - d. Is the kinase activated by cAMP.
 - e. None of a, b, c or d is true of phosphodiesterase.

13. You have grown a culture of *Danio rerio* gill cells and discover that they are heavily contaminated with bacteria. Which one of the following procedures is most likely to eliminate the bacteria without killing the fish cells?
 - a. Treating the culture with a drug that damages DNA.
 - b. Treating the culture with a drug that dissolves cell walls.
 - c. Treating the culture with a detergent that destroys cell membranes.
 - d. Treating the culture with a drug that causes the cytoskeleton to disassemble (break down)
 - e. None of a, b, c or d will eliminate the bacteria without killing the fish cells.

14. The fluid-mosaic model describes the plasma membrane as...
- A lipid bilayer coated on both sides with thin sheets of protein
 - A cholesterol-rich lipid-protein assembly held together by covalent bonds
 - A lipid bilayer studded with a unique complement of proteins
 - A fluid protein layer encased in a mosaic of lipids
 - None of the above describes the fluid-mosaic model
15. A typical eukaryotic cell is...
- 30 nm in diameter
 - $3 \times 10^6 \mu\text{m}$ in diameter
 - 0.03 mm in diameter
 - $3 \times 10^{-6} \text{m}$ in diameter
 - None of the above
16. Homeoviscous adaptation refers to...
- The adjustment of membrane composition to maintain membrane fluidity at different environmental temperatures.
 - A molecule that includes both hydrophobic and hydrophilic regions.
 - The unique, three-dimensional, stable structure adopted by a polypeptide chain that allows it to acquire biological activity.
 - A membrane that allows selected molecules to pass while preventing or impeding the passage of other molecules.
17. Which one of the following statements about cell membranes is **not** correct?
- Membrane proteins serve numerous functions including cell-to-cell attachment and the detection of extracellular signals.
 - The chemical composition of membranes differs between organelles, between cells, and even between the two layers of the bilayer.
 - The fluidity of the membrane is determined by the extent of covalent bonding among membrane components as well as the length and degree of saturation of fatty acid chains in phospholipids.
 - The lipid bilayer functions as a permeability barrier because it is difficult for hydrophilic molecules to traverse its hydrophobic core.
18. The ligand-binding domain of a membrane receptor often consists of an alpha-helix sequence of hydrophobic amino acid residues.
- True
 - False
19. Which one of the following adjustments would **not** be used by a rainbow trout to maintain the same level of membrane fluidity following transfer from water of 20°C to water of 5°C?
- Increase the glycolipid content of the membrane.
 - Increase the proportion of unsaturated hydrocarbon tails in its membrane phosphoglycerides.
 - Increase the cholesterol:phosphoglyceride ratio.
 - Increase the proportion of phosphatidylethanolamine relative to phosphatidylcholine.
 - All of a, b, c and d would be employed by a rainbow trout transferred from 20°C to 5°C.

20. Following transfer to an unknown solution, a human red blood cell rapidly shrivels and shrinks. The cytoplasm of the red blood cell...
- Was more concentrated than the unknown solution.
 - Was hypotonic relative to the unknown solution.
 - Contained a solute concentration that was higher than that of the unknown solution.
 - Was isotonic with the unknown solution.
 - None of the above adequately describes the cytoplasm of the red blood cell

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WRITTEN-ANSWER QUESTIONNAIRE GG

Answer the following questions **on the questionnaire in the space** provided. (20 marks)

1. Complete the following statements. (1 mark per answer)
 - a. Binding of the signal molecule to the receptor is followed by _____, the process of translating the signal into a cellular response.
 - b. A _____ phosphorylates a protein by catalyzing the transfer of Pi from ATP to the protein.
 - c. Receptors activated by _____ signalling molecules bind to specific response elements within DNA to regulate gene transcription.
 - d. In the process of _____, light energy is transformed into chemical energy.
 - e. A molecule that has both hydrophobic and hydrophilic regions is said to be _____.
 - f. NAD^+ is oxidized OR reduced (**choose one**) to NADH by the gain of two electrons and a proton, with the input of energy.

2. Sketch and label a sphingolipid. Use your sketch to explain the orientation of the molecule within the cell membrane. (3 marks)

5. Contrast and compare kleptoplasty and the endosymbiotic origin of chloroplasts. (5 marks)