Physiology 115 **Name _____**
Spring 2015

MIDTERM

For the multiple choice questions, there is *one* and *only one* best answer.

1. Which kind of transport mechanism works on a substance dispersing itself from high concentration to low but requires a transport protein to get through the membrane?
   (a) Simple passive diffusion/transport
   (b) Facilitated diffusion/transport
   (c) Coupled active transport
   (d) Direct active transport
   (e) None of the above

2. Which of these membrane proteins moves glucose into cells by a known *active* transport system?
   (a) a sodium (Na)-glucose co-transporter, usually found in intestinal epithelial and kidney tubule cells
   (b) a transport protein that moves glucose with its concentration (high to low) by facilitated diffusion
   (c) a sodium-calcium (Na^+/Ca^{2+}) exchanger
   (d) both (a) and (b)
   (e) all of the above

3. Coupled active transport in a membrane protein means that:
   (a) ATP is used directly by the protein to move substances across the membrane
   (b) Glycolipids are converted into glycoproteins
   (c) Protons (H+ ions) transfer into the nucleus to alter the structure of DNA
   (d) ATP was used to pump some ion like sodium (Na^+) to generate a concentration difference across the membrane which is then exploited to move other substances across the membrane
   (e) Lipoproteins degrade chylomicrons into VLDL

4. Which of these has the lowest lipid-to-protein ratio: that is, which has much less lipid content relative to non-lipid content?
   (a) VLDL
   (b) chylomicrons
   (c) HDL
   (d) LDL
   (e) both (a) and (b)

5. Which of these molecular forms will *add* or *increase* the fluidity of the cell (plasma) membrane?
   (a) glycolipids
   (b) cholesterol
   (c) glycoprotein
   (d) saturated fatty acid(s) as part of the phospholipid molecule structure
   (e) unsaturated fatty acid(s) as part of the phospholipid molecule structure

6. The formation of alpha helices and beta sheets in a polypeptide corresponds to what level of protein structure?
   (a) primary (1°)
   (b) secondary (2°)
   (c) tertiary (3°)
   (d) quaternary (4°)
   (e) quinternary (5°)

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7. Which of these is a name for polymeric storage forms of glucose?
   (a) glycolipid
   (b) glycogen
   (c) starch
   (d) both (b) and (c)
   (e) glycoprotein

8. A **connexon** is a principal feature of which type of cell junction?
   (a) adherens junction
   (b) desmosome
   (c) gap junction
   (d) tight junction
   (e) both (a) and (b)

9. What kind of chemical bond is formed when one atom takes electrons from another atom and it acquires a negative charge while the other atom acquires a positive charge?
   (a) covalent bond
   (b) polar covalent bond
   (c) ionic bond
   (d) hydrophobic interaction
   (e) hydrogen bond

10. A chemical that is an acid is put into water and it only partially ionizes, that is, gives up hydrogen ions (H^+) to the solution: what kind of chemical is that?
   (a) triglyceride
   (b) strong base
   (c) strong acid
   (d) weak base
   (e) weak acid

11. Where the signal or hormone for a receptor protein in the plasma membrane likely to bind on that receptor?
   (a) nucleus
   (b) intracellular domain
   (c) transmembrane domain
   (d) extracellular domain
   (e) ATP

12. What part of an enzyme's structure is responsible for catalyzing the chemical reaction?
   (a) the active site
   (b) the substrate-binding site
   (c) an activating regulatory site
   (d) an inhibitory regulatory site
   (e) the glycoprotein site

13. The deposition of oxidized LDL resulting from inflammation consequent to injury of blood vessel endothelial cells has been shown to increase the risk of which of these disorders or diseases?
   (a) diabetes
   (b) atherosclerosis
   (c) hypertension
   (d) magnesium deficiency
   (e) ATP storage disease

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14. In the action potential, when sodium (Na^+) ions cross the membrane of a neuron to cause a change in polarity (switching of positive and negative across the membrane), what is that event called?
    (a) condensation
    (b) dephosphorylation of the E2 conformation
    (c) conformational change from E2 to E1
    (d) repolarization
    (e) depolarization

15. In the action potential, when potassium (K^+) ions cross the membrane of a neuron to cause a change in polarity (switching back to negative and positive across the membrane), what is that event called?
    (a) depolarization
    (b) repolarization
    (c) E2 phosphorylation
    (d) hydrolysis
    (e) unsaturation

16. (a) In an action potential, which happens first, depolarization or repolarization? (2)
    depolarization

    (b) Sodium ions have two "forces" that make them want to cross the membrane of the neuron when the voltage-gated sodium ion channel proteins are opened. What are those two forces? (4)
    i) a chemical potential or concentration difference, with more Na+ ions on outside than inside, and so more Na+ ions want to diffuse into the cell
    ii) an electrical potential or resting membrane voltage, in which is there is a net count of more positive charges on the outside of the cell membrane and so this helps to drive positive ions like Na+ in to the cell

17. (a) In G-protein coupled receptor activation, the G protein heterotrimer binds to something. What is that? (2)
    GTP
    also acceptable: **G protein receptor**
    (b) After binding, what two more steps happen to the G protein heterotrimer to cause activation? (5)
    (i) GDP exchanges with GTP, and with GTP bound
    (i) or (ii) the protein GTP-alpha bound to GTP separates from GTP-beta-gamma
    (ii) each of those two complexes will bind to other target proteins, either to activate them or to inhibit them, depending on function

18. What happens on the extracellular side in receptor tyrosine kinases (RTK) to start their activation? (4)
    The signal, usually a growth factor, will dimerize with another of itself. One part will attach to one transmembrane polypeptide and the other will attach to another. This brings them together to start the activation

    (b) What happens on the intracellular side of RTKs to complete their activation? What kind of enzymatic (catalytic) activity do RTKs have? (4)
    The RTKs have a tyrosine kinase enzymatic activity, and they use it phosphorylate their own polypeptides (autophosphorylation) before they start phosphorylating the tyrosine residues of target proteins that continue the signaling process

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19. Polysaccharides are known in nature to serve many types of functions. Just name or describe one. (3)
Cellulose is one that is used to form cell walls of plants. Glycogen and starch are storage forms of glucose. Polysaccharides like chitin form the bodies of insects. Oligosaccharides (a kind of small polysaccharide) are used to attach to lipids and proteins that perform functions that include cell-cell recognition.

Almost any reasonable explanation accepted

20. Name two **monosaccharides** (3)
Glucose, mannose, galactose, fructose, glyceraldehyde were among those mentioned. Any other monosaccharide also acceptable

21. Name two of the many types of **membrane proteins** discussed in lecture, and simply describe the function of that protein (6)
Receptors: transmit signals
Channel: typically gated proteins that can allow diffusion of small molecules
Carriers: proteins that change their structure to allow diffusion of small molecules they are specific for
Transporters: proteins that often use energy (utilizing ATP directly or coupled to that process) to move substances across the membrane
Exchangers: the specific name given to transporters that couple ATP energy

22.
(a) Name any one *similarity* between a **desmosome** and an **adherens junction** (3)
Any of these:
(i) both are anchoring junctions
(ii) both use cadherin class proteins between cells to form the anchor
(iii) both make use of some kind of filamentous structure through the cell space as part of their function
(iv) ?

(b) Name any one *difference* between a **desmosome** and an **adherens junction** (3)
(i) Desmosomes use intermediate filaments as the through-cell filamentous structure, while AJs use polymerized actin
(ii) the proteins forming connection between through-cell and between-cell connections are different
(iii) ??

23. Consider the Na+/K+ ATPase pump:
(a) How many Na^+ ions does it pump in one cycle and in what direction across the membrane? (2)
It pumps 3 Na^+ ions and from the inside (intracellular side) to the outside (extracellular side)

(b) How many K^+ ions does it pump in one cycle and in what direction across the membrane? (2)
It pumps 2 K^+ ions and from the outside (extracellular side) to the inside (intracellular side)

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(c) How many ATP molecules does it use in one cycle and from which side of the membrane does the Na/K pump protein use ATP? (3)

One ATP molecule is used, and it is used on the intracellular side. [All energetic processes of the cell utilizing ATP should be used from the intracellular side]

(d) What is the role of ATP in the pumping mechanism? (2)

It is the source or representation of the cell's energy that drives the reaction

(e) Why does the Na/K pump these ions (your answer might describe an example)? (4)

It does it to create a concentration difference of ions that can be utilized for other energetic processes. In particular, it generates a resting membrane potential in cells like neurons so that an action potential can occur