**CHEM523 Exam #2 13 March, 2014 Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Section1: Fun! Answer the following 25 multiple choice questions by circling the entire answer. Each question is worth 2 points.**

 1. Which of the following is an epimeric pair?

 A) D-glucose and D-glucosamine

 B) D-glucose and D-mannose

 C) D-glucose and L-glucose

 D) D-lactose and D-sucrose

 E) L-mannose and L-fructose

 2. When the linear form of glucose cyclizes, the product is a(n):

 A) anhydride.

 B) glycoside.

 C) hemiacetal.

 D) lactone.

 E) oligosaccharide.

 3. Starch and glycogen are both polymers of:

 A) fructose.

 B) glucose1-phosphate.

 C) sucrose.

 D) -D-glucose.

 E) -D-glucose.

 4. Which of the following is a heteropolysaccharide?

 A) Cellulose

 B) Chitin

 C) Glycogen

 D) Hyaluronate

 E) Starch

 5. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:

 A) asparagine, serine, or threonine.

 B) aspartate or glutamate.

 C) glutamine or arginine.

 D) glycine, alanine, or aspartate.

 E) tryptophan, aspartate, or cysteine.

 6. Which of the following is a dominant feature of the outer membrane of the cell wall of Gram negative bacteria?

 A) Amylose

 B) Cellulose

 C) Glycoproteins

 D) Lipopolysaccharides

 E) Lipoproteins

 7. The biochemical property of lectins that is the basis for most of their biological effects is their ability to bind to:

 A) amphipathic molecules.

 B) hydrophobic molecules.

 C) specific lipids.

 D) specific oligosaccharides.

 E) specific peptides.

 8. Peripheral membrane proteins:

 A) are generally noncovalently bound to membrane lipids.

 B) are usually denatured when released from membranes.

 C) can be released from membranes only by treatment with detergent(s).

 D) may have functional units on both sides of the membrane.

 E) penetrate deeply into the lipid bilayer.

 9. The shortest  helix segment in a protein that will span a membrane bilayer has about \_\_\_\_\_ amino acid residues.

 A) 5

 B) 20

 C) 50

 D) 100

 E) 200

 10. Which of these statements is generally *true* of integral membrane proteins?

 A) The secondary structure in the transmembrane region consists solely of -helices or -sheets.

 B) The domains that protrude on the cytoplasmic face of the plasma membrane nearly always have covalently attached oligosaccharides.

 C) They are unusually susceptible to degradation by trypsin.

 D) They can be removed from the membrane with high salt or mild denaturing agents.

 E) They undergo constant rotational motion that moves a given domain from the outer face of a membrane to the inner face and then back to the outer.

 11. The fluidity of the lipid side chains in the interior of a bilayer is generally increased by:

 A) a decrease in temperature.

 B) an increase in fatty acyl chain length.

 C) an increase in the number of double bonds in fatty acids.

 D) an increase in the percentage of phosphatidyl ethanolamine

 E) the binding of water to the fatty acyl side chains.

 12. When a bacterium such as *E.* *coli* is shifted from a warmer growth temperature to a cooler growth temperature, it compensates by:

 A) increasing its metabolic rate to generate more heat.

 B) putting longer-chain fatty acids into its membranes.

 C) putting more unsaturated fatty acids into its membranes.

 D) shifting from aerobic to anaerobic metabolism.

 E) synthesizing thicker membranes to insulate the cell.

 13. Which of these statements about facilitated diffusion across a membrane is *true*?

 A) A specific membrane protein lowers the activation energy for movement of the solute through the membrane.

 B) It can increase the size of a transmembrane concentration gradient of the diffusing solute.

 C) It is impeded by the solubility of the transported solute in the nonpolar interior of the lipid bilayer.

 D) It is responsible for the transport of gases such as O2, N2, and CH4 across biological membranes.

 E) The rate is not saturable by the transported substrate.

 14. The phosphodiester bonds that link adjacent nucleotides in both RNA and DNA:

 A) always link A with T and G with C.

 B) are susceptible to alkaline hydrolysis.

 C) are uncharged at neutral pH.

 D) form between the planar rings of adjacent bases.

 E) join the 3*'* hydroxyl of one nucleotide to the 5*'* hydroxyl of the next.

 15. Manual DNA sequencing gels are read from \_\_\_\_\_.

 A) from the left side (when viewed from the loading wells)

 B) the top down

 C) the bottom up

 D) from backside using infrared light

 E) from the right side (when viewed from the loading wells)

 16. Dideoxy nucleoside triphosphates \_\_\_\_\_.

 A) will terminate DNA synthesis when incorporated into a growing DNA strand

 B) can form a sugar phosphate bond with a new nucleoside triphosphate during DNA synthesis

 C) has an oxygen at the 3' carbon

 D) cannot bind to a growing DNA chain

 17. In the Watson-Crick model of DNA structure:

 A) both strands run in the same direction, 3*'*  5*'*; they are parallel.

 B) phosphate groups project toward the middle of the helix, where they are protected from interaction with water.

 C) T can form three hydrogen bonds with either G or C in the opposite strand.

 D) the distance between the sugar backbone of the two strands is just large enough to accommodate either two purines or two pyrimidines.

 E) the distance between two adjacent bases in one strand is about 3.4 Å.

 18. Triacylglycerols are composed of:

 A) a glycerol backbone.

 B) three fatty acids.

 C) amide linkages between the fatty acids and the glycerol.

 D) A and B above.

 E) A, B, and C above.

 19. Which of the following statements about membrane lipids is true?

 A) Glycerophospholipids are found only in the membranes of plant cells.

 B) Glycerophospholipids contain fatty acids linked to glycerol through amide bonds.

 C) Lecithin (phosphatidylcholine), which is used as an emulsifier in margarine and chocolate, is a sphingolipid.

 D) Some sphingolipids include oligosaccharides in their structure.

 E) Triacylglycerols are the principal components of erythrocyte membranes.

 20. Which of the following is *not* a feature of signal transduction?

 A) Integration of multiple pathways toward the same downstream response

 B) Signal amplification

 C) Covalent binding between the ligand and the receptor

 D) Desensitization or adaptation of the receptor

 E) Variable affinity for different signaling components

 21. Which of the following is *not* true for G protein–coupled receptors (GPCRs)?

 A) Agonists mimic the effect of the natural ligand.

 B) Antagonists block the normal effect of the natural ligand.

 C) GPCRs interact with heterodimeric G proteins.

 D) GPCRs are have seven transmembrane helices.

 E) There exist >100 orphan GPCRs in the human genome with no known ligand.

 22. Which of the following is *not* involved in signal transduction by the **-adrenergic receptor pathway?

 A) Cyclic AMP synthesis

 B) GTP hydrolysis

 C) GTP-binding protein

 D) Protein kinase

 E) All of the above are involved.

 23. Which of the following are involved in desensitization of the **-adrenergic receptor?

 A) **-adrenergic receptor kinase

 B) Arrestin

 C) GTPase activating proteins (GAPs)

 D) A and B above

 E) A, B, and C above

 24. Autophosphorylation of receptor tyrosine kinases depends on which of the following?

 A) Dimerization of the receptor

 B) ATP

 C) Ligand binding

 D) Transmission of conformational changes through the membrane

 E) All of the above

 25. Which of the following statements concerning signal transduction by the insulin receptor is *not* correct?

 A) Activation of the receptor protein kinase activity results in the activation of additional protein kinases.

 B) Binding of insulin to the receptor activates a protein kinase.

 C) Binding of insulin to the receptor results in a change in its quaternary structure.

 D) The receptor protein kinase activity is specific for tyrosine residues on the substrate proteins.

 E) The substrates of the receptor protein kinase activity are mainly proteins that regulate transcription.

**Section 2: Games! Answer the following 10 questions thoroughly, completely and as succinctly as possible.**

26. (4 points) Draw the structure of and write the proper chemical name for the following:

a) Maltose

b) Sucrose

c) Chitin's repeating unit

d) Lactose

27. (4 points) Match these molecules with their biological roles.

|  |  |
| --- | --- |
| (a) glycogen | \_\_ viscosity, lubrication of extracellular secretions |
| (b) starch | \_\_ carbohydrate storage in plants |
| (c) trehalose | \_\_ transport/storage in insects |
| (d) chitin | \_\_ exoskeleton of insects |
| (e) cellulose | \_\_ structural component of bacterial cell wall |
| (f) peptidoglycan | \_\_ structural component of plant cell walls |
| (g) hyaluronate | \_\_ extracellular matrix of animal tissues |
| (h) proteoglycan | \_\_ carbohydrate storage in animal liver |

 28. (4 points) (a) Define the hyperchromic effect being certain to include the chemical basis for the phenomenon in your answer.

(b) Draw a thermal denaturation curve for DNA being certain to label the axes and identify the Tm.

 29. (4 points) (a) What kinds of forces or bonds anchor an integral membrane protein in a biological membrane? (b) What forces hold a peripheral membrane protein to the membrane?

 30. (4 points) Draw the structure of phosphatidylethanolamine containing one palmitate and one oleate in the chemical form expected at pH 7.

 31. (10 points) What are the 5 characteristics of a signal transduction system? Give a brief description/explanation of each using specific examples we discussed in class.

 32. (6 points) Answer the following questions about the insulin receptor tyrosine kinase pathway.

1. What makes the receptor different from the one found in the beta-adrenergic pathway?
2. What is the substrate of the insulin receptor tyrosine kinase?
3. The protein that binds the protein from question b) has 2 discrete domains that we talked about in class. What are these domains and what do they do?

d) Ras is a crucial protein in the pathway. What type of protein is it and what does it do? (Hint: there are homologues in GPCR mediated pathways)

33. (6 points) Answer the following questions about the beta-adrenergic pathway.

1. What is the ligand that triggers the pathway?
2. Once the ligand is bound, what happens on the cytosolic side of the plasma membrane?
3. What is the effector enzyme and what is the second messenger of the pathway?
4. What triggers the effector enzyme?
5. The second messenger activates what protein? How many second messenger molecules does it take to activate this protein and why?

f) Name 2 of the 3 possible ways that the signal can be stopped (NOT dampened, but stopped).

34. (4 points) Explain the importance of membrane rafts in cell signaling pathways.

35. (4 points) What are cyclins? What is their role in the regulation of the cell cycle?

**Answer Key - CHEM523 Test 2 Possible Questions**

 1. B

 2. C

 3. D

 4. D

 5. A

 6. D

 7. D

 8. A

 9. B

 10. A

 11. C

 12. C

 13. A

 14. E

 15. C

 16. A

 17. E

 18. D

 19. D

 20. C

 21. C

 22. E

 23. D

 24. E

 25. E

 26. a) Maltose is D-Glucopyranosyl-alpha-(1,4)-D-glucopyranose

b) Sucrose is D-Glucopyranosyl-alpha-(1,2)-beta-D-fructofuranose

c) Chitin is composed of N-acetyl-glucosamine linked beta-(1,4)

d) Lactose is D-galactopyranosyl-(1,4)-D-glucopyranose

 27. g; b; c; d; f; e; h; a

 28.

 29. (a) The forces that hold integral membrane proteins in the membrane are hydrophobic interactions between hydrophobic domains of the protein and the fatty acyl chains of the bilayer interior. (b) Peripheral membrane proteins associate with membranes primarily through ionic interactions and hydrogen bonds between charged and polar side chains of the protein and polar head groups of membrane lipids. Some peripheral membrane proteins contain a covalently bound lipid that anchors them to the bilayer.

 30. See Fig. 10-9 for the phospholipid structure and Table 10-1,for the structures of the fatty acids. There are two carboxylate esters and two phosphate esters (one phosphodiester) in the molecule.

 31.

 32.

 33.

 34. Rafts are membrane regions enriched in sphingolipids and sterols, which can sequester certain signaling proteins (usually ones from the same pathway), increasing the probability of productive interactions between them.

 35. Cyclins are regulatory subunits of protein kinases. The presence of the cyclin subunits is essential for activation of the protein kinase activity. The levels of cyclins fluctuate during the cell cycle and in response to cellular and extracellular signals. These changes result in changes in the activities of the cyclin-dependent protein kinases that in turn regulate and control the cell cycle.