

BIOLOGY 205H

SAMPLE EXAM 1

A red X mark has been added to the one question that is not relevant to BIOL240H before exam 1 for Fall 2024.

- PRINT YOUR NAME AT THE TOP OF EVERY PAGE.
- USE PEN, NOT PENCIL.
- SIGN THE HONOR PLEDGE AT THE END OF THE EXAM.
- ANSWERS WILL BE GRADED BASED ON HOW CORRECT AND HOW COMPLETE YOUR ANSWER IS.

1. (4 points) What was Dorothy Hodgkin's main contribution to cell biology?

2. (4 points) What is the difference between "cytosol" and "cytoplasm"?

3. a. (3 points) Explain the difference between direct and indirect immunofluorescence.

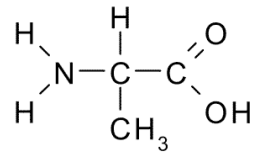
b. (3 points) Explain why indirect immunofluorescence is often used instead of direct immunofluorescence.

X 4. (4 points) Explain what the results of Gorter and Grendel's famous experiment revealed. _____

5. (4 points) Proteins have several levels of organization. The native, non-denatured, three-dimensional conformation of just a *domain* of a protein is referred to as its _____ structure.

6. (6 points) You are a cell biologist who wants to visualize the surface topology of a cell's plasma membrane at the best resolution possible. Explain step-by-step how you would prepare and then image your cell (be sure to explain *each* step, and not just name techniques, where possible).

7. (8 points) Alanine is an amino acid with the following structure:



- a. What class of amino acid is alanine (charged, polar, or nonpolar)? _____
- b. Will the side chain of alanine form weak bonds with water? _____
- c. Can the side chain of alanine be phosphorylated? _____
- d. Can the side chain of alanine form disulfide bonds? _____

8. a. (3 points) What molecule made PALM microscopy possible?

b. (3 points) Explain why PALM microscopy is sometimes used.

9. (3 points) Although a protein chain can fold into its correct conformation on its own, in living cells, protein folding is generally assisted by special proteins called

_____.

10. (5 points) Osmium tetroxide has multiple highly reactive =O groups. Explain why this specific feature is important for its function as a fixative.

11. (6 points) Explain in detail how, in sickle cell anemia, an alteration in the sequence of a gene encoding beta-hemoglobin can affect the shape of red blood cells.

12. (3 points) An enzyme that catalyzes the phosphorylation of proteins is called a _____.

13. (6 points) The endosymbiont theory proposes that mitochondria are derived from bacteria. Weak evidence for the theory includes that mitochondria are similar in size to bacteria and divide by fission, mitochondria have double membranes, and mitochondria have their own DNA and ribosomes. Give three stronger pieces of evidence for this theory.

14. (6 points) Explain how white blood cells are recruited to sites of infection by nearby endothelial cells. _____

15. (4 points) The ER and golgi have enzymes that catalyze the transfer of phospholipids from one layer to the other layer of their membrane bilayers. These enzymes are called _____ and _____.

NAME _____

16. (3 points) Although water molecules can flow slowly across plasma membranes, cells also contain special channel proteins in their plasma membranes that greatly facilitate this flow. These special channel proteins are called _____.

17. Below is a standard table of the amino acids, and the sequence of a short polypeptide that has one transmembrane domain.

D negative charge	A nonpolar
E negative charge	G nonpolar
R positive charge	V nonpolar
K positive charge	L nonpolar
H positive charge	I nonpolar
N polar	P nonpolar
Q polar	F nonpolar
S polar	M nonpolar
T polar	W nonpolar
Y polar	C nonpolar

MYKQHADVERNISKLEKRIGAFAIMYMLPTAMNAAIMWDQR

- (3 points) Underline the predicted transmembrane domain in the polypeptide above.
- (3 points) Sketch the expected hydrophathy plot for this polypeptide (label your y-axis).

18. a. (2 points) What are the two most common folding patterns in proteins?

b. (3 points) Explain why these two folding patterns are so common.

19. (3 points) What technique could you use to separate cellular components with identical sizes but different bouyant densities? _____

20. (8 points) You are a cell biologist who has conducted the experiments below, in order to identify the types of plasma membrane proteins present in a cell type that you are studying (not a red blood cell). Based on the results below, what have you learned about each of the following questions (identify proteins by their molecular weights):

- How many major membrane proteins are in this plasma membrane? _____
- Which, if any, proteins are integral membrane proteins? _____
- Which, if any, proteins are peripheral membrane proteins? _____
- Which, if any, of the proteins have carbohydrate chains? _____
- Are the carbohydrate chains on the extracellular or intracellular side? _____
- One protein is a transmembrane protein. Which one? _____
- One protein is a cytosolic protein. Which one? _____
- The 70kD protein binds one of these other proteins. Which one must that be? _____

molecular weights:	lysed cells, collected plasma membranes:		leaky ghosts extracted with salt, centrifuged to pellet membrane fraction, then ran on gel:		labeled each of the following with membrane-impermeant carbohydrate label, then ran on gel:			labeled each of the following with membrane-impermeant fluorescent probe for protein, then ran on gel:		
	pellet	supernatant	leaky ghosts	resealed normal oprientation	resealed inside-out	leaky ghosts	resealed normal oprientation	resealed inside-out		
150kD	█		█	█		█	█			
80kD	█		█	█		█	█	█		
70kD		█						█		
55kD		█				█	█			

ON MY HONOR, I HAVE NEITHER GIVEN NOR RECEIVED UNAUTHORIZED AID ON THIS ASSIGNMENT. SIGNED _____