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## Cell Biology

Write your team number on EVERY page

Team Name: \_\_\_\_\_

Competitor Names: \_\_\_\_\_

1. (8pt) What are the four levels of protein structure? Give the terms and describe what they correspond to.

2. (6pt) Given this **non-template strand** DNA sequence, write the corresponding template RNA sequence, from 3' to 5' :

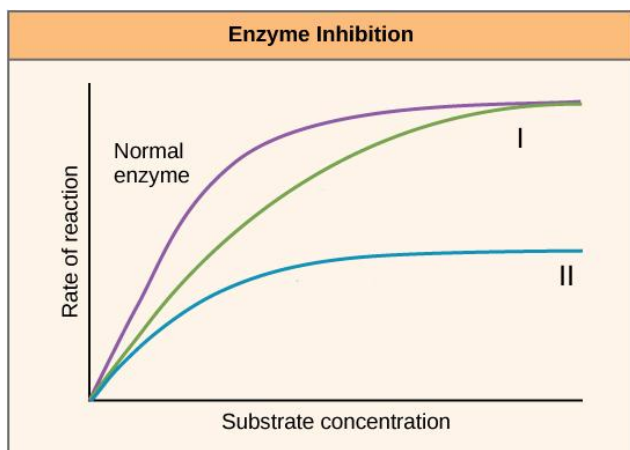
3'ATG GCA AAA GAG CTC GAA GCT AGG AAT TAG 5'

3. (5pt) Given the same non-template DNA sequence, write the **1-letter amino acid** sequence of the polypeptide encoded. Write out any stop codons as (STOP)

4. (4pt) What are the monomers that make up a triglyceride?

5. (2pt) How many types of amino acids are there?

6. (4pt) Name two storage polysaccharides of glucose and tell whether they are found in plants or animals
  
7. (2pt) What is the buffering system used by the blood to maintain pH?
  
8. (2pt) What pH range does this system maintain?
  
9. (6pt) What are the two compensatory mechanisms used to help regulate the pH? Briefly describe how one of them works (your choice)
  
  
  
  
  
  
  
  
  
  
- 10.(2pt) A cell is placed in distilled water and begins to swell. What is the tonicity of the water?
  
  
  
  
  
  
  
  
  
  
11. (2pt) A cell is placed in honey and begins to shrivel. What is the tonicity of the honey?



The above image shows the reaction rate vs substrate concentration plots for an enzyme with two different inhibitors.

12. (2pt) What kind of inhibitor is inhibitor I?

13. (2pt) How does inhibitor I affect the Michaelis-Menten constant ( $K_m$ ) of the enzyme?

14. (2pt) How does inhibitor I affect the maximal velocity ( $V_{max}$ ) of the enzyme?

15. (2pt) What kind of inhibitor is inhibitor 2?

16. (2pt) How does inhibitor II affect the Michaelis-Menten constant ( $K_m$ ) of the enzyme?

17. (2pt) How does inhibitor II affect the maximal velocity ( $V_{max}$ ) of the enzyme?

18. Which enzymes involved in the citric acid cycle involve converting NAD<sup>+</sup> to NADH? What steps do they each catalyze (list enzyme, starting material and product e.g. aconitase, citrate to cis-aconitate)(12 pts)?

Place the letter corresponding to the function in the blank left of the organelle (1pt ea

- |                                      |  |
|--------------------------------------|--|
| 19. ___ Mitochondria                 | a. Capture solar energy                                    |
| 20. ___ Chloroplast                  | b. Package and distribute products                         |
| 21. ___ Lysosome                     | c. Digest excess products                                  |
| 22. ___ Golgi complex                | d. Contain DNA   |
| 23. ___ Rough endoplasmic reticulum  | e. Transform energy through respiration                    |
| 24. ___ Smooth endoplasmic reticulum | f. Produce proteins  |
| 25. ___ Nucleus                      | g. Store substances  |
| 26. ___ Ribosome                     | h. Site of chemical reactions that contains ribosomes      |
| 27. ___ Vacuole                      | i. Provides internal structure                             |
| 28. ___ Cytoskeleton                 | j. Site of chemical reactions where lipids are synthesized |

29. (2pt) What enables the apparent rigidity of plant cell walls?

30. (2pt) What does lignin do to plant cell walls?

31. (3pt) What are the 3 layers that can be found in plant cell walls?

32. (3pt) What do we call the two types of cell wall in bacteria and where do they get their names?

Fill in the blanks (2pt per blank)

33. Flippases catalyze the transport of lipids from the \_\_\_\_\_ side of the membrane to the \_\_\_\_\_ side.

34. Floppases catalyze the transport of lipids from the \_\_\_\_\_ side of the membrane to the \_\_\_\_\_ side.

35. A membrane composed primarily of phospholipids with \_\_\_\_\_ chains is more dynamic than a membrane composed primarily of phospholipids with \_\_\_\_\_ chains.

36. (4pt) What are 2 major lipid components found in lipid rafts that distinguish them from the rest of the membrane?

37. (2pt) Caveolae are a type of lipid raft characterized by the presence of what protein?

38. (12pt) There are three types of vesicle coat proteins. What are they and what kind of trafficking does each participate in?

1.

2.

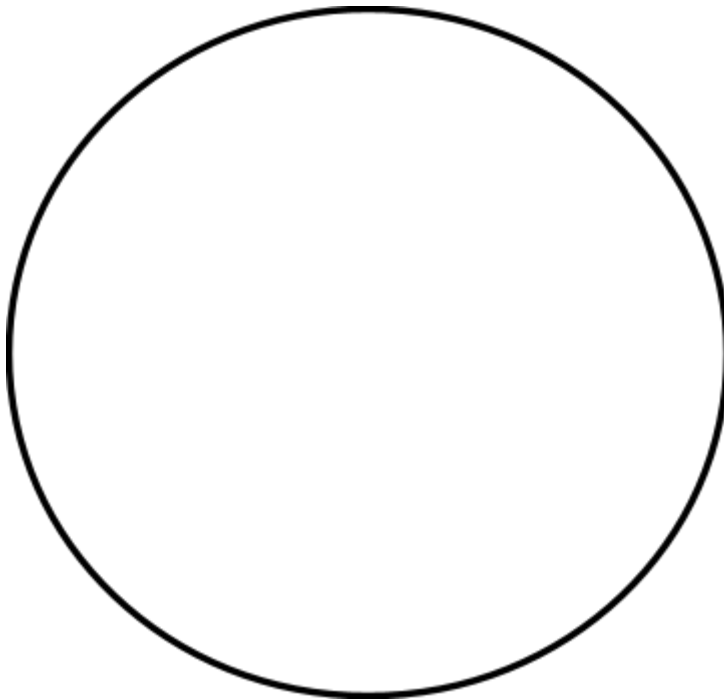
3.

39. (2pt) The surface proteins that identify cargo and help facilitate fusion are called what?

40. (2pt) How close together do membranes need to be for vesicle fusion?

41. (8pt) Use the circle below to draw a diagram of the cell cycle. Use all of the words in the word bank below.

G2, metaphase, S, anaphase, G1, prophase, telophase, cytokinesis



42. (4pt) On your diagram, indicate where the two main checkpoints are.

Fill in the blanks with a word or phrase (2pt each blank)

43. At the first checkpoint (after division), the cell checks for \_\_\_\_\_ so that \_\_\_\_\_ (process) can happen.

44. At the second checkpoint, the cell checks for \_\_\_\_\_ so that \_\_\_\_\_ (process) can happen.

45. What are the two main components of cell cycle regulation in eukaryotes (4pt)?

Match the example of an oncoprotein with what kind of protein it is. Put the letter in the space left of the protein (2pt each)

46. \_\_\_\_ VEGFR

47. \_\_\_\_ C-Src

48. \_\_\_\_ Raf

49. \_\_\_\_ Ras

50. \_\_\_\_ Myc

a. Regulatory GTPase/G protein

b. Receptor tyrosine kinase

c. Cytoplasmic serine/threonine kinase

d. Transcription factor

e. Cytoplasmic tyrosine kinase

Decide whether each plant is a C3, C4, or CAM plant. Put C3, C4, or CAM in the space left of the plant (1 pt each)

51. \_\_\_\_ Sugarcane

52. \_\_\_\_ Pineapple

53. \_\_\_\_ wheat

54. \_\_\_\_ Cacti

55. \_\_\_\_ Orchids

56. \_\_\_\_ Corn

57. \_\_\_\_ Daisies

58. \_\_\_\_ Rice

59. \_\_\_\_ Aloe vera

60. \_\_\_\_ Cabbage

61. \_\_\_\_ Barley



62. Pseudoephedrine (Sudafed, a nasal decongestant) binds to and activates the beta-adrenergic receptor, a GPCR which couples to Gs. What is the second messenger effect you would expect (2pt)?

63. Propranolol (a beta-blocker) also binds to the beta-adrenergic receptor, but does not activate it. What is this mechanism called (2pt)?

64. In 2012, the Nobel prize for Chemistry was awarded for studies on G protein coupled receptors. What are the names of the scientists who won?(2pt)

Match the type of signaling with the description. Put the letter in the space provided. (2pt each)

65. \_\_\_ Signaling that involves molecules that diffuse over short distances like fibroblast growth factors

66. \_\_\_ Signaling that involves molecules that diffuse over long distances via the circulatory system like hormones

67. \_\_\_ Signaling that occurs via two proteins on two different cells that interact

6 \_\_\_ Signaling that occurs when secreted molecules bind receptors on the same cell that secreted them

- a. Paracrine signaling
- b. Autocrine signaling
- c. Endocrine signaling
- d. Juxtacrine signaling

68. (6pt) Order the following by ability to diffuse through a lipid bilayer from most able to least able:

Ca<sup>2+</sup>, CO<sub>2</sub>, Ethanol, glucose, RNA, H<sub>2</sub>O

69. (4pt) Someone's coming to dinner! Your lettuce is soggy :( Should you soak it in salt water, sugar water, or tap water to perk it up? Why?

The epidermal growth factor receptor (EGFR) is an RTK activated by epidermal growth factor (EGF).

70. (2pt) When EGF binds an EGFR, what is the first change that happens?

71. (2pt) After that change happens, what kind of side chain is phosphorylated ?

72. (4pt) After phosphorylation, what are the two types of protein domains that can bind?

73. (2pt) What kind of cell death results from acute cellular injury?

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74. (2pt) What kind of cell death results in fingers and toes during development?

75. (2pt) What are the highly conserved proteases involved in apoptosis called?

Draw a picture of the following lipid structures:

76. (3pt) Lipid bilayer

77. (3pt) Micelle

78. (3pt) Liposome

79. (10pt) Draw and label a diagram of a lipid raft. Include both an integral membrane protein and a peripheral membrane protein, and indicate the lipid composition of the raft in comparison to normal cell membrane (with relative quantities).

80. (9pt) What are the three irreversible steps of glycolysis? Indicate the enzyme, substrates, and products

1.

2.

3.