

Name _____

Use complete sentences when requested. There are 105 possible points on this exam.

Exam Memory Bank

$V_0 = \frac{V_{\max} \times [S]}{K_m + [S]}$ $V_{\max} = k_{\text{cat}} \times E_t$ $k_{\text{cat}} = \frac{kT}{h} \times e^{\frac{-G^\ddagger}{RT}}$ $\Delta G = \Delta H - T\Delta S$	$\Delta G^{\text{net}} = -nF\Delta E^{\text{net}}$ $\Delta G^{\text{net}} = -RT \ln K_{\text{eq}}$ $\Delta G_t = RT \ln \frac{c_2}{c_1}$ $\Delta G_t = RT \ln \frac{c_2}{c_1} + ZF\Delta\psi$	$R = 8.314 \text{ J/mol}\cdot\text{K}$ $F = 96,500 \text{ J/V}\cdot\text{mol}$ Boltzman constant, $k = 1.381 \times 10^{-23} \text{ J/K}$ Plank's constant, $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{sec}$ Avogadro's number, $6.02 \times 10^{23} / \text{mol}$ $\ln x = 2.303 \log_{10} x$ calorie = 4.184 J
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- 1) (10 points) ATP is synthesized in the mitochondrial matrix by coupling the energy from proton flow into the matrix with ATP synthesis. Calculate the energy that is available for ATP synthesis when 3 moles of protons flow into the mitochondrial matrix. The pH inside the mitochondrial matrix is 7.6, the pH outside the matrix is 6.8. The membrane potential is 70mV (inside is negative) and the temperature is 37°C.
- 2) (2 points) What is the primary biological function of triglycerides?
- They provide membrane stability.
 - They are used to insulate neurons.
 - They are involved in biological signalling.
 - They are used for energy storage.
 - None of these or more than one of these, circle all correct statements.
- 3) (2 points) What are lipid rafts and what is their function?
- They are regions in cell membranes that are enriched in cholesterol and sphingomyelin and they hold related proteins in close proximity to each other.
 - They are regions in the mitochondria that directly transport electrons for oxidative phosphorylation.
 - They are regions in cell membranes that are enriched in glycolipids and phosphatidyl choline, then maintain membrane stability.
 - They are regions in cells that are enriched in proteins that are all part of the same phosphorylation signal cascade.
 - None of these or more than one of these, circle all correct statements

- 4) (10 points) Linoleic acid has a melting point of 2°C and linolenic acid has a melting point of -11°C .
- a) Draw the structures and give the shorthand notation for each structure. (Short hand notation for stearic acid is 18:0.)

Linoleic acid

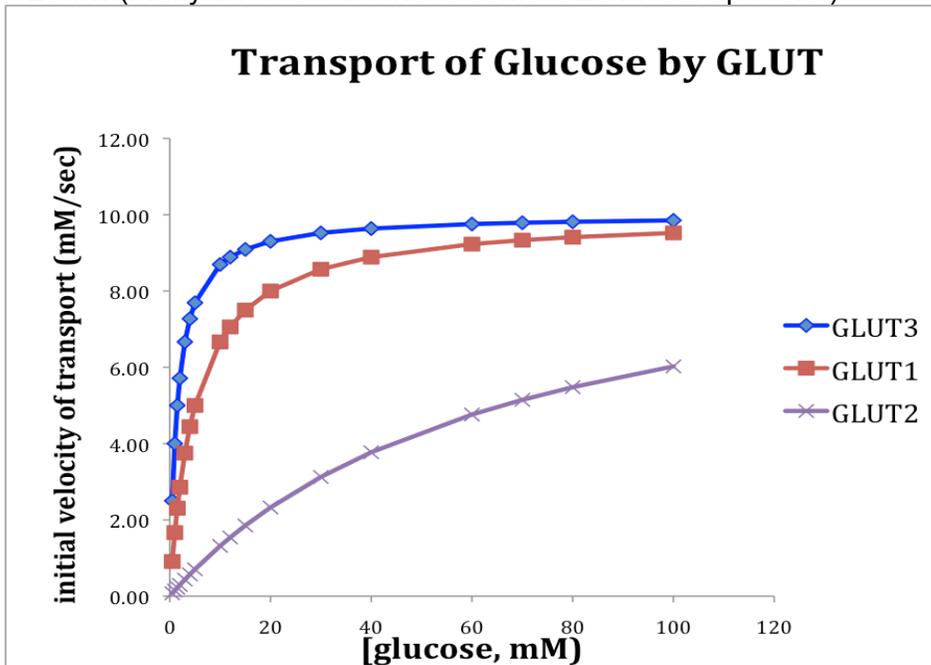
Linolenic acid

- b) Give an explanation for the difference in melting temperatures for the two structures. Be sure to discuss the relevant intermolecular forces.

- 5) (10 points) Describe how cells keep their intracellular Na^+ levels low and their intracellular K^+ levels high. What transporter or ion channel is involved? How does it work?

- 6) (6 points) Eggs have been wrongly accused of causing heart attacks! The body makes about a gram of cholesterol every day, so the amount obtained from eating an egg (200 mg) or two is not excessive. In fact, eggs are a very inexpensive source of a complete protein and thus should be included in most diets. In order to get cholesterol "out of jail" describe the functions and roles of cholesterol.

7) (10 points) The liver has GLUT2 transporters, brain cells have GLUT 3 and red blood cells have GLUT1. (Many other tissues have some GLUT1 transporters.)



- Use the data in the above graph to determine the K_t value for each transporter.
- When blood glucose levels are 5 mM, which tissue(s) have the highest velocity of glucose uptake? Fully explain your reasoning.
- How is the K_t value for each glucose transporter related to the function of the cells where the receptor is found?

8) (10 points) If a mixture of phosphatidylinositol, triglyceride, phosphatidylcholine, and cholesterol, was dissolved in chloroform, then separated by thin-layer chromatography on silica gel using a mixture of chloroform/methanol as the developing solvent, which would move fastest? Draw the silica gel plate and identify the spots.

9) (15 points) Describe how the epinephrine (or glucagon) signal is amplified inside a cell. (pictures are ok.)

10) (10 points) What is a heterotrimeric G protein? How does it work? Give an example of a signal that is transferred into the cell by a heterotrimeric G protein. What is a GAP? GEF? Write your answer in complete sentences. If you use a figure, be sure to fully describe it.

11) (20 points) Choose **one** of the following and give a detailed description of everything you learned about this **one** topic. Avoid vague generalizations, use specific examples.

- a) Underline your **one** choice: vision, taste, insulin signalling, calcium signalling, receptor enzymes, ligand gated ion channels, sodium-glucose transporter, tumor suppressor genes, steroid receptors, regulation by cyclic AMP, voltage gated ion channels, regulation by phosphorylation, protein kinases,
- b) Write your detailed description of the **one** topic that you underlined, using complete sentences. If you use a figure, make sure it is fully described. Only **one** topic will be graded.