

Use complete sentences or complete structures when needed. There are seven questions on six pages. The points are indicated for each question.

1. (20 points) Draw all of the structures for glycolysis and gluconeogenesis, include all of the enzymes, cofactors and all reactants for each reaction.

2. (15 points) Which reactions in glycolysis are controlled by regulatory enzymes? How are these enzymes regulated?

3. (10 points) Compare and contrast lactose intolerance and galactosemia, what enzymes are defective or missing, what are the physiological effects? How do the treatments differ, or are they the same?

4. (10 points) You may recall Runner Ron from last semester. He took several short breaths to decrease his blood carbon dioxide levels to counteract the drop in pH that will occur after his intense 100 M Sprint. Why does this blood pH drop occur? What molecule is made in the muscle cells? Why is it made? Where does the blood take it? What happens to it when it gets there? Fully describe the cycle that occurs during intense anaerobic exercise.

5. (15 points) Draw all of the reactions for the TCA cycle (Citric Acid Cycle). Include all of the structures, enzymes and co-factors.

6. (15 points) There were six presentations on drugs that treat diabetes or cancer by targeting glucose metabolism. Match each drug with its mechanism of action, then describe one mechanism in detail.

Drugs:

Actos
Canagliflozin
Exenatide
Metformin.
STF-31
Voglibose

Mechanisms:

1. Agonist for PPAR γ
2. Triggers the release of insulin and decreases glucagon secretion
3. Blocks GLUT1, a transporter that is elevated in cancer cells
4. Inhibits α amylase in the intestine
5. Activates AMP kinase (AMPK)
6. Inhibits SGLT2

Drug selected for detailed description_____

7. (30 points) A 40 year old female (113 kg, 160 cm) had been experiencing extreme thirst. She also experienced the stress of not going to Hawaii and had to eat an entire box of chocolate covered macademia nuts to ease this stress. To wash down the chocolate yummys, she consumed a 24 pack of Gatorade in three days. On her way to Costco to replenish her Gatorade, she became nauseous and could not catch her breath. (She thought it was due the excitement of going to Costco). While she was shopping, she lost consciousness and was then transported to the ER. In the ER, it was noticed that her breath smelled fruity. Blood tests were done and her insulin level was very elevated. What would you expect for the following molecules?

Molecule	High or low relative to normal	Reason(s)
Glucose		
Free fatty acids		
Ketone bodies		

What was the effect of excess insulin on the following tissues and pathways? For each pathway, give at least one example of a control mechanism that has been affected.

Adipose:

Glycolysis

Fatty acid synthesis

Muscle:

Glycolysis

Fatty acid synthesis

Glycogen synthesis

Liver:

Glycolysis

Gluconeogenesis

Glycogen synthesis

Fatty acid synthesis

Pentose phosphate pathway