1. Two years ago, I was stricken with brachial neuritis. When I visited the emergency room following eight hours of severe shoulder pain, testing showed that my blood glucose was slightly elevated, even though I had not eaten for nine hours.

a) Which hormone caused the increase in blood glucose (HINT: I was fairly stressed out that evening)?

b) When this hormone binds to its receptor, the activated G protein caused what second messenger molecule to be produced?

c) From which organ did the blood glucose come from?

d) If serum fatty acids were measured at the same time, would you expect their levels to be higher, lower, or the same as normal? Explain your answer.
2. Examine the graphs on the following page, which describe the effects of refeeding of starved
animals on the levels of mRNA, rate of enzyme synthesis, and the enzymatic activities of two
liver enzymes, PEP carboxykinase and glucokinase. Animals were starved for two days, then
refed beginning at time 0.

(a) Using structures for reactants and products, write out the reactions catalyzed by PEP
carboxykinase and glucokinase.

(b) Which graph (a or b) describes PEP carboxykinase? Which graph describes glucokinase?
SUPPORT YOUR ANSWER!

(c) Which symbol describes mRNA levels, which the rate of enzyme synthesis, and which the
enzymatic activity? (There are three symbols on each graph; the symbols mean the same thing
in the two graphs).
3. Mescaline (structure shown below) is a psychotic agent produced by the peyote cactus. Describe a reasonable metabolic sequence for preparing mescaline from phenylalanine. (HINT: there are no enzymes that can add methoxy groups to aromatic rings, but there are enzymes that can catalyze aromatic hydroxylation reactions).

Phenylalanine | Mescaline
4. (15 pts.) A common chemotherapeutic strategy against cancer is to administer **5-fluorouracil** and **methotrexate** at the same time.

   a) What enzyme is inhibited by 5-fluorouracil? What enzyme is inhibited by methotrexate?
   b) Why are these two substances administered to reduce the growth of cancerous tumors?
   c) What is the advantage of administering both substances, rather than just 5-fluorouracil or methotrexate? What are the disadvantages?
5. (15 pts.) The synthesis of adenine occurs by building the adenine ring onto 5-phosphoribosyl-1-pyrophosphate. There are five nitrogens on the base adenine.
a) Which small molecules donate the five nitrogen atoms found in adenine?
b) Suppose that a cell has an excess of purine nucleotides. Which enzyme(s) control the rate of biosynthesis of purines, and how are they regulated?
6. These questions can be answered by looking at the data figure following the question. Resistin is a protein isolated from rats that is believed to affect the response of liver cells to insulin in rats. Rats were injected with resistin or nothing (called “vehicle”), followed by a second injection ten minutes later. Figures c and d describe the effect of resistin on rat blood glucose after an injection of glucose, or blood glucose after an injection of insulin.

a) Explain Figure c. That is, after glucose injection, blood glucose immediately rises, and then decreases. What causes the decrease in blood glucose after the initial spike.

b) Why does blood glucose decrease after insulin injection (figure d)?

c) Does resistin accentuate (increase) or mediate (decreases) the normal affect of insulin? How did you come to your conclusion?

d) Resistin is a protein, and as a result likely does not get inside of cells. Describe a mechanism at the molecular level that would explain resistin’s effect on the insulin response of rat liver cells.