Chem 454-Phat Problems 5 -I prefer you type on this document as a template. DUE 9:30 AM Tuesday. SHOW ALL WORK KEY

1. Compare (numerically) the metabolic efficiencies, in *moles ATP/gram* of completely oxidized fat (tripalmitoylglycerol) versus completely oxidized glucose derived from glycogen. ASSUME all the fat is anhydrous and that glycogen is stored with *twice* its weight in water.

Oxidation of glycerol to DHAP
DHAP to pyruvate
Pyruvate is metabolized to CO2 and H2O in citric acid cycle Total= 14 ATP

3 palmitates * 106/palmitate Total=318 ATP

318+14=332 ATP/mole

409 moles ATP/807g = 0.51 mol ATP/g tripalmitoyglycerol

When glucose goes through glycolysis, TCA, and phosphorylation you get 30 ATP, So glycogen yields 30 mol of ATP + 1 that you don't lose due to phsophorolysis / (180 g glucose) glycogen + 2 x 180 g H2O). 31 ATP/540g= 0.06 mol ATP/mol glucose as glycogen

The fat gives .51/.06=8.5 times more ATP/g

2. What is the ATP yield from the complete oxidation of a molecule of (a) □-linolenic acid (9,12,15-octadecatrienoic acid, 18:3) and (b) margaric acid (heptadecanoic acid, 17:0)? Which has a greater amount of available biological energy on a *per carbon* basis.

a. Linolenic Acid
(acetyl CoAs, 9 GTP+ 27NADH+ 9$FADH_2$) + 8$FADH_2$+8NADH-2ATP= 146 ATP

One less $FADH_2$ (2ATP) will be generated for every odd number double bond because the double bond must be reduced

146-2x2-3=139 ATP
139/18= 7.72 ATP/Carbon

b. Margenic Acid

(7GTP+21NADH+ 7$FADH_2$)+7$FADH_2$+7NADH-2ATP= 117ATP
117 ATP -1+6+15= 137ATP
137/17=8.06 ATP/Carbon

Margenic Acid gives 4% more energy.

3. Although linoleic acid is an essential fatty acid in animals, it is NOT required by animal cells in tissue culture. Explain.

Linoleic acid is needed for intercellular and tissue communications as eicosanoids derived from arachidonic acid (like prostaglandins). In a cell culture, you would not need this function.