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 tripalmitoylglycerol

   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 phosphorolysis / (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) Δ6-linolenic acid (9,12,15-octadecatrienoic acid, 18:3) and (b) margenic 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+ 9FADH₂) + 8FADH₂+8NADH-2ATP= 146 ATP

   One less FADH₂ (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+ 7FADH₂)+7FADH₂+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.