1. On a per carbon basis, where does most of the energy in a triacylglycerol reside, in the fatty acid or in the glycerol? Rationalize this in terms of the molecular structure of a TAG.

   Each of the carbons in glycerol is bonded to an oxygen and thus already partially oxidized. The methylene carbons in a fatty acid are much more reduced and thus have a higher reducing potential/generate more energy.

2. The compound dinitrophenol is basic. Due to resonance delocalization of the charge, however, both it’s protonated and unprotonated forms are relatively hydrophobic and can cross through a membrane. In the 1920’s it was used as a dieting aid. Why would dinitrophenol make you slimmer?

   Because both the protonated and unprotonated forms of dinitrophenol can cross the membrane, this compound can carry protons into the mitochondria. It thus destroys the proton gradient, decoupling the respiratory cascade from proton pumping. No proton gradient, no ATP. Thus while reduction potential is consumed (ie calories burned), no useful energy is generated.

3. When glutamate labeled at C2 with \(^{14}\text{C}\) and at the amino group with \(^{15}\text{N}\), where will the isotopic labels end up in a) urea, b) succinate, c) arginine, d) citrulline, e) ornithine, f) aspartate?

   The carbon in the glutamate is not used in the urea cycle and does not appear in any of these intermediates/products. Both nitrogens in urea come from glutamate, however.

   Urea: nitrogens ultimately come from glutamate and thus both are labeled.

   Succinate: No nitrogen and thus no label from glutamate.

   Arginine. The delta nitrogen (the “inner” nitrogen) comes from ornithine and thus is not labeled. The other two nitrogens ultimately come from glutamate.

   Citrulline. The terminal nitrogen comes from glutamate and thus is labeled.

   Ornithine. The nitrogen in ornithine does not come from glutamate and thus is not labeled.

   Aspartate: The alpha amino group comes from glutamate and thus is labeled.