Exam 2
BC 368
Spring 2015
Answer Key

1. A
2. B
3. E
4. C
5. A
6. C
7. A
8. C
9. C
10. E

11. a) The cyanobacterium has only photosystem II, which contains the oxygen-evolving complex. Since the amount of O_2 evolved is very similar in the mutant to the wild type, it looks like PSII is working quite well.

    b) **no effect** ATP production relies on PSII and cytochrome b_6f only (no need for PS I).

    decreased NADPH production requires PSI

    c) Most of chlorophyll b is not ending up in the reaction centers, so it must be in the antenna complexes.

    d) The antenna complexes absorb light and pass the energy via resonance energy transfer to P680 (eventually). As long as they absorb higher energy than P680 does, they can do their job.

12. a) Insulin promotes uptake of glucose by the peripheral tissues via GLUT4. (The liver's glucose transporters are not induced by insulin.) Blood sugar spikes when the glucose is absorbed into the bloodstream, then it drops over time as the tissues take it up. The rats treated with DNPME showed increased glucose uptake, meaning a better insulin response. This is promising.

    b) Insulin turns off gluconeogenesis and glycogen breakdown and turns on glycolysis and glycogen synthesis. It is the former two effects that lead to suppression of glucose production by the liver. Both of these processes would contribute to hyperglycemia if the liver does not respond to insulin. DNPME enhances the suppression of glucose production, meaning that it is helping with insulin resistance.

    c) It looks like DNPME increases oxygen consumption dramatically in the liver.

    d) DNPME is chemically quite similar to the uncoupling agent DNP and is in fact converted to DNP in the liver. Although DNP is dangerous when given to the whole organism, by limiting its action to the liver, it can reverse insulin resistance, at least in rats. (This is a very recent paper.)

13. a) The pesticide seems to be inhibiting either ETC or ox-phos. Since the two are coupled, inhibiting one directly leads to inhibition of the other indirectly.

    b) These data support that the target is the ETC. By slowing down the ETC, electrons can "fall out", leading to production of reactive oxygen species such as H_2O_2.

    c) It looks like the pesticide is targeting complex I, since when the electrons enter at complex II, there is no effect.

14. a) Rubisco. Ru 1,5-BP + CO_2 → 2 PG H^+, nocturnal inhibitor

    b) Pyruvate carboxylase. Pyruvate + CO_2 → OA Avidin

c) There would be more radiolabel in the plant polysaccharides. Animals can't truly perform carbon fixation, because the carbon added is lost in the next step.

15. a) False The Calvin cycle enzymes need ATP and NADPH produced in the light reactions. For several reasons, their activities are also dramatically reduced in the absence of light.

b) False The products of the light reactions are ATP, NADPH, and O_2. If you include the Calvin cycle, the ATP and NADPH are used to make glyceraldehyde 3-P.

c) False We cannot make glucose from acetyl-CoA, which fats, leucine, and lysine are degraded to, because the bridging reaction cannot run backwards.

d) True

e) False First, it depends which tissue has the defective enzyme. If it's a muscle isozyme, the liver will be unaffected. Next, it depends whether the problem is with glycogen breakdown or not.

16. a) Pyruvate carboxylase or pyruvate dehydrogenase complex

b) Sounds like the Mees' lines of arsenic poisoning! Arsenic targets the lipoic acid group of PDH complex.

17. a) $\Delta E'^{\circ}$ for the two half reactions = -0.12 V – (0 V) = - 0.12 V.

$\Delta G'^{\circ} = -nF\,\Delta E'^{\circ} = -2 \text{ mol} \times 96.48 \text{ kJ/V-mol} \times -0.12 \text{ V} = +23 \text{ kJ}$

b) $\Delta G'^{\circ} = -2.3\ RT\ \Delta pH + ZF\Delta\Psi$
= -2.3 (8.315 J/mol-K) * 298K * 0.7 + 96.48 kJ/V-mol × -0.130 V
= -4.0 kJ/mol – 12.5 kJ/mol
= -16.5 kJ/mol

c) 23 kJ/16.5 kJ/mol = 1.4 moles H^+