Fall 2001 Biology 111 Exam #3 – BioEnergetics

There is no time limit on this test, though I have tried to design one that you should be able to complete within 2.5 hours, except for typing. There are three pages for this test, including this cover sheet. You are not allowed to use your notes, old tests, the internet, or any books, nor are you allowed to discuss the test with anyone until all exams are turned in at 11:30 am on Monday November 19. **EXAMS ARE DUE AT CLASS TIME ON MONDAY NOVEMBER 19**. You may use a calculator and/or ruler. The **answers to the questions must be typed on a separate sheet of paper** unless the question specifically says to write the answer in the space provided. If you do not write your answers in the appropriate location, I may not find them.

You must have access to the web to take this exam.

-3 pts if you do not follow this direction.
Please do not write or type your name on any page other than this cover page.
Staple all your pages (INCLUDING THE TEST PAGES) together when finished with the exam.

Name (please print):

Write out the full pledge and sign:

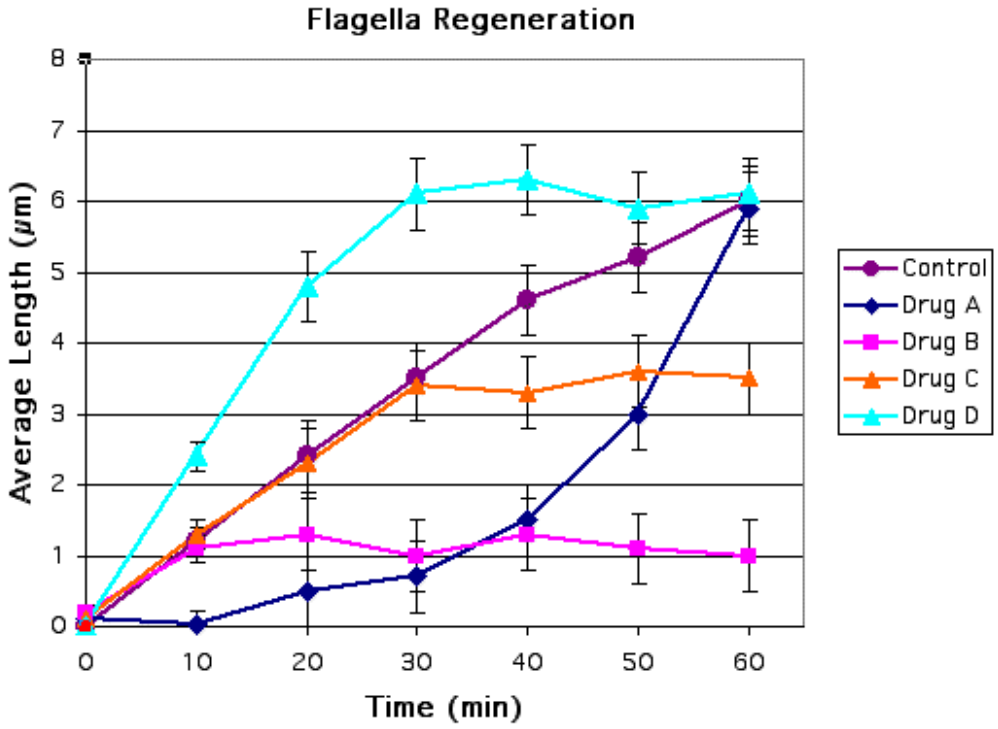
How long did this exam take you to complete (excluding typing)?

Lab Question:

10 pts.

1) Go to this URL <http://www.bio.davidson.edu/people/macampbell/111/oldexams/111fall01/graph111.gif> and view the color figure. If you print it out, be very careful where you print it so someone else in class does not see it before he or she begins to take the test.

This figure shows the results of 4 experimental conditions and one control. *Chlamydomonas* cells were deflagellated and then allowed to regrow their flagella. The average lengths of 30 flagella are graphed and the 95% confidence interval is shown for each point.



Here is the question: What affect does each drug have on the cells? To receive full credit, you must explain your observations by providing a mechanism similar to those given during the presentations. I am NOT asking you to remember what each lab group did and tell me those interpretations. Make fresh conclusions based on the data in this web figure.

Drug A – slows down the growth rate initially, but by 30 minutes, it accelerates. This acceleration may be due to a stockpiling of tubulin dimers ready to build new flagella. Perhaps the drug is metabolized and thus no longer active.

Drug B – This drug allows only a little growth (1 µm compared to 6 µm for control cells) and then no more. Perhaps it blocks any new protein production but allows assembly of any proteins in cytoplasm.

Drug C – Allows only about half flagella regeneration (about 3.5 µm). Then the drug blocks further growth. Perhaps this drug blocks transcription and thus allows assembly (see above) as well as translation. This results in a longer flagellum than drug B did.
Drug D – Alters the growth rate by accelerating it so that by 30 minutes the flagella have grown full length (6 µm). Then the flagella stop at control length. Perhaps the drug accelerated the slowest step in normal growth and thus sped up the entire process.

Lecture Questions:

8 pts.

2) What are the two laws of thermodynamics? Define them in everyday terms, not by regurgitating a set phrase you have memorized.

Energy is not created or destroyed but converted from one form to another. For example, you can charge up a battery and the electricity is converted to chemical potential energy.
All things tend to spread out over time, unless you exert energy to maintain order.

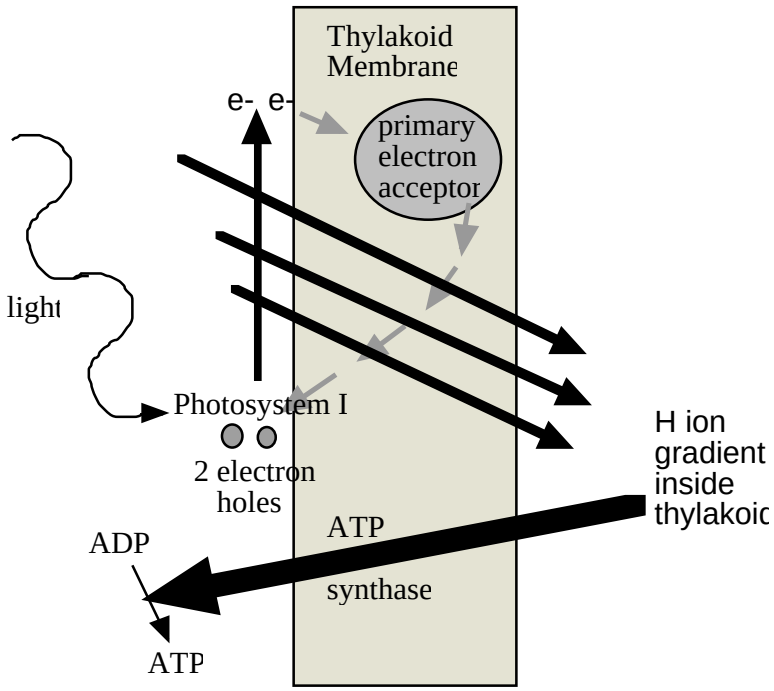
6 pts.

3) Chemically and physically, what makes something appear to have color?

Chemically, a subset of all light energy is absorbed by the chemical structure of pigment molecules. **Physically**, the non-absorbed light is reflected back and our eyes see only these colors of light.

10 pts.

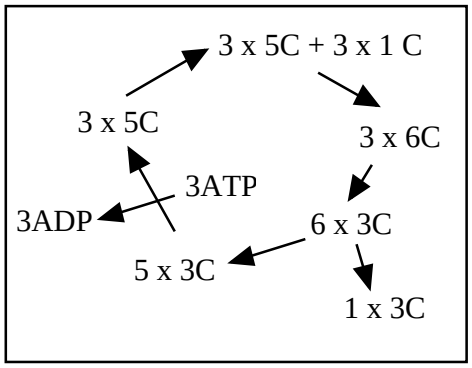
4) Draw a diagram of the flow of energy in cyclic electron flow. Begin with light and end with the final energy storage molecule. Label all the parts to your diagram, but use very neat writing.



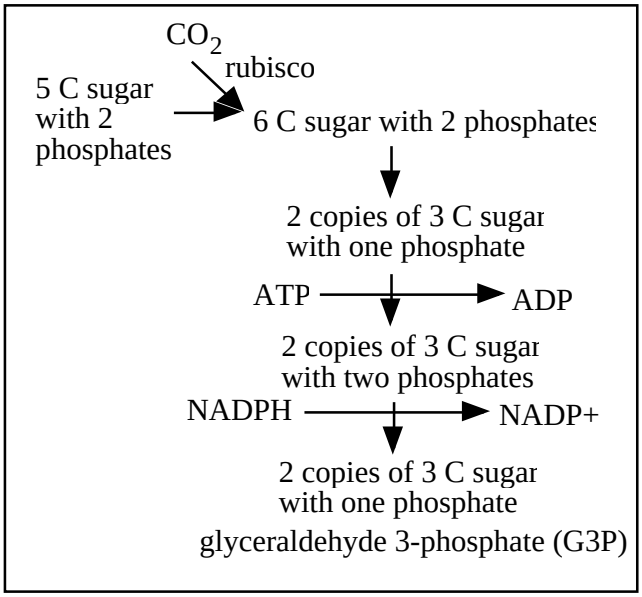
10 pts.

5) Diagram the dark reaction. In your diagram, make sure you tell me what goes in, what comes out. Label the carbon and all energy sources.

Three Cycles of Dark Reaction

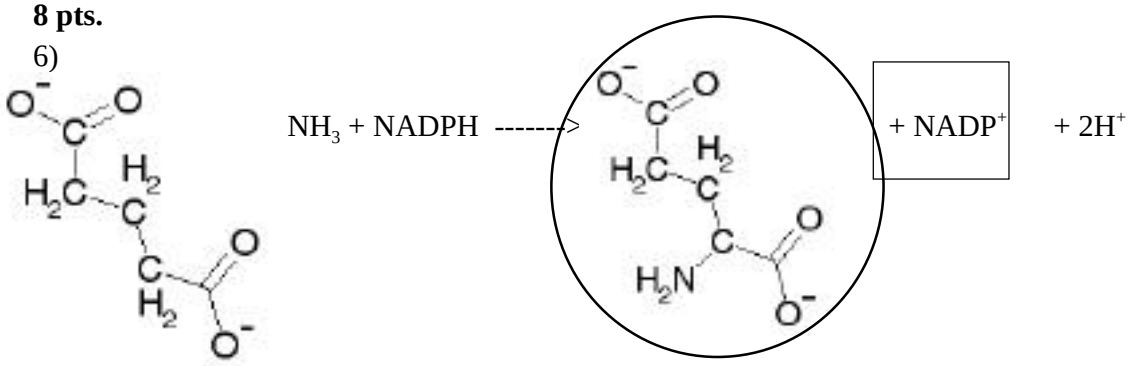


One Cycle of Dark Reaction



8 pts.

6)



This is a redox reaction that plants perform. Draw a circle around the product that was reduced and a square around the product that was oxidized. Then, explain how you know which was reduced and which was oxidized.

4 pts.

7) Explain how the delivery of oxygen is a self-regulating process that adjusts its rate as needed.

Oxygen is able to pass through membranes down its concentration gradient. As oxygen is consumed, more moves into cells thus regulating its own delivery to cells as needed.

6 pts.

8) Write (not draw) the overall reaction of glycolysis. Include quantities.

1glucose + $2NAD^+$ + 2ADP → 2 pyruvate + 2 NADH + 2 ATP

8 pts.

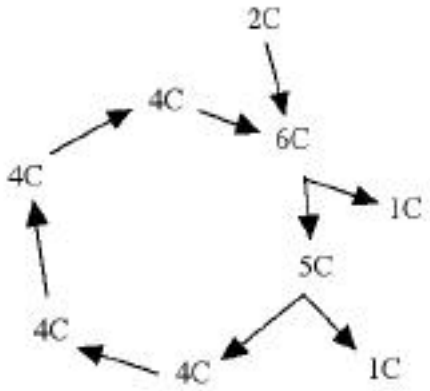
9) Write (not draw) the overall reaction of the citric acid cycle (citric acid cycle defined as everything after glycolysis). Include quantities.

2 pyruvate + 8 NAD^+ + 2 ATP + 2 FAD → 6 CO_2 + 8 NADH + 2 ATP + 2 $FADH_2$

6 pts.

10) What is cyclical about the citric acid cycle? To get full credit, draw the parts of the cycle that illustrate the cycle. Label all parts.

The cycle start with a 4 carbon sugar and ends with its production, thus it is cyclical. See figure.



6 pts.

11) Hypothesize why paraquot is probably toxic to animals.

Paraquot works in plants by acting a an electron sink in the electron chain. In animals, it is possible that paraquot might also pull electrons away from the mitochondrial pathway and thus reduce the production of ATP.

8 pts.

12) Are humans capable of anaerobic metabolism? Explain why your answer makes sense in terms of evolution.

Yes. This makes sense because there are times when we might need a burst of energy beyond our capacity to deliver oxygen to cells. For those individuals that can ferment for a short time, they can out compete those who cannot and thus pass on the genes that gave them that capacity.

10 pts.

13) <u>List</u> five molecules you would expect to find in an obligate aerobe that you would not expect to see in an obligate anaerobe.

citric acid and other intermediates in the citric acid cycle
oxygen
ATP synthase proteins
electron transfer pathway molecules
enzymes in the citric acid cycle