Biology 113 Closed Book Take-Home Exam #3 – Chapters 9 - 11

There is no time limit on this test, though I have tried to design one that you should be able to complete within 3 hours. There are 6 pages in this test, including this cover sheet. You are not allowed to look at someone else's test, nor use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone until all exams are turned in by 10:30 am on Monday 21 November. **EXAMS ARE DUE BY 10:30 AM ON MONDAY 21 NOVEMBER**. If you turn in your exam late, you will lose a letter grade which accumulates for each day you are late. The **answers to the questions must be typed within this test** unless you want to draw on a separate page. If you do not write your answers in the appropriate location, I may not find them. Tell me where to look if you put your answer at the back of your test.

I have provided you with a "Data Gallery" in the form of figures and tables. To choose a figure in support of your answer, simply state Figure #x. You do NOT need to move the figure on your test. Do not assume how many of the data images you will use, or not use. **Simply choosing the data is not sufficient support for your answer. You must explain the significance of the data and how they support your answer.** I have given you word limits so be concise.

-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.
Email all your work when finished with the exam.

Name (please print):

Read the pledge and sign if you can do so with honor:

____

On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

<u>Lab Questions:</u>

12 pts.

1) You have the tools to evaluate DNA that you have cloned.

a) Here are some miniprep DNA values from the Nanodrop spectrophotometer. Tell me which one sample you would send for sequencing and why. Remember you need 320 ng in a final volume of 8 µL. (20 word maximum)

Sample 1: 298.1 ng/µL 260/280 ratio 1.63

Sample 2: 23.7 ng/µL 260/280 ratio 1.85

Sample 3: 85.2 ng/µL 260/280 ratio 1.91

Sample 1 has low purity DNA (ratio) and sample 2 is too dilute.

b) Tell me how you would prepare your chosen sample to make 320 ng of DNA in a final volume of 8 µL. (20 word maximum)

3.76 µL DNA + 4.24 µL water

c) Use the Word file called Sequencing_Results.docx and Clustal omega to find the SNP. You must insert a screenshot to show your answer. https://www.ebi.ac.uk/Tools/msa/clustalo/ (20 word maximum)

```
Sequence1      GCAGTTCCAGTAGGGTTCCAAAGCTTACGTTAAACACCCGGCTGACATCCCGGACTACCT     540
Sequence2      GCAGTTCCAGTACGGTTCCAAAGCTTACGTTAAACACCCGGCTGACATCCCGGACTACCT     540
Sequence3      GCAGTTCCAGTACGGTTCCAAAGCTTACGTTAAACACCCGGCTGACATCCCGGACTACCT     540
Sequence4      GCAGTTCCAGTACGGTTCCAAAGCTTACGTTAAACACCCGGCTGACATCCCGGACTACCT     540
               ************ ***********************************************
```

C mutated to G in sequence 1

<u>ICB Questions:</u>

16 pts.

2) Without neurons, you could not feel the keyboard.

a) How does a neuron receive chemical information and convert it to a full action potential? Support your answer with data. (35 words maximum)

ligand-gated sodium channels open (#5), if depolarized to threshold (#34), the full action potential

b) Make a numbered list of four major differences in voltage-gated ion channels found on a neuron. Support your list with figures from the gallery. (30 words maximum for each difference)

1. Different ions (#18)
2. Refractory period for voltage-gated Na+ channel (#28)
3. K+ channels delayed opening (#34)
4. Location of different channels (#31)

20 pts.

3) Your muscles allow you to type answers on this exam.

a) Focusing only on Ca^{2+} ions, list two similarities and two differences (compare and contrast) between muscle and neuron function. Support your answers with data. (35 words maximum for each numbered response)
Similarities
1 floods cytoplasm in both #31
2 triggers cellular response in both #13
Differences
1 Ca2+ extracellular in neuron, from SR in muscles #23
2 binds vesicle protein in neurons, troponin in muscles #23

b) Explain to someone taking Bio111 how muscles get bigger with repeated exercise. Support your answer with data. (35 words maximum)
muscle cells add more protein (actin & myosin) = hypertrophy 1000x more mass than DNA
muscle cells add more precursor cells via fusion = hyperplasia #15

22 pts
4) Providing answers to exam questions can require short-term or long-term memory, but the latter is better.
a) Use gallery figure 36 to describe the function of each molecule listed below: (30 word maximum for each)

- PKA essential for short and long term learning
- CREB-1 transcription factor for long memory proteins
- Protease closes circle for positive feedback loop in long memory
- exocytosis protein added to synapse where long memory is stored

b) list two similarities and two differences between short-term and long-term memory. Support your answers with data. (30 words maximum for each numbered response)
Similarities
1 both produce more output with same input #35
2 PKA critical to both #36
Differences
1 longer lasting in long-term memory #38
2 new proteins produced in long memory #36

15 pts
5) When you're hungry, you should eat.
a) List three major categories of food you can eat and summarize how their high energy products go to the citric acid cycle and the electron transport chain. Support each category with figures from the gallery. (30 words maximum for each numbered response)

1 lipids (#11) NADH, $FADH_2$ → ETC and acetyl-CoA → citric acid cycle
2 proteins (#7) NADH → ETC and acetyl-CoA → citric acid cycle
3 carbohydrates (#22) NADH → ETC and next step: acetyl-CoA → citric acid cycle

b) How do some products of the citric acid cycle and the ATP synthase slow down cellular respiration? Choose two specific enzymes and list all the products that inhibit them. To get full

credit, you must support both enzyme choices with data. (30 words maximum for each numbered response)
enzyme 1: GDH inhibited by GTP and NADH from citric acid cycle and ATP from synthase #7
enzyme 2: PFK inhibited from citrate (cycle) and high ATP from synthase #8

15 pts
6) Plants and animals co-evolved.
a) Summarize the daily homeostatic regulation that affects the production of ATP and NADPH in plants. Support your answer with two figures. (30 words maximum for figure)
blue light, mid-day, no water splitting, cyclic electron transport and ~ATP synthesis
red light, twice a day, water splitting, non-cyclic e- transport = ~APT and NADPH synthesis
figures #21 and #4

b) Explain two homeostatic mechanisms that assure carbon fixation takes place primarily during the day. Support your answer with data. (35 words maximum)
#17: high stromal pH and maximum rubisco activity + elevated Mg^{2+} concentration to offset charge accumulation in thylakoid space; both when sun shining only

Data Gallery

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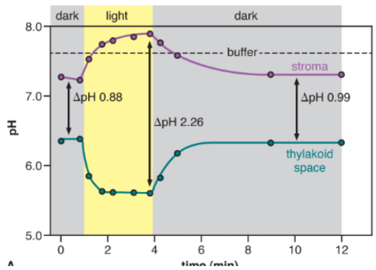

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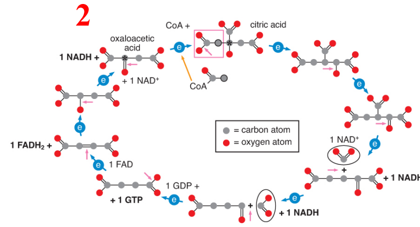

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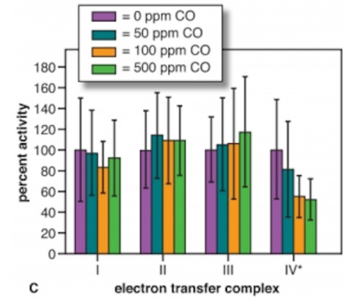

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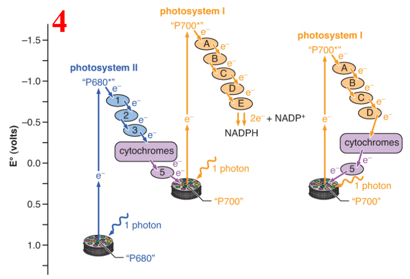

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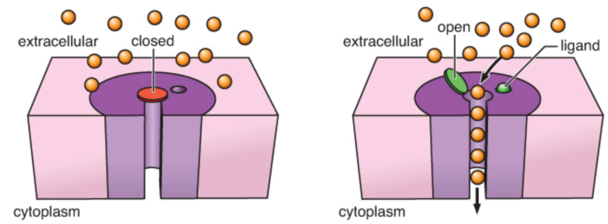

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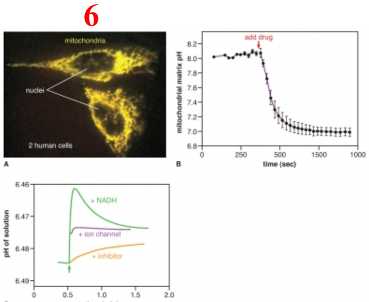

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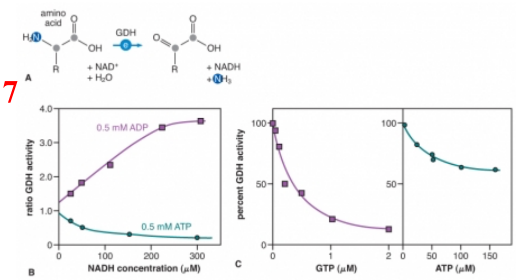

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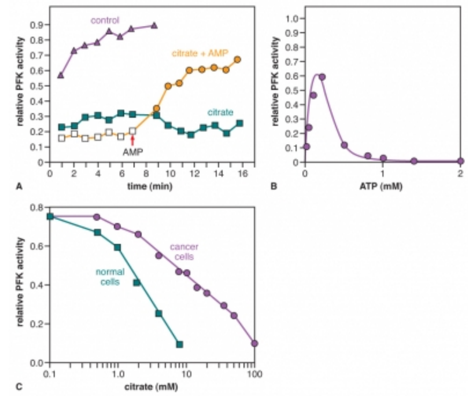

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enzyme identification	enzyme (μM)	substrate (μM)	
e1	n.a	s1	near 0
phosphofructokinase	n.a	s2	1,500
e3	810	s3	80
e4	1,400	s4	80
e5	130	s5	50
e6	540	s6	20
pyruvate kinase	170	s6a	65

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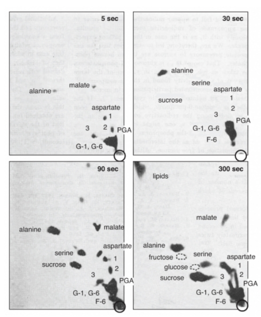

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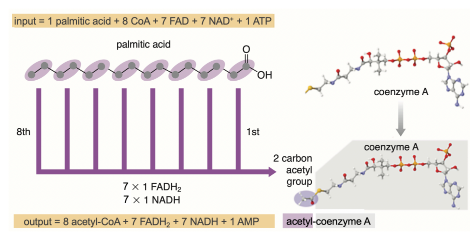

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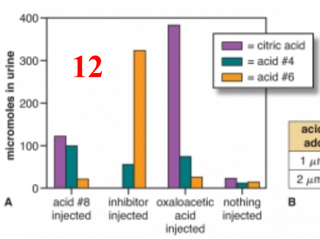
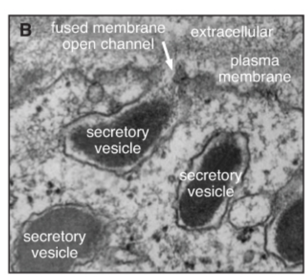


acid #8 added	oxygen uptake (calculated)	oxygen uptake (measured)
1 μmole	6 μmoles	47.2 μmoles
2 μmoles	12 μmoles	69.4 μmoles

B

13



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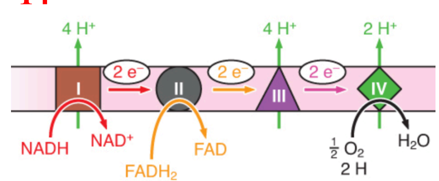

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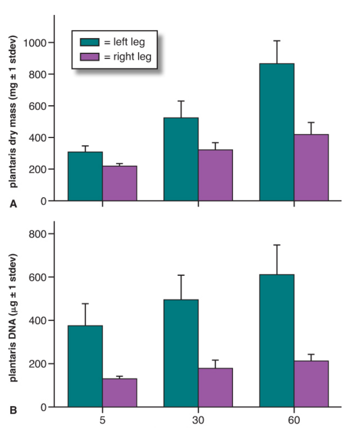

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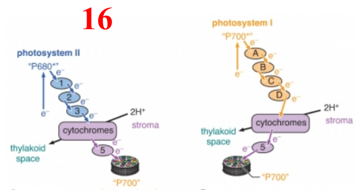

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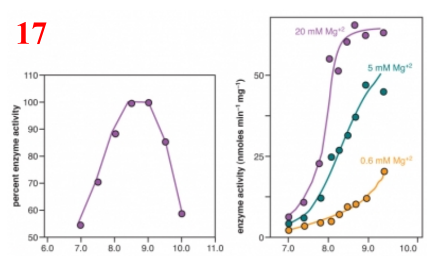

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ion	intracellular concentration	extracellular concentration
K^+	155 mM	4 mM
Na^+	12 mM	145 mM
Ca^{2+}	0.0001 mM	1.5 mM
Cl^-	4 mM	120 mM

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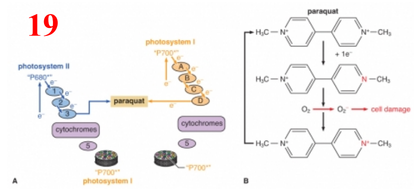

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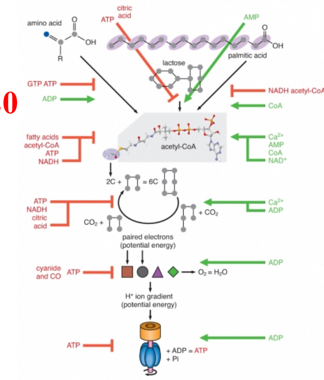

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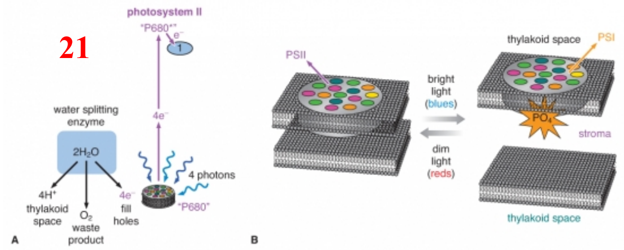

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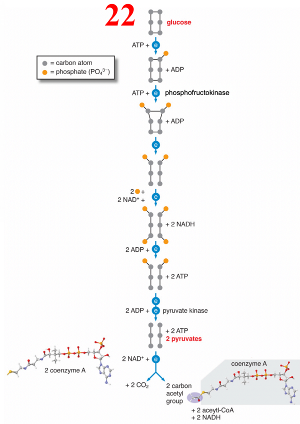

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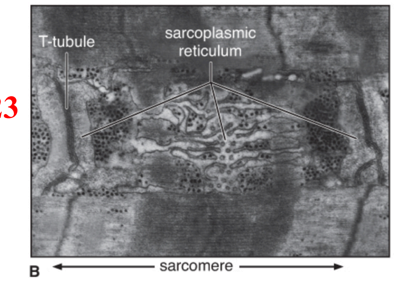

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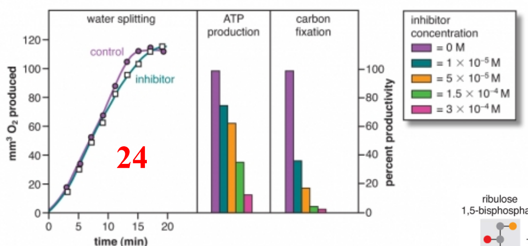

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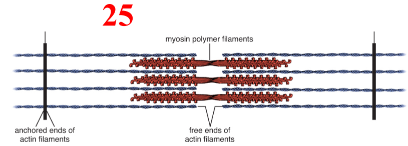

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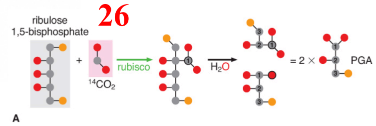

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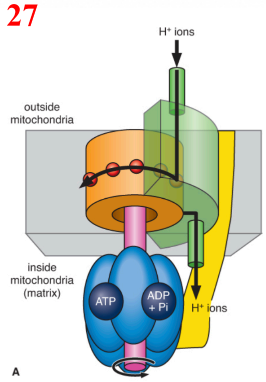

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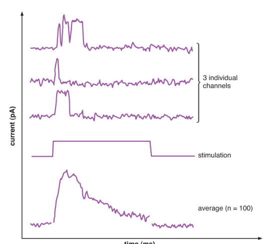

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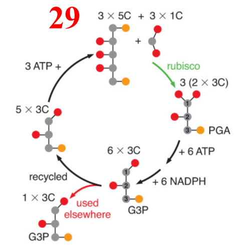

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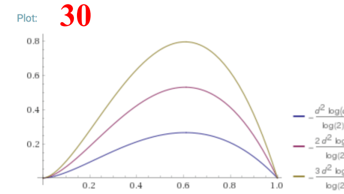

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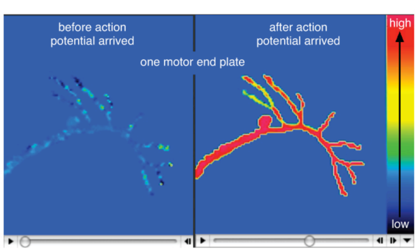

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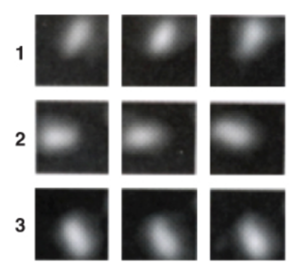

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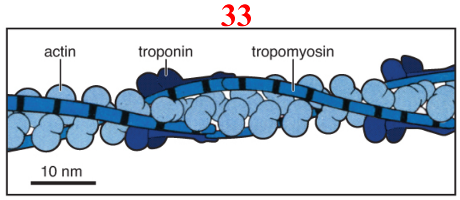

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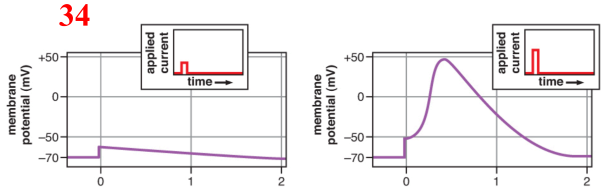

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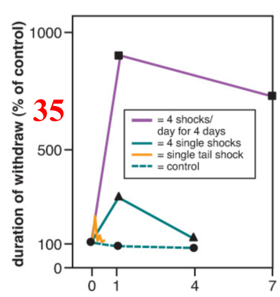

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