Spring 2008 Biology 111 KEY Take-Home Exam #2 – Classical Genetics

There is no time limit on the take-home portion of this exam, though I have tried to design one that you should be able to complete within 2 hours. There are 4 pages for this exam, 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 the in-class exam is completed at 12:30 pm on Friday February 29. **EXAMS ARE DUE AT CLASS TIME ON FRIDAY FEBRUARY 29.** You may use a calculator and/or ruler for both portions of the exam. The **answers to the take-home exam must be typed on separate sheets 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 can draw by hand or using the drawing tool in Word or Excel.

For the in-class test, bring a **black ink pen**, **a red ink pen**, and a regular pencil.

-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:

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 (excluding typing)?

Lab Questions
10 pts.

1) a. Calculate the molecular weights of the two bands marked by dots in lane B. You must generate a graph in Excel and paste it into your exam to get credit. Molecular weights are in kilobases.

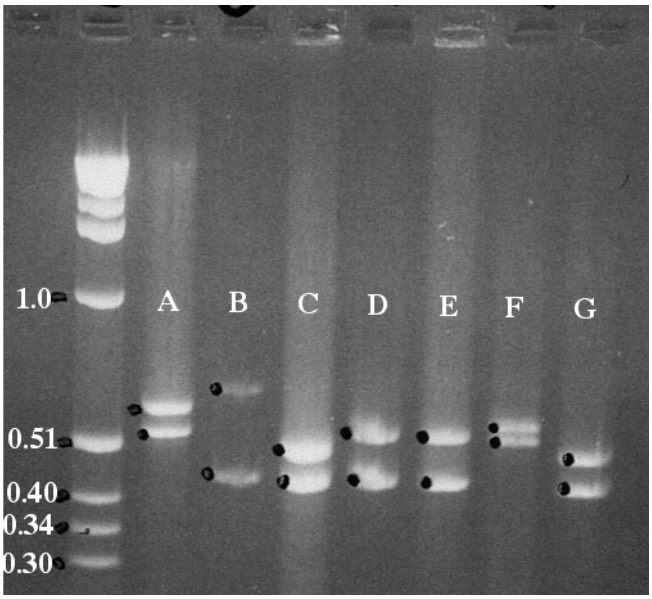
Top Band = ___~700_____

Bottom Band = __~450_____

Graph needed to have exponential Y axis and labeled axes.

b. If the evidence for the terrible crime of taking someone's favorite pen is in lane G, which lane contains DNA from the person who left a drop of blood at the crime scene? The DNA from lanes A – F are from different people who were near the crime scene at about the time of the crime. Please tell me who committed the crime and how you reached your conclusion.

All you can do is rule out suspects A, B, D, E, and F. C is still as suspect but you cannot say s/he is guilty. DNA data is good for exonerating people, not convicting them. Just because C was in the area does not mean C did the crime.



Lecture Questions
4 pts.

2) a. What is an oligonucleotide?

Single-stranded piece of DNA of no set length.

b. Name two experimental methods that use oligonucleotides. For each method, describe in no more than two sentences how the oligos are used.

primers for PCR

probes for Southern blots/ RFLP

8 pts.

3) We are interested in two rare traits recently discovered. One recessive traits is an inverted nose where the nostrils point up rather than down (rare because most homozygotes drown when they walk in the rain). The other trait is dominant - an inverted navel which appears on a person's back rather than stomach (also increasingly uncommon due to navel piercings that puncture kidneys and lead to rapid death).

Design a mating experiment to determine if these two genes are linked or not when you have any combination of alleles available to you for experimental purposes. (Do not worry about ethical dilemmas associated with real humans – this is not a real case.) Your answer should **NOT be in written words**, but diagramed as matings (*e.g.*, red x blue) with genotypes given for each mating. Following your mating experimental design, provide two tables of data for the offspring with frequencies of F1 individuals. One table should predict the outcome if the genes are linked, and the other table should be for unlinked genes. Be sure to label which table is which.

N = wt nostril down **n = nostrils up**
B = bellybutton backwards **b = wt bellybutton forwards**

Nnbb x NnBb

If two phenotypes – linked
If all 4 phenotypes – not linked

10 pts.

4) Describe in one sentence each of the following:

a. CFTR locus in sweat glands of a parent with CF

locus has two mutant alleles

b. RFLP linked to CF

banding pattern that is inherited along with mutant alleles of CF

c. splicosome in HD patient's brain cells

probably normal since error in spliceosome is pretty severe and would probably lead to early onset disease

d. wild-type beta hemoglobin proteins in sickle cell carrier

these proteins would be associated with either other wt B, or mutant B since there are two in each hemoglobin molecule and they pair up randomly.

e. codon #6 in sickle cell patients' beta hemoglobin mRNA

This is wt since codon 7 is the mutated one.

4 pts.

5) Which process consumes more energy, adding an amino acid to a tRNA or assembling the ribosome on an mRNA? Explain your answer.

They are the same: 1 ATP to add the amino acid to tRNA and one GTP to assemble the ribosome.

6 pts.

6) Determine if the disease in Figure 1 is dominant, recessive, or incomplete dominant. You must explain how you reached your conclusion.

You cannot tell. Not enough information.
It is NOT incomplete dominant since no partial phenotypes.

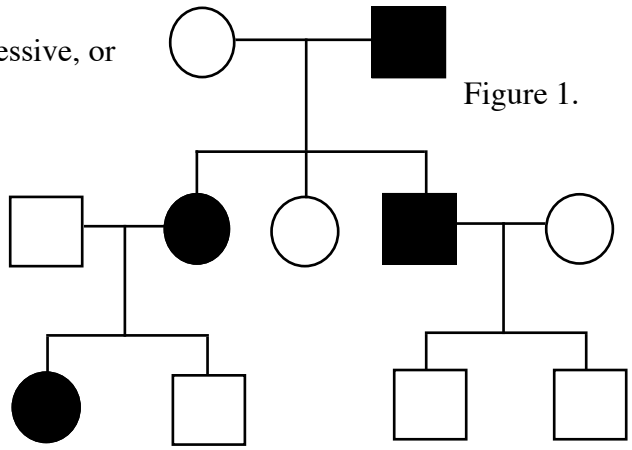


Figure 1.

6 pts.

7) Let's assume the disease in Figure 1 is recessive (don't let this assumption affect your answer to number six above). What is the probability for:

a. individual II.1 to be heterozygous?

1

b. couple II.3&4 to have two boys?

1/4

c. P generation to have 2 girls and then a boy where the first and third child have the disease?

1/64

Show your work for partial credit.

6 pts.

8) Type a bacterial RNA immediately after it has been transcribed. Make the RNA 33 bases long and label any parts other than the sequence that you think are critical to show your understanding of bacterial transcription (ignore translation events).

Needed 33 bases
No intron
No poly A or G cap
Needed AUG
No Ts
Best if 5' and 3' untranslated regions

6 pts.

9) Make a **numbered list** of only the proteins involved in replicating DNA during the S phase. After listing each protein, write a one sentence description of its function.

1. DNA polymerase
2. ssBinding Protein
3. helicase
4. ligase

5. primase
6. topoisomerase
7. telomerase