# Fall 2002 Biology 111 Exam #2.5 - Molecular Genetics Half Exam

There is no time limit on this test, though I have tried to design one that you should be able to complete within 1.5 hours, except for typing. You are not allowed to use your notes, old tests, any electronic sources, any books, nor are you allowed to discuss the test with anyone until all exams are turned in by class on Monday November 4. **EXAMS ARE DUE AT CLASS TIME ON MONDAY NOVEMBER 4**. 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 on the appropriate pages, I may not find them unless you have indicated where the answers are. There are 4 pages to this exam, including this cover sheet.

- 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)?

**10 pts.**

1) On the last page of this exam are some PCR/VNTR data. Please analyze them and answer these questions:

a) calculate the molecular weights in base pairs for each allele in this pedigree. List your findings for each person (1 = x and y, etc.)

1 = 450 hemizygote
2 = 525 homozygote  3 = no data
4 = 450 and 525
5 = 470 and 525
6 = 450 and 525
7 = 525 hemizygote
8 = 450 and 525

b) Explain the mode of inheritance for this disease.

This is a sex-linked recessive disease and the recessive allele is linked to the 525 bp band. Note the boy and the father are both hemizygous.

Note, individual 7 has only one band (focus on the main band with a black dot next to it).

Use the graph paper included in this test to calculate the molecular weights. Without a graph, done by hand, you will not get credit for part a.

**6 pts.**

2) a. What is a tetrad?

The collection of 4 chromatids gathered together during prophase I.

b. When does recombination normally occur?

During prophase I.

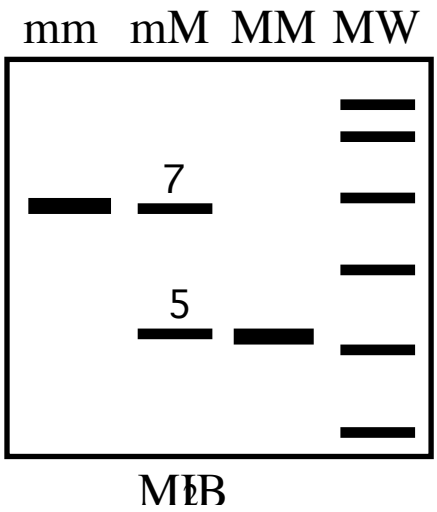
c. Linkage is proportional to the distance between two loci. Explain what this means using non-jargon terminology.

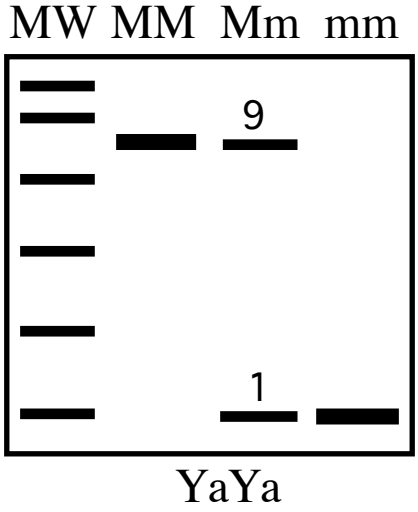
The greater the distance between two positions on a chromosome, the higher the probability of recombination, or crossing over, between these two points. Because there is more room for crossing over, linkage analysis shows recombination is more likely. Shorter distances result in less frequent recombination.

**7 pts.**

3) Map these three loci (MIB, YaYa, MR). Two loci are RFLPs and one locus is a gene. Your answer must include a map drawn on the line below. For partial credit options, include any scrap paper you use. MR is a recessive disease.

| genotypes | frequency |
|---|---|
| wild-type & 5 | 368 |
| disease & 7 | 367 |
| wild-type & 7 | 12 |
| disease & 5 | 11 |
| wild-type & 9 | 348 |
| disease & 1 | 349 |
| wild-type & 1 | 31 |
| disease & 9 | 30 |
| 5 & 9 | 338 |

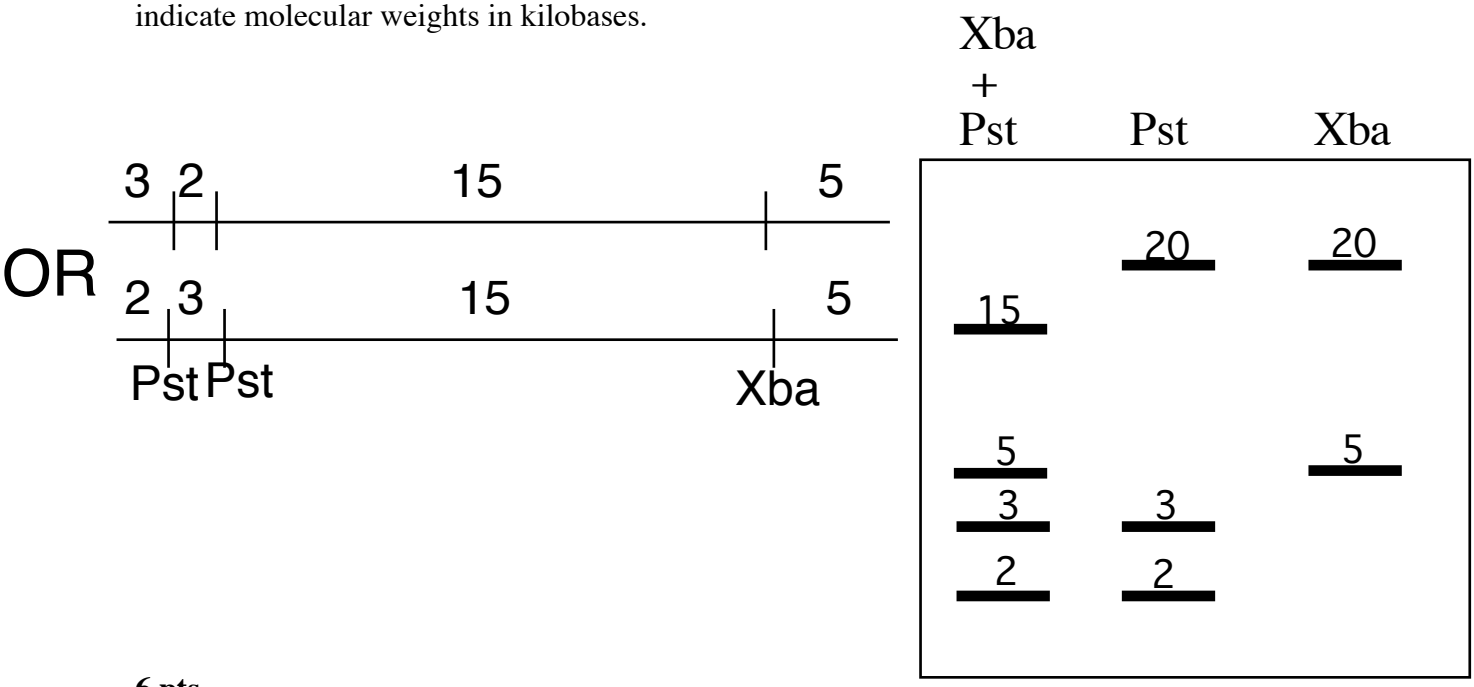


| | |
|---|---|
| 7 & 1 | 336 |
| 5 & 1 | 41 |
| 7 & 9 | 43 |


**9 pts.**

4) Map the restriction sites using the data in the gel below. This gel contains DNA fragments on a gel, it is not a blot. Draw your map on the line below the gel. The numbers above each band indicate molecular weights in kilobases.




**6 pts.**

5) a. Explain why DNAse is prescribed as medication for people with cystic fibrosis.

Their mucus has DNA in it from the dying cells. DNA makes the mucus more viscuous. DNase destroys the DNA and reduces the viscosity which allows the mucus to be coughed up from the lungs.

b. List 3 potential hazards of performing gene therapy for cystic fibrosis.

Autoimmune disease.

Delivery vehicle (e.g. virus) can kill patient.

May overproduce and become detrimental.

**6 pts.**

6) a. How was exon amplification used to clone the HD gene?

It allowed the investigators to identify which piece of DNA contained the coding region because a new mRNA was produced.

b. Give two names for the type of mutation that leads to HD.

Trinucleotide repeat/expansion and VNTR

c. Design an experiment to detect whether you have HD or not.

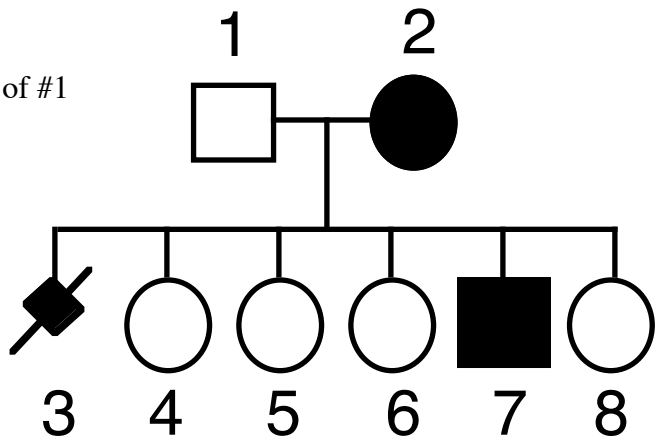
As in lab, do PCR using primers that flank the region of duplication and then run the PCR products on a gel. Be sure to include a known wt allele and a known mutant allele.

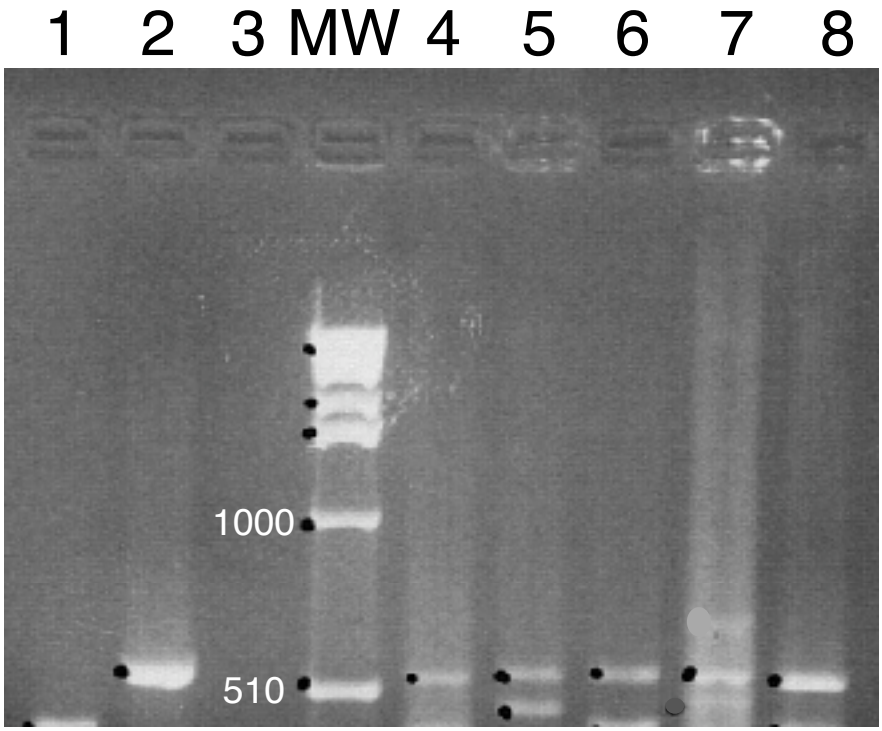
**6 pts.**

7) Read this sequencing gel beginning with the band pointed to by the arrow. List the first 20 bases and label the appropriate ends 5' and 3'.

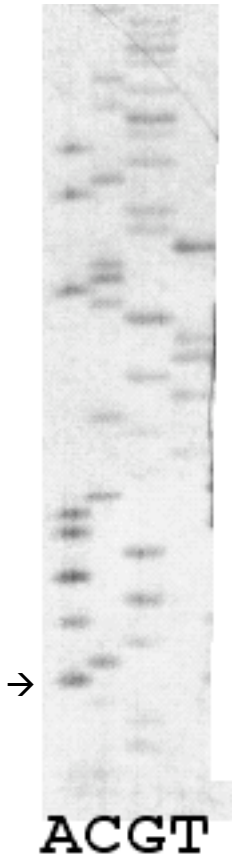
**5′ ACG AGA GAA CGT GCT GTT GC 3′**

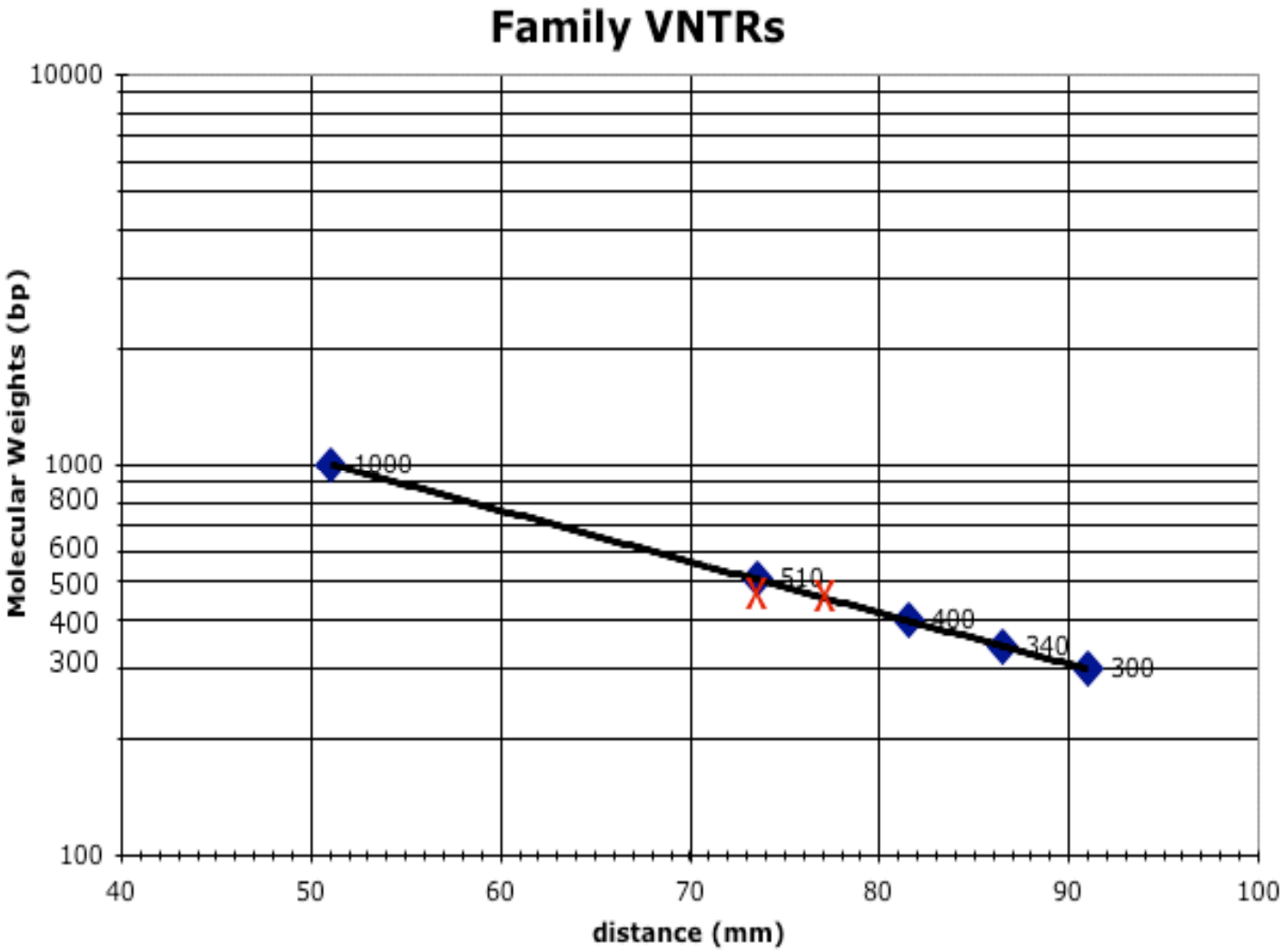
Part of #1




Part of #7




Family VNTRs
Molecular Weights (bp)
10000
1000
800
600
500
400
300
100
1000
510
400
340
300
40
50
60
70
80
90
100
distance (mm)