NAME_____TA_____Section #_____

7.013 Problem Set 2 Solutions

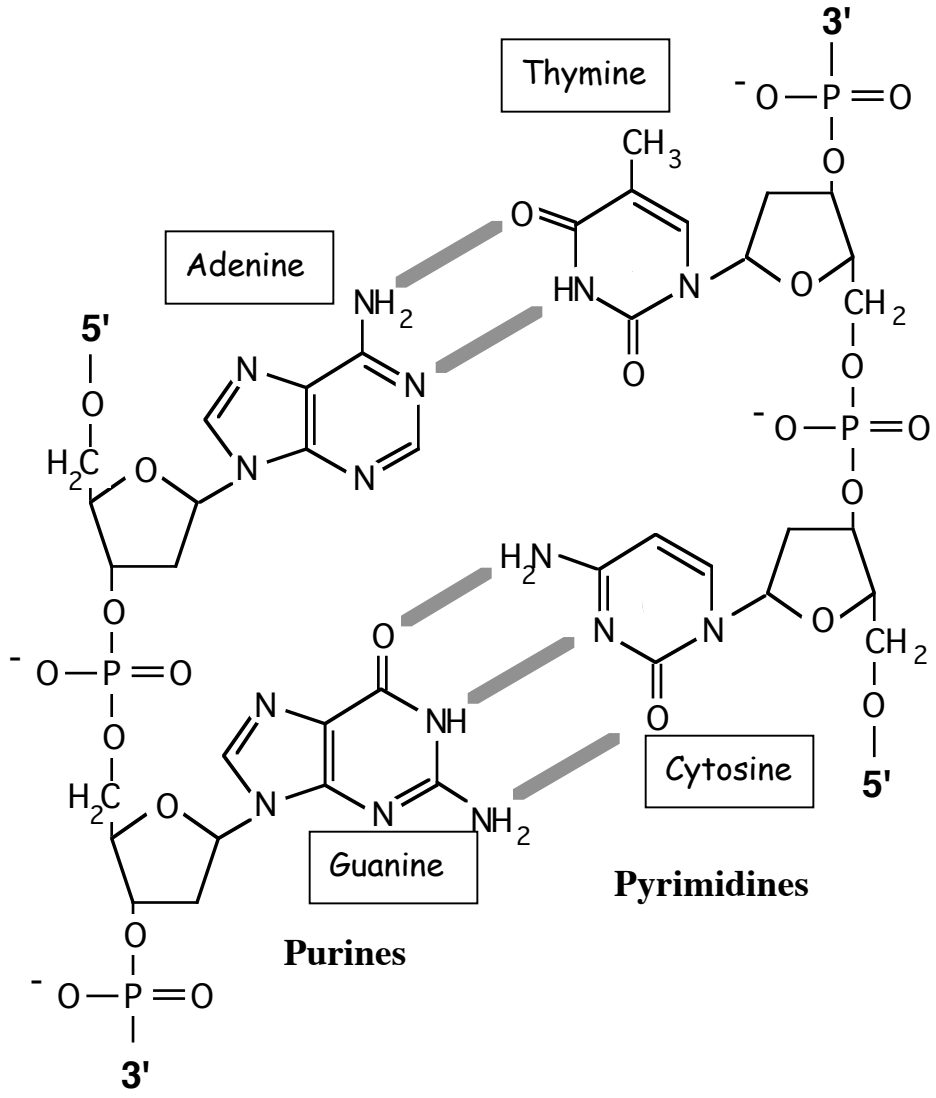
FRIDAY September 17, 2004

Answers to this problem set must be inserted into the box

Problem sets will NOT be accepted late. Solutions will be posted on the web.

Question 1

a) What is the molecule shown below?



b) What kind of bonds are indicated by the gray lines?

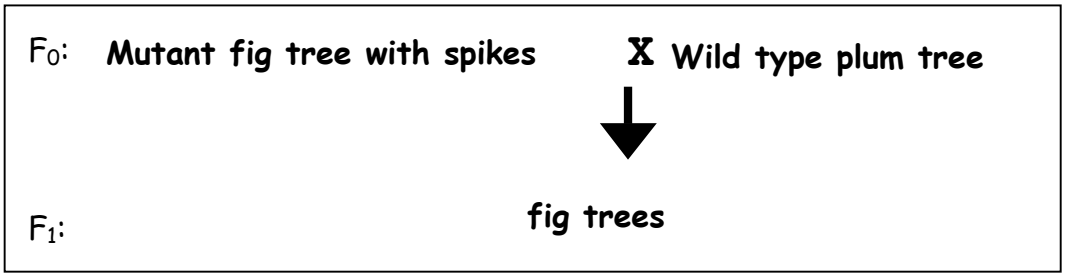
HYDROGEN

c) Identify the purines and pyrimidines shown.

Question 2

Harry studies plum tree genetics.

He had a pure-breeding mutant strain of plum trees that has two unusual characteristics; the mutant tree produces figs instead of plums and there are huge spikes growing out of the branches. Harry crossed the mutant with a pure-breeding wild-type plum tree. The F_1 progeny produce figs, but have no spikes.



a) For each pair, circle the dominant phenotype.

Plums **Figs** Spikes **No spikes**

b) Harry performed a backcross of an F_1 individual with an F_0 individual from the mutant strain. If there are **32** progeny trees from this cross how many trees have each of the following phenotypes?

Figs, spikes _____16____

Figs, no spikes _____16___

Plums, spikes _____0_____

Plums, no spikes _____0_____

Harry performed a test cross of an F_1 individual (from the very first cross) with a tree exhibiting both of the phenotypes that you have identified as recessive. He got progeny with the following characteristics.

Phenotype	**# of individuals in F_2 generation**
Figs, spikes	897
Figs, no spikes	97
Plums, no spikes	903
Plums, spikes	103

c) What is the recombination frequency between the "*fig*" and the "*spike*" genes? Show your work.

97+103/ 103+97+903+897= 200/2000--> 10%

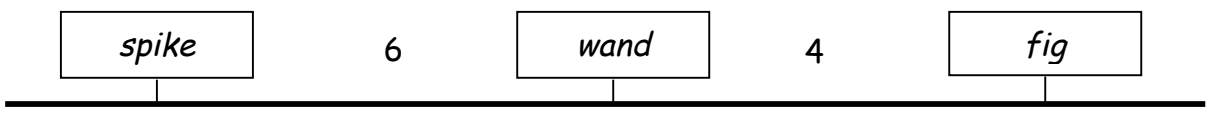
_____10%_____

Harry had previously identified a mutant plum tree whose branches are magical, and can be used to make magic wands. The gene that produces this phenotype (the "*wand*" gene) was previously determined to be 6 map units away from the "*spike*" gene on one chromosome.

d) Based on the above data, there are two possible arrangements for the "*fig*", "*spike*", and "*wand*" genes on the chromosome. Draw them below naming the genes in the boxes and indicating between them the distances in map units.

Arrangement 1:

Arrangement 2:



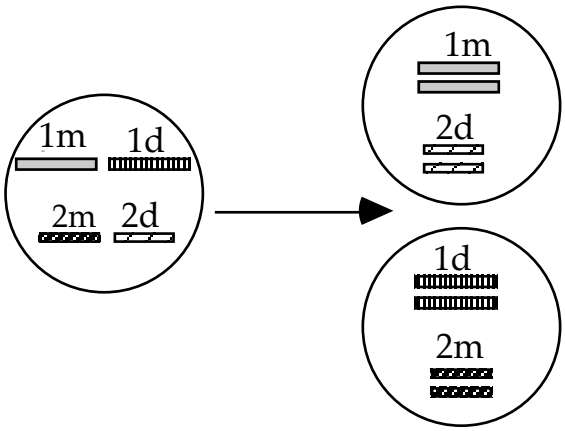
e) What experiment could Harry perform to distinguish between these two possibilities?

A cross to determine the distance between fig and wand. A tree heterozygous at both the wand and fig loci crossed with the double recessive homozygote will lead to information to determine the correct orientation.

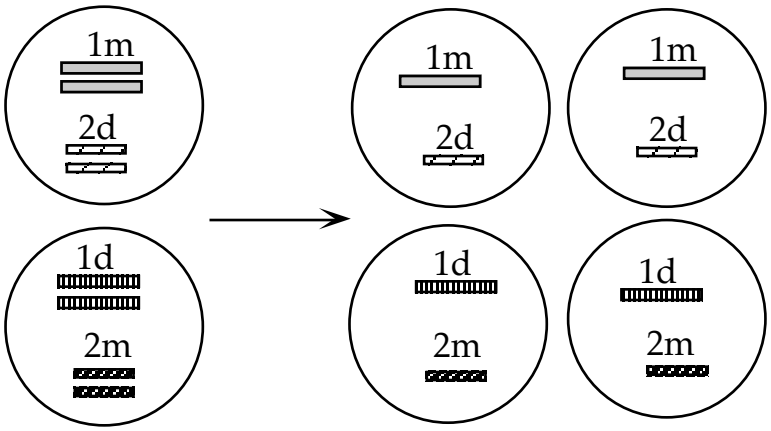
Question 3

The following diagrams show a diploid cell with 2 chromosomes, 1 and 2. The chromosome derived from the mother is denoted "m", and the chromosome derived from the father is denoted "d".

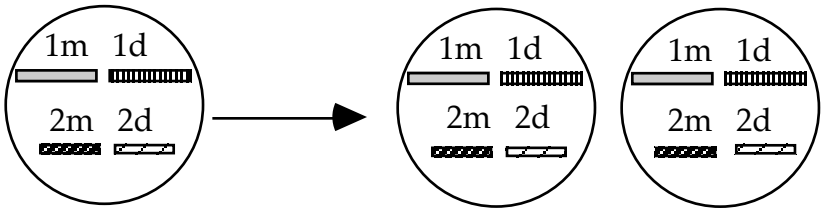
a) The picture below shows the end of mitosis/<u>meiosis I</u>/meosis II. (Circle one.)



b) The picture below shows the end of mitosis/meiosis I/<u>meosis II.</u> (Circle one.)



c) The picture below shows the end of <u>mitosis</u>/meiosis I/meosis II. (Circle one.)



d) In which stage of mitosis or meiosis does most of the recombination occur? Explain why. Meosis 1 because the chromosomes derived from one parent are duplicated and line up right next to the homologous duplicated chromosomes derived from the other parent. A crossover occurs most of the time at this point. See this great animation.

http://www.johnkyrk.com/meiosis.html

http://www.johnkyrk.com/mitosis.html

Question 4

It is Year 2030, and the first "personned" expedition to Mars is successful. (With the invention of impulse engines and inertial dampers, this is a trivial accomplishment.) A stunning discovery is made: There is life on Mars! There are round, purring, fuzzy, friendly, furry creatures that come in 3 colors: Plush Purple, Ruby Red and Bright Blue.

They are dubbed "*Martianiti tribbli*", "tribbles" for short (an allusion to an archaic 20th Century television show).

The MIT rocket scientists come to you, a renowned geneticist, Prof. Seven O. One, to solve the mystery of tribble coat inheritance.

Here are the facts.

The scientists can get pure breeding lines of Blue and Red tribbles, but cannot get pure breeding Purple tribbles.

Cross 1: Blue x Red

F1: All Purple tribbles

a) What is the inheritance pattern for coat color? (Circle one)

Complementation Dominant Recessive **Codominant** X-Linked

b) What is the predicted ratio of Blue: Red: Purple tribbles for each of the following crosses?

i) Cross: Red x Purple

F1: Blues: 0 Reds: 1 Purples: 1

ii) Cross: Purple x Purple

F1: Blues: 1 Reds: 1 Purples: 2

iii) Cross: Blue x Blue

F1: Blues: 1 Reds: 0 Purples: 0

Question 4 continued

You find that there is another gene locus (Albino) that controls coat color and is **epistatic** to the red/purple/blue color locus. When (and only when) a tribble is homozygous "aa" for this locus, it is pure white, "albino". (Assume that allele B codes for Blue color and allele b codes for Red color.)

c) Predict the coat color for tribbles with the following genotype:

i) Genotype: BB aa ; Phenotype: _____*Albino*_____

ii) Genotype: BB AA ; Phenotype: _____*blue*_____

iii) Genotype: Bb Aa ; Phenotype: _____*purple*_____

iv) Genotype: bb aa ; Phenotype: _____*Albino*_____

d) Fill in the ratio of progeny classes from the following crosses.

Cross	Purple Progeny	Blue Progeny	Red Progeny	White Progeny
BBAA X Bbaa	1	1	0	0
BbAa X BbAa	*6*	*3*	*3*	*4*
Bbaa x BBaa	*0*	*0*	*0*	*1*
Bbaa X bbAa	*1*	*0*	*1*	*2*

Question 5

A woman with blood type O has a child with blood type O. She claims that a friend of hers is the child's father. In the ABO system, I^A and I^B are both dominant to *i* and are codominant to each other. ABO genotypes are summarized below and described on page 187 of the 6th edition of Purves.

I^AI^A and I^Ai	A
I^BI^B and I^Bi	B
I^AI^B	AB
i	O

a) Her friend's blood type is A. Can he be excluded as the father on this evidence alone?
NO.
The mother is ii and the child is ii. The man (with type A blood) could be I^AI^A or I^Ai. If he is I^A i, he could contribute a i allele, so he cannot be ruled out as the child's father.

b) Does the fact that the accused man's mother has type A and his father has type AB exclude him from being the parent?
NO.
His mother (type A) could be I^AI^A or I^A i. *and his father (type AB) must be I^AI^B. The man could have type A blood (and the I^A* i *genotype) if his mother contributed her* i *allele and his father contributed his I^A allele. Therefore, this information cannot rule exclude the man as the child's father.*

c) Does the additional information that his mother's parents are both AB permit him to be excluded?

YES.

If his mother's parents are both type AB (I^AI^B), then his mother must be I^AI^A and she could not contribute an i allele to her son. Therefore, the man must also be I^AI^A. This information would exclude him as the child's father. (Provided these are his real parents.)