

Biol 163 Midterm Oct 15 **Answer Key** **Answers are in Bold Face**

Honor Pledge: I have neither given nor received any unauthorized help on this exam:

Name Printed: _____

Signature: _____

Question 1 (15 total points)

An Hfr mating experiment is carried out mating the following strains:

Hfr $a^+ b^+ c^+ Str-s$ X

$a^- b^- c^- Str-r$

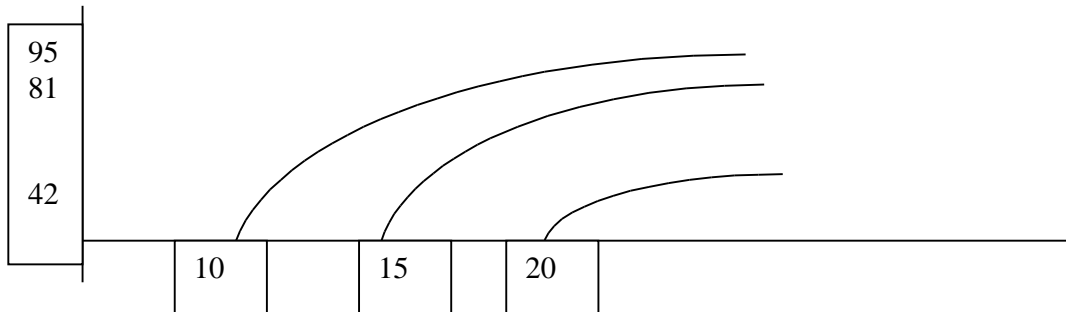
The data in the accompanying table are obtained.

Time of mating In minutes	Number of recombinants of indicated genotype per 100 Hfr bacteria in initial mating		
	$a^+ str-r$	$b^+ str-r$	$c^+ str-r$
0	0.01	0.006	0.008
10	5	0.1	0.01
15	50	3	0.1
20	90	35	2
25	95	80	20
30	98	82	43
40	96	80	40
50	97	80	40
60	95	81	42

1. Draw a graph of the data with time as the X axis and Proportion of recombinants as the Y axis. (10 pts)

See page 2

Your graph should look something like this. Except steeper. I am limited by my drawing program here. You get the time of entry by drawing a line along the steepest part of your curve to the X axis. The time point at which the line crosses the X axis is the time of entry. Some people took the midpoint of the steep part of the curve. This is incorrect.



2. What are the times of entry of each gene (*a b* and *c*)? (3 pts)

A is 10 min

B is 15 min

C is 20 min

3. What is the gene order on the chromosome? (1 point)

A, b, c

4. Which gene is farthest from the site of integration of the F plasmid in the *Hfr* strain? (1 point)

c

Question 2 (5 points) In the following mating:

Hfr met- his+ leu+ trp+ X F- met+ his- leu- trp-

What is the purpose of the *met-* mutation in the *Hfr* strain?

The *met* gene is needed to select recombinants on plates that will not allow growth of the *Hfr* strain. The *Hfr* strain needs the amino acid methionine added to the plates to grow but the recombinants will have a functional *met* allele from the recipient's genotype.

Question 3 (3 points)

You are starting your career as a molecular biologist and you have been given a previously unculturable bacteria from dental plaque. Your colleagues have just learned how to grow it on defined medium in petrie plates. You want to identify genes for

resistance to the antibiotic ampicillin. If you are using a genetic approach, The first step will be to identify mutants.

How will you generate mutants?

Expose to UV light or Chemical mutagens I also accepted grow on antibiotic and select spontaneous resistance. However, mutagenesis, when it works, will give you a higher frequency of getting mutants.

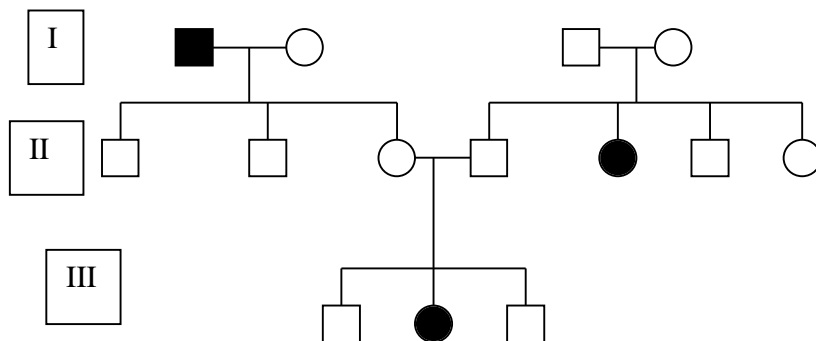
Calculate the mutation frequency.

	Replicate 1	Replicate 2
Plated on full medium,	7.0×10^7	1.2×10^8
Plated on medium plus ampicillin	4.5×10^6	6.0×10^6

Average values: $5.25 \times 10^6 / 9.5 \times 10^7 = 5.5 \times 10^{-2}$

Question 4 (3 total points)

From the following pedigree, determine if the affected trait is caused by a dominant or a recessive allele. Determine the most probable genotype for each individual based on your prediction



Answer on next page

I-1 tt

I-2 T/- (I accepted Tt or TT since I said probable in the question)

I-3 Tt

I-4 Tt

II-1 Tt

The gene is recessive

II-2 Tt

II-3 Tt

II-4 Tt

II-5 tt

II-6 T/-

II-7 T/-

III-1 T/-

III-2 tt

III-3 T/-

Question 5 (8 total points) In which of the following cases can you use RNAi to induce a mutation and in which would it be better to use a chemical mutagen?

1. You have a cloned cDNA (gene transcript) isolated from adult *C. elegans* and you want to identify the function of the gene.

RNAi because you have a cloned gene to make the RNA

2. You want to identify genes essential for development of the vulva in adult *C. elegans*.

Chemical mutagen because you do not have any clone to generate RNA but you have a clear expected phenotype to select.

3. You want to identify genes important for mating behavior in *C. elegans*.

Chemical mutagen because you do not have any clone to generate RNA but you have a clear expected phenotype to select.

4. You have cloned a gene from *C. elegans* that has strong homology to a transcription factor that affects wing development in *Drosophila* and you want to determine the function of the gene in *C. elegans*.

RNAi because you have a cloned gene to make the RNA

Why did you make the choices you made?

Question 6 (6 total points): Assume seed color can be controlled by maternal effects (maternal tissues make up seed) or by a maternally inherited mutation (a chloroplast mutation that leads to reduced seed color. You have fertilized the flowers of a plant generated from yellow seeds with pollen from a plant generated from a brown seed. All

the seeds are yellow even though you know that brown is dominant to yellow. Explain fully how you can use genetic crosses to determine if the gene is maternally inherited vs a maternal effect gene?

Maternal effect: next generation will be heterozygous for the brown and the yellow alleles and when crossed to a wild type plant (from brown seeds) all the seeds will be brown.

Maternal inheritance. The next generation will have the chloroplasts from the maternal parent. If this plant is crossed as the maternal parent (seed producer) to a wild type plant (pollen producer), the seeds will all be yellow. If you cross it in the opposite direction the seeds will all be red.

Original cross:

Assuming that the gene is Nuclear call the locus Y Brown would be $Y/-$ and yellow would be yy . If the gene is cytoplasmic (maternal inheritance) designate the cytoplasm as cm^+ for Brown and cm^y for yellow

**Take the plants from the yellow seed as females: If the gene was nuclear with a maternal effect the genotype is $cm^+ Yy$ because the yellow seed came from mating a pure line mother with yellow seed $cm^+ yy$ with a pure line male with brown seed:
 $cm^+ YY$.**

If the gene was cytoplasmic the plant derived from the yellow seed has $cm^y yy$, YY or Yy . I'll use $??$ here for the nuclear genes. The nuclear genotype has no effect on the cytoplasm. The brown seed has $cm^+ ??$.

So to distinguish the two types of inheritance, take a plant derived from a yellow seed after the cross described in the question and use it as the female parent. Cross it to a male derived from a brown seed (you could use the pure line male used in the first mating):

If the mutation is a maternal effect, The parent genotypes are $cm^+ Yy \times cm^+ YY$

The resulting seed will be brown (this is true no matter what is the genotype the male parent)

If the mutation is maternally inherited the parental genotypes are $cm^y ?? \times cm^+ ??$

The resulting seed will be yellow