

Name: \_\_\_\_\_

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Genetics 320 Exam II. October 28, 2005.

1. Lac Operon (25 pt) \_\_\_\_\_

2. Recombination/complementation in phage (20 pt) \_\_\_\_\_

3. Mitotic Recombination (25pt) \_\_\_\_\_

4. T/F short answer (25 pt) \_\_\_\_\_

5. Extra Problem: F' reversion (5 pt) \_\_\_\_\_

TOTAL \_\_\_\_\_

**1. Lac Operon (25 points)**

A. Given the genotypes, fill in the appropriate phenotypes for LacZ and LacY. The inducer is lactose or IPTG.

Genotype	Phenotypes			
	LacZ expression		LacY expression	
	no inducer	inducer	no inducer	inducer
1 I <sup>+</sup> O <sup>+</sup> Z <sup>+</sup> Y <sup>+</sup>	-	+	-	+
2 I <sup>S</sup> O <sup>+</sup> Z <sup>+</sup> Y <sup>-</sup>	-	-	-	-
3 I <sup>S</sup> O <sup>C</sup> Z <sup>+</sup> Y <sup>-</sup> / F' I <sup>+</sup> O <sup>+</sup> Z <sup>-</sup> Y <sup>+</sup>	+	+	-	-
4 I <sup>+</sup> O <sup>+</sup> Z <sup>+</sup> Y <sup>+</sup> / F' I <sup>-</sup> O <sup>+</sup> Z <sup>-</sup> Y <sup>-</sup>	-	+	-	+
5 I <sup>S</sup> O <sup>C</sup> Z <sup>-</sup> Y <sup>-</sup> / F' I <sup>-</sup> O <sup>+</sup> Z <sup>+</sup> Y <sup>-</sup>	-	-	-	-

10 pt, 1/2 ea

B. Name one strain that indicates that I<sup>S</sup> is dominant to I<sup>+</sup> or I<sup>-</sup>. What data tells you that?

#3 no Lac Y (permease) expression

2pt

#5 no LacZ (β galactosidase) expression

C. One new gene, called Gene V, was identified that regulates the Lac operon.

An allele Gene V-1 was analyzed.

We know that Gene V<sup>+</sup> acts in the glucose, ADC1, CRP pathway.

(The assays are done in an I<sup>-</sup> cell.)

i. Is Gene V-1 mutation recessive or **dominant** (circle one)

ii. Draw the **New pathway**, with gene order and sign of regulation (bar or arrow)



**New pathway**



iii. Why would a CRP-ADC1- double mutant not be informative for determining their order of function?

*Each single mutant has the same phenotype.*

Strain	LacZ expression	
	No	Yes
1. Gene V <sup>+</sup>	+	-
2. Gene V-1	+	+
3. Gene V-1/ Gene V <sup>+</sup>	+	-
4. CRP1-	-	-
6. CRP-/CRP+	+	-
7. ADC1-	-	-
8. ADC1- /ADC1+	+	-
8. Gene V-1, CRP1-	-	-
9. Gene V-1, ADC1-	+	+

Name: \_\_\_\_\_

## 2. Recombination and Complementation in phage (20 points)

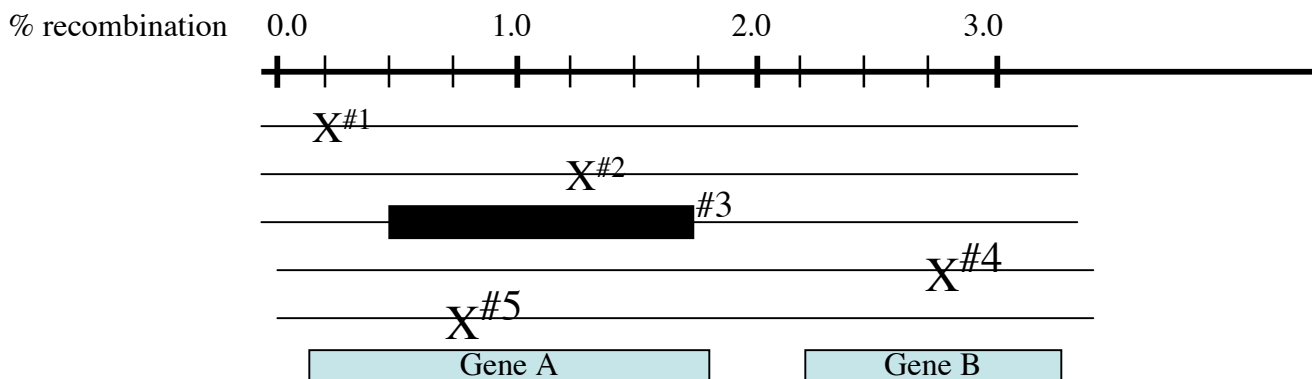
Below is a table of complementation and recombination results from studies of phage mutants.

A. In the space immediately below the table, indicate where mutations are. Mutation #1 is given and is present on the far left side of the map. The map is given in % recombination. For example, mutations #2 crossed with mutation #1 gave 1.0% wildtype recombinants, so the two are placed 1.0% apart.

Indicate point mutations with an “X”, and any deletions with a black bar. **All mutations are recessive.**

B. Below the diagram, indicate the likely positions of genes consistent with the data. (You may not know exactly where genes begin and end.)

<u>Cross</u>	<u>Complementation</u>	<u>Recombination (%)</u>
1x1	-	0
1x2	-	1.0
1x3	-	0.25
1x4	+	2.5
1x5	-	0.5
2x3	-	0
2x4	+	1.5
2x5	-	0.5
3x4	+	1.0
3x5	-	0
4x5	+	2.0



C. In a complementation test of mutant3 x mutant 4, discuss briefly whether mutant or wildtype phage are produced in the plaques, and what their relative proportions are, if appropriate. **Both mutant and wildtype phage are produced; ~99% single mutants and ~1% wildtype.** (Actually, it would be 1% wildtype, 98% single and 1% double mutants, but 99:1 is ok)



**4. True/False short answer. (25 points)**

Write “True” or “False” then provide one statement that is relevant to the question. Credit for T/F is given only if you provide a relevant comment. Do not restate question in your comment.

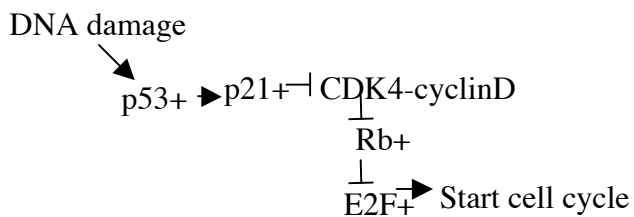
- A. Mendel would have discovered the principles of independent assortment if he had been studying conjugation in bacteria.

**False, gene transfer using conjugation is not reciprocal, OR since bacteria are typically haploid and do not segregate chromosomes as eucaryotics do you cannot analyze segregation of markers as you can for diploids.**

- B. In an Hfr A<sup>+</sup> B<sup>+</sup> C<sup>+</sup> X F<sup>-</sup> a<sup>-</sup> b<sup>-</sup> c<sup>-</sup> cross, you need 1 single crossover to get A<sup>+</sup> B<sup>+</sup> C<sup>+</sup> genes integrated into the F<sup>-</sup> genome.

**False. You need 2 single crossovers or one double crossover Or, 1 single crossover is lethal.**

- C. Consider the Cancer Genetics Pathway shown below. The order of function of Rb and p53 can be determined by using recessive mutations in both genes.



**False. Recessive mutations are typically loss of function mutations, and such mutations in Rb and p53 will have the same phenotype. Thus a order of function tests with recessive mutations in those two genes will not be informative.**

- D. Consider the Cancer Genetics Pathway again. One successful drug target would be CDK4-cyclinD; a drug inactivating CDK4-cyclinD might stop cancer cells from dividing.

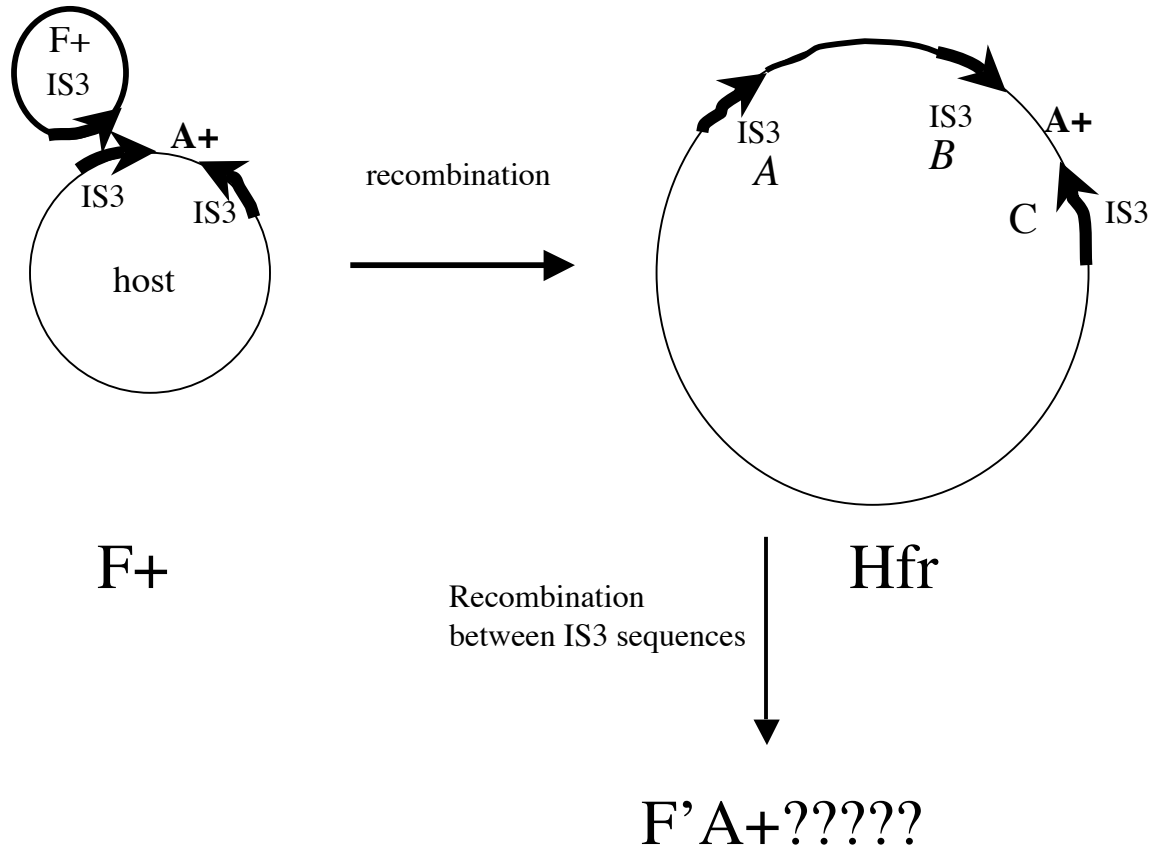
**True. Inactivation of CDK-cyclinD should leave Rb active which will inhibit E2F and thus stop cell division and stop the cancer cell from dividing.**

- E. The zinc-finger nuclease is not relevant for introducing the ccr5 $\Delta$ 32 mutation into the wildtype CCR5 genes to generate resistance to the AIDS virus.

**False. The zinc finger nuclease makes the DNA break in the wildtype CCR5 gene which then stimulates/leads to pairing and a double crossover with the other injected ccr5 $\Delta$ 32 mutant DNA.**

**5. Extra Problemette..Resolving an Hfr to F+ or F'. (5 points).**

An F+ integrates into a host chromosome that has two IS3 sequences while the F+ has one IS3 sequence (dark arrows). The direction of the sequences are shown; the two IS3 sequences in the host chromosome lie in opposite orientation. Recombination of the host chromosome with the F+ leads to formation of an Hfr as shown. Can the Hfr then undergo another recombination between the IS3 sequences to form an F'A+?? Discuss briefly.



*No, an F'A+ cannot be made by recombination between IS3 sequences because the 2 IS3 that would need to recombine are in inverted orientation to each other. That would generate an inversion, but not a looping out of the F DNA. The 2 IS3 sequences (labeled A and C above) would need to be in direct repeat orientation to generate an F'A+.*