MIDTERM 1. MCB 104. Genetics, Genomics, and Cell Biology, Spring 2014

NAME:

SID:

KEY

Points:

Pg 2. Definitions:

Pg. 3. Short answers:

Pg. 4. Short answers:

Pg. 5. Problem set:

Pg. 6. Problem set:

Pg. 7. Problem set:

Total Points:

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Definitions. 2 pts each. Restrict your answers to the space provided.

1. Twin spot. Mitotic recombination - adjacent patches of recessive cell types.
2. Chromosome interference. suppression expected % double cross over
3. Klinefelter's Syndrome. XXY males / humans. reduced fertility.
4. Dosage compensation. equivalent expression of X-linked genes in ♀, ♂
5. Pilus. structure of DNA transfer connecting conjugating bacteria
6. Rb. tumor suppressor gene. Rb⁻/Rb⁻ cells → eye tumors.
7. Prototroph. Bacterial strains that grow on minimal media
8. Chiasmata. Structures holding homologous chromosomes. sites of recombination
9. Gradient of Gene Transfer. genes closer to origin more likely to be transferred
10. Galactose. alternate sugar source. glucose preferred by bacteria.
11. Xist. gene that determines X-inactivation. when ON → Barr body
12. plasmid. extrachromosomal, autonomous circular DNA → drug resistance
13. IS element. insertion sequence. sites of F-plasmid integration on Bacterial chromosome
14. Mosaic. single individual containing tissues of different genotype/phenotype
15. H19. gene linked to IgF2. ON in ♀ / OFF in male alleles

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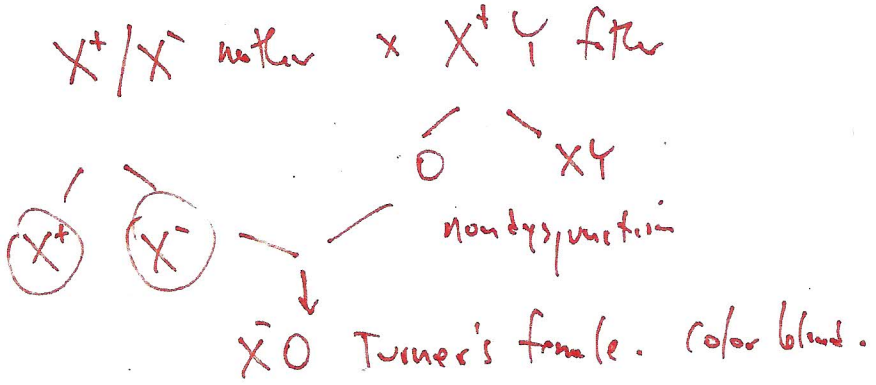
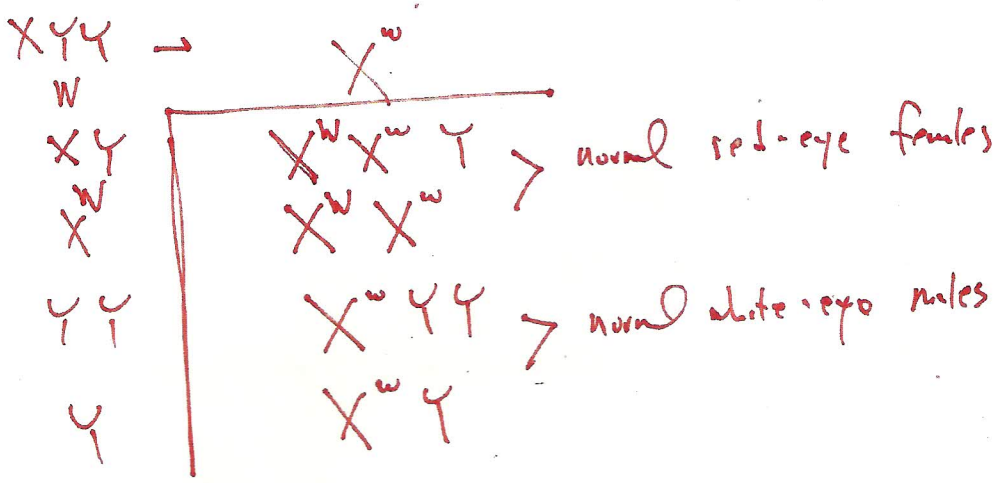
Short Answers. Restrict your answers to the space provided.

1. (5 pts). Parents with normal vision have a daughter who is color blind. Provide a simple explanation for this unusual occurrence.



2. (10 pts). Consider the mating of an exceptional XYY red-eye male and normal XX white-eye female (fruitflies). Do you predict a higher than expected frequency of exceptional progeny? No.



No exceptional progeny (white-eye females or red-eye males)

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3. (10 pts). An embryonic growth factor gene, IgfX, is maternally imprinted in mice. That is, the gene is inactivated by methylation in the female germ line. Predict the phenotypes of F1 embryos from the following matings. Briefly justify your answers.

A. Heterozygous mother (IgfX+/IgfX-) X normal father (IgfX+/IgfX+).

All embryos normal.

♀ $Igf X^-$ / $Igf X^+$ ♂

$Igf X^-$: inactive due to imprinting

$Igf X^+$: only normal copy DNA.

B. Normal mother (IgfX+/IgfX+) X heterozygous father (IgfX+/IgfX-).

50% ~~stunted~~ stunted embryos.

♀ $Igf X^+$ / $Igf X^-$ ♂

$Igf X^+$: inactive due to Imprinting

$Igf X^-$: inactive due to mutation

4. (5 pts). Briefly explain why XXX humans are perfectly normal while XXX flies are lethal.

Humans: XXX → 2 Barr bodies. 1 active X

Flies: XXX → all 3 X chromosomes active.

upregulation of X-linked genes in males.

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Problem Sets. Restrict your answers to the space provided.

XXXX SEQUENTIAL EVENTS 1. recombination 2. recombination OR nondisjunction

1. (10 pts). Consider the notum (middle thorax) of y+ sn-/y- sn+ female flies. Explain the very rare occurrence of a tiny patch of yellow tissue contained within a larger patch of singed bristles. ANSWERS VARY. BE GENEROUS.

1. first mitotic recombination between y-sn. later: second recombination between centromere and yellow.

2. double cross-over: centromere - singed and singed - yellow
later: non disjunction chromosome loss of y^+ chromosome
(small yellow patch = mole tissue).

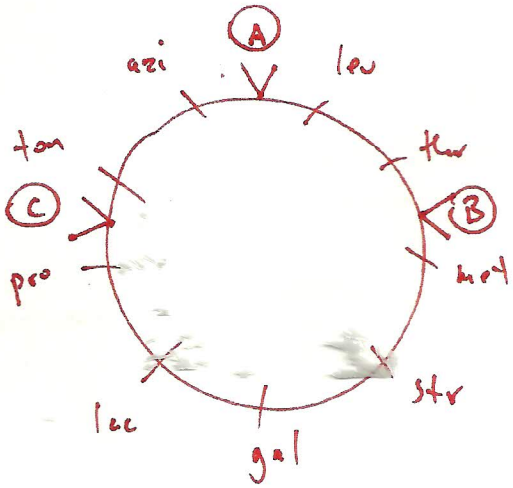
2. (9 pts). Timed conjugation experiments between F- bacteria and different Hfr strains exhibit the following orders of gene transfer:

A. Hfr strain A. leu thr met str gal lac pro ton azi

B. Hfr stain B. met str gal lac pro ton azi leu thr

C. Hfr strain C. ton azi leu thr met str gal lac pro

Draw a genetic map of the parental bacterial chromosome and indicate the locations of the integrated F plasmid in each strain.



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3. (12 pts). Consider the following genetic cross in fruitflies. v+/v+ cv-/cv- ct-/ct- X v-/v- cv+/cv+ ct+. F1 triply heterozygous females (v+/v- cv+/cv- ct+/ct- are test-crossed with triply homozygous recessive males (v-/v- cv-/cv- ct-/ct-). The phenotypes of the F2 flies are shown below. The order of the genes is arbitrary.

v+: brick red eyes, v-: vermilion eyes (bright red). cv+: normal wing veins, cv-: cross-veins absent on wings. ct+: normal wings, ct-: cuts (notches) at the margins of the wings. v-, cv- and ct- are strictly recessive to the wild-type "+" alleles.

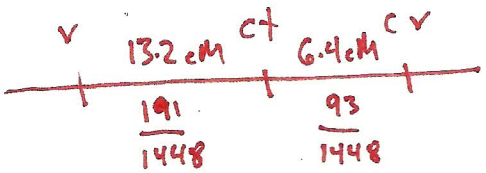
580 vermilion eyes, normal wings
592 normal eyes, cross-veins missing, cut wings

94 normal eyes and wings
89 vermilion eyes, cross-veins missing, cut wings

45 vermilion eyes, cross-veins missing, no cuts on wings
40 normal eyes, cross-veins present, cut wings

5 normal eyes, cross-veins missing, no cuts on wings
3 vermilion eyes, cross-veins present, cut wings

A. Draw a genetic map showing the order of the three genes and distances between neighboring genes.



B. Calculate % interference.

$$\text{interference} = 1 - \left[\frac{\text{observed}}{\text{expected}} = \frac{8}{\left[\left(\frac{191}{1448}\right)\left(\frac{93}{1448}\right)\right] \times 1448}\right] = 1 - \frac{8}{12} = 1 - .67$$

$$= 0.33$$

$$\approx 33\%$$

OK

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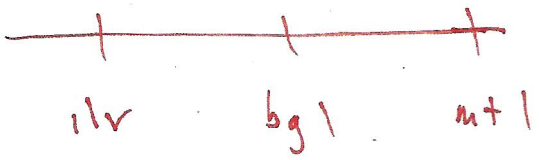
4. (9 pts). You cross a prototrophic Hfr strain (ilv+ mtl+ bgl+) that is sensitive to ampicillin with an auxotrophic F- strain (ilv- mtl- bgl-) that is resistant to ampicillin. The ilv gene is the last to be transferred. The order of the mtl and bgl genes is uncertain.

A. What do you add to the growth media in order to select for recombinant F- bacteria? Ampicillin. to kill parental Hfr strain

(ensures that all 3 genes are transferred: gradient of gene transfer

B. Draw the gene order based on the following recombinant phenotypes:

ilv+ mtl+ bgl+	220
ilv+ mtl- bgl-	60
ilv+ mtl+ bgl-	0
ilv+ mtl- bgl+	20



C. What are the relative distances between the gene pairs?

ilv - bgl. 3X

bgl - mtl. 1X.