Name **Section:**
ID#

LS4-1/Pham
INTRODUCTION TO GENETICS
Summer 2015/session A
07/10/2015
MIDTERM-version A/key

Please circle your TA's name:

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Instructions:

1. **This exam has 7 pages.**
2. Clearly write **your name on every page**. Be sure to write clearly. Only legible answers will be graded.
3. **We will not grade the backs of pages**.
4. All books, notes, and cell phones (turned off) must be put in zipped backpacks.
5. Calculators may be used. **NO GRAPHING CALCULATORS ARE ALLOWED!**

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Page 3 _____

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Total: _____/100

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1. (12 points) The gene for nose shape is found on the X chromosome. Round nose is dominant to pointed nose. Human individuals with XXY (an additional X chromosome) are male. Individuals with XO (only one X chromosome) are female.

For each of the following families, identify the possible nondisjunction events (rare mistakes during meiosis) that could explain the phenotype of the child. Circle one answer for each parent. *(Select "neither" if nondisjunction in that parent could not produce the child's phenotypic outcome. For example, if you think nondisjunction only in the father could explain the child's phenotype, then circle "neither" for the mother).*

a) A man with a pointed nose and a woman with a round nose have a daughter with round nose. This daughter has Turner Syndrome (genotype XO; one X chromosome).

Father (circle one): Meiosis I Meiosis II Either I or II Neither

Mother (circle one): Meiosis I Meiosis II Either I or II Neither

Answer: Father: Either I or II Mother: Neither

b) A man with a pointed nose and a woman with a round nose have a son with Klinefelter Syndrome (genotype XXY) with a pointed nose.

Father (circle one): Meiosis I Meiosis II Either I or II Neither

Mother (circle one): Meiosis I Meiosis II Either I or II Neither

Answer: Father: Meiosis I Mother: Meiosis II

c) A man with a round nose and a woman with a pointed nose have a son with Klinefelter Syndrome (genotype XXY) with a pointed nose.

Father (circle one): Meiosis I Meiosis II Either I or II Neither

Mother (circle one): Meiosis I Meiosis II Either I or II Neither

Answer: Father: Neither Mother: Either I or II

2. (5 points) In a diploid organism, if gene A has 4 different alleles, how many different genotypes would be found in the population?

 # homozygous + # heterozygous = 4 + ½*4*3 = 10

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3. (4 points) If your blood type is **O**, your sister is **O**, and your mother is **B**, what are the possible blood types for your father? **(Circle one)**

a. A
b. B
c. AB
d. O
e. b and c
f. b and d
g. a, b, and d
h. a, b, c, and d
i. none of these above

4. (4 points) Woodland hedgehog has a diploid number of 2n = 88. For each of the following stages, identify the number of chromosomes present in each cell.

a. end of mitotic metaphase: **88**

b. meiotic metaphase II: **44**

c. end of meiotic anaphase I: **88**

d. early prophase I: **88**

5. (4 points) Aquatic rat has a diploid number of 2n = 92. If nondisjunction occurs at chromosome 3 during meiosis I, how many chromosomes will be present in each of the four gametes?

47, 47, 45, 45

6. (5 points) Show your work and Circle your answer. Suppose that Rosie and Ross are both carriers for PKU (a rare autosomal recessive disease.) If they have three children, what is the probability that all of their children will have the same **genotype**?

P(all three are AA) + P(all three are Aa) + P(all three are aa) =

$= (1/4)^3 + (1/2)^3 + (1/4)^3 = 0.156 = 15.6\%$

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7. (4 points) Organisms with the genotypes *AaBbCcDd* and *AaBbCcdd* are crossed. Assuming independent segregation and complete dominance for each trait, what is the expected proportion of the progeny will be breed true? **Show your work and Circle your answer.**

1/2 * 1/2 * 1/2 * 1/2 = 1/16 = 0.0625 = 6.25%

8. (4 points) Organisms with the genotypes *AaBbCcDdEEff* and *AaBbCcDdeeFF* are crossed. Assuming independent segregation and complete dominance for each trait, what is the expected proportion of the progeny will be homozygous for three genes and heterozygous for three genes? **Show your work and Circle your answer.**

4 x 1/2 * 1/2 * 1/2 * 1/2 = 1/4 = 0.25 = 25%

9. (4 points) Organisms with the genotypes *AaBbCcDdEEff* and *AaBbCcDdeeFf* are crossed. Assuming independent segregation and complete dominance for each trait, what is the expected proportion of the progeny will be breed true? **Show your work and Circle your answer.**

0

10. (4 points) Organisms with the genotypes *AaBBCcDd* and *AabbCcDd* are crossed. Assuming independent segregation and complete dominance for each trait, what proportion of the progeny would have dominant phenotypes for two of the genes, but be recessive for the other two genes? **Show your work and Circle your answer.**

3 x ¾ x ¼ x ¼ = 9/64 = 0.1406 = 14.06%

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11. (6 points) If three six-sided dice are rolled, what is the probability that the total number of spots showing is more than 14? **Show your work and Circle your answer.**

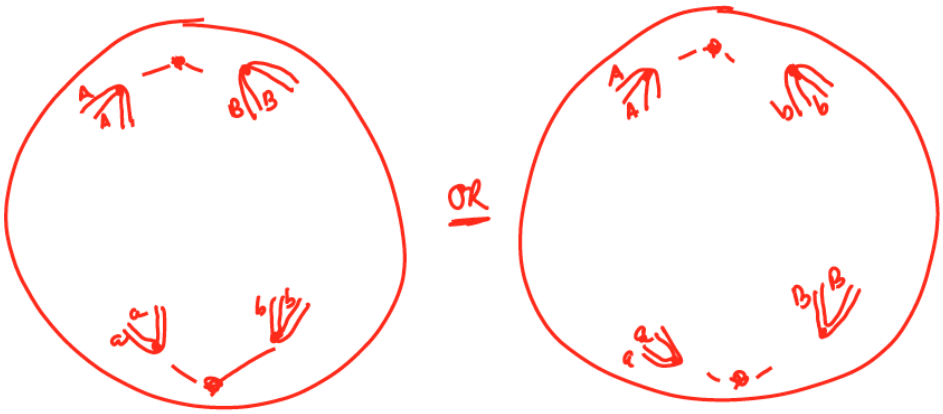
= P[more than 14]
= P[6,6,6] + P[6,6,5] + P[6,6,4] + P[6,5,5] + P[6,6,3] + P[6,5,4] + P[5,5,5]
= 1 x 1/6^3 + 3 x 1/6^3 + 3 x 1/6^3 +3 x 1/6^3 +6 x 1/6^3 + 3 x 1/6^3 +3 x 1/6^3
= 20*1/6^3
= 20/216
= 5/54 = 0.0926 = 9.26%

12. (4 points) *Drosophila* has four pairs of chromosomes (2n=8). Gene A is located on chromosome 2. If a nondisjunction event happens at chromosome 2 during meiosis II in a fly with Aa genotype, what would be possible genotypes of the resulting four gametes? If there are multiple scenarios, list all of them. **Circle your answer.**

A, A, aa, 0

AA, 0, a, a

13. (6 points) An organism has alleles *A* and *a* on one pair of homologous chromosomes, and it has alleles *B* and *b* on another pair. Diagram these pairs of homologs at the end of anaphase I. If there are multiple scenarios, just draw one.



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14. (17 points) Annabeth and Percy are concerned about having a child with Canavan disease, which causes brain tissue degeneration. This condition, which is very rare, has affected Annebeth's aunt (her father's sister) and Percy's brother (Tyson). No one else in either family has the condition. **Show your work and circle your answer.**

a) **(2 points)** What is the most likely mode of inheritance of Canavan disease? Be specific.

Autosomal recessive

b) **(4 points)** Based on their family history, what is the probability Annabeth and Percy's first child will be affected by Canavan disease?

P(child with Canavan disease) = P(Annabeth is a carrier) x P(Percy is a carrier) x ¼ =

= (2/3 x ½) x (2/3) x ¼ = 1/18 = 0.0556 = 5.56%

The couple is also concerned about their child inheriting hemophilia, another rare disease, which is X-linked. Annabeth's brother and Tyson (Percy's brother) have the condition. No one else in either family has the condition.

c) **(4 points)** What is the probability Annabeth and Percy's first child will be a boy affected by both diseases?

P(child with Canavan disease) x P(child with hemophilia)
= 1/18 x P(Annabeth is X^HX^h) x P(X^h from Annabeth) x P(Y from Percy) =
= 1/18 x ½ x ½ x ½ = 1/144 = 0.0069 = 0.69%

d) **(2 points)** What is the probability their first child will be a girl affected by both diseases?

0

e) **(2 points)** What is the probability their first child will be affected by both diseases?

= 1/144 = 0.0069 = 0.69%

f) **(3 points)** What is the probability their first child will be a carrier for both diseases?

=P(Annabeth is X^HX^h) x P(X^h from Annabeth) x P(X^H from Percy) x P(child with Aa)
=(½ x ½ x ½) x (1/3*2/3*½ + 2/3*2/3*1/2 + 1/3*1/3*1/2)
= 1/8 x 7/18
=7/144 = 0.0486 = 4.86%

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15. (17 points) Three different pure-breeding strains of corn that produce ears with white kernels were crossed to each other. In each case, the F1 plants were selfed to produce F2. The results are tabulated below.

Cross	Parental phenotypes	F1 phenotype	F2 phenotypes (with ratio)
#1	white-1 x white-2	red	9 red: 7 white
#2	white-2 x white-3	blue	9 blue: 7 white
#3	white-1 x white-3	white	all white

When F1 from cross #1 and F1 from cross #2 were crossed with each other, the progeny included four different phenotypes with the following proportions:

-white: 7/16
-red: 3/16
-blue: 3/16
-purple: 3/16

a) **(3 points)** How many genes are involved in determining kernel color?
2 genes
b) **(6 points)** Define your symbols and show the genotypes for the pure-breeding strains:

A>a
$B^R = B^B > b$

white-1: **aaB^RB^R**

white-2: **AAbb**

white-3: **aaB^BB^B**

c) **(8 points)** When F1 from cross #1 and F1 from cross #3 were crossed with each other, what are the proportions for the following phenotypes among the progeny?

-white: **1/2**

-red: **1/4**

-blue: **1/8**

-purple: **1/8**