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

**BIOL 2416, Genetics**

**Jill Buettner, Instructor**

**HW1 - Problem Set - 50 points total**

**Purpose:** To learn (by struggling, in some cases) how to clearly think through and solve genetics problems by logically applying the concepts of Mendelian/transmission genetics.

**Task:** Show your work as much as possible. Attach extra pages as needed. You may talk to other students. You may contact me for a hint. Think: What do I know about cell division and sexual reproduction that could help me solve this question?

**Criteria:** I want the correct answer and, in some cases, an explanation of your reasoning. I will give partial credit if I can see some correct thought processes, even if the final answer is incorrect. You will see similar questions on the exam, so simply copying someone else’s work will come back and bite you later.

1) What are the haploid genotypes of the gametes and frequencies/proportions of those gametes that can be formed in individuals of each of the following diploid genotypes? (DON’T do a cross. Just predict the different haploid gamete genotypes that could be produced by each diploid genotype below.)

1. Aa Bb
2. Aa BB
3. Dd Ee ff GG
4. Mm Nn Zz
5. Mm Nn RR Zz

2) According to Professor Buettner, what is the definition of the term “diploid number”? Write it here, then memorize it.

3) a. Assuming DNA content of 14 picograms in each diploid G1 nucleus, what would be the expected DNA content (in picograms) of a diploid cell in mitotic metaphase? Explain your logic.

 b. Assuming a DNA content of 12 picograms in each diploid G1 nucleus, what would be the expected DNA content (in picograms) of a 3n cell in mitotic metaphase? Explain your logic.

 4) Assume that the typical diploid chromosome content of an organism is four chromosomes, two large and two small (2n=4).

1. Of the following figures, which represents a 3n (triploid) cell in mitotic metaphase?

A B C D

1. Pick one of the “wrong” answers from the question above. Tell me which one you chose, and explain why it cannot represent a triploid cell in mitotic metaphase.

5) Consider a diploid organism with a diploid number of 20. Show your work on all parts.

a. How many chromatids will be present in a typical cell at mitotic metaphase?

b. How many tetrads are present in a metaphase I cell of meiosis?

c. How many dyads are present in a metaphase I cell in meiosis?

d. How many monads are expected in each product cell at the end of meiosis II?

6) Assume that a diploid cell contains three homologous pairs of chromosomes, designated with the symbols Am, Ap, Bm, Bp, Cm, and Cp, where “m” stands for “maternal origin” and “p” stands for “paternal origin.”

a. What is the diploid number of this cell?

b. Using the symbols given above, state the possible chromosomal composition of daughter cells of this cell following mitosis.

c. Using the symbols given above, state the possible chromosomal compositions of all possible daughter cells following meiosis I.

7) a. Albinism is caused by an autosomal recessive allele that interferes with skin pigmentation in mammals. Two normally pigmented parents have an albino girl. What is the probability that their next child will be a boy with albinism? Explain your reasoning. b. Albinism is caused by an autosomal recessive allele that interferes with skin pigmentation in mammals. Two normally pigmented parents have an albino girl. What is the probability that their first male child will be albino? Explain your reasoning.

 c. Explain why the answer to 7b is different from the answer to 7a.

8) Albinism is caused by an autosomal recessive allele that interferes with skin pigmentation in mammals. Two normally pigmented parents have an albino girl.

1. What is the probability that their next two children will be normally pigmented? Show your work.
2. What is the probability that their next two children will both have albinism? Show your work.
3. What is the probability that, if they have 2 more children, they will end up with a family including 2 albino children and one normal? Show your work.
4. What is the probability that the next child they have will be normal, followed by a child with albinism? Show your work.
5. Explain why the answers to part (c) and part (d) are calculated differently.

9) a. Given the following pedigree, suggest a pattern of inheritance that is consistent with the data given, if the disease allele is extremely rare in the general population. Then assign each individual with his/her most likely genotype.

 b. Given the following pedigree, suggest a pattern of inheritance that is consistent with the data given, if the disease allele is extremely rare in the general population. Then assign each individual with his/her most likely genotype.

10) Assume that a particular unusual phenotype is caused by an autosomal recessive allele. John has a brother who appears normal. Jane has a sister with the unusual phenotype. No one else in either family has the unusual phenotype. John marries Jane, and they have a daughter with the unusual phenotype. Draw a 3-generation pedigree that depicts this family and assign the most likely genotypes to each individual. (You can use any letter you wish to represent the gene.)

11) In a series of crosses involving pea plants that have round or wrinkled seeds (round is dominant to wrinkled) and yellow or green seeds (yellow is dominant to green), the following ratios were observed in the progeny:

 **Parents** **Progeny**

1. round, green x wrinkled, yellow all round, yellow
2. round, yellow x round, yellow 9/16 round, yellow

3/16 round, green

3/16 wrinkled, yellow

1/16 wrinkled, green

c) round, yellow x round, yellow 3/4 round, yellow

1/4 wrinkled, yellow

d) wrinkled, yellow x round, yellow 6/16 wrinkled, yellow

2/16 wrinkled, green

6/16 round, yellow

2/16 round, green

On the basis of these progeny ratios, determine a possible genotype for each of the parent plants in each set of crosses (a,b, c, and d). Sometimes more than one genotype is possible, but you need only suggest one.

12) What is the probability (give a fraction) that 2 parents (whose genotypes are AABbCc and AaBBCc) will have a child with the following genotype:

a. AaBbcc \_\_\_\_\_\_\_\_\_\_\_\_\_

b. aaBBCC \_\_\_\_\_\_\_\_\_\_\_\_\_

c. AaBbCc \_\_\_\_\_\_\_\_\_\_\_\_\_

d. AABbcc \_\_\_\_\_\_\_\_\_\_\_\_\_