**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pd:\_\_\_\_\_\_\_\_\_**

**Genetics Practice Problems Packet**

**Part I: Genetics Vocabulary and Complete Dominance**

1. In humans, curly hair is dominant over straight hair. A woman heterozygous for hair curl marries a man with straight hair and they have children. **Model** how you arrive at your answers in the area below the questions.

* 1. What is the genotype of the mother? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. What gametes can she produce?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. What is the genotype of the father?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. What gametes can he produce?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	5. What is the probability that the 1st child will have curly hair?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	6. What is the probability that the 2nd child will have curly hair?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. In pea plants round (R) is dominant to wrinkled (r). Cross 2 heterozygous green parents and record the genotype and phenotype ratios.

|  |  |
| --- | --- |
|  |  |
|  |  |

Genotype=

Phenotype=

3. A couple has six children, all daughters. If the woman has a seventh child, what is the probability that the seventh child will be a daughter? \_\_\_\_\_\_\_\_\_\_\_\_\_

4. In a certain strain of mice, black coat (B) is dominant over white coat (b). **Describe** what you would do to determine the genotype of a male with a black coat and how this would enable you to choose between the genotypes BB or Bb. (Hint: This is a Test Cross)

5. In seals, the gene for the length of the whiskers has two alleles. The dominant allele (W) codes long whiskers and the recessive allele (w) codes for short whiskers. Predict the percentage of offspring that would be expected from the cross of two long whiskered seals, one that is homozygous dominant and one that is heterozygous? **Justify** your answer in the space below.

6. List all the gametes that are possible with each of the following genotypes.

* 1. Aabb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. AaBB\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. AaBb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. AABb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	5. AAbb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	6. Aabb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What is the probability of getting the gamete ab from each of the following parents? **Justify** your response in the space provided. (aka show your calculations)

* 1. Aabb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. aaBb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. AaBb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. AABb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	5. AAbb\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. What is the probability that each of the following pairs of parents will produce the indicated offspring? (Assume independent assortment of all gene pairs).

* 1. AABBCC x aabbcc 🡪 AaBbCc
	2. AABbCc x AaBbCc 🡪 AAbbCC
	3. AaBbCc x AaBbCc 🡪 AaBbCc

9. Two pea plants are heterozygous for the characters of pod color and pod shape. Draw a Punnett square to determine the phenotypic ratios of the offspring.

Pod shape= Inflated (I) or constricted (i)

Pod color= Green (G) or yellow (g)

10. Flower position, stem length, and seed shape were three traits that Mendel studied. Each is controlled by an independently assorting gene and has dominant and recessive expression as follows:

Trait Dominant Recessive
Flower position Axial (A) Terminal (a)
Stem length Tall (T) Short (t)
Seed shape Round (R) Wrinkled (r)

If a plant that is heterozygous for all three traits is allowed to self-fertilize, what proportion of the offspring would you expect to be as follows? (Hint: Use the rules of probability…don’t draw a huge Punnett square!)

1. Homozygous for the three recessive traits
2. Heterozygous for all three traits
3. Homozygous for axial and tall, heterozygous for seed shape

11. In pea plants, yellow seed color is dominant over green, and tall stem length is dominant over dwarf. Two pea plant parents possess the following alleles for these traits: YYTT X yytt

For the above, answer the following:

* 1. What gametes will each parent produce as a result of meiosis?
	2. Assume fertilization has occurred. What phenotype will the offspring have?
	3. The F1 generation is crossed with itself. What alleles will be present in the gametes, assuming no crossover has occurred?

**Part II:**  **Advanced Genetics Concepts: Incomplete Dominance, Co-dominance, Sex-Linkage, Multiple Alleles**

12. In humans, there are four types of blood; type A, type B, type AB, and type O. The alleles A and B are codominant to each other and the O allele is recessive to both A and B alleles.

* 1. What possible genotypes will produce type A blood? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. What possible genotypes will produce type B blood? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. What is the only genotype that will produce type O blood? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. What is the only genotype that will produce type AB blood? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. A child has blood type O and his mother has blood type A.

a. What could be the possible genotype(s) for the father? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. If the type O individual were to mate with a person with type AB blood, what would be the phenotypic ratio for the offspring?

14. A man with type A blood marries a woman with type B blood. Their child has type O blood. What are the genotypes of these individuals? What other genotypes, and in what frequencies, would you expect i n offspring from this marriage?

15. At Metro Hospital’s maternity ward on a busy afternoon, two female babies were born within 5 minutes of one another. A couple of days after returning home from the hospital, one of the mothers, Mrs. Finch, noticed that the tag on the baby’s wrist was marked “D" and began to panic as she did not think the baby she had was hers. The mother of the other baby, Mrs. Darwin, was insistent that the baby she took home was hers and refused to exchange babies with Mrs. Finch. Both sets of parents decided that the matter should be settled in court, where a judge ordered all four parents to submit to a blood test to settle the dispute. Here are the results of the court ordered test:

Mrs. Finch: Type O Mrs. Darwin: Type O

Mr. Finch: Type O Mr. Darwin: Type AB

Baby taken home by the Finches: Type A Baby taken home by the Darwins: Type O

You are the expert scientist called in to interpret the results. Explain who is right, using what you know about the type of inheritance shown here.

16. In the 1950’s, a young actress named Joan Barry accused the actor Charlie Chaplin of being the father of her unborn child. Chaplin denied the claim, and Barry filed a paternity suit against him in court in an attempt to collect child support. Chaplin’s blood type was known to be AB, Barry’s blood was type A, and the child’s blood type was found to be type O. The judge ruled in favor of Ms. Barry and ordered Chaplin to pay child support until the child reached the age of 21. Does the evidence presented support Ms. Barry’s claim? Explain why or why not.

17. Imagine that a newly discovered, recessively inherited disease is expressed only in individuals with type O blood, although the disease and blood group are independently inherited. A normal man with blood type A and a normal type B woman have a child with the disease. What is the probability that a second child will also have the disease? Assume that both parents are heterozygous for the gene that causes the disease.

18. In Labrador retrievers there is a gene that determines coat color (*B*) and a gene that determines whether or not the pigment is deposited on the hair (*E*). Black labs are *BB* and brown labs are *bb*. For the second allele, the dominant allele symbolized by *E* results in the deposition of either black or brown pigment, depending on the genotype at the first locus. But if the second allele is homozygous recessive *ee*, then the lab is yellow regardless of the first allele. What happens if we mate black labs that are heterozygous for both genes?

19. Adrenoleukodystrophy (ALD) is a metabolic disorder inherited through sex linkage and caused by a mutant transport protein found in lysosomes. If a woman who is heterozygous for this trait has children with a man who is normal for this trait, what is the probability that:

* 1. Her sons will be phenotypically normal?
	2. Her daughters will be carriers?
	3. Her sons will have ALD?

20. In humans, the genes for colorblindness and hemophilia are both located on the X chromosome with no corresponding gene on the Y chromosome. These are both recessive alleles.

a. If a man and a woman, both with normal vision, marry and have a colorblind son, draw a Punnett square to illustrate this. What is the percentage of each?

b. If the man dies and the woman remarries to a colorblind man, draw a Punnett square showing the children that could be expected from her second marriage. What percentage of each?

21. Red-green colorblindness in humans is a recessive sex-linked trait. Celeste and Lars are a married couple, both with normal color vision. Several years into their marriage, Celeste gives birth to a colorblind daughter. Lars claims that he is not the father of this child, and files for divorce on the grounds of questionable paternity and infidelity. Celeste decides to fight the case in court, claiming that she has not been unfaithful. You are Lars’ attorney and are preparing for the upcoming trial. What scientific explanations will you use to support Lars’ claim?

22. A snapdragon pure breeding for red flowers is bred with one for white flowers. The F1 generation flowers are all pink. What would you predict for the phenotypic ratios for the F2 generation?

23. In drosophila, vestigial wings (mutant) are recessive to normal long wings (wild type), and the gene for this trait is autosomal. The gene for the white eye trait is on the X chromosome and white eyes (mutant) are recessive to red eyes (wild type). Suppose a homozygous white eyed, long winged female fly is crossed with a homozygous red eyed, vestigial winged male.

* 1. What is the probability of producing an offspring that is a white eyed, vestigial winged female? **Justify** your response in the space below.
	2. What is the probability of producing an offspring that is a white eyed, vestigial winged male? **Justify** your response in the space below.

24. An investigator observes that when pure-breeding, long-winged fruit flies are mated with pure-breeding, short-winged flies, the F1 offspring have an intermediate wing length. When several intermediate-winged flies are allowed to interbreed, the following results are obtained:

 ***230 long-winged flies, 510 intermediate winged flies, 260 short winged flies.***

a. What is the genotype of the F1 intermediate-wing-length flies? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Write a null hypothesis describing the mode of inheritance of wing length in fruit flies.

c. Complete Table 1.

 **Table 1.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Phenotype** | **Observed (o)** | **Expected (e)** | **(o-e)** | **(o-e)2** | **(o-e)2****e** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| $X^{2}$ =Σ (o-e)2 e |  |

d. How many degrees of freedom (df) are there? \_\_\_\_\_

e. Chi-square ($X^{2}$) = \_\_\_\_\_

f. What is the probability value for these data? \_\_\_\_\_

g. **Explain** your results.

25. In corn the gene for colored (C) seeds is completely dominant to the gene for colorless (c) seeds. Similarly, for the character of the endosperm (the part of the seed that contains the food stored for the embryo), a single gene pair controls whether the endosperm is full or shrunken. Full (Sh) is colorless, shrunken seeded one. The F1 colored, full plants were testcrossed to the doubly recessive type, that is, colorless and shrunken. The result was as follows:

|  |  |
| --- | --- |
| **Phenotype** | **# individuals** |
| Colored, full | 4039 |
| Colored, shrunken | 156 |
| Colorless, full | 149 |
| Colorless, shrunken | 4056 |
| **Total** | 8400 |

1. **Evaluate** the data above and propose a logical explanation for the results. **Justify** your response below.
2. **Predict** the relative location of these genes on the chromosome. **Justify** your response below.
3. **Propose** a pattern of inheritance that would lead a scientist to suspect that an inherited disorder of cell metabolism is due to a defective mitochondrial gene.

**Part II: Pedigrees**

26. The pedigree below traces brachydactyly, a condition in which fingers are abnormally short, through several generations of a family. Those individuals affected by brachydactyly are shaded. Use this pedigree to answer the questions that follow.



1. Based on the pedigree, is brachydactyly a dominant or recessive disorder?
2. What is the probable genotype of the following individuals?
	* 1. I-1
		2. II-7
		3. III-4

27. Familial Adenomatous Polyposis (FAP) is an inherited condition in which thousands of small polyps form in the large intestine, and if left untreated, can lead to colon cancer. FAP is caused by a mutation to the APC gene, which is a tumor suppressor gene. Look at the pedigree seen at right and explain the type of inheritance demonstrated by this trait. What is the likely genotype of the following individuals?

* 1. Alice
	2. Peter
	3. George Jr.
	4. Carol

(diagram source: [*http://www.hopkins-gi.org/Upload/200803121547\_53515\_000.jpg*](http://www.hopkins-gi.org/Upload/200803121547_53515_000.jpg)*)*

28. For each of the pedigrees below, determine whether the list of the patterns of inheritance are possible.  ***Justify your response for each in the space below by predicting the probably genotypes on the pedigree.*** If that mode of inheritance is impossible, indicate the **evidence** that allowed you to form that conclusion.

a. Autosomal recessive trait—**YES or NO** e.Y linked trait—**YES or NO**



b. Autosomal dominant trait—**YES or NO** f. Autosomal recessive trait—**YES or NO**



c. X linked recessive trait—**YES or NO** g. Autosomal dominant trait—**YES or NO**



d. X linked dominant trait—**YES or NO**  h. X linked recessive trait—**YES or NO**

