Genetics Problems

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

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

If a plant that is heterozygous for all three characters is allowed to self-fertilize, what proportion of the offspring would you expect to be as follows? (*Note:* Use the rules of probability instead of a huge Punnett square.)

a. homozygous for the three dominant traits
b. homozygous for the three recessive traits
c. heterozygous for all three characters
d. homozygous for axial and tall, heterozygous for seed shape

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2. Phenylketonuria (PKU) is an inherited disease caused by a recessive allele. If a woman and her husband, who are both carriers, have three children, what is the probability of each of the following?

a. All three children are of normal phenotype.
b. One or more of the three children have the disease.
c. All three children have the disease.
d. At least one child is phenotypically normal.

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3. The genotype of F_1 individuals in a tetrahybrid cross is AaBbCcDd. Assuming independent assortment of these four genes, what are the probabilities that F_2 offspring will have the following genotypes?

a. AaBbCcDd
b. AaBBccDd

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4. In corn plants, a dominant allele, *I*, inhibits kernel colour, while the recessive allele, *i,* permits colour when homozygous. At a different locus, the dominant allele, *P,* causes purple kernel colour, while the homozygous recessive genotype *pp* causes red kernels. If plants heterozygous at both loci are crossed, what will be the phenotypic ratio of the offspring?

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5. In foxes, two alleles of a single gene, *P* and *p*, may result in lethality *(PP)*, platinum coat *(Pp)*, or silver coat *pp)*. What ratio is obtained when platinum foxes are interbred? Is the *P* allele behaving dominantly or recessively in causing:
(a) lethality; (b) platinum coat colour?

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6. The following genotypes of two independently assorting autosomal genes determine coat color in rats:

A-B- (gray); *A-bb* (yellow); *aaB* (black); *aabb* – (cream)

A third gene pair on a separate autosome determines whether any colour will be produced. The *CC* and *Cc* genotypes allow colour according to the expression of the *A* and *B* alleles. However, the *cc* genotype results in albino rats regardless of the *A* and *B* alleles present. Determine the F_1 phenotypic ratio of the following crosses:

(a) *AaBbCc* X *AaBbcc.*

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7. In humans, the ABO blood type is under the control of three autosomal alleles (I^A,I^B, i) such that I^AI^A , I^Ai, type A); I^BI^B, I^Bi (type B); I^AI^B (type AB); ii (type O). Red-green colour blindness is a recessive X-linked trait. If two parents who are both type A and have normal vision produce a son who is colour-blind and type O, what is the probability that their next child will be a female who has normal vision and is type O?

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8. While *vermilion* is X-linked in *Drosophilia* and causes eye colour to be bright red, *brown* is an autosomal recessive mutation that causes the eye to be brown. Flies carrying both mutations lose all pigmentation and are white-eyed. Predict the F_1 and F_2 results of the following crosses:

(a) vermilion females X brown males
(b) white females X wild males
