

Problem Set on Inheritance
(ungraded; to be used as practice for last test)

Answers and explanations will be posted by Wednesday, Dec. 15
Be sure to do the problems by yourself first, to make sure you've given yourself the chance to try

- 1) A woman underwent genetic testing and found out that she has a 1 in 10 chance of developing lung cancer and a 2 in 1000 chance of developing colon cancer. If these two cancers are completely independent, what is the probability that she will develop *both* cancers?

- 2) A couple are both heterozygous for two autosomal recessive diseases: cystic fibrosis (CF) and phenylketonuria (PKU). What is the probability of their first child having either CF or PKU?

- 3) a) With respect to five different genes located on five different chromosomes, how many different types of gametes could be formed by an individual with the genotype Aa BB cc Dd Ee?

b) How many different genotypes could be produced if this individual mated with someone of genotype AA bb CC Dd EE?

- 4) Suppose you were studying mouse gametogenesis (production of gametes) and you found a rare case in which several eggs had been produced after several rounds of mitosis, but no meiotic division. Describe the chromosomal content of these eggs, and describe the chromosomal content you would expect after fertilization with regular sperm.

- 5) Another Blood Type is the MN blood type. There are three phenotypes: M, N, and MN. There are only two alleles, M and N, and they are codominant, thus Blood type M represents the MM genotype and Blood Type N represents the NN genotype, while the heterozygote is MN.

Consider the following couple and their genotype, and answer the following questions about their offspring:

$$I^A I^O \text{ MM} \times I^A I^B \text{ MN}$$

- a) What is the probability of having a child with the genotype $I^A I^A \text{ MM}$

- b) What is the probability of having a child with the blood phenotype A M ?

- c) What is the probability that a child that has the blood type A M is homozygous for both genes?

- d) What is the probability that a child who has AB blood will also have MN blood?

6) Chands syndrome is an autosomal recessive condition characterized by very curly hair, underdeveloped nails, and abnormally shaped eyelids. In the pedigree at right, which individuals must be carriers?

7) Achondroplasia is a common form of hereditary dwarfism that causes very short limbs, stubby hands, and an enlarged forehead. Below are four pedigrees depicting families with this specific type of dwarfism: What is the most likely mode of inheritance? Cite a reason fro your answer.

8) This partial pedigree of Egypt's Ptolemy dynasty (pedigree shows people living between 323 B.C. and 30 B.C.) shows only genealogy, not traits.

a) What is unusual about this pedigree?

b) In what way were they trying to "preserve the royal blood"?

9) Green colorblindness can result from a recessive mutation in the “G” gene on the X chromosome. Consider a heterozygous mother (a carrier)

- a) If she marries a man with normal vision, what is the probability of their first child being color blind?
- b) This couple finds out from an ultrasound that they are having a girl; what is the probability that she will be color blind?
- c) If it was a boy, what would be the probability?
- d) Consider a green color blind man who marries a woman with normal vision and she is not a carrier, what would be the probability that their sons would be colorblind? How about their daughters?

10) Consider 7 genes that assort independently of each other. Each has a dominant allele, represented by an uppercase letter, and a recessive allele, represented by a lowercase letter. For the cross:

$AaBBcddEeFfGG \times AaBbccDdEEFfGg$

- a) what is the probability of obtaining progeny with the genotype $aaBBcDdEEFfGG$?
- b) what is the probability of obtaining progeny with the genotype $aaBbccddEeffGg$?
- c) what is the probability of obtaining progeny with the dominant phenotype for all 7 traits?
- d) what is the probability of obtaining progeny with the recessive phenotype for all 7 traits?

11) (real life puzzle): Look at the attached letter that my husband recently received from the Red Cross. Didn't we say that Blood Type O is known as the “universal donor” and Blood Type AB as the “universal acceptor” and yet the letter claims that AB people are particularly useful donors... The Red Cross knows blood, so it is unlikely that this letter contains a mistake. Based on what you know about blood, can you come up with an explanation for the sentence in bold (third paragraph).