**Genetics Practice Problems**
**AP Biology**

1. A pea plant with round seeds is crossed with a pea plant that has wrinkled seeds. For the cross, indicate each of the following:
a) the genotype of each of the parents if the round seed plant is heterozygous.
b) the gametes produced by the parents
c) the genotypes and phenotypes of the $F_1$ generation
d) the $F_2$ generation if two round plants from the $F_1$ generation were crossed

2. A pea plant with a tall phenotype is pollinated by a short plant, and the seeds of the first generation hybrid produce 327 tall plants and 321 short plants. Give the genotypes of all the plants.

3. PKU is a recessive disorder. Suppose two people who were heterozygous for PKU married and had a child. What is the probability that the child will have PKU?

4. In guinea pigs, black coat color (B) is dominant to white (b), and short hair length (S) is dominant to long (s). Indicate the genotypes and phenotypes from the following crosses:
a) Homozygous for black, heterozygous for short hair guinea pig crossed with a white, long hair guinea pig.
b) Heterozygous for black and short hair guinea pig crossed with a white, long hair guinea pig.
c) Homozygous for black and long hair crossed with a heterozygous black and short hair guinea pig.

5. A geneticist notes that crossing a round shaped radish with a long shaped radish produces oval shape radishes. If oval radishes are crossed with oval radishes, the following phenotypes are noted: 100 long, 200 oval, and 100 round radishes. For the cross between a pure-breeding round and a pure-breeding long radish, use symbols to show the $F_1$ and $F_2$ generations.

6. Palomino horses are known to be caused by the interaction of two different genes. The allele $C^r$ in the homozygous condition produces a chestnut, or reddish color, horse. The allele $C^m$ produces a very pale cream color, called cremello, in the homozygous condition. The palomino color is caused by the interaction of both the chestnut and cremello alleles. Indicate the expected ratios in the $F_1$ generation from mating a palomino with a cremello.

7. The flower color alleles in the red and white 4 o'clock flower are incompletely dominant. If we mate a homozygous red flower ($F^RF^R$) with a homozygous white flower ($F^WF^W$), all of the $F_1$ flowers are pink. If two pink flowered plants are crossed,
a) What are the chances of having pink offspring?
b) What are the chances of having red offspring?
c) What are the chances of having white offspring?
d) What is the genotypic ratio in the $F_2$?
e) What is the phenotypic ratio in the $F_2$?

8. Indicate the blood types possible from the mating of a male who is blood type O with a female of blood type AB. Could a female with blood type AB ever produce a child with blood type AB? Could she ever have a child with blood type O?

9. For the family outlined below, draw a pedigree and give the genotype of each individual.
a) Generation I : A male with blood type O marries a female with blood type A.
b) Generation II : They have 4 children. The first born is a male with A type blood, the second born is a girl with O type blood, and the last two children were identical twin boys.
c) Generation III : The last boy married a woman with type B blood. They had two girls, one with AB blood type and one with B blood type.

10. In fruit flies, eye color is sex-linked. What are the expected sexes and eye colors from the following crosses?
a) red-eyed (homozygous) female x white-eyed male
b) carrier female x white-eyed male
c) white-eyed female x red-eyed male
d) female carrier x red-eye male

11. Larry has hemophilia (a recessive, X-linked condition) but his daughter, Lauren, has a normal phenotype. She marries Jake who is normal for the trait.
a) What is the probability that Lauren and Jake have a daughter with hemophilia?
b) What are the chances of having a son with the disorder?
c) If the couple has four sons, what is the probability that all four will be hemophiliac?
d) If Jill's father had hemophilia and her mother was a carrier, what are the chances that she has the trait?

12. One of the genes for cat color is sex linked with two alleles - yellow and black. The heterozygous condition results in a mixed coat color referred to as calico. A calico cat is mated to a black cat.
a) What are the chances of them producing calico females?
b) What are the chances of them producing calico males?

13. In 1911, Thomas Morgan collected the following crossover gene frequencies while studying Drosophila. Bar-shaped eyes are indicated by the B allele, and carnation eyes are indicated by the allele C. Fused veins on wings (F) and scalloped wings (S) are located on the same chromosome.

| Gene | Frequencies of recombinations |
|---|---|
| F/B | 2.5% |
| F/C | 3.0 |
| B/C | 5.5 |
| B/S | 5.5 |
| F/S | 8.0 |
| C/S | 11.0 |

Use the crossover frequencies to make a gene map.

**Solutions**

1. a) P Rr x rr
b) R, r and r, r
$F_1$ Rr, Rr, rr, rr 1 round:1 wrinkled

$F_2$ RR, Rr, Rr, rr 3 round:1 wrinkled

2. P T_ x tt
$F_1$ 327 tall: 321 short - almost 1:1 therefore unknown parent must be heterozygous. Note: homozygous (LL) would give ALL tall plants in $F_1$.

3. P Pp x Pp
$F_1$ PP, Pp, Pp, pp chance of PKU is 1/4

4. B - black; b - white; S - short; s - long
a) P BBSs x bbss
$F_1$ BbSs, Bbss 1 black, short:1 black, long

b) P BbSs x bbss
$F_1$ BbSs, Bbss, bbSs, bbss 1 black, short:1 black, long: 1 white, short:1 white, long

c) P BBss x BbSs
$F_1$ BBSs, BBss, BbSs, Bbss 1 black, short:1 black, long

5. $S^R$ - round; $S^L$ - long
P $S^RS^L$ x $S^RS^L$
$F_2$ $S^RS^R$, $S^RS^L$, $S^RS^L$, $S^LS^L$ (incomplete dominance)

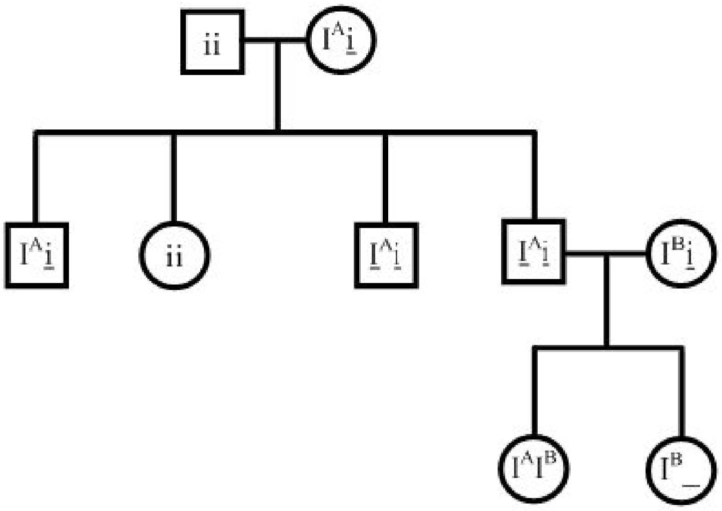
6. $C^RC^R$ - chestnut; $C^MC^M$ - cremello; $C^MC^R$ - palomino
P $C^MC^R$ x $C^MC^M$
$F_1$ $C^MC^M$, $C^RC^M$ 1 cremello:1 palomino

7. P $F^RF^W$ x $F^RF^W$
$F_1$ $F^RF^R$, $F^RF^W$, $F^RF^W$, $F^WF^W$
a) ½ pink
b) 1/4 red
c) 1/4 white
d) 1:2:1
e) 1:2:1

8. P ♂ ii x ♀ $I^AI^B$
$F_1$ $I^Ai$, $I^Bi$

AB ♀ could produce AB offspring if ♂ were type A, B, or AB; she could never produce type O in $F_1$ because she always donates either A or B.

9.




10. a) all red eyed, half male
b) 1/4 red eyed female, 1/4 white eyed female, 1/4 red eyed male, 1/4 white eyed male
c) half female, all red eyed; half male, all white eyed.
d) half females are carriers; half males are white-eyed

11. a) 0 - Jake always gives the normal allele
b) $P(X^h y) = 1/2 \times 1/2 = 1/4$
c) $P(4\ X^h y \text{ sons}) = 1/4 \times 1/4 \times 1/4 \times 1/4 = 1/16$
d) She would inherit the $X^h$ allele from her father all the time, making her a carrier. She would inherit the $X^h$ allele from her mother half the time giving her a 1/2 chance of having hemophilia.

12. a) 1/4
b) no calico males unless nondisjunction occurs resulting in Klinefleter syndrome

13. S — B — F — C
5.5 2.5 3