
Human Genetics: Problem Set I

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Abstract

This work contains the solutions to the problem set I of Human Genetics 2015 course at New York University.

Question 1.

Solution. a. As the gamete from the YY pea must be Y , the peas in the F_1 generation must contain a Y allele. Since we are given that YY and Yy genotypes result in yellow color, we have that the peas in the F_1 generation must be yellow. In other words, the expected frequency of yellow peas in the F_1 generation of a cross between YY and yy is 1.

b. In part a, we have reasoned that the peas in the F_1 generation must possess a Y allele. Symmetrically, with the presence of yy parent, we can conclude that F_1 generation peas must possess a y allele. Therefore, all peas in the F_1 generation has Yy genotype. We proceed to compute the expected frequency of yellow peas in the F_2 generation through the Punnett Square analysis with two Yy parents.

Figure 1: A Punnett Square with two Yy parents

	Y	y
Y	YY	Yy
y	Yy	yy

As the yellow color is the dominant trait, the Punnett Square analysis tells us that the expected frequency of yellow peas in the F_2 generation of the cross is 0.75.

c. As Mendelaian The expected frequency of green peas in the F_2 generation of the cross is 0.25.

Question 2.

Solution.

Question 3.

Solution. a. As the father is type AB , we know that his genotype is $I^A I^B$. For the case of the mother, since O is the recessive trait, her genotype is $I^O I^O$.

b. The genotype of their children can be either $I^A I^O$ or $I^B I^O$. Since I^A and I^B are both dominant to I^O , the phenotype of their children can be either A or B .

c. Since the father is type A , he can have either $I^A I^A$ or $I^A I^O$ for his genotype. As the mother is type B , she can have either $I^B I^B$ or $I^B I^O$. We see that the possible genotypes of their children, created through the process of segregation, are $I^A I^O$, $I^B I^O$, $I^A I^B$, and $I^O I^O$, which respectively corresponds to the phenotype A , B , AB and O . Hence, the possible blood types among their children are A , B , AB , and O .

Question 4.

Solution. a. Notice that none of the parents possess a I^B allele. As the AB phenotype requires a possession of a I^B allele, their first child cannot have the phenotype AB for the I locus. Hence, the probability that their first child will have the phenotype $AB+$ is 0.

b. Notice that one parent has DD genotype for the Rh locus. Hence, their first child will always possess a D allele, which makes the recessive trait $Rh-$ not a possibility. Therefore, the probability that their first child will have the phenotype $A-$ is 0.

c. The possible genotype for the I locus, in this case, is $I^A I^A$, and $I^A I^O$, both of which correspond to the phenotype A . Furthermore, the possible genotype for the Rh locus is DD and Dd , both of which correspond to the phenotype $+$. Therefore, the overall phenotype of their first child is $A+$. Hence, the probability that their first child will have the phenotype $A+$ is 1.