

Answers to Assigned Problems

In the syllabus, I suggested many questions from H&J and the Gist to work through.

Answers to the odd-numbered H&J problems I suggested can be found below.

Answers to even-numbered H&J problems are in back of book.

Answers to all Gist problems are in back of book.

Answers to H&J Chapter 2 odd-numbered problems:

2.16. (a) Because the trait is rare, it is reasonable to assume that the affected father is heterozygous HD/hd , where hd represents the normal allele. Half of the father's gametes contain the mutant HD allele, so the probability is $1/2$ that the son received the allele and will later develop the disorder. **(b)** We do not know whether the son is heterozygous HD/hd , but the probability is $1/2$ that he is; if the son is heterozygous, half of his gametes will contain the HD allele. Therefore, the overall probability that the grandchild has the HD allele is $(1/2) * (1/2) = 1/4$.

2.19. (a) The trait is more likely to be due to a recessive allele because there is consanguinity (mating between relatives) in the pedigree. **(b)** The double line indicates consanguineous mating. **(c)** III-1 and III-2 are first cousins. **(d)** Either I-1 or I-2 are likely to be heterozygous Aa (but not both, because the trait is said to be rare), and all of II-2, II-3, III-1, and III-2 are likely to be Aa . On the other hand, II-1 and II-4 are most likely to be AA .

Answers to H&J Chapter 4 odd-numbered problems:

4.13. (a) The mother of II-1 has genotype $hd A/hd A$, and the father of II-1 has genotype $HD a/hd a$. Therefore, II-1 must have the genotype $HD a/hd A$. **(b)** The male II-2 has genotype $hd A/hd A$ and therefore must contribute an $hd A$ gamete to each offspring. Among the gametes from II-1, the possible genotypes are:

1. $HD A$ with frequency $0.10/2 = 0.05$ (recombinant)
2. $HD a$ with frequency $(1 - 0.10)/2 = 0.45$ (nonrecombinant)
3. $hd A$ with frequency $(1 - 0.10)/2 = 0.45$ (nonrecombinant)
4. $hd a$ with frequency $0.10/2 = 0.05$ (recombinant)

Because individual III-1 has the RFLP genotype Aa , she must have resulted from an egg with genotype either $HD a$ or $hd a$. Among these two possibilities, only the $HD a$ gamete will result in Huntington disease. Therefore, the probability that III-1 will be affected is given by $0.45/(0.45 + 0.05) = 0.90$. **(c)** In this case, because III-2 is AA , the egg cell giving rise to III-2 would have to have the genotype either $HD A$ or $hd A$. Only the $HD A$ gamete will result in Huntington disease. Therefore, the probability that III-2 will be affected is $0.05/(0.05 + 0.45) = 0.10$.

Answers to H&J Chapter 6 odd-numbered problems:

6.7. (a) yes; (b) no; (c) no; (d) no; (e) no.

Answers to H&J Chapter 14 odd-numbered problems:

14.3. Set $q = 1/50 = 0.02$. Then the frequency of carrier females equals $2pq = 2 * 0.02 * 0.98 = 0.0392$, or about two times the frequency of affected males. The expected frequency of affected females equals $q^2 = 0.0004$, or 1 in 2500.

14.9. If the genotype frequencies satisfy the Hardy-Weinberg principle, they should be in the proportions p^2 , $2pq$, and q^2 . In each case, p equals the frequency of AA plus one half the frequency of Aa , and $q = 1 - p$. The allele frequencies and expected genotype frequencies with random mating are: (a) $p = 0.50$, expected: 0.25, 0.50, 0.25; (b) $p = 0.635$, expected: 0.403, 0.464, 0.133; (c) $p = 0.7$, expected: 0.49, 0.42, 0.09; (d) $p = 0.775$, expected: 0.601, 0.349, 0.051; and (e) $p = 0.5$, expected: 0.25, 0.50, 0.25. Therefore, only (a) and (c) fit the Hardy-Weinberg principle.

14.13. (a) $2/3$; (b) $2pq/(p^2 + 2pq) = 0.0198$ because $q = \sqrt{1/10,000} = 0.01$; (c) $2/3 * 0.0198 * 1/4 = 0.0033$, or roughly 1 in 300.

14.17. The frequency of the recessive allele is $q = \sqrt{1/14,000} = 0.0085$. Hence, $p = 1 - 0.0085 = 0.9915$, and the frequency of heterozygotes is $2pq = 0.017$ (about 1 in 60).