Test Bank for Genetic Analysis An Integrated Approach 3rd Edition by Sanders

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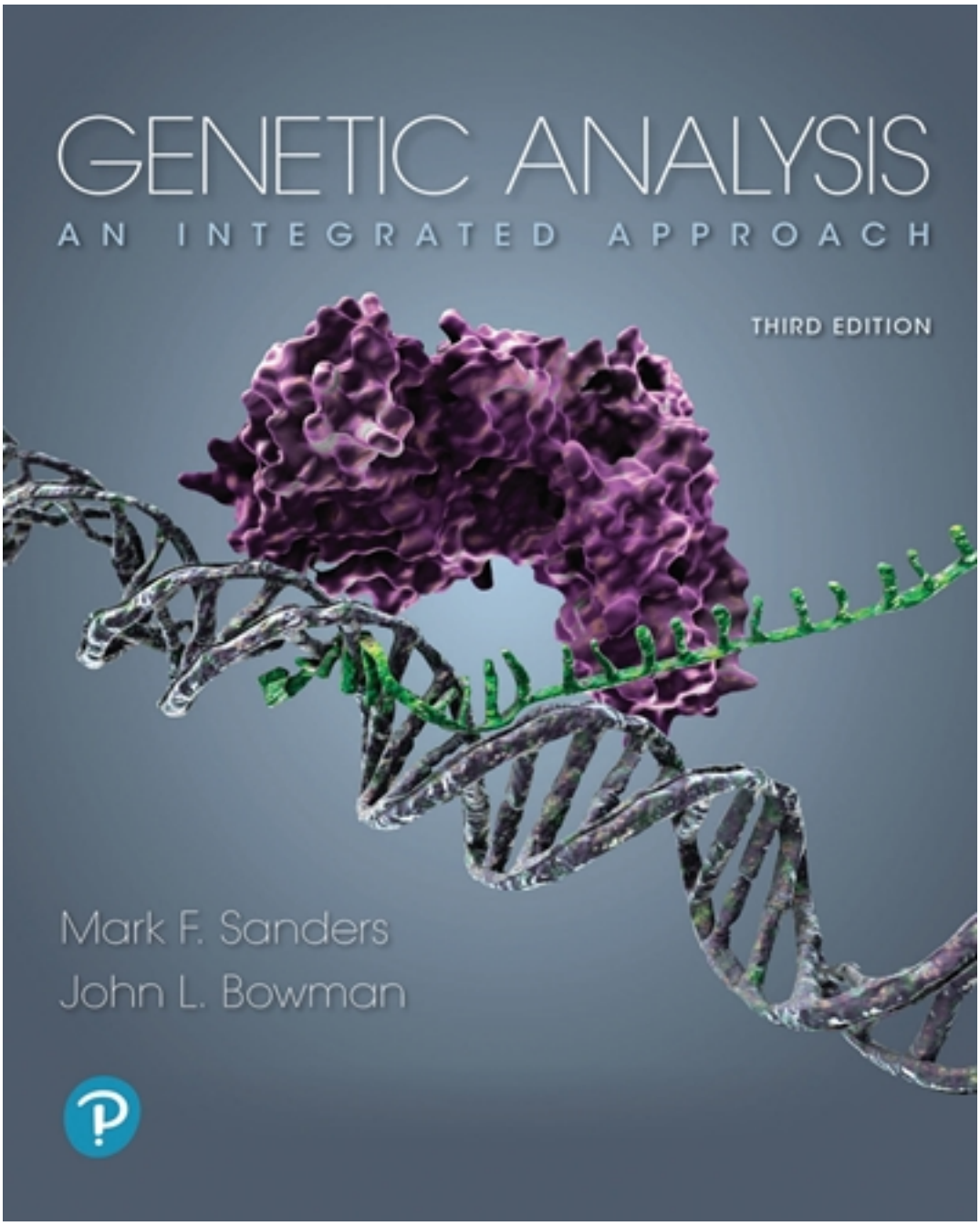


Test Bank

Exam

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Genetic crosses in which F_1 plants heterozygous for a given allele are crossed to generate a 3:1 phenotypic ratio in the F_2 generation are known as _____. 1) _____
A) replicate crosses
B) test crosses
C) dihybrid crosses
D) monohybrid crosses
E) reciprocal crosses

2) In peas, the smooth allele is dominant over the wrinkled allele. A plant with round peas was crossed to a plant with wrinkled peas and all of the resulting plants had smooth peas. What are the genotypes of the parents in this cross? 2) _____
A) *Rr* × *rr* B) *Rr* × *Rr* C) *rr* × *rr* D) *RR* × *rr* E) *RR* × *Rr*

3) In peas, the yellow allele is dominant over the green allele. A plant with yellow peas was crossed to a plant with green peas. The resulting plants were 50% yellow and 50% green. What are the genotypes of the parents in this cross? 3) _____
A) *YY* × *yy* B) *Yy* × *Yy* C) *YY* × *Yy* D) *yy* × *yy* E) *Yy* × *yy*

4) What genotypic ratio would you expect to observe among the progeny of a monohybrid cross? 4) _____
A) 1:3:2:1 B) 3:1 C) 1:2:1 D) 9:3:3:1 E) 1:3

5) You count 1000 F2 seeds from a monohybrid cross. How many seeds do you expect to display the dominant phenotype? 5) _____
A) 250 B) 0 C) 750 D) 500 E) 1000

6) Assuming independent assortment, what phenotypic ratio would you expect to see if an individual with the genotype *RrGg* is self–crossed? 6) _____
A) 1:3:2:1 B) 9:3:3:1 C) 1:3 D) 3:1 E) 1:2:1

7) In peas, axial (*A*) flower position is dominant to terminal (*a*), tall (*L*) is dominant to short (*l*), and yellow (*Y*) is dominant to green (*y*). If a plant that is heterozygous for all three traits is allowed to self–fertilize, how many of the offspring would show the dominant phenotype for all three traits? 7) _____
A) 64/64 B) 3/64 C) 32/64 D) 27/64 E) 9/64

8) In peas, axial (*A*) flower position is dominant to terminal (*a*), and tall (*L*) is dominant to short (*l*). If a plant that is heterozygous for both traits is allowed to self–fertilize, how many of the offspring would also be heterozygous for both traits? 8) _____
A) 1/8 B) 1/4 C) 9/16 D) 1/16 E) 3/16

9) What phenotypic ratio would you expect as a result of a test cross between two individuals where one that is homozygous recessive for alleles at two independent loci? 9) _____
A) 9:3:3:1 B) 9:4:2:1 C) 3:1 D) 1:1:1:1 E) 1:2:1

10) If a plant with purple, axial flowers and green, inflated pods is heterozygous for all four genes, how many different types of gametes can it produce? 10) _____
A) 8 B) 16 C) 1 D) 4 E) 9

11) In Guinea pigs, short hair (*S*) is dominant over long hair (*s*), rough coat (*R*) is dominant over smooth coat (*r*), and black hair (*B*) is dominant over white hair (*b*). Which of the following individuals could produce these (and only these) four possible gametes: *SRb*, *Srb*, *sRb*, *srb*. 11) _____
A) *ssRrBB* B) *SSRRbb* C) *SsRrBb* D) *SSRrBb* E) *SsRrbb*

12) The gene L determines hair length in rabbits. The gene B determines hair color. A rabbit with long, black hair is crossed to a rabbit with short, white hair. All the offspring have long, black hair. What are the genotypes of the parents? 12) _____
A) *LlBb* × *LlBb*
B) *LLBB* × *llbb*
C) *Llbb* × *llBb*
D) *LlBb* × *llbb*
E) Impossible to determine from the information given

13) In rabbits, long hair and black fur are produced by the dominant alleles L and B, which assort independently. The genotype ll produces short hair and the genotype bb produces white fur. A cross between a male with short, black fur and a female with long, white fur produces four offspring with short, black fur, four offspring with long, white fur, four offspring with short, white fur, and four offspring with long, black fur. What are the genotypes of the parents? 13) _____
A) *LlBb* × *LlBb*
B) *llBB* × *LLbb*
C) *LLBB* × *llbb*
D) *llBb* × *Llbb*
E) Impossible to determine from the information given.

14) A couple has four children. What is the probability that they have four boys? 14) _____
A) 1/8 B) 1/4 C) 1/16 D) 1/32 E) 1/2

15) By convention, when an OBSERVED experimental outcome has a probability of occurrence of less than 5% (<0.05), the experimental results are considered to be _____. 15) _____
A) within normal expected range
B) statistically significant and different from the expected outcome
C) equal to the mean
D) not significant
E) less than one standard deviation from the mean

16) The statistical interpretation of a chi-square value is determined by identifying the _____. 16) _____
A) mean
B) average
C) *P* value
D) degrees of freedom
E) joint probability

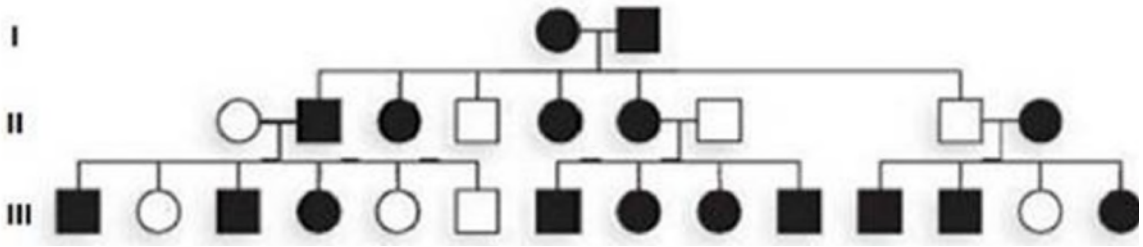
17) The *P* value is a quantitative expression of the probability that the results of another experiment of the same size and structure will DEVIATE FROM EXPECTED RESULTS AS MUCH AS OR MORE THAN BY CHANCE. The greater the difference between observed and expected results of an experiment, _____. 17) _____

A) the greater the $\chi 2$ value and the greater the P value
B) the lower the $\chi 2$ value and the lower the P value
C) the lower the $\chi 2$ value and the greater the P value
D) the greater the $\chi 2$ value and the lower the P value
E) the greater the $\chi 2$ value; but the P value is unaffected

18) Humans have a gene, *T*, that is involved in muscle formation of the tongue. Individuals homozygous for one allele can roll their tongues, while individuals homozygous for the other allele cannot. If both parents can roll their tongues, but their child cannot, what can be said about the mode of inheritance? 18) _____

A) Tongue rolling is recessive.
B) Tongue rolling is dominant, and both parents were heterozygous (*Tt*).
C) The parents were both homozygous, but the child was heterozygous.
D) Tongue rolling is recessive, and both parents were heterozygous (*Tt*).
E) Tongue rolling is dominant.

19) In mice, black coat color is dominant to white coat color. In the pedigree below, mice with a black co represented by darkened symbols, and those with white coats are shown as open symbols. 19) _____



What is the genotype of III–1?

A) homozygous recessive
B) heterozygous
C) homozygous dominant
D) homozygous dominant or heterozygous
E) heterozygous or homozygous recessive

20) In mice, black coat color is dominant to white coat color. In the pedigree below, mice with a black co represented by darkened symbols, and those with white coats are shown as open symbols. 20) _____

What is the probability that I–1, I–2, II–2, AND III–1 are all heterozygous?

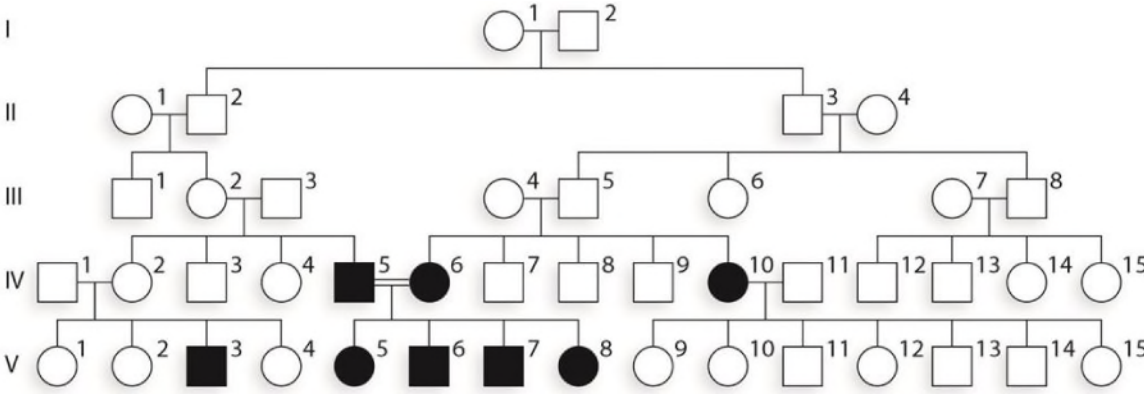
A) 0 B) 1 C) 1/2 D) 2/3 E) 1/4

21) In mice, black coat color is dominant to white coat color. In the pedigree below, mice with a black co represented by darkened symbols, and those with white coats are shown as open symbols. 21) _____

What could you conclude regarding the genotype of mouse II–3 if a testcross resulted in 5 mice with black coat color and 6 mice with white coat color?

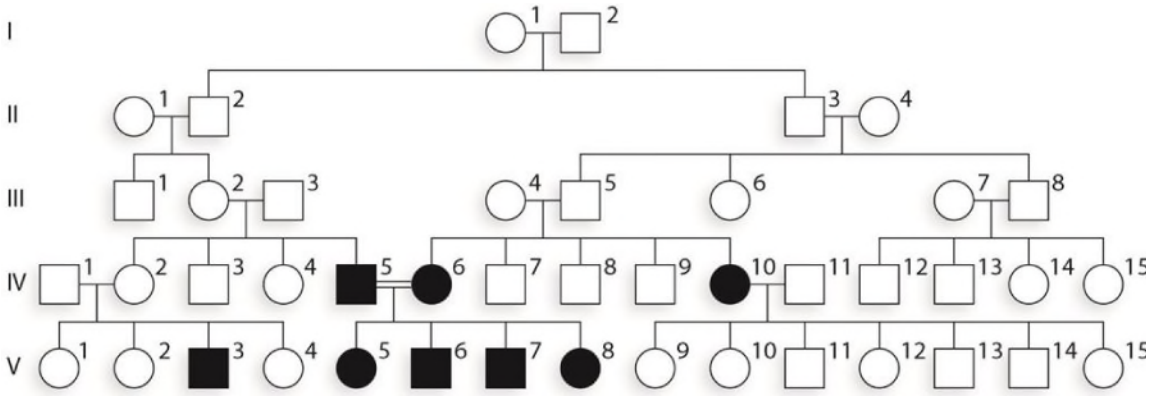
A) The genotype of II–3 must be heterozygous.
B) The genotype of II–3 could be homozygous recessive or heterozygous.
C) The genotype of II–3 must be homozygous recessive.
D) The genotype of II–3 must be homozygous dominant.
E) The genotype of II–3 could be homozygous dominant or heterozygous.

22) In the accompanying figure, the chance that individual III–5 is a heterozygous carrier is _____. 22) _____



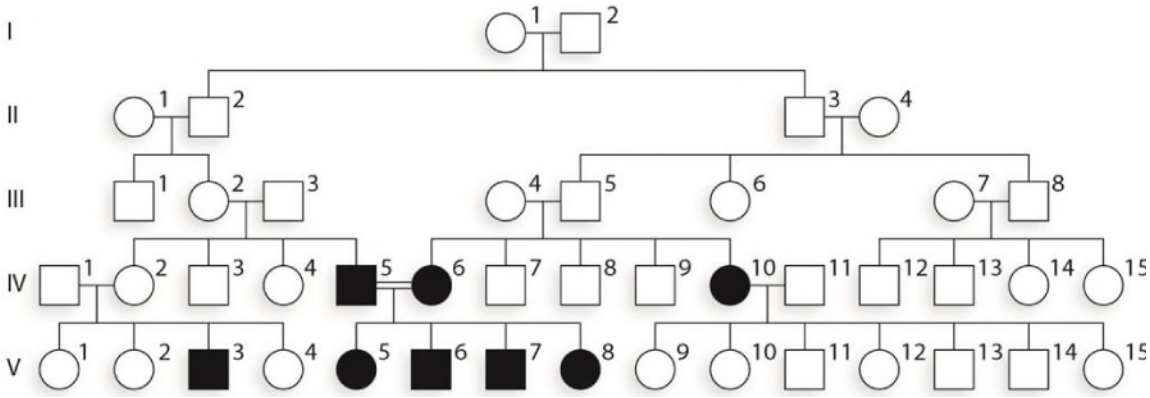
A) 75% B) 25% C) 100% D) 50% E) 0%

23) In the accompanying figure, the chance that individual IV–7 is a heterozygous carrier is _____. 23) _____



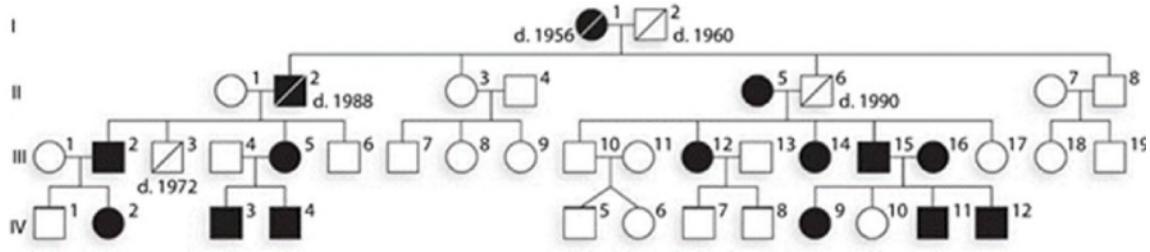
A) 1/4 B) 3/4 C) 1/2 D) 2/3 E) 1/3

24) In the accompanying figure, if individual IV–7 has three children with individual IV–2 what is the probability (to the nearest hundredth) that they would have exactly two affected offspring? 24) _____



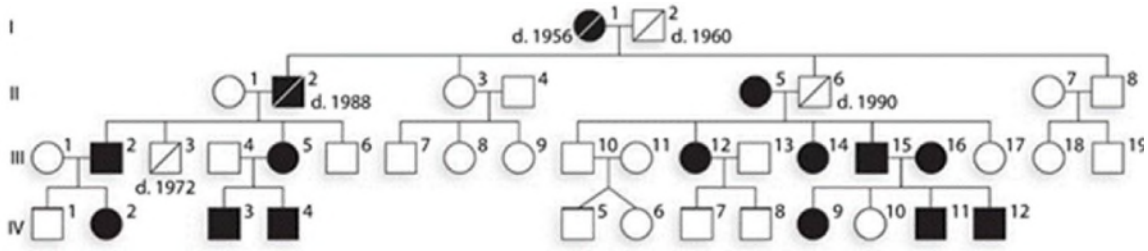
A) 0.17 B) 0.07 C) 0.67 D) 0.44 E) 0.02

25) Huntington's disease is an autosomal dominant trait. Given the pedigree below, if individual IV–2 has three children with a normal man, what is probability that exactly two of the three children wou the disorder? 25) _____



A) 1/8 B) 3/8 C) 7/8 D) 0 E) 1/2

26) Huntington's disease is an autosomal dominant trait. Given the pedigree below, if individual IV–4 has three children with a normal woman, what is probability that they would have at least one child the disorder? 26) _____



A) 1/2 B) 1/8 C) 7/8 D) 3/8 E) 0

27) The genes responsible for some of the traits that Mendel observed have been recently identified and have helped in determining how molecular variation produces morphologic variation in pea plants. Allelic variation in the Sbe1 gene, which produces starch–branching enzyme 1, is responsible for which trait in peas? 27) _____

A) purple and white flowers
B) tall and short plant height
C) yellow and green pea color
D) smooth and wrinkled pea shape
E) axial and terminal flower position

28) In 1997, a gene called *Le* was discovered by two research groups led by David Martin and Diane Lester. Allelic variation in the *Le gene*, which controls elongation of the plant stem between branches, is responsible for which trait in peas? 28) _____

A) axial and terminal flower position
B) tall and short plant height
C) inflated and constricted pod shape
D) purple and white flowers
E) yellow and green pod color

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

29) Mendel performed numerous controlled genetic crosses to obtain strains that consistently produced a single phenotype without variation. What are these strains that consistently produce the same phenotype called? 29) _____

30) In a test cross, a pure–breeding plant is crossed with a plant suspected to be heterozygous (*Aa*). What is the genotype of the pure–breeding plant? 30) _____

31) Why did Mendel cut off the nascent anthers during the process of artificial cross–fertilization? 31) _____

32) In some of Mendel's experiments, a cross in which one plant provides the pollen and another with the same genotype provides the egg is followed be another cross in which the first plant provides the egg while the second provides the pollen. During his experiments, these _____ crosses produced identical results. 32) _____

33) What simple type of cross that investigates the inheritance of only one trait could be used to illustrate Mendel's law of segregation? 33) _____

34) A cross between a short pea plant and a tall pea plant results in a 1:1 genotypic AND phenotypic ratio in the offspring. What are the genotypes of the parent plants? 34) _____

35) The law of independent assortment predicts that crossing of dihybrid F1 plants to one another would produce nine genotypes in a _____ ratio among F2 progeny. 35) _____

36) What is the probability of rolling one six–sided die and obtaining a 1 or a 2? 36) _____

37) What is the probability of rolling one six–sided die and obtaining any number but 6? 37) _____

38) What is the probability of rolling two six–sided dice and obtaining two 4's? 38) _____

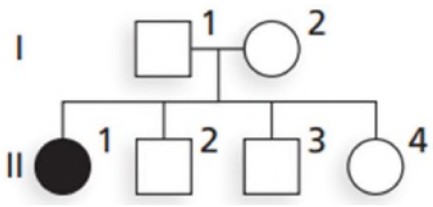
39) What is the probability of rolling two six–sided dice and obtaining at least one 3? 39) _____

40) What is the probability of rolling two six–sided dice and obtaining an odd number on at least one die? 40) _____

41) Geneticists must be able to compare the outcomes they obtain in their experiments to the outcomes that might be expected to occur. Which test would they use to confirm that the difference between observed and expected outcomes could be attributed to chance? 41) _____

42) If an affected individual is born to parents who are unaffected, what is the likely mode of inheritance? 42) _____

43) The pedigree suggests which mode of inheritance for an allele on chromosome 15? 43) _____



44) One key to Mendel's success was choosing to observe _____ traits, which exhibit one of two possible phenotypes. 44) _____

45) A ratio of 9:3:3:1 is expected among the F_2 progeny of a dihybrid cross as a result of _____ of alleles at two loci. 45) _____

46) In a cross between individuals who are both heterozygous (carriers) for a recessive disease, such as albinism, you would like to determine the risk of one or more children inheriting the recessive phenotype. _____ probability can be used to calculate the probability of a particular combination of events that each have two alternative outcomes? 46) _____

47) You have self-fertilized a plant with round seeds that is heterozygous, and you want to determine what proportion of the offspring will be dominant and true breeding. _____ probability can be used to calculate the probability of obtaining a particular outcome when specific information about that outcome modifies the probability calculation? 47) _____

48) The *P* value is dependent on the number of _____, which is equal to the number of independent variables in an experiment. 48) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

49) Describe the traits that make *Pisum sativum* an ideal organism for genetic studies.

50) Describe the blending theory of heredity and how Mendel's results help to reject this theory.

51) What are Mendel's first and second laws of inheritance, and what do they state?

52) In Guinea pigs, short hair (S) is dominant over long hair (s), rough coat (R) is dominant over smooth coat (r), and hair (B) is dominant over white hair (b). List all the different possible gametes that can be produced by each of th individuals below.
a. *SSRRbb*
b. *ssRrBB*
c. *SsRrbb*
d. *SsRrBb*

53) A geneticist is investigating the inheritance of two autosomal recessive genes in mice, one for obesity (LEP) and a for autism (oprm1). The table below provides the number of offspring observed, for each phenotype, when dihyb mice are crossed:

Phenotype	Observed(O)	Expected (E)	O–E	(O–E)2	(O–E)2/E
wild-type	154				
obese	69				
autistic	58				
obese, autistic	23				
					Σ (O–E)^2/E=

Fill in the table above and determine:
a. the chi-square (χ^2) value (to the nearest hundredth) for the chance hypothesis that the two genes assort independently
b. the degrees of freedom
c. whether or not you would reject your chance hypothesis that the two genes assort independently, based on y approximate P value, and the justification for why

54) A geneticist is investigating the inheritance of two autosomal recessive genes in mice, one for obesity (LEP) and a for autism (oprm1). The table below provides the number of offspring observed, for each phenotype, when dihyb mice are testcrossed:

Phenotype	Observed(O)	Expected (E)	O–E	(O–E)2	(O–E)2/E
wild-type	88				
obese	68				
autistic	64				
obese, autistic	80				
					$\Sigma (O-E)^2/E=$

Fill in the table above and determine:

a. the chi–square (χ^2) value (to the nearest hundredth) for the chance hypothesis that the two genes assort independently

b. the degrees of freedom

c. whether or not you would reject your chance hypothesis that the two genes assort independently, based on y approximate P value, and the justification for why

55) Tim and Mary are planning to start a familiy. While neither of them have cystic fibrosis, a rare autosomal recessi disease, they are concerned that their children could have the disease since Tim's father, John, AND Mary's broth Ralph both have the disease.

a. Draw a pedigree of the inheritance of the cystic fibrosis allele in this family.
b. On your pedigree, indicate any individuals that must be carriers.
c. What is the probability that Tim will be a carrier for the disease allele?
d. What is the probability that Mary will be a carrier for the disease allele?
e. What is the probability that Tim and Mary will have a child with the disease?

1) D
2) D
3) E
4) C
5) C
6) B
7) D
8) B
9) D
10) B
11) E
12) B
13) D
14) C
15) B
16) C
17) D
18) B
19) B
20) B
21) A
22) C
23) D
24) B
25) B
26) C
27) D
28) B
29) pure–breeding or true–breeding strains
30) *aa*
31) to prevent self–fertilization or to prevent uncontrolled crosses
32) reciprocal
33) monohybrid cross
34) *Ss* × *ss* (heterozygous × homozygous recessive)
35) 9:3:3:1
36) 1/6 + 1/6 = 2/6 = 1/3
37) 1 – 1/6 = 5/6
38) 1/6 × 1/6 = 1/36
39) Probability of die 1 being a 3 and die 2 not: 1/6 × 5/6 = 5/36
Probability of die 2 being a 3 and die 1 not: 1/6 × 5/6 = 5/36
Probability of die 1 and 2 being a 3: 1/6 × 1/6 = 1/36
Probability of any of these possibilities = addition rule: 5/36 + 5/36 + 1/6 = 11/36
40) 9/36 + 9/36 + 9/36 = 27/36 = 3/4
Probability of rolling odd number the first die only = 3/6 (odd) × 3/6 (even) = 9/36
Probability of rolling odd number the second die only = 3/6 (even) × 3/6 (odd) = 9/36
Probability of rolling odd number both dice = 3/6 (odd) × 3/6 (odd) = 9/36
Probability of any one of these three possible scenarios = addition rule
41) chi–square test
42) autosomal recessive
43) autosomal recessive

44) dichotomous
45) independent assortment
46) Binomial
47) Conditional
48) degrees of freedom (df)
49) There are many varieties of peas with distinct, heritable features in the form of dichotomous phenotypes that can be easily observed and quantified. In addition, mating of plants can be closely controlled. Since each pea plant has both sperm-producing (stamens) and egg-producing (carpels) organs, they can be self-crossed to generate true-breeding plants. After creating these true-breeding plants, Mendel could test for dominant or recessive inheritance patterns by cross-pollination (fertilization between different plants).
50) The blending theory viewed the traits of progeny as a mixture of the characteristics possessed by the two parental forms. Under this theory, progeny were believed to display characteristics that were approximately intermediate between those of the parents. Mendel reasoned that if the blending theory were true, he would see evidence of it in each trait. If no blending was seen in individual traits, the blending theory would be disproven. F_1 experimental results reject the blending theory of heredity because all F_1 progeny have the same phenotype (i.e., the dominant phenotype) that is indistinguishable from the phenotype of one of the pure-breeding parents. This specifically contradicts the blending theory prediction that the F_1 would display a mixture of the parental phenotypes. The persistence of the dominant phenotype and the reemergence of the recessive phenotype in the F_2 also contradict the blending theory.
51) *First Law: Law of Segregation*—The two alleles for each trait will separate from one another during gamete formation, and allele will have an equal probability (1/2) of inclusion in a gamete. Random union of gametes at fertilization will unite o gamete from each parent to produce progeny in ratios that are determined by chance.
Second Law: Law of Independent Assortment—During gamete formation, the segregation of alleles at one locus is independent of the segregation of alleles at another locus.
52) a. *SSRRbb: SRb*
b. *ssRrBB: sRB, srB*
c. *SsRrbb: SRb, Srb, sRb, srb*
d. *SsRrBb: SRB, SRb, SrB, Srb, sRB, sRb, srB, sr*
53)

Phenotype	Observed(O)	Expected (E)	O-E	(O-E)2	(O-E)2/E
wild-type	154	171	-17	289	1.690
obese	69	57	12	144	2.526
autistic	58	57	1	1	0.018
obese, autistic	23	19	4	16	0.842
					$\Sigma (O-E)^2/E = 5.08$

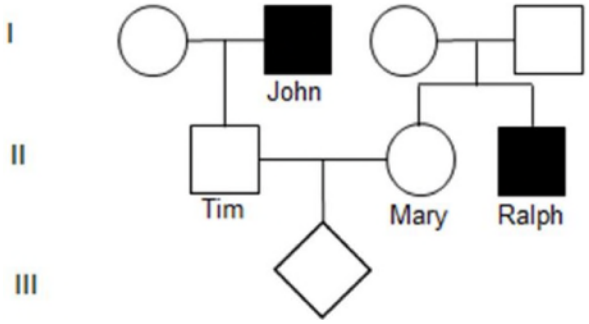
a. 5.08
b. 3
c. You would fail to reject the chance hypothesis since the observed outcomes have a P value greater than 5% (> 0.05). Therefore, the chance hypothesis that the two genes assort independently cannot be rejected.

54)

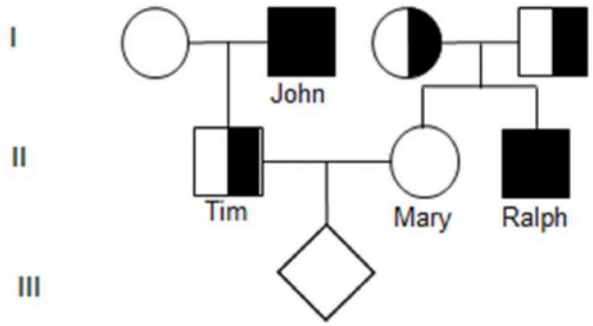
Phenotype	Observed(O)	Expected (E)	O–E	(O–E)2	(O–E)2/E
wild-type	88	75	13	169	2.533
obese	68	75	–7	49	0.653
autistic	64	75	–11	121	1.613
obese, autistic	80	75	5	25	0.333
					$\Sigma (O-E)^2/E = 4.85$

a. 4.85
b. 3
c. You would fail to reject the chance hypothesis since the observed outcomes have a P value greater than 5% (> 0.05). Therefore, the chance hypothesis that the two genes assort independently cannot be rejected.

55) a.



b.



c. 1
d. 2/3
e. 1/6