1. In dihybrid crosses, the ratio 9:3:3:1 indicates

A. codominance.
B. independent assortment. ✓
C. intermediate dominance.
D. three alleles for each trait.

2. Mating of two organisms produces a 1:1 ratio of phenotypes in the progeny. The parental genotypes are

A. *Aa* × *Aa.*
B. *Aa* × *aa.* ✓
C. *AA* × *aa.*
D. *AA* × *AA.*

3. Mating two organisms produces a 3:1 ratio of the phenotype in progeny. The parental genotypes are

A. *Aa* ×*Aa.* ✓
B. *Aa* × *aa.*
C. *AA* × *aa.*
D. *AA* × *AA.*

4.The interaction between non-allelic genes in their effects on a trait is called

A. epistasis. ✓
B. epigenetics.
C. dominance.
D. codominance.
E. incomplete dominance.

5. The situation in which an expected phenotype is not expressed is referred to as

A. pleiotropy.
B. variable expressivity.
C. incomplete penetrance. ✓
D. recessivity.

6. Parents heterozygous for a recessive allele are called

A. carriers. ✓
B. codominant.
C. hybrids.
D. true-breeding.
E. pleiotropic.

7. Probabilities are calculated using the addition rule when they

A. are equally likely.
B. are independent.
C. are mutually exclusive. ✓
D. occur disproportionately.

8. Probabilities are calculated using the multiplication rule when they

A. are equally likely.
B. are independent. ✓
C. are mutually exclusive.
D. occur disproportionately.

9. In families where both parents are heterozygous for a recessive trait, what is their probability of having a child with the homozygous recessive genotype?

A. 1
B. 1/2
C. 1/4 ✓
D. 3/4

10. In a complementation test, if the combination of two recessive mutations results in a mutant phenotype, then the mutations are regarded as

A. pleiotropic.
B. alleles of the same gene. ✓
C. alleles of different genes.
D. codominant.
E. epistatic.

11. A dihybrid cross *SS tt* × *ss TT* is made in which *S* is dominant, but there is no dominance between *T* and *t*. Assuming independent assortment, how many phenotypic classes are expected in $F_2$?

A. 2
B. 3
C. 4
D. 5
E. 6 ✓

12. Two parents with blood types A and B have a child who has O blood type. What is the chance that their next child will be A?

A. 0
B. 1/2
C. 1/4 ✓
D. 1

13. In the cross *Aa Bb Cc Dd* × *Aa Bb Cc Dd*, in which all genes undergo independent assortment, what

proportion of offspring are expected to be homozygous recessive for all four genes?

A. 1/2
B. 1/4
C. $(1/2)^4$
D. $(1/4)^4$ ✓
E. 0

14. Among sibships consisting of five children, and assuming a sex ratio of 1:1, what is the proportion with no boys?

A. 1/2
B. $(1/2)^5$ ✓
C. $(1/5)^5$
D. $1 - (1/2)^5$

15. Assuming equal sex ratios, if a mating has already produced 3 girls, what is the probability that the next child will be a girl?

A. 0
B. 1
C. 1/2 ✓
D. $(1/2)^3$
E. $1 - (1/2)^3$

16. A woman with keratosis, a skin condition caused by a rare dominant allele, marries a normal man, and they have two children. What is the probability that both children are normal?

A. 0
B. 1/2
C. 1/4 ✓
D. 3/4
E. 1

17. Assuming independent assortment, how many different gametes can be formed by an organism that is homozygous for 3 and heterozygous for 2 genes?

A. 2
B. 4 ✓
C. $3^2$
D. 5
E. 6

18. Assuming independent assortment, how many different gametes can be formed by an organism that is heterozygous for n genes?

A. $n^{1/2}$
B. $(1/2)^n$
C. 1 - [n(n – 1)]/2
D. $2^n$ ✓

19. A normal woman has a sister who suffers from deafness determined by a rare recessive allele. What is the probability that her phenotypically normal daughter is heterozygous for the gene?

A. 1/2
B. 1/3 ✓
C. 1/4
D. 1/6
E. 0

Short Answer

20. Assuming independent assortment, how many different gametes can be formed by an organism that is homozygous for 10 genes and heterozygous for 5 genes?

**$2^5$**

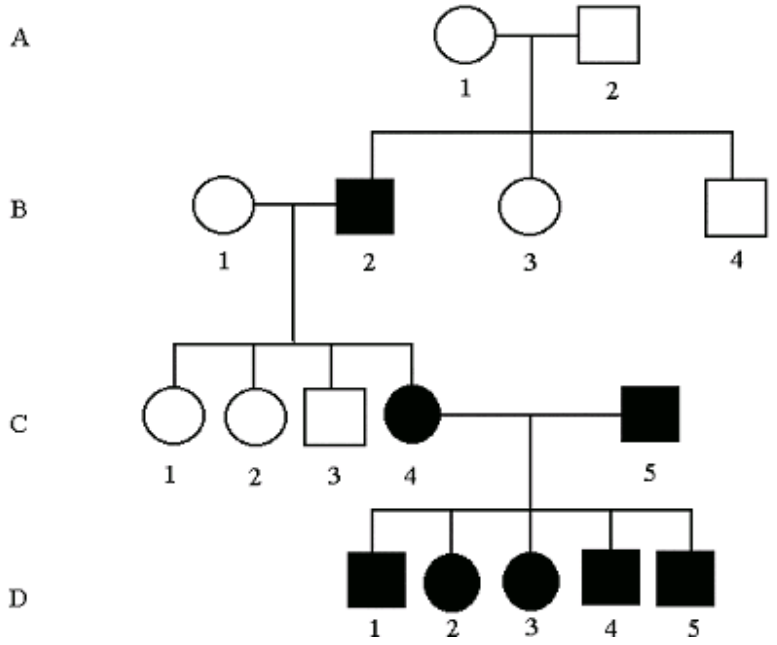
21. Phenylketonuria (PKU) is a recessive human condition resulting from inability to convert phenylalanin into tyrosine. Two normal parents have a child with PKU.

**a.** What is the probability that the parents will have another child that is a carrier of the recessive allele? **½ (assuming one other child)**

b. What is the probability that out of five children the couple will have three that are normal and two that have PKU? **Knowing that the first is affected, this means that amongst the four next ones one will be affected, three not. The corresponding probability is** $4x\frac{1}{4}x\left(\frac{3}{4}\right)^3 = \frac{27}{64}$

22. The pedigree in the accompanying illustration shows the inheritance of albinism, a homozygous recessive condition resulting in a total lack of pigment. Specify the following genotypes using *A* and *a* to indicate dominant and recessive alleles, respectively. Solid figures represent albino individuals.

a. A-1 **: Aa**
b. A-2 **: Aa**
c. B-1 **: Aa**
d. B-2 **: aa**
e. C-3 **: Aa**
f. C-4 **: aa**
g. D-5 **: aa**




23. Albinism is a total lack of skin pigment due to a recessive gene. What is the probability of a couple having an albino child if:

a. She is albino, he is normally pigmented but his father was albino. **1/2**
b. Both are normally pigmented as are their parents, but both have albino siblings. **1/9**
c. He's albino, but she has no albinism in her family history. **Close to 0**

24. Instead of the expected 9:3:3:1 ratios in an $F_2$ generation from true-breeding parents, one sees a 9:7 ratio. What does this deviation indicate? **9:7 is observed when a homozygous recessive mutation in either or both of two different genes results in the same mutant phenotype (complementation)**

25. In the cross *AABB* × *aabb*, $F_2$ progeny is produced in a phenotypic ratio of 9:4:3. What does this deviation from the expected 9:3:3:1 indicate? **Recessive epistasis. An example is coat color in Labradors where the recessive golden coat color is epistatic to black (dominant) and chocolate (recessive).**

26. In the cross *Aa Bb Cc Dd* × *Aa Bb Cc Dd*, in which all genes undergo independent assortment, what proportion of offspring are expected to be homozygous for dominant alleles of genes *A, B* and *C* and heterozygous for gene *D*? $\left(\frac{1}{4}\right)^3 x \frac{1}{2}$

27. In a testcross of *Aa Bb CC Dd Ee,* where the genes show independent assortment:

a. What is the expected frequency of *aa bb Cc dd ee* progeny? $\left(\frac{1}{2}\right)^4$

b. What is the expected frequency of progeny that are heterozygous for all five genes? $\left(\frac{1}{2}\right)^4$

28. In the ABO blood groups:

a. What mating or matings can produce progeny of only a single genotype? **O x O**
b. If a child has blood group AB, what are the possible blood groups of the parents? **AxB, ABxB, ABxA**
c. What mating or matings can produce progeny of all four blood groups? **AxB**
d. What property of the blood from blood group AB persons justifies the term "universal recipient"? **absence of circulating anti-A and anti-b antibodies**
e. What property of the blood from blood group O persons justifies the term "universal donor"? **absence of A and B antigens**

29. Assuming sex ratio of 1:1.

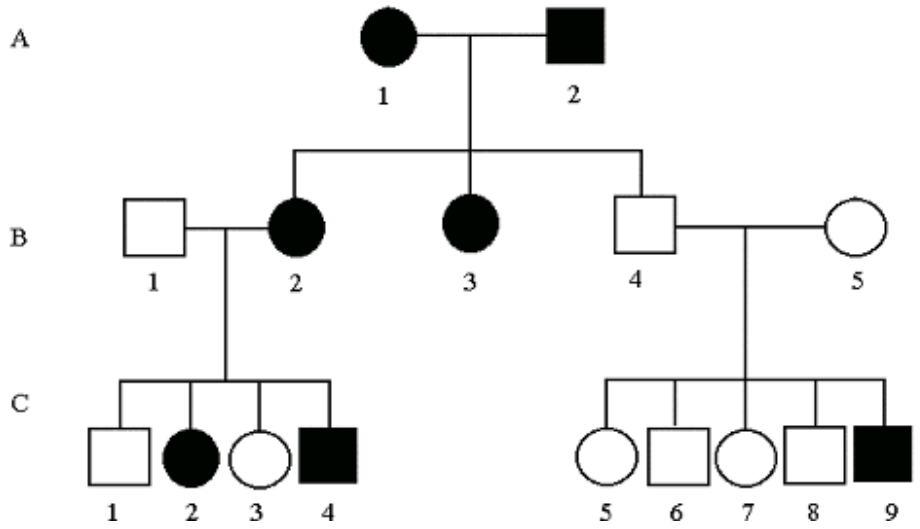
a. What is the probability that a couple will have seven girls? $\left(\frac{1}{2}\right)^7$
b. If they already have six girls, what is the probability that the seventh child will be female? **1/2**

30. In mice, the dominant *T* (tailless) allele results in a short tail. Consider a cross of $TT^+ \times T^+T^+$, where the symbol $T^+$ represents that wildtype, non-mutant allele:

a. What are the expected proportions of tailless versus normal-tailed offspring? **1:1**
b. In a litter consisting of 4 pups, what is the probability that two will be short-tailed and two normal-tailed? $6x\left(\frac{1}{2}\right)^4$
c. In a litter consisting of 4 pups, what is the probability that at least one will be short-tailed? $1-\left(\frac{1}{2}\right)^4$

31. The ability to roll the tongue is a dominant trait. In the pedigree below, solid symbols represent "rollers" and open symbols "non-rollers". Using *R* and *r* for dominant and recessive alleles, respectively, give the likely genotype of:

a. A-1 **: Rr**
b. A-2 **: Rr**
c. B-1 **: rr**
d. B-3 **: Rr or RR**
e. B-4 **: Rr (incomplete penetrance ?)**
f. C-1 **: rr**
g. C-9 **: Rr**




32. Use *P* and *p* for purple and red and *S* and *s* for sweet and non-sweet. If two corn plants *PpSs* are crossed, what fraction of the offspring will be

a. Purple : **3/4**
b. Non-sweet: **1/4**
c. Red and non-sweet: **1/16**
d. Red and sweet: **3/16**
e. Purple and sweet: **9/16**