Student name:_____

CHECK ALL THE APPLY. Choose all options that best completes the statement or answers the question.

1) ABO blood type demonstrates which of the following inheritance patterns?

A) incomplete dominance
B) complete dominance
C) pleiotropy
D) codominance
E) three genes are involved

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

2) Two alleles of gene *C* control hair color in horses: C^1 and C^2. Horses homozygous for allele C^1 are red, heterozygotes are yellow, and C^2 homozygotes are cream. What type of allele interaction is described?

A) pleiotropy
B) complete dominance
C) incomplete dominance
D) recessive lethality
E) codominance

3) If a trait is controlled by two different genes, a possible interaction between alleles of these genes can be called

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

4) Curly-winged flies mate with pure-breeding straight-winged (wild-type) flies. The curly-winged F_1 mate with each other to produce an F_2 generation that consists of 160 flies with curly wings and 80 with straight wings. What can you infer from this observation?

A) Curly wings is a recessive trait.
B) The dominant curly wing allele is also a recessive lethal.
C) Wing shape is controlled by two codominant alleles.
D) Two interacting genes determine wing shape.
E) All of the hybrid F_1 flies had straight wings.

5) What can explain the phenomenon where in different individuals, a particular genotype might give rise to different phenotypes?

A) pleiotropy
B) codominance
C) incomplete dominance
D) complete dominance
E) penetrance and expressivity

6) Two alleles of gene *C* control hair color in horses: C^1 and C^2. Horses homozygous for allele C^1 are red, heterozygotes are yellow, and C^2 homozygotes are cream. In the offspring of matings between heterozygotes, what phenotypic ratio is expected?

A) 2 yellow: 1 red
B) 3 red: 1 cream
C) 1 red: 2 yellow: 1 cream
D) all red
E) 9 red: 3 yellow: 4 cream

7) If a trait is controlled by two codominant alleles of one gene, what phenotypic ratio is expected in the offspring of a mating of two heterozygotes?

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

8) Which genotypic ratio indicates a recessive lethal allele when two heterozygotes are mated?

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

9) A particular flower can be blue, red, or white. A pure-breeding red-flowered plant is crossed with a pure-breeding white-flowered one. The F_1 are then crossed to produce an F_2 generation. Which of the following phenotypic ratios in the F_2 indicate that flower color in these two strains is controlled by two genes?

A) 2:1
B) 3:1
C) 1:2:1
D) 9:3:4

10) If a gene for a trait is monomorphic in a population and two random individuals mate, what would be the most likely phenotypic ratio for that trait in the offspring?

A) 2:1
B) More information is needed
C) 1
D) 3:1

11) What genetic phenomenon might a 2:1 phenotypic ratio indicate?

A) additivity
B) codominance
C) complete dominance
D) recessive epistasis
E) recessive lethality

12) A particular flower can be purple, blue, red, or white. Plants from two different pure-breeding strains of white-flowered plants are crossed and the F_1 are then crossed to produce an F_2 generation. What might a 9:7 phenotypic ratio in the F_2 indicate about the genes that control flower color in these plants?

A) two genes with reciprocal recessive epistasis
B) one gene with two codominant alleles
C) two genes and dominant epistasis
D) two genes and recessive lethality
E) two genes and additive interactions

13) A particular flower can be purple, blue, red, or white. A pure-breeding purple-flowerd plant is crossed with a pure-breeding white-flowered plant and the F_1 are then crossed to produce an F_2 generation. What might a 9:3:4 phenotype ratio in the F_2 indicate?

A) reciprocal recessive epistasis
B) codominance
C) dominant epistasis
D) recessive epistasis
E) additivity

14) Which ratio in the F_2 of a cross between two pure-breeding strains would indicate that a phenotype is controlled by more than one gene?

A) 3:1
B) 2:1
C) 1:2:1
D) 9:3:3:1

15) A disease is caused by homozygosity for the *g* allele (*G* is the corresponding wild-type allele). However, the penetrance of the disease is 75%. Two individuals known to be heterozygotes have a child. What is the probability that the child exhibits the disease?

A) 1/4
B) 3/4
C) 1/8
D) 3/16
E) 9/16

16) Some complex traits are determined by many interacting genes, each of which may have several alleles. If such a trait is measured in a population, what phenotypic pattern is expected?

A) All individuals will have the same phenotype.
B) Two types of individuals will exist, and most will have the dominant phenotype.
C) Different individuals will each have one of a few discrete phenotypes.
D) The population will have continuous variation in phenotypic expression.

17) In some flowers, a purple pigment is synthesized from a red precursor pigment. In the absence of all pigment, flowers are white. Pure-breeding plants with red flowers were crossed to a pure-breeding plants with white flowers. All of the F_1 plants had white flowers. The F_1 plants were crossed to each other, and the F_2 consisted of 166 plants: 123 with white flowers, 32 with purple flowers, and 11 with red flowers. How is flower color is determined in these plants?

A) One gene with two alleles exists and heterozygotes have a different phenotype than either homozygote.

B) The dominant allele of one gene masks the effect of a second gene.

C) Recessive alleles of one gene mask the effect of a second gene.

D) A dominant allele of each gene is necessary for purple flowers.

E) A dominant allele of either of two genes is sufficient for purple flowers.

18) A particular flower can be purple, blue, red, or white. A pure-breeding purple-flowered plant is crossed with a pure-breeding white-flowered plant and the F1 are then crossed to produce an F2 generation. Which phenotypic ratio in the F2 may indicate that flower color in these plants is controlled by two genes that interact additively?

A) 3:1

B) 1:2:1

C) 9:3:3:1

D) 9:3:4

E) 15:1

19) In dogs, Gene *B* specifies a protein required for eumelanin (dark pigment) deposition. Protein B (specified by the *B* allele) deposits eumelanin densely so that the dog's hair is black. Protein b (specified by the *b* allele) deposits eumelanin less densely, producing brown hair (chocolate). Allele *B* is dominant to allele *b*. Gene *D* specifies another protein that is also required for pigment deposition. The recessive allele d^1specifies a protein that functions less efficiently than that specified by the dominant allele *D*. Less pigment is deposited in d^1d^1homozygous dogs than in dogs with a *D* allele, and so the color dictated by gene *B* is lighter. Which of the following genotypes would a light-chocolate dog have?

A) $Bb\ d^1d^1$

B) $BB\ d^1d^1$

C) $bb\ d^1d^1$

D) $bb\ Dd^1$

SECTION BREAK. Answer all the part questions.

20) In rats, the *P* gene allele for pigmentation (*P*) is dominant to the allele for albinism (*p*). The *B* gene allele for black pigmentation (*B*) is dominant to the allele for cream pigmentation (*b*). The *pp* homozygous recessive genotype is epistatic to any allele combination at gene *B*.

20.1) Predict the genotypes and phenotypes of the F_1 progeny of a cross between a pure-breeding black rat and an albino that is also homozygous for cream.

A) *PP BB*, black
B) *Pp Bb*, black
C) *Pp Bb*, albino
D) *pp Bb*, albino

20.2) Predict the phenotypic ratio of the F_2 progeny of a parental cross between a pure-breeding black rat and an albino that is also homozygous for cream.

A) 1 black: 2 cream: 1 albino
B) 9 black: 3 cream: 4 albino
C) 9 black: 7 albino
D) 12 black: 3 cream: 1 albino
E) 15 black: 1 albino

21) In the common daisy, genes *A* and *B* control flower color. Both genes have a dominant allele (*A* or *B*) and a recessive allele (*a* or *b*). At least one copy of each dominant allele is required for flowers to be colorful instead of white.

21.1) Predict the genotypes and phenotypes of the F_1 progeny of a cross between two white-flowered plants, one homozygous *AA* and the other homozygous *BB*.

A) *AA bb*, white
B) *aa BB*, white
C) *Aa Bb*, colorful
D) *Aa Bb*, white
E) *aa bb*, colorful

21.2) Predict the phenotypic ratio of the F_2 progeny of a cross between two white-flowered plants, one homozygous *AA* and the other homozygous *BB*.

A) 3 colorful : 1 white
B) 9 colorful : 7 white
C) 9 white : 7 colorful
D) 15 white : 1 colorful
E) 15 colorful : 1 white

21.3) The inheritance pattern of daisy flower color provides an example of what type of gene interaction?

A) additivity
B) recessive epistasis
C) reciprocal recessive epistasis
D) dominant epistasis
E) redundancy

22) Achondroplasia is a form of dwarfism in humans. It is caused by a mutant allele of the *fibroblast growth factor receptor 3* gene (*FGFR3*) that produces an overactive protein. Having one copy of the mutant allele results in dwarfism. Two copies of the mutant allele results in death before birth. The mutant *FGFR3* allele is completely penetrant.

22.1) What can you infer about the inheritance of the *FGFR* alleles?

A) The mutant *FGFR3* allele is pleiotropic.
B) Some achondroplastic dwarfs are heterozygous for the mutant allele and some are homozygous.
C) The wild-type and mutant *FGFR3* alleles are codominant.
D) The mutant *FGFR3* allele shows incomplete penetrance.

22.2) If two people with achondroplasia have a child together, what is the probability that their child will also have achondroplasia?

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

23) In primroses, the dominant allele of gene *K* is necessary to synthesize blue flower pigment. Blue pigment synthesis is inhibited by a dominant allele of gene *D*. In other words, plants with the genotype *K*− *D*− will not produce pigment (and their flowers will be white) because of the presence of the *D* allele.

23.1) If two dihybrid plants (*Kk Dd*) are crossed, what is the ratio of blue to white offspring in the progeny?

A) 3 blue: 1 white
B) 7 blue: 9 white
C) 4 blue: 12 white
D) 3 blue: 13 white
E) 1 blue: 15 white

23.2) What type of interaction between alleles of different genes determines flower color in primroses?

A) reciprocal recessive epistasis
B) recessive epistasis
C) redundancy
D) dominant epistasis
E) complete dominance

24) Two pure-breeding phlox plants were crossed, one with dark-blue flowers and the other with pink flowers. The F_1 generation all had dark-blue flowers. When the F_1 were crossed with each other, the F_2 generation consisted of 176 plants: 101 with dark-blue flowers, 33 with light-blue flowers, 30 with red flowers, and 10 with pink flowers.

24.1) How is flower color controlled in phlox?

A) one gene with four alleles that form a dominance series
B) one gene with two codominant alleles
C) two genes whose alleles interact additively
D) two genes with dominant epistasis

24.2) What progeny types would result from crossing pure-breeding plants with light-blue flowers to pure-breeding plants with red flowers?

A) all would be dark blue
B) all would be red
C) 1 light blue : 1 red
D) 9 dark blue : 3 light blue : 3 red : 1 pink

25) In dogs, the dominant allele *E* (of gene *E*) specifies dark pigment; the recessive *e* allele specifies a light pigment (cream). Genes *A* and *K* determine how the phenotype associated with the *E* allele is expressed. The dominance series for *A* gene alleles is A^Y (fawn) > a^w (gray) > a^t (tan belly). The dominance series for the gene *K* alleles is K^b (solid color) > k^{br} (brindled) > k^y (gene *A* markings expressed normally). Note that of all the gene *K* alleles, only the k^y allele allows the phenotypes associated with the gene *A* genotypes to be expressed normally. Also, the *ee* genotype is epistatic to all alleles of genes *A* and *K*.

25.1) What is the coat color of a dog with the genotype $Ee\ k^yk^y\ A^Ya^w$?

A) cream
B) fawn
C) gray
D) tan belly

25.2) Which of the following genotypes could a gray dog have?

A) *ee* $k^y k^y$ $a^w a^w$
B) *Ee* $k^y k^y$ $A^Y a^w$
C) *EE* $k^y k^y$ $a^w a^t$
D) *Ee* $K^b k^y a^w a^w$

25.3) Using the at-home genetic test '39Fetch' you discover that your dog is *ee*. What color is your dog's coat?

A) cream
B) fawn
C) gray
D) tan belly

Answer Key

Test name: Hartwell 2

1) [B, D]
2) C
3) A
4) B
5) E
6) C
7) C
8) A
9) D
10) C
11) E
12) A
13) D
14) D
15) D
The disease is seen only in *gg* individuals. Because the disease is 75% penetrant, 75% of *gg* individuals will show disease symptoms.The chance that the child of two heterozygotes (*Gg* ×*Gg*) is *gg* is 1/4. If the child is *gg*, there is a 75% (or 3/4) chance the child will show disease symptoms. Because both of those events must happen for the child to have the disease, the probabilities are multiplied (1/4 × 3/4) to equal 3/16.
16) D
17) B
18) C
19) C

20) Section Break
    20.1) B
    20.2) B
21) Section Break
    21.1) C
    21.2) B
    21.3) C
22) Section Break
    22.1) A
    22.2) C
23) Section Break
    23.1) D
    23.2) D
24) Section Break
    24.1) C
    24.2) A
25) Section Break
    25.1) B
    25.2) C
    25.3) A