Multiple Choice Review - Heredity

Questions #1-3 refer to the following situation:

In humans, detached earlobes (D) is dominant to attached earlobes (d). Alison and her father have attached earlobes. Her mother has detached earlobes.

1. What is Alison's phenotype?
   a. Recessive
   b. dd
   c. Attached earlobes
   d. Homozygous

2. What is the father's genotype?
   a. Recessive
   b. dd
   c. Attached earlobes
   d. Homozygous

3. What is a correct description of the mother, in terms of the earlobe gene?
   a. She is heterozygous for the gene.
   b. She expresses incomplete dominance for the gene.
   c. She only has one allele for the gene.
   d. It is an unlinked gene.

4. On chromosome 1 of fruit flies, the gene for yellow body is 27.5 map units away from the gene for tan body, 43 map units away from the gene for sable body, and 56.7 map units away from the gene for forked bristles. Which two genes have the highest recombination frequency?
   a. Sable body and forked bristles
   b. Yellow body and forked bristles
   c. Yellow body and tan body
   d. Tan body and sable body

5. Every organism has two alleles for each gene. During meiosis, however, these two alleles separate from each other into different gametes. What did Mendel call this phenomenon?
   a. Law of independent assortment
   b. Law of separation
   c. Law of causation
   d. Law of segregation

6. A new flower species is discovered in the rainforest. Back in the lab, a scientist crosses a red variety with a blue variety. The result includes some red flowers, some blue flowers, and some purple flowers. What type of dominance pattern do these plants display?
   a. Complete dominance
   b. Incomplete dominance
   c. Epistasis
   d. Codominance

Questions #7-10 refer to the following situation:

Blood type in humans is determined by the type of carbohydrate present on the red blood cells. A red blood cell may have carbohydrate A (I^A), carbohydrate B (I^B), or no carbohydrate (i). Carbohydrate A and carbohydrate B are codominant to each other and both A and B are completely dominant to the allele for no carbohydrate.

7. How many phenotypes are possible for this situation?
    a. 2
    b. 3
    c. 4
    d. 5

8. How many genotypes are possible for this situation?
    a. 3
    b. 4
    c. 6
    d. 8

9. Human blood type is an example of what type of inheritance pattern?
    a. Incomplete dominance
    b. Epistasis
    c. Linked genes
    d. Multiple alleles

10. If two recessive alleles are inherited by a person, they are said to have type "O" blood. If a type O person and a homozygous type A person have a child, what will be the child's phenotype?
    a. A
    b. O
    c. AB
    d. Not enough information

11. For two organisms to have a genetic relationship, which of the following must they share?
    a. A common ancestor
    b. Phenotypes
    c. Genotypes
    d. Linked genes

12. A blue-eyed (bb), blond haired (hh) female and a brown-eyed (Bb), brown haired (HH)male decide to have a baby. What rule would be used to determine the probability that the baby will have the genotype bbHh?
    a. Addition rule
    b. Multiplication rule
    c. Trihybrid rule
    d. Chi-squared rule

Questions #13-14 refer to the following scenario:

In the primula plant, flower color is the result of epistasis. The pigment malvidin (M) creates blue flowers. If this gene is homozygous recessive, the flower is not blue. Also, production of malvidin can be suppressed if there is a dominant allele at gene D.
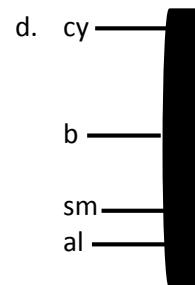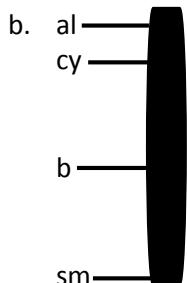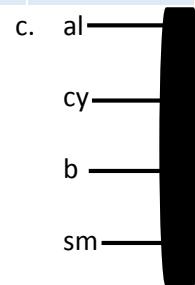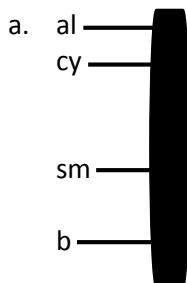
13. What does it mean for a phenotype to be the result of epistasis?
    a. One gene controls more than one phenotype.
    b. The phenotype is the result of unlinked genes.
    c. More than one gene controls one phenotype.
    d. The phenotype is the result of linked genes.

14. If two plants heterozygous for both genes are crossed, what will be the ratio of blue to nonblue flowers?
    a. 13 nonblue: 3 blue
    b. 12 nonblue: 3 blue
    c. 13 blue: 3 nonblue
    d. 12 blue: 3 nonblue

15. What is the location of a sex-linked gene?
    a. The X chromosome.
    b. The Y chromosome.
    c. Any autosome.
    d. Either the X or Y chromosome.

16. Based on his experiments with pea plants, Mendel came up with a model for inheritance. Which of the following is not part of his model?
    a. Alleles are alternate versions of genes.
    b. All gametes have two alleles for each genes.
    c. One allele is dominant to the other.
    d. Alleles separate from each other during gamete formation.

17. Recombination frequency applies to what type of genes?
    a. Unlinked
    b. Homeobox
    c. Codominant
    d. Linked

18. Pod color in pea plants can be either green or yellow, with green (G) being dominant to yellow (g). What would be the alleles for the parental generation in a monohybrid cross for this trait?
    a. Gg x Gg
    b. GG x gg
    c. GG x GG
    d. gg x gg

19. In humans, having a cleft chin (C) is dominant to having a smooth chin. If two people heterozygous for the trait have children, what percentage of their offspring will be heterozygotes?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

20. The table below shows the recombination frequencies for four genes located on chromosome 2 of fruit flies. Using this information, choose the most accurate representation of chromosome 2.
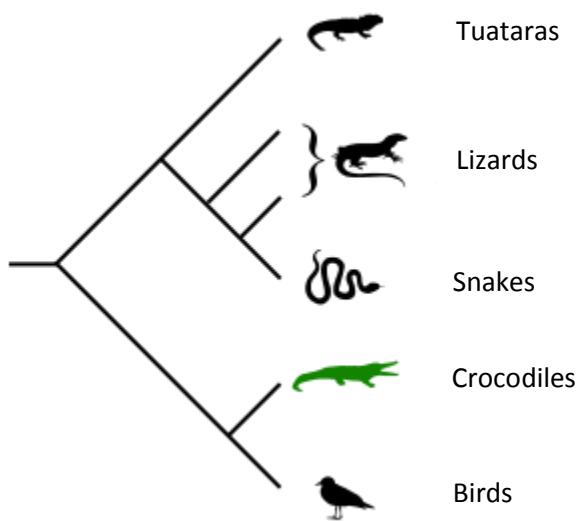
Rf	al	cy	b	sm
al	X	6.1%	48.5%	91.5%
cy	X	X	42.4%	85.4%
b	X	X	X	43%
sm	X	X	X	X

a. al
   cy
   sm
   b

b. al
   cy
   b
   sm

c. al
   cy
   b
   sm

d. cy
   b
   sm
   al

21. In pea plants, round seed is dominant to wrinkled seed. What rule would be used to determine the probability that an F_1 plant resulting from the cross of an Rr plant and an rr plant would be heterozygous for the trait?
    a. Addition rule
    b. Multiplication rule
    c. Trihybrid rule
    d. Chi-squared rule

22. The diagram below shows the relationships between animals in the order Crocodilia. Each branch of the cladogram indicates a common ancestor. Which two animals would have the strongest genetic relationship?

Tuataras

Lizards

Snakes

Crocodiles

Birds

    a.   Snakes and tuataras
    b.   Crocodiles and snakes
    c.   Birds and crocodiles
    d.   Lizards and tuataras

Questions #23-25 refer to the following scenario:

Pod shape in pea plants can be inflated or constricted, with inflated (I) being dominant over constricted (i).

23. A pea plant displays inflated pods but has an unknown genotype. What possible genotypes could the plant have?
    a.   II
    b.   Ii
    c.   ii
    d.   Either a or b.

24. With what plant should it be crossed in order to determine the correct genotype?
    a.   II
    b.   Ii
    c.   ii
    d.   Either a or b.

25. What is this type of procedure called?
    a.   Testcross
    b.   Dihybrid cross
    c.   Epistasis
    d.   Mendelian cross

26. If a person is heterozygous for both brown eyes (Bb) and a widow's peak (Ww), the resulting gamete could have any one of the following combinations of alleles: BW, Bw, bW, or bw. Mendel referred to this as what?
    a. Law of independence
    b. Law of segregation
    c. Law of independent assortment
    d. Law of recombination

27. You are working with a white rat in the lab. When you cross the white rat with a gray rat, half of the offspring are white and half of the offspring gray. When the F_1 gray rats are interbred, all of the F_2 rats are gray. What can you conclude from this experiment?
    a. Gray is dominant to white coat color in this species of rat.
    b. The gray parental rat was heterozygous for the gene.
    c. White is dominant to gray coat color in this species of rat.
    d. The white rat was homozygous for the gene.
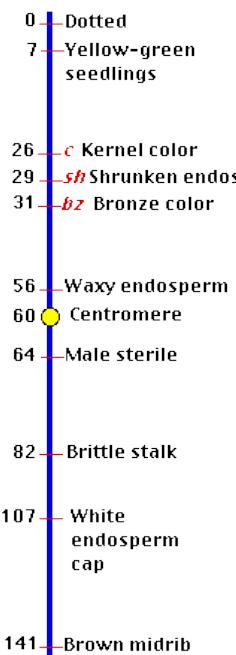
Questions #28-29 refer to the following image of a camellia flower. It was produced by crossing a red camellia and a white camellia.

28. What type of dominance pattern does this camellia display?
    a. Complete dominance
    b. Incomplete dominance
    c. Linked dominance
    d. Codominance

29. If the camellia in the picture is crossed with a camellia of similar coloring, what phenotypic ratio will result?
    a. All red
    b. 1 red: 2 red/white: 1 white
    c. All white
    d. 3 red/white: 1 red

30. The image below shows the genetic map for chromosome 9 of the corn plant. Which gene pair below would have the highest frequency of recombination?

Chromosome 9

```
  0 ──┬── Dotted
  7 ──┼── Yellow-green
      │   seedlings
      │
 26 ──┼── c Kernel color
 29 ──┼── sh Shrunken endosperm
 31 ──┼── bz Bronze color
      │
 56 ──┼── Waxy endosperm
 60 ──○── Centromere
 64 ──┼── Male sterile
      │
 82 ──┼── Brittle stalk
      │
107 ──┼── White
      │   endosperm
      │   cap
      │
141 ──┴── Brown midrib
```

Source: http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/L/Linkage.html

    a. Yellow-green seedlings and brittle stalk
    b. Male sterile and brown midrib
    c. Kernel color and bronze color
    d. Dotted and brown midrib

Questions #31-32 refer to color blindness, a recessive sex-linked disorder carried on the X chromosome.

31. If a male is color blind, from whom did he receive the recessive allele?
    a. Mother
    b. Father
    c. Either mother or father
    d. Not enough information

32. If a female is color blind, which of the following is not true?
    a. Her father is also color blind.
    b. Both parents are color blind.
    c. If she has a son, he will be color blind.
    d. Her father was a carrier.

Questions #33-36 refer to the following scenario:

In cats, one of the alleles responsible for coat color is located on the X chromosome. There are two alleles for coat color, orange and black. Orange coat color (X^B) is completely dominant to black coat color (X^b). However, there are tortoiseshell cats who have a mixture of black and orange fur. This occurs because, in gametes with two X chromosomes, one X chromosome is randomly inactivated in each cell. If the chromosome with a black allele is inactivated, that cell will display orange coloring, and vice versa. This results in a mixture of coloring on these cats.

33. Upon first glance, a cat with a mixture of black and orange fur appears to follow what dominance pattern?
    a. Epistasis
    b. Incomplete dominance
    c. Codominance
    d. Multiple alleles

34. What type of cats typically display the tortoiseshell coloring?
    a. Males
    b. Females
    c. Homozygous X^B
    d. Homozygous X^b

35. If a black male mates with an orange female, what percentage of the female offspring will be tortoiseshell?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

36. If an F_1 male from the cross in #35 is crossed with a tortoiseshell female, what percentage of the offspring will be orange?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

Questions #37-40 refer to the following scenario:
In pea plants, yellow seeds (Y) are dominant to green seed (y) and round seeds (R) are dominant to wrinkled seeds (r).

37. In a YyRr x yyrr cross with 1,000 offspring, what are the expected phenotypic results?
    a. 250 yellow round; 250 yellow wrinkled; 250 green wrinkled; 250 green round
    b. 500 yellow round; 500 green wrinkled
    c. 750 yellow round; 250 green wrinkled
    d. 375 yellow round; 375 green wrinkled; 125 yellow wrinkled; 125 green round

38. The actual results for the cross are as follows:
    - 296 yellow round
    - 201 green wrinkled
    - 241 yellow wrinkled
    - 262 green round

    What is the recombination frequency between these two traits?

    a. 49.7%
    b. 53.7%
    c. 50.3%
    d. 46.3%

39. What does this recombination frequency reveal about the traits?
    a. The traits are close to each other on the same chromosome.
    b. The traits are considered to be unlinked.
    c. The traits have a low degree of crossing over.
    d. The traits are sex-linked.

40. The experimental results differed from the expected results. Use the chi-squared value chart below, using 0.05 as the p value, to decide how to interpret the results from the cross.

df	0.25	0.2	0.15	0.1	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
	25%	20%	15%	10%	5%	2.5%	2%	1%	0.05%	0.025%	0.01%	0.005%
1	1.32	1.64	2.07	2.71	3.84	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.6	11.98	13.82	15.2
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.59	6.74	7.78	9.49	11.14	11.67	13.23	14.86	16.42	18.47	20
5	6.63	7.29	8.12	9.24	11.07	12.83	13.33	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.53	14.45	15.03	16.81	13.55	20.25	22.46	24.1
7	9.04	5.8	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02
8	10.22	11.03	12.03	13.36	15.51	17.53	18.17	20.09	21.95	23.77	26.12	27.87
9	11.39	12.24	13.29	14.68	16.92	19.02	19.63	21.67	23.59	25.46	27.83	29.67
10	12.55	13.44	14.53	15.99	18.31	20.48	21.16	23.21	25.19	27.11	29.59	31.42

p value

a. Accept the results as being statistically insignificant.
b. Accept the null hypothesis.
c. The difference between the expected results and the observed results were due to random chance.
d. Reject the null hypothesis.

Quantitative Review – Heredity

1. Brown spots (B) are dominant over no spots (b). If a Bb individual is crossed with a BB individual resulting in 200 offspring, how many offspring will be heterozygous for the trait?

2. In humans, having dimples (D) is dominant over not having dimples (d) and a cleft chin (C) is dominant over a smooth chin (c). If a male and female heterozygous for both genes have children, what percentage will have dimples and a smooth chin?

3. Colorblindness is a recessive x-linked trait. If a colorblind female has children with a normal male, what percentage of their male children will be colorblind?

4. In humans, having a widow's peak (W) is dominant to not having a widow's peak (w). If a male with genotype Ww has children with a female with genotype ww, what percentage of offspring will not have a widow's peak?

5. In pea plants, tall stems (T) are dominant to dwarf stems (t) and round seeds (R) are dominant to wrinkled seeds (r). In a TtRr x ttrr F_1 cross that produces 500 F_2 plants, how many plants have dwarf stems and round seeds?

6. In guinea pigs, white coat color (b) is recessive to black coat color (B). If two heterozygotes are crossed, what percentage of offspring will also be heterozygous?

7. White eyes in fruit flies is a recessive x-linked trait. If a carrier female is crossed with a wild type male, resulting in 742 female and 760 male offspring, how many of the males will have white eyes?

8. In a AaBbCc x AaBbcc cross, what percentage of offspring are homozygous recessive for all traits?

ANSWER KEY

1.	C	26.	C
2.	B	27.	C
3.	A	28.	D
4.	B	29.	B
5.	D	30.	D
6.	B	31.	A
7.	C	32.	B
8.	C	33.	C
9.	D	34.	B
10.	A	35.	D
11.	A	36.	B
12.	B	37.	A
13.	C	38.	C
14.	A	39.	B
15.	D	40.	D
16.	B		
17.	D		
18.	A	1.	100
19.	B	2.	18.75%
20.	B	3.	100%
21.	A	4.	50%
22.	C	5.	125
23.	D	6.	50%
24.	C	7.	380
25.	A	8.	12.5%