Biology 30 – Unit C: Cell Division, Genetics and Molecular Biology – Outcome #2 Knowledge Check

Use the following information to answer the next two questions.

Gregor Mendel examined the inheritance of two traits in pea plants: seed coat texture and colour. Seed coat texture can be represented as S-smooth and s-wrinkled, and seed coat colour can be represented as Y-yellow and y-green. SSYY plants were crossed with ssyy plants to yield F_1 pea seeds that were all smooth and yellow. By crossing plants grown from the F_1 seeds, Mendel obtained four different phenotypes of F_2 seeds:

-smooth and green seeds
-wrinkled and green seeds
-smooth and yellow seeds
-wrinkled and yellow seeds

1. The F_2 seed phenotype ratio that Mendel obtained upon crossing two heterozygous smooth and yellow F_1 individuals would have been:
   9:3:3:1

Use the following additional information to answer the next question.

Mendel selected two varieties of pea plants from seeds he had grown. One variety of peas came from a field planted with smooth, yellow seeds. Another variety of peas came from a field planted with wrinkled green seeds. These two varieties of peas were crossed to produce:

-255 plants with smooth and green seeds
-268 plants with wrinkled and green seeds
-237 plants with smooth and yellow seeds
-240 plants with wrinkled and yellow seeds

From the phenotype ratio of the offspring, Mendel deduced that the smooth and yellow parents had the genotype YySs.

2. This type of cross is referred to as a:
   a. test cross
   b. monohybrid cross
   c. homozygous cross
   d. heterozygous cross

Use the following information to answer the next two questions.

In cattle, hornless or polled (P) is dominant over the horned (p) condition. This is an autosomal trait. The semen of a polled bull is used to artificially inseminate three cows. Cow 1 (horned) produces a horned calf, cow 2 (polled) produces a horned calf, and cow 3 (polled) produced a polled calf.

3. Which of the cattle **must** have a heterozygous genotype for this trait?
   a. Cow 3 and calf 2
   b. Cow 3 and calf 3
   c. The polled bull and cow 1
   d. The polled bull and cow 2

4. Which of the above cattle could have two possible genotypes?
   a. Cow 1
   b. Cow 2
   c. Cow 3
   d. The polled bull

Use the following information to answer the next question.

In Labrador retriever dogs, two alleles, B and b, determine whether the coat colour will be black (B) or brown (b). Black coat is dominant. A second pair of alleles, E and e, are on a separate chromosome from B and b. The homozygous recessive condition, ee, prevents the expression of either allele B or b and produces a dog with a yellow-colored coat. Some examples of genotypes and phenotypes for Labrador retrievers are shown below.

Genotype	**Phenotype**
BBEe	black
bbEe	brown
Bbee	yellow

5. What is the probability of obtaining a black puppy from the cross: BbEe x BbEE?

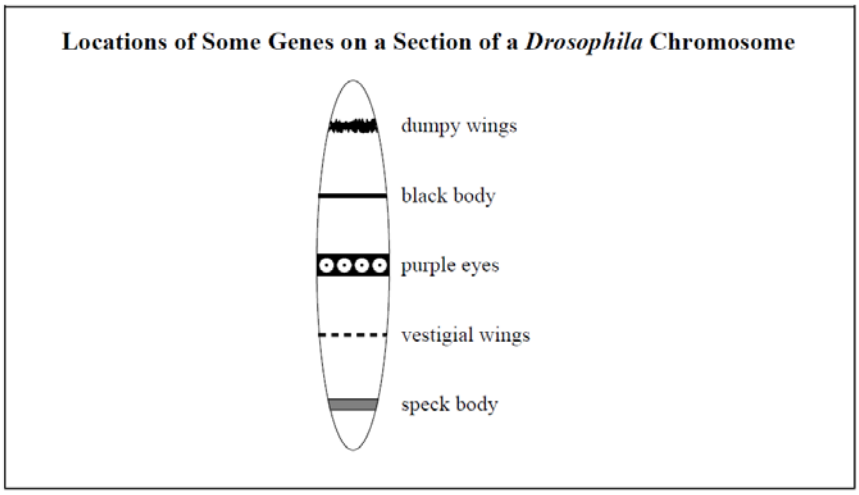
a. $\frac{9}{16}$

b. $\frac{3}{16}$

c. $\frac{3}{4}$

d. $\frac{1}{4}$

Use the following information to answer the next question.



6. During meiosis, which pair of genes have the **best** chance of being transferred **together** to a new cell?

a. dumpy wings and purple eyes

b. dumpy wings and speck body

c. black body and purple eyes

d. purple eyes and speck body

Use the following information to answer the next question.

Hypophosphatemia is one of the few genetic diseases caused by a dominant allele carried on the X chromosome. It causes a severe deficiency of phosphate ions in the blood.

- from *Rimoin, et. Al., 1996*

7. A female with hypophosphatemia whose father had the disease but whose mother did not will likely transmit the disorder to:

a. Her sons only

b. Her sons and daughters equally

c. All her daughters but none of her sons

d. All of her daughters and 50% of her sons.

Use the following information to answer the next question.

Feather colour in parakeets is controlled by two genes. For one pigment gene, the B allele produces blue colour and the b allele does not produce any colour. For the other pigment gene, the Y allele produces yellow colour and the y allele does not produce any colour. Any genotype containing at least one B allele and one Y allele will produce a green parakeet.

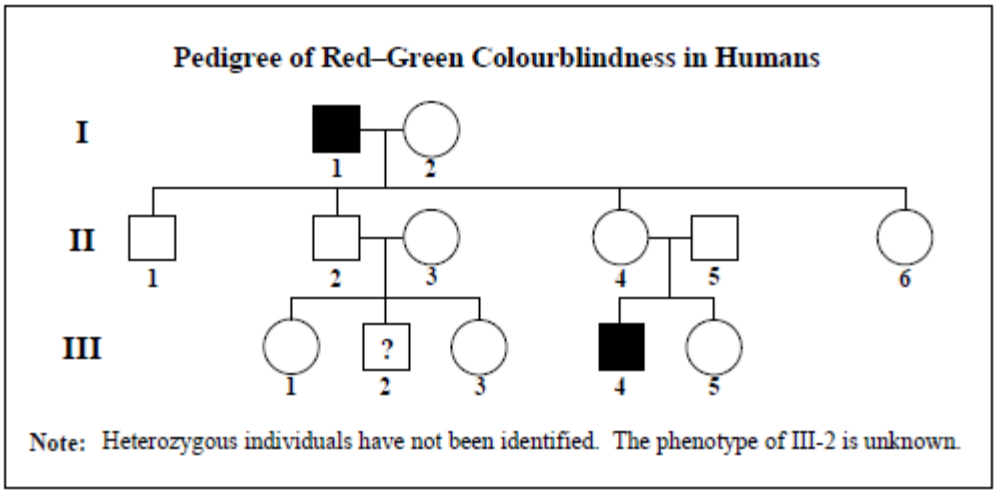
8. Which of the following parental genotypes could produce offspring with the four different colour patterns?
   a. BBYy x BbYy
   b. BbYY x Bbyy
   c. bbYY x bbyy
   d. Bbyy x bbYy

The following information to answer the next two questions.

The gene for a light-sensitive protein found in red cones and the gene for a light-sensitive protein found in green cones be side by side on the X chromosome. A third gene for a light-sensitive protein found in blue cones was discovered on chromosome 7. Mutations to any of these genes results in the common forms of colourblindness. The mutant alleles for these disorders are recessive.

9. A valid assumption based on this information is that:
   a. all types of colourblindness are sex-influenced.
   b. males may be carriers for all types of colourblindness.
   c. only females may be carriers for blue colourblindness.
   d. blue colourblindness occurs in males and females with equal frequency.

Use the following additional information to answer the next question.



10. Based on this pedigree:
    a. the probability that individual II-4 is a carrier is 50%.
    b. it is impossible to determine whether individual II-6 is a carrier.
    c. if individual III-5 is a carrier, all of her female children will have red-green colourblindness.
    d. if individual II-3 is a carrier, there is a 50% chance that her male child will have red-green colourblindness.

Use the following information to answer the next two questions.

A recessive allele causes *Drosophila* to have white eyes instead of wild-type eyes. The eye color gene is known to be x-linked. In a cross between homozygous wild-type females and white-eyed males, all F_1 progeny have wild-type eyes.

11. What ratio of wild-type to white-eyed progeny can be expected in each sex if F_1 females are crossed to males with the same genotype as their father?
    a. Males – 1:0; Females – 1:0
    b. Males – 1:1; Females – 1:0
    c. Males – 0:1; Females – 1:1
    d. Males – 1:1; Females – 1:1

Use the following information to answer the next question.

Crossover Frequencies for Some Genes on *Drosophila* Chromosome 1

Genes	Crossover Fequency
White eyes (w) and Facet eyes (f)	1.5%
White eyes (w) and Echinus eyes (e)	4.0%
White eyes (w) and Ruby eyes (r)	6.0%
Facet eyes (f) and Echinus eyes (e)	2.5%
Facet eyes (f) and Ruby eyes (r)	4.5%

12. The crossover frequency between genes *e* and *r* is:
    a. 3.5%
    b. 2.0%
    c. 1.5%
    d. 0.5%

Use the following information to answer the next two questions.

Assume that there are two gene pairs involved in determining eye colour: one codes for pigment in the front of the iris and the other codes for pigment in the back of the iris.

If the genotype is	***then the eye colour is***
AABB	*black-brown*
AABb	*dark brown*
AAbb	*brown*
AaBB	*brown-green flecked*
AaBb	*light brown*
Aabb	*grey-blue*
aaBB	*green*
aaBb	*dark blue*
aabb	*light blue*

13. A man has grey-blue eyes and a woman has green eyes. Which eye colour phenotypes would be possible for children born to this man and woman?
    a. Grey-blue and green
    b. Dark blue and brown
    c. Light brown and dark blue
    d. Brown-green flecked and light blue.

14. If one parent has light brown eyes and the other has dark brown eyes, what is the probability that they would have an offspring with grey-blue eyes? *(Record your **answer as a percentage of three digits** in the space provided.)*

    Answer: 12.5%