Review for Meiosis and Genetics Unit Test: Theory

1. What is a karyotype? What stage of mitosis is the best for preparing karyotypes?
2. What are genes and what is their function?
3. What are alleles?
4. Below are the links to two very good reviews of meiosis. They are worth watching:
   http://www.lpscience.fatcow.com/jwanamaker/animations/meiosis.html
   http://www.sumanasinc.com/webcontent/animations/content/meiosis.html

5. Regarding meiosis:

a) Which type(s) of cells perform meiosis?

b) What are the two main (overall) purposes of meiosis?

c) Which two processes of meiosis increase the genetic diversity of the offspring? During which stages of meiosis do these processes take place?

6. Identify the following phases of Meiosis from the description. Include whether it is meiosis I or II.

a) Homologous chromosomes pair up and form tetrads _____

b) Spindle fibers move homologous chromosomes to opposite sides _____

c) Nuclear membrane reforms, cytoplasm divides, 4 daughter cells form _____

d) Chromosomes line up along equator, not in homologous pairs _____

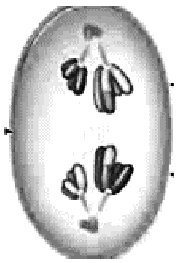
e) Crossing-over occurs _____

f) Chromatids separate _____

g) Homologous pairs of chromosomes line up alone equator _____

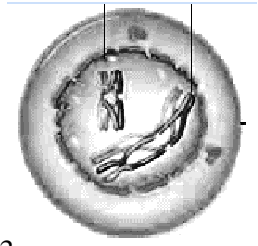
h) Cytoplasm divides, 2 daughter cells are formed _____

7. Name the following stages of meiosis. Include whether it is meiosis I or II.



1. _____

2. _____



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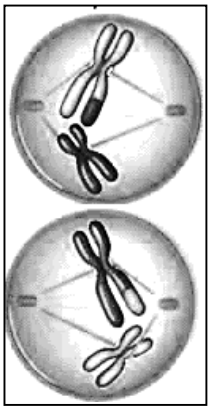

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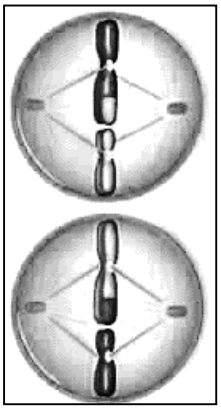

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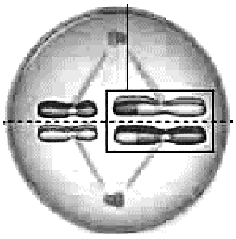
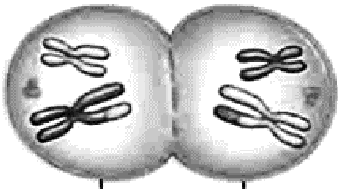


6. _____



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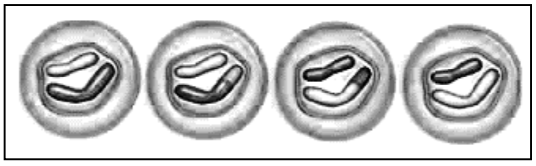


8. _____

8. Mendel studied the inheritance of traits in the common garden pea and made significant discoveries in genetics.

a) Give three reasons why the garden pea is an excellent species to study.

b) Define or explain what is meant by a monohybrid cross and a dihybrid cross.

c) Mendel used true-breeding plants for his F_1 cross. What are two other genetic terms that mean "true-breeding"?

d) The offspring of Mendel's F_1 cross were hybrids. What are two other genetic terms that mean "hybrid"?

e) The traits that Mendel studied showed complete dominance. What does this mean?

f) What is the principle of dominance? Give an example to illustrate this concept.

g) What is the law of segregation? Give an example to illustrate this concept.

h) What is the law of independent assortment? Give an example to illustrate this concept.

9. How is the law of segregation related to meiosis?

   An animation showing how independent assortment during meiosis produces all the different combinations of alleles in gametes:

   http://www.sumanasinc.com/webcontent/animations/content/independentassortment.html

10. How is the law of independent assortment related to meiosis? During what phase(s) of meiosis does the law of independent assortment apply?

    animation: http://www.sumanasinc.com/webcontent/animations/content/mendelindassort.html

11. Explain what is meant by each of the following types of inheritance. Give an example of each to illustrate your answer:

a) complete dominance b) incomplete dominance c) co-dominance

d) multiple alleles e) sex-linked inheritance

12. Explain why boys are much more likely to suffer from X-linked recessive disorders than girls.

13. How is an autosomal genetic disorder different from a sex-linked disorder?

14. What is a test cross and why is it used? Give an example to illustrate your answer.

15. Give one example of each of the following and give a very brief description of the symptoms of this disorder:

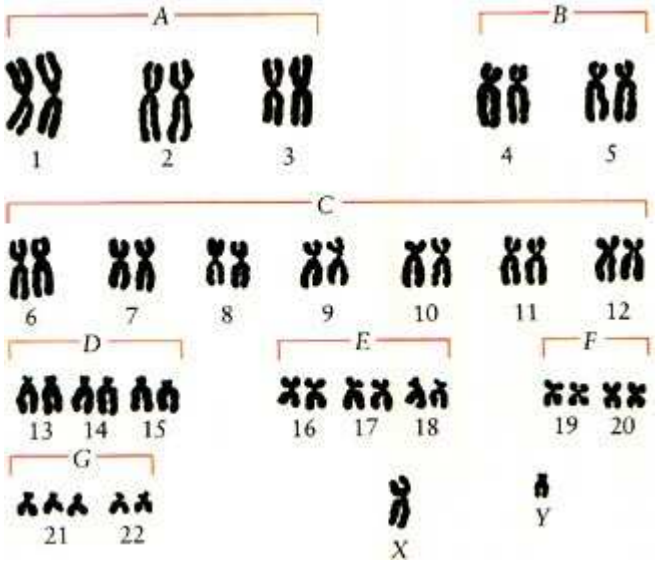
    a) an autosomal recessive disorder
    b) an autosomal dominant disorder
    c) an X-linked recessive disorder
    d) a non-disjunction disorder
    e) a trisomy
    f) a monosomy

16. Study the karyotype shown to the right.

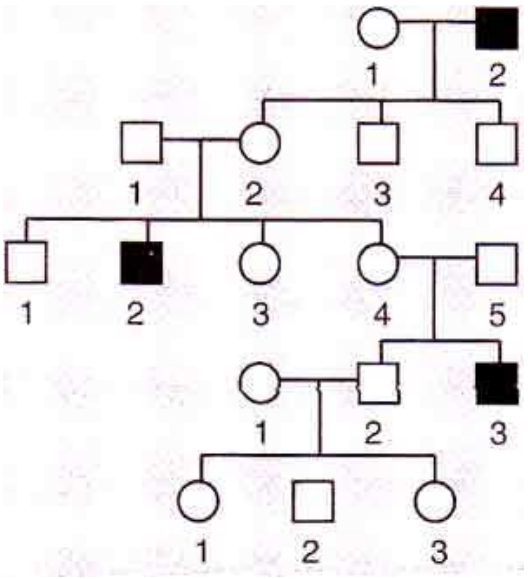
a) What is the sex of this person?

b) What is the name of the syndrome of this person?

c) Describe very briefly what happened during meiosis to cause this disorder.



Review for Meiosis and Genetics Unit Test: Pedigrees



1. Study the pedigree shown to the right and answer the following questions:

a) How many generations are shown?

b) Is this disorder caused by a dominant or recessive allele? How do you know? Be very specific.

c) Could this disorder be X-linked? Explain why or why not.

d) What are the genotypes of individuals (assurme it is not X-linked and use alleles A/a):

I – 1 _____ I – 2 _____

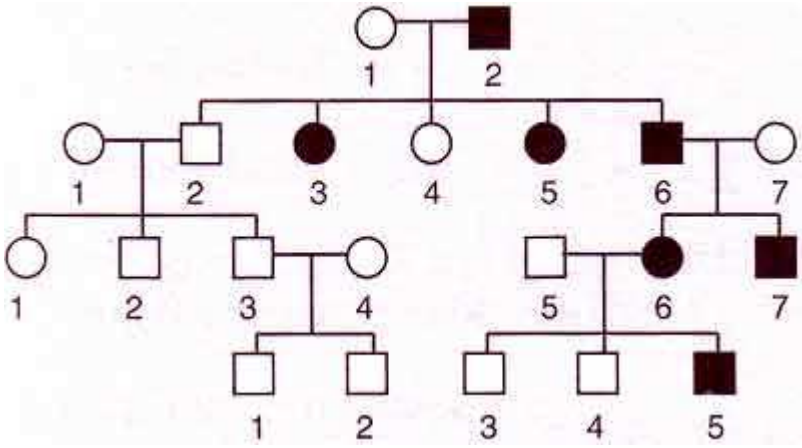
II – 1 _____ II – 2 _____

III – 4 _____ IV– 2 _____

e) Could individual IV – 1 be a carrier for the disorder? Explain why or why not.

f) Could the individuals in the fifth generation be carriers of the disorder? Explain why or why not.

g) If the disorder is X-linked, from which parent did individual IV – 3 get the recessive allele? Explain.



2. Study the pedigree shown to the right, then answer the following questions:

a) Is this disorder caused by a dominant or recessive allele? How do you know?

b) Is this disorder X-linked?

c) What are the genotypes of individuals (use alleles B/b):

I – 1 _____

I – 2 _____

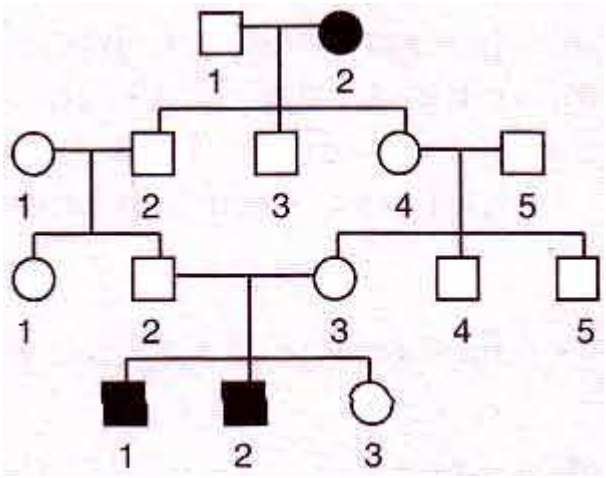
II – 2 _____

II – 3 _____

III – 6 _____

IV– 5 _____

d) Are any of the individuals carriers of the allele for this disorder? Explain why or why not.



3. Study the pedigree shown to the right, then answer the following questions using the alleles C/c:

a) Is this disorder caused by a dominant or recessive allele? How do you know?

b) Is this disorder X-linked?

c) What are the genotypes of individuals:

I – 2 _____ II – 1 _____

II – 2 _____ III – 3 _____

IV – 2 _____ IV– 3 _____

d) Is it possible to know the genotype of individual I – 1 from this pedigree? Why or why not?

e) Identify two carriers of the allele for this disorder: _____ and _____.

f) What is the relationship between the following individuals:

I – 1 is III – 3's: _____ II – 4 is II – 5's _____

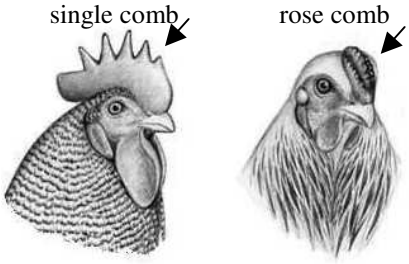
IV – 2 is III – 4's: _____ III – 2 is III – 4's _____

Review for Meiosis and Genetics Unit Test: Practice Problems

1. Albino animals do not make melanin. This is a recessive trait. A purebred albino male rat is crossed with a hybrid female rat with normal colouring (N). Predict the possible genotypes and phenotypes of the offspring of these animals.

2. In pigeons, red feathers are dominant to grey feathers and a plain pattern is dominant over a checkered pattern. Use a Punnett square to determine the possible genotypes of the offspring of a male which is heterozygous for both traits and a grey, checkered female. What are the possible phenotypes of the offspring and in what ratio?

3. In humans, hair colour is controlled by multiple alleles with various types of dominance. The allele for black hair is incompletely dominant over the allele for light (blonde) hair. Heterozygous individuals have brown hair. Predict the possible genotypes and phenotypes of the children of a brown-haired man and a blonde haired woman.



4. Many chickens have a "comb" on their head. Its function is not fully known, but it may be important in cooling the chicken and in attracting mates. Combs have different shapes. A rose comb is dominant to a single comb. If a single-combed rooster is bred to a homozygous rose-combed hen, predict the possible genotypes and phenotypes of their offspring.

5. In tomatoes, red fruit is dominant to yellow fruit and tall tomato vines are dominant over short vines. If homozygous tall plants that produce yellow fruit are bred with short plants that are heterozygous for red fruit, use a Punnett square to determine the possible genotypes of the offspring.

a) What percentage of the offspring will have tall vines and yellow fruit?

b) What percentage of the offspring will have dwarf vines and red fruit?

6. In fruit flies, eye colour is X-linked. Red eyes are dominant to white eyes.

a) What are the sexes and eye colors of flies with the following genotypes?

$X^R X^r$ _____ $X^R Y$ _____ $X^r X^r$ _____

$X^R X^R$ _____ $X^r Y$ _____

b) What are the genotypes of these fruit flies:

white eyed, male _____ red eyed female (heterozygous) _____

white eyed, female _____ red eyed, male _____

c) Predict the genotypes and phenotypes of the offspring of a white eyed female with a red-eyed male.

7. Human blood types exhibit both co-dominance and multiple alleles. Complete the chart below:

Blood Type	Possible Genotype(s)	Type of Immunoglobulins on their RBCs	Will make antibodies to	Can Donate Blood to	Can Receive Blood from
A					
B					
AB					
O					

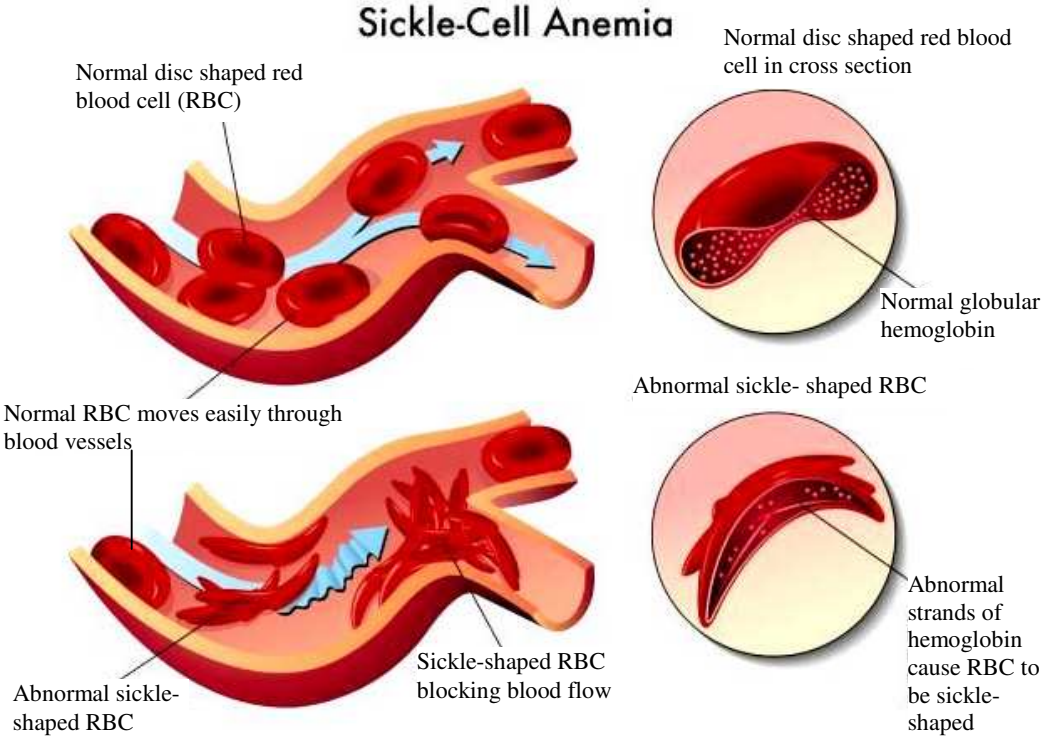
8. A man who is blood type A (heterozygous) marries a woman who is blood type B (homozygous). Is it possible for this couple to produce a child with type O blood?

9. A man who is hybrid type A blood and hybrid for the allele for Rh marries a woman who is type O negative. What are the chances that they will produce a type O+ child?

10. What are the possible blood types of the children of a type AB man and a type O woman?

11. Hemoglobin is the protein in red blood cells (RBCs) that carries oxygen. Normal hemoglobin is 'globular' (spherical) and RBCs with normal hemoglobin are disc-shaped with an indented centre. This shape allows RBCs to fold and bend so they can move through tiny blood vessels without getting stuck. Some people have a genetic disorder in which a single amino acid in the hemoglobin molecule is changed. This hemoglobin doesn't fold up properly so it has a long thread-like shape instead of being globular. RBCs with the abnormal hemoglobin have a 'sickle' shape. These RBCs do not move as easily through the tiny blood vessels and can get stuck. If this happens, the tissues do not get enough oxygen so the person experiences muscle cramps and organ damage.

The normal hemoglobin and sickle hemoglobin genes are co-dominant. If a person is heterozygous, they make both types of hemoglobin and may have both disc-shaped and sickle-shaped RBCs in their blood at the same time. This seems to provide some resistance to the parasite that invades RBCs and causes malaria. People who are homozygous for the sickle hemoglobin gene experience severe symptoms and develop 'sickle cell anemia' which can be fatal.



Two individuals who are heterozygous for normal and sickle hemoglobin plan to have children.

a) What are the chances that their children will be carriers of the abnormal hemoglobin gene?
b) What is the probability that a child will be homozygous and have severe symptoms?

12. In humans, hemophilia is a sex linked recessive trait. Females can be normal, carriers, or have the disease. Males will either have the disease or not, but they will never be carriers.

$X^H X^H$ = female, normal $X^H X^h$ = female, carrier $X^h X^h$ = female, hemophiliac
$X^H Y$ = male, normal $X^h Y$= male, hemophiliac

If a man with hemophilia marries a woman who is a carrier, what is the probability that they will have a:

a) daughter with the disease_____
b) daughter who is a carrier _____
c) son with the disease _____

13. A woman who has hemophilia marries a normal man. What proportion of their children may have hemophilia? How is the probability of hemophilia affected by the sex of the child?

14. Duchenne muscular dystrophy is an X-linked recessive disorder. It is the most aggressive type of muscular dystrophy and affects boys almost exclusively. Muscle wasting symptoms start between the ages of 2 to 6 years and progressively get worse with age. Most boys lose their ability to walk around 10 to 12 years of age. Life expectancy is about 25 years. If a healthy male marries a woman who is a carrier for Duchenne muscular dystrophy, what is the probability that:
    a) their son will be affected?
    b) their daughter will be a carrier?

15. Sweet bell peppers come in many colours. When a true-breeding red pepper plant is crossed with a true-breeding yellow pepper plant, the F_1 generation of plants all produce orange peppers.
    a) What type of dominance is this?
    b) Predict the genotypes and phenotypes of the F_2 generation.

16. In Dalmatian dogs, the gene for black spots (B) is dominant to the gene for brown coloured spots (b). If a breeder has a black spotted male dog, how can she find out whether it is homozygous (BB) or heterozygous (Bb)?

17. Coat colour of shorthorn cattle is controlled by two dominant alleles. When a red coloured bull is crossed with a white cow, the offspring exhibit a mixed coat with both white and red hair. This mixed coat colour is called "roan" . If a red bull is crossed with a roan cow, predict the genotypes and phenotypes of their offspring.