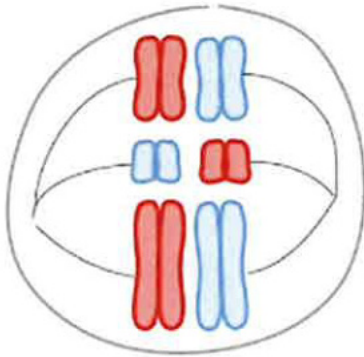


Name \_\_\_\_\_

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

- 1) Which of the following gametes could result from the cell shown? (Assume that meiosis proceeds normally.) Select all that apply. 1) \_\_\_\_\_



A)



B)



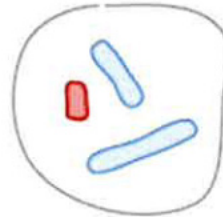
C)



D)



E)



F)



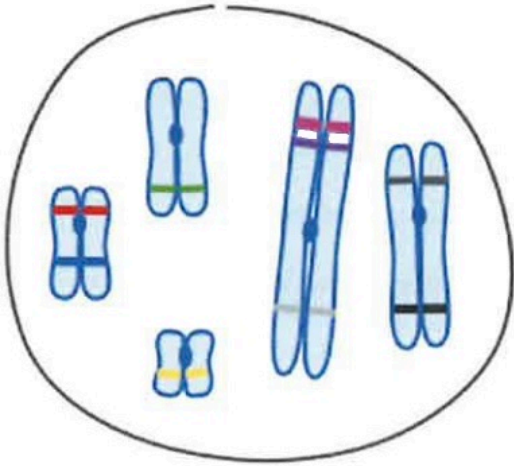
In a particular plant, leaf color is controlled by gene locus *D*. Plants with at least one allele *D* have dark green leaves, and plants with the homozygous recessive *dd* genotype have light green leaves. A true-breeding, dark-leaved plant is crossed with a light-leaved one, and the F<sub>1</sub> offspring are allowed to self-pollinate. The predicted outcome of the F<sub>2</sub> is diagrammed in the Punnett square shown in the figure, where 1, 2, 3, and 4 represent the genotypes corresponding to each box within the square.

	<i>D</i>	<i>d</i>
<i>D</i>	1	2
<i>d</i>	3	4

- 2) Which of the boxes marked 1–4 correspond to plants with light leaves? 2) \_\_\_\_\_
  - A) 1, 2, and 3
  - B) 1 and 2
  - C) 4 only
  - D) 2 and 3
  - E) 1 only
  
- 3) Which of the following happens at the conclusion of meiosis II? 3) \_\_\_\_\_
  - A) Cohesins are cleaved at the centromeres.
  - B) Homologous chromosomes of a pair are separated from each other.
  - C) Two daughter cells are formed.
  - D) The chromosome number per cell remains the same as before Meiosis I.
  - E) Sister chromatids are separated into 4 new daughter cells.
  
- 4) For a species with a haploid number of 6 chromosomes, how many different combinations of maternal and paternal chromosomes are possible for the gametes? 4) \_\_\_\_\_
  - A) About 1000
  - B) About 8 million
  - C) 64
  - D) 23
  - E) About 70 trillion
  
- 5) You conducted an experiment in which you grew watermelon in full sun, partial sun, and full shade to determine how sunlight affects sweetness of the fruit. After 7 weeks, you conducted a blind taste test with 40 participants and asked them to rank sweetness of each of the fruits. You want to create a graph showing how sweet the watermelons were after 7 weeks grown in the different conditions. What type of graph should you use, and what variable will be on the x-axis and the y-axis? 5) \_\_\_\_\_
  - A) bar graph; x-axis – amount of sun; y-axis – average sweetness rank
  - B) line graph; x-axis – amount of sun; y-axis – average sweetness rank
  - C) bar graph; x-axis – average sweetness rank; y-axis – amount of sun
  - D) line graph; x-axis – time (weeks); y-axis – average sweetness rank

- 6) A researcher is conducting an experiment to test the effectiveness of a new drug, XyloCure, on inhibiting bacterial growth. The experiment includes three petri dishes: Dish A contains bacteria and a standard antibiotic known to inhibit bacterial growth, Dish B contains bacteria and XyloCure and Dish C contains bacteria with no treatment applied. After 24 hours, bacterial growth is observed in Dishes B and C, but no growth was found in Dish A. What do the results suggest? 6) \_\_\_\_\_
- A) The lack of bacterial growth in Dishes A and Dish B suggests that both the standard antibiotic and XyloCure are effective at inhibiting bacterial growth.
  - B) The bacterial growth in Dish C indicates that the experiment was contaminated and the results are thus invalid.
  - C) The lack of bacterial growth in Dishes A and B suggests Xylocure is less effective than a standard antibiotic.
  - ☒ D) Because bacteria grew on the XyloCure plate, but not on the known positive control, it suggests XyloCure is not effective against this strain of bacteria.
- 7) In rabbits, the homozygous  $CC$  is normal,  $Cc$  results in long deformed legs, and  $cc$  results in very short deformed legs. The genotype  $BB$  produces black fur,  $Bb$  brown fur, and  $bb$  white fur. If a cross is made between brown rabbits with long deformed legs and white rabbits with long deformed legs, what percentage of the offspring would be expected to have short deformed legs and white fur? 7) \_\_\_\_\_
- A) 100 percent
  - B) 50 percent
  - C) 33 percent
  - ☒ D) 12.5 percent
  - E) 25 percent
- 8) If a species is diploid and a certain gene found in the species has 18 known alleles. Any given individual of that species can/must have which of the following? 8) \_\_\_\_\_
- A) Up to 36 different alleles for that gene
  - B) Up to 18 chromosomes with that gene
  - ☒ C) Up to two different alleles for that gene
  - D) A haploid number of 9 chromosomes
  - E) Up to 9 alleles for that gene
- 9) You are looking at a slide of onion root tip cells and counting the number of cells in each phase of the cell cycle. You count 5 cells in interphase, 2 in prophase, 3 in metaphase, 4 in anaphase, and 2 in telophase. What is the mitotic index for this selection of cells, rounded to the nearest whole number? 9) \_\_\_\_\_
- A) 37%                      B) 63%                      C) 17%                      ☒ D) 69%
- 10) A diploid organism has 10 total chromosomes ( $2n=10$ ). At a given point in time, a cell from this organism has 10 total chromosomes and 20 sister chromatids. This cell could be at which of the following stages of cell division? 10) \_\_\_\_\_
- ☒ A) Prophase I
  - B) Directly after meiosis II
  - C) Prophase II
  - D) Metaphase II
  - E) Directly before S phase

Use the chromosome model below to answer the following questions.



11) The chromosomes are not replicated.

A) True

B) False

11) \_\_\_\_\_

12) This cell is  $n = 10$ .

A) True

B) False

12) \_\_\_\_\_

13) This cell is haploid.

A) True

B) False

13) \_\_\_\_\_

14) There are 10 molecules of double-stranded DNA represented by this model.

A) True

B) False

14) \_\_\_\_\_

15) Two plants are crossed, resulting in offspring with a 3:1 ratio for a particular trait. This ratio suggests that \_\_\_\_\_.

A) the parents were true-breeding for contrasting traits

B) each offspring has the same alleles for each of two different traits

C) a blending of traits has occurred

D) the particular trait shows incomplete dominance

E) the parents were both heterozygous for the particular trait

15) \_\_\_\_\_

16) According to the central dogma, what molecule should go in the blank?

16) \_\_\_\_\_

DNA → \_\_\_\_\_ → Proteins

A) mRNA

B) rRNA

C) tRNA

D) mtDNA



- 17) Carlos and Aisha are expecting a child and are curious about the potential for dimples in their baby. The gene for dimples is located on an autosome; having dimples is a dominant trait (D), while not having dimples is recessive (d). Both Carlos and Aisha have dimples. However, Carlos's sister and father do not have dimples, and Aisha's brother also does not have dimples. Aisha's dad has dimples, and her mom's sister has dimples. What is the probability that Carlos and Aisha will have a child without dimples?

A) 50%      B) 100%      C) 12.5%      D) 25%

17) \_\_\_\_\_

- 18) A scientist is testing a new drug to see if it is effective against harmful bacteria. She adds the new drug to one sample of cultured bacteria, a regular antibiotic to another sample, and distilled water to a third sample. What is the negative control?

A) Regular antibiotic      B) Distilled water  
C) New drug      D) Cultured bacteria

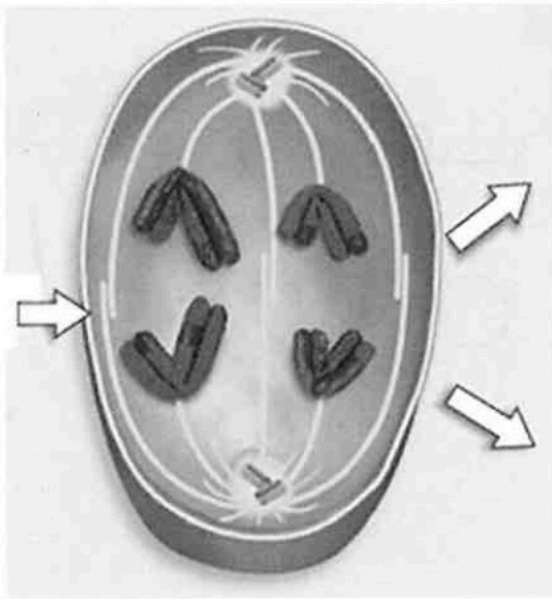
18) \_\_\_\_\_

- 19) Cinnabar eyes is a sex-linked, recessive characteristic in fruit flies. If a female having cinnabar eyes is crossed with a wild-type male, what percentage of the F<sub>1</sub> females will have cinnabar eyes?

A) 50 percent  
B) 0 percent  
C) 100 percent  
D) 25 percent  
E) 75 percent

19) \_\_\_\_\_

20)



20) \_\_\_\_\_

What phase of meiosis is seen in the accompanying figure?

A) Anaphase I      B) Anaphase II      C) Metaphase II      D) Metaphase I

- 21) A man has extra digits (six fingers on each hand and six toes on each foot). His wife and their daughter have a normal number of digits. Having extra digits is a dominant trait. The couple's second child has extra digits. What is the probability that their next (third) child will have extra digits? Assume full penetrance.

A) 1/2      B) 3/4      C) 9/16      D) 1/8      E) 1/16

21) \_\_\_\_\_

22) When does DNA replication take place regarding meiosis? DNA replication \_\_\_\_\_.

22) \_\_\_\_\_

- A) occurs between prophase II and metaphase II
- B) occurs before meiosis I begins**
- C) does not take place in cells destined to undergo meiosis
- D) occurs during prophase I

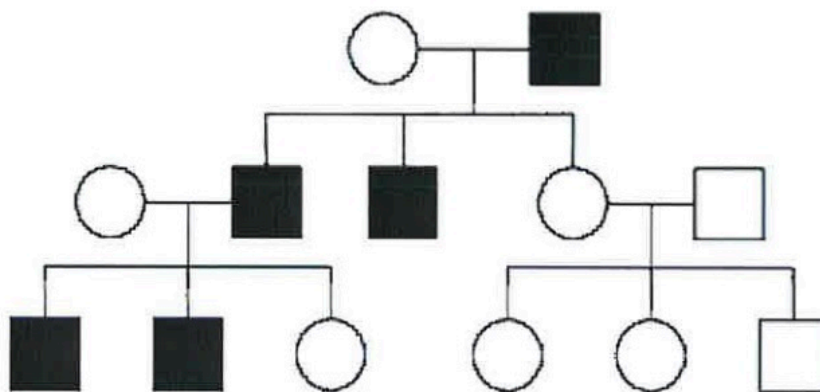
23) Mendel accounted for the observation that traits that had disappeared in the F<sub>1</sub> generation reappeared in the F<sub>2</sub> generation by proposing that \_\_\_\_\_.

23) \_\_\_\_\_

- A) traits can be dominant or recessive, and the recessive traits were obscured by the dominant ones in the F<sub>1</sub> generation**
- B) members of the F<sub>1</sub> generation had only one allele for each trait, but members of the F<sub>2</sub> had two alleles for each trait
- C) the mechanism controlling the appearance of traits was different between the F<sub>1</sub> and the F<sub>2</sub> plants
- D) new mutations were frequently generated in the F<sub>2</sub> progeny, "reinventing" traits that had been lost in the F<sub>1</sub>

24) The accompanying figure shows the pedigree for a family. Dark-shaded symbols represent individuals with one of the two major types of colon cancer. Assume full penetrance.

24) \_\_\_\_\_

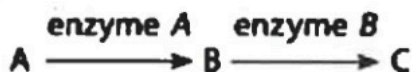


From this pedigree, this trait seems to be inherited \_\_\_\_\_.

- A) as an X-linked dominant trait
- B) as an autosomal recessive trait
- C) as a Y-linked trait**
- D) as an autosomal dominant
- E) as an X-linked recessive trait

25)

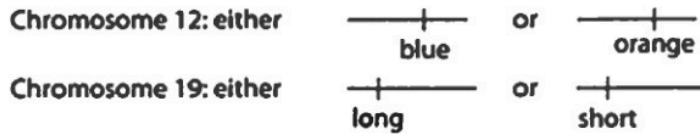
25) \_\_\_\_\_



Refer to the metabolic pathway illustrated in the figure. If A, B, and C are all required for growth, a strain mutant for the gene encoding enzyme A would be able to grow on medium supplemented with \_\_\_\_\_.

- A) nutrient A only
- B) nutrient B or C**
- C) nutrient C only
- D) nutrients A or C

A certain (hypothetical) organism is diploid, has either blue or orange wings as the consequence of one of its genes on chromosome 12, and has either long or short antennae as a result of a second gene on chromosome 19, as shown in the figure.

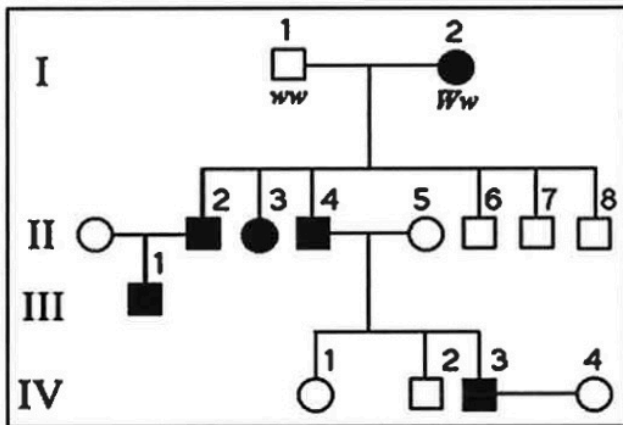


- 26) A certain female's number 12 chromosomes have the blue and orange alleles and number 19 chromosomes have both long alleles. As cells in her ovaries undergo meiosis, her resulting eggs (ova) may have which of the following?

26) \_\_\_\_\_

- ☒ A) One chromosome 12 with one blue or with one orange allele and one chromosome 19 with one long allele.  
 B) Either one long or one short allele in addition to the blue allele.  
 C) Either two number 12 chromosomes with blue genes or two with orange genes.  
 D) Either two number 19 chromosomes with long genes or two with short genes.

The following questions refer to the pedigree chart in the accompanying figure for a family, some of whose members exhibit the trait, *W*. Affected individuals are indicated by a dark square or circle. Assume complete penetrance.



- 27) What is the genotype of individual II-4?

27) \_\_\_\_\_

- ☒ A) *Ww*  
 B) *ww* or *Ww*  
 C) *ww*  
 D) *WW*  
 E) *WW* or *ww*

- 28) What is the likelihood that the progeny of IV-3 and IV-4 will have the trait?

28) \_\_\_\_\_

- ☒ A) 75 percent  
☒ B) 50 percent  
 C) 100 percent  
 D) 25 percent  
 E) 0 percent

- 29) The karyotype of one species of primate has 48 chromosomes. In a particular female, cell division goes awry and she produces one of her eggs with an extra chromosome ( $n=25$ ). The most probable

29) \_\_\_\_\_

29) The karyotype of one species of primate has 48 chromosomes. In a particular female, cell division goes awry and she produces one of her eggs with an extra chromosome ( $n=25$ ). The most probable source of this error would be a mistake in which of the following?

29) \_\_\_\_\_

- A) Telophase II of one meiotic event
- B) Telophase I of one meiotic event
- C) Mitosis in her ovary
- D) Metaphase I of one meiotic event
- E) Either anaphase I or II

30) Mendel crossed yellow-seeded and green-seeded pea plants and then allowed the offspring to self-pollinate to produce an F<sub>2</sub> generation. The results were as follows: 9022 yellow and 3001 green (8023 total). The allele for yellow seeds has what relationship to the allele for green seeds?

30) \_\_\_\_\_

- A) Incomplete dominant
- B) Dominant
- C) Recessive
- D) Codominant

31) Red-green color blindness is a sex-linked recessive trait in humans. Two people with normal color vision have a color-blind daughter. What are the genotypes of the parents? Assume full penetrance.

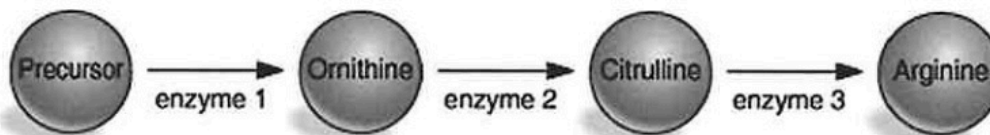
31) \_\_\_\_\_

- A)  $X^N X^N$  and  $X^n Y$
- B)  $X^N X^n$  and  $X^N Y$
- C) It is not possible for two normal vision parents to produce a colorblind daughter caused by a mutant allele on the X chromosome.
- D)  $X^N X^N$  and  $X^N Y$
- E)  $X^n X^n$  and  $X^N Y$

32)

32) \_\_\_\_\_

Mutant Strain	Medium with: No ornithine No citrulline No arginine	Medium with: Ornithine No citrulline No arginine	Medium with: No ornithine Citrulline No arginine	Medium with: No ornithine No citrulline Arginine
arg1	No growth	GROWTH	GROWTH	GROWTH
arg2	No growth	No growth	GROWTH	GROWTH
arg3	No growth	No growth	No growth	GROWTH



According to the table and the figure, which enzyme is defective in the strain with the arg3 mutation?

- A) The enzyme that converts ornithine to citrulline
- B) The enzyme that converts citrulline to arginine
- C) The enzyme that converts the precursor to ornithine
- D) The enzyme that converts the precursor to citrulline



- 33) Homologous chromosomes \_\_\_\_\_. 33) \_\_\_\_\_  
A) separate into different daughter cells during Meiosis II  
B) are identical with the same genes and alleles  
C) are typically inherited from the same parent  
D) carry the same genes that code for the same traits
- 34) Assuming independent assortment for all gene pairs, what is the probability that the following parents,  $AABbCc \times AABbCc$ , will produce an  $AaBbCc$  offspring? 34) \_\_\_\_\_  
A) 1/16 B) 0 C) 3/4 D) 9/16 E) 1/8
- 35) Crossing over normally takes place during which of the following processes? 35) \_\_\_\_\_  
A) Metaphase I B) Prophase I C) Prophase II D) Interphase
- 36) Plants produce more seeds when they reproduce asexually than sexually. Yet most plants reproduce sexually in nature. What is the probable explanation for the prevalence of sexual reproduction? Sexual reproduction \_\_\_\_\_. 36) \_\_\_\_\_  
A) mixes up DNA, thus increasing genetic diversity in a species which is beneficial for adaptation  
B) ensures genetic continuity from parents to offspring  
C) produces a greater number of offspring per individual  
D) is more energy efficient than asexual reproduction
- 37) Somatic cells of roundworms, which are diploid, have four individual chromosomes per cell ( $2n=4$ ). How many chromosomes would you expect to find in a heart cell from a roundworm? 37) \_\_\_\_\_  
A) 4 B) 2 C) 8 D) 6
- 38) In cats, black fur color is caused by an X-linked allele; the other allele at this locus causes orange color. The heterozygote is tortoiseshell (splotches of black and orange fur). What colors of offspring would you expect from the cross of a black male and an orange female? 38) \_\_\_\_\_  
A) Tortoiseshell females; black males  
B) Orange males; tortoiseshell females  
C) Tortoiseshell females; tortoiseshell males  
D) Orange females; orange males  
E) Black females; orange males
- 39) What does it mean when we say the genetic code is redundant? 39) \_\_\_\_\_  
A) The genetic code is different for different domains of organisms.  
B) A single codon can specify the addition of more than one amino acid.  
C) The genetic code is universal (the same for all organisms).  
D) More than one codon can specify the addition of the same amino acid.
- 40) Radish flowers may be red, purple, or white. A cross between a red-flowered plant and a white-flowered plant yields all-purple offspring. The flower color trait in radishes is an example of which of the following? 40) \_\_\_\_\_  
A) Sex linkage B) Codominance  
C) Incomplete dominance D) A multiple allelic system

- 41) A group of students are conducting an experiment to understand the factors affecting the growth rate of a particular type of bacteria. They propose the following hypothesis: "If the temperature of the environment and the pH level of the growth medium are increased, then the bacteria will grow faster because both higher temperatures and more alkaline conditions stimulate bacterial metabolism."

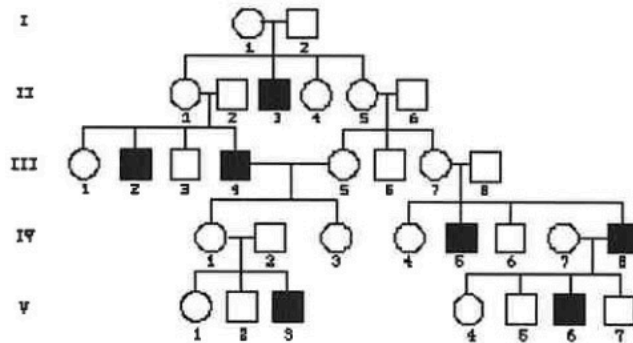
41) \_\_\_\_\_

Evaluate the quality of the proposed hypothesis for a scientific experiment.

- A) It is a problematic hypothesis because it lacks specificity and tests two independent variables simultaneously making it difficult to determine which variable is responsible for any observed changes in bacterial growth.
- B) It lacks specificity but is otherwise acceptable, as it does not clearly define what is meant by "faster growth" or the exact increases in temperature and pH levels.
- C) It is a good hypothesis because it identifies two variables that could affect bacterial growth, allowing for a comprehensive understanding of environmental impacts.
- D) It is a strong hypothesis because testing more variables at once is more efficient and saves time.

- 42) What is the most likely mode of inheritance in this pedigree?

42) \_\_\_\_\_



- A) X-linked Recessive
- B) Autosomal Recessive
- C) X-linked Dominant
- D) Autosomal Dominant

- 43) What is the genotype of individual I-1?

43) \_\_\_\_\_

- A) Homozygous Dominant
- B) Homozygous Recessive
- C) Homozygous Recessive or Heterozygous
- D) Heterozygous

- 44) Imagine an individual had a mutation such that the SRY gene typically found on the Y chromosome was now located on chromosome 3. This individual had two children. Both children have two X chromosomes and both have a chromosome 3 with the SRY gene. What is the chromosomal sex of these 2 children? What is the likely gonadal sex of these two children assuming SRY and other genes involved in sex determination are fully functional?

44) \_\_\_\_\_

- A) Male; Female
- B) Male; Male
- C) Female; Female
- D) Female; Male