1. Using the results of his experiments with pea plant crosses, what did Gregor Mendel discover?

A) the principles of dominance, segregation, and independent assortment
B) that pea plants develop mutations after exposure to radiation
C) intermediate inheritance and gene linkage
D) that DNA is involved in the inheritance of dominant traits

2. After observing the offspring of many generations of pea plant crosses, Gregor Mendel formulated the principle of

A) dominance
B) polyplody
C) crossing-over
D) mutation

3. Base your answer to the following question on the pedigree chart below, which shows a history of ear lobe shape, and on your knowledge of biology.

![Pedigree Chart]

What could the genotype of individual 1 be?

A) EE, only
B) Ee, only
C) ee
D) EE or Ee

4. In a certain type of plant, tall is dominant over short, and green seed coat is dominant over yellow seed coat. When two plants heterozygous for both of these traits are crossed, the offspring produced are tall, with green seed coats; tall, with yellow seed coats; short, with green seed coats; and short, with yellow seed coats. What do the results of this cross illustrate?

A) vegetative propagation
B) mutagenic agents
C) intermediate inheritance
D) independent assortment

5. When red-flowered snapdragons are crossed with white-flowered snapdragons, all the F1 plants will have pink flowers. If Mendel had used snapdragons instead of pea plants, he would have had difficulty in formulating his principle of

A) dominance
B) sex-linked traits
C) multiple alleles
D) mutation

6. In a certain species of mouse, gray fur (G) is dominant over black fur (g). If a homozygous gray mouse is crossed with a cream-colored mouse, the genotype of the F1 generation will most likely be

A) 100% Gg
B) 50% GG and 50% gg
C) 25% GG, 50% Gg, and 25% gg
D) 75% Gg and 25% gg

7. F represents the gene for brown coat color and f represents the gene for white coat color. In the cross FF x ff all the offspring have a brown coat. Which genetic principle is illustrated by this cross?

A) crossing-over
B) multiple alleles
C) codominance
D) dominance

8. In canaries, the gene for singing (S) is dominant over the gene for non-singing (s). When hybrid singing canaries are mated with non-singing canaries, what percentage of the offspring is likely to possess the singing trait?

A) GG × Gg
B) GO × GO
C) Gg × gg
D) gg × gg

9. In squirrels, the gene for gray fur (G) is dominant over the gene for black fur (g). If 50% of a large litter of squirrels are gray, the parental cross that produced this litter was most likely

A) GG × Gg
B) GO × GO
C) Gg × gg
D) gg × gg

10. In screech owls, red feathers are dominant over gray feathers. If two heterozygous red-feathered owls are mated, what percentage of their offspring would be expected to have red feathers?

A) 25%  B) 50%  C) 75%  D) 100%
11. In summer squash, white-colored fruit is dominant over yellow-colored fruit. If homozygous yellow-fruit plants are crossed with heterozygous white-fruit plants, what is the expected percentage of fruit color produced in the offspring?

A) 100% yellow  
B) 100% white  
C) 50% yellow, 50% white  
D) 25% yellow, 75% white

12. Two mice that are heterozygous for black coat color are mated. Assuming coat color in mice is controlled by a single pair of genes, which genotypic ratio for coat color is expected in the offspring?

A) 1:2:1  
B) 9:7  
C) 3:1  
D) 1:3:1

13. In humans, the ability to roll the tongue is dominant over the inability to roll the tongue. If two parents who are homozygous dominant for this trait have 8 children, how many children would be expected to be unable to roll their tongues?

A) 0  
B) 2  
C) 8  
D) 4

14. In a certain species of plant, the allele for tallness is dominant over the allele for shortness. To determine whether a tall plant is heterozygous or homozygous, it should be crossed with a

A) short plant  
B) tall plant  
C) medium-sized plant  
D) different species of plant

15. A geneticist wishes to determine if a red rose of a certain variety is homozygous for the color red. If red is dominant over white, the red rose should be cross-pollinated with roses of the same variety that are

A) homozygous red  
B) homozygous white  
C) heterozygous red  
D) heterozygous pink

16. Which sequence correctly represents the arrangement of structures containing genetic material, from the largest to the smallest size?

A) chromosome → gene → nucleus
B) nucleus → chromosome → gene
C) gene → chromosome → nucleus
D) gene → nucleus → chromosome

17. Changes in the genetic code of a human can be transmitted to offspring if they occur in

A) cancer cells  
B) gametes  
C) cell membranes  
D) antibodies

18. Base your answer to the following question on The diagram below shows a process that can occur during meiosis.

The most likely result of this process is

A) a new combination of inheritable traits that can appear in the offspring  
B) an inability to pass either of these chromosomes on to offspring  
C) a loss of genetic information that will produce a genetic disorder in the offspring  
D) an increase in the chromosome number of the organism in which this process occurs
19. Base your answer to the following question on Which process is illustrated by the diagram below?

A) crossing-over  
B) nondisjunction  
C) sex determination  
D) independent assortment

20. Base your answer to the following question on Molecule 1 represents a segment of hereditary information, and molecule 2 represents the portion of a molecule that is determined by information from molecule 1.

What will most likely happen if there is a change in the first three subunits on the upper strand of molecule 1?

A) The remaining subunits in molecule 1 will also change.  
B) A portion of molecule 2 may be different.  
C) Molecule 1 will split apart, triggering an immune response.  
D) Molecule 2 may form two strands rather than one.

21. In a species of plant, the sudden appearance of one plant with a different leaf structure would most likely be the result of

A) stable gene frequencies  
B) chromosomal mutations  
C) slow environmental changes  
D) asexual reproduction

22. Mustard gas removes guanine (G) from DNA. For developing embryos, exposure to mustard gas can cause serious deformities because guanine

A) stores the building blocks of proteins  
B) supports the structure of ribosomes  
C) produces energy for genetic transfer  
D) is part of the genetic code

23. When a person's teeth are being x rayed, other body parts of this person are covered with a protective lead blanket to prevent

A) loss of hair  
B) increase in cell size  
C) changes in DNA molecules  
D) changes in glucose structure

24. Which situation would most directly affect future generations naturally produced by a maple tree?

A) Ultraviolet radiation changes the DNA sequence within some leaves of the tree.  
B) Ultraviolet radiation changes the DNA sequence within the gametes of some flowers of the tree.  
C) An increase in temperature reduces the number of cell divisions in the roots.  
D) Rapidly growing cells just under the bark are exposed to radiation, causing changes in genetic material.

25. Some weed killers, insecticides, and food additives alter the DNA of certain cells. Because of this effect, these substances are known as

A) parasites  
B) mutagens  
C) contagions  
D) producers

26. Although genetic mutations may occur spontaneously in organisms, the incidence of such mutations may be increased by

A) radioactive substances in the environment  
B) lack of vitamins in the diet  
C) a long exposure to humid climates  
D) a short exposure to freezing temperatures

27. X-rays, formaldehyde, and asbestos fibers are all similar in that they

A) increase the rate of gene mutations  
B) decrease the rate of gene mutations  
C) have no effect upon the rate of gene mutations  
D) cause gene mutations but not other chromosomal changes

28. Mutagenic agents are substances that

A) usually lead to the death of the organism  
B) cannot be passed on to offspring  
C) are usually beneficial to the organism  
D) lead to more serious mutations in offspring

29. Mutations that occur in skin or lung cells have little effect on the evolution of a species because mutations in these cells

A) usually lead to the death of the organism  
B) cannot be passed on to offspring  
C) are usually beneficial to the organism  
D) lead to more serious mutations in offspring

30. A mutation may be passed on to future generations if it occurs within specialized cells of the

A) stomach  
B) liver  
C) pancreas  
D) ovary

31. Mutations can be transmitted to the next generation only if they are present in

A) brain cells  
B) sex cells  
C) body cells  
D) muscle cells
32. To determine whether a fetus has inherited Down syndrome, a doctor would most likely
   A) perform amniocentesis and analyze cells removed by this technique
   B) analyze the fetal blood for phenylalanine
   C) screen the mother's blood for abnormal cells
   D) examine the fetal nervous system for the accumulation of fatty material

33. Base your answer to the following question on the list below. Select the laboratory technique that is most closely associated with that phrase.

   **Laboratory Techniques**
   (1) Blood screening
   (2) Amniocentesis
   (3) Karyotyping
   (4) Urine analysis

   Enlarging photographs of chromosomes from a fetal cell and arranging these chromosomes in homologous pairs

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

34. In some individuals, G–A–G, the codon for glutamic acid, is changed to G–U–G, the codon for valine. This error causes misshapen red blood cells. This genetic disorder is known as
   A) albinism  B) hemophilia  C) Tay-Sachs  D) sickle-cell anemia

38. Which diagram illustrates fertilization that would most likely lead to the development of a normal human female?
   A) [Diagram A]  B) [Diagram B]  C) [Diagram C]  D) [Diagram D]

39. The development of a normal human zygote into a male or female is determined by
   A) an autosome contributed by the egg  B) a sex chromosome contributed by the egg
   C) an autosome contributed by the sperm  D) a sex chromosome contributed by the sperm

35. The individual from whom these chromosomes were taken is a
   A) male  B) female  C) hermaphrodite  D) polyploid

36. The diagram represents a
   A) deletion  B) synapsis  C) karyotype  D) disjunction

37. This chromosomal arrangement indicates that the individual has
   A) phenylketonuria  B) Down's syndrome  C) sickle-cell anemia  D) Tay-Sachs disease
40. Base your answer to the following question on the pedigree chart below. The pedigree chart represents the inheritance of color blindness through three generations.

![Pedigree Chart]

Which statement about the genotype of Linda and Donna regarding color blindness is correct?

A) Both carry one recessive allele.
B) Linda is a carrier, and Donna is homozygous dominant.
C) Both are homozygous recessive.
D) Linda is homozygous dominant, and Donna is a carrier.

41. A human male will normally transmit the genes on his X-chromosome to

A) his sons, only
B) his daughters, only
C) all of his sons and daughters
D) half of his sons and half of his daughters

42. In a DNA sample, 15% of the bases are thymine (T). What percentage of the bases in this sample are adenine (A)?

A) 15%  B) 30%  C) 35%  D) 85%

43. The diagram below represents an incomplete section of a DNA molecule. The boxes represent unidentified bases.

![Incomplete DNA Diagram]

When the boxes are filled in, what will the total number of bases represented by the letter A (both inside and outside the boxes) be?

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

44. Base your answer to the following question on Three structures are represented in the diagram below.

What is the relationship between these three structures?

A) DNA is made up of proteins that are synthesized in the cell.
B) Protein is composed of DNA that is stored in the cell.
C) DNA controls the production of protein in the cell.
D) The cell is composed only of DNA and protein.
45. Base your answer to the following question on The diagram below represents a portion of a nucleic acid molecule.

![Diagram of DNA molecule]

The part indicated by arrow X could be

A) adenine  
B) ribose  
C) deoxyribose  
D) phosphate

46. Base your answer to the following question on the diagram below and on your knowledge of biology. The diagram represents molecules involved in protein synthesis.

![Diagram of protein synthesis]

In plant cells, molecule 1 is found in the

A) centriole  
B) nucleus  
C) cell wall  
D) lysosome

47. Which scientists developed the double helix model of the DNA molecule?

A) Watson and Crick  
B) Hardy and Weinberg  
C) Darwin and Lamarck  
D) Weismann and Miller

48. Base your answer to the following question on the diagram below which represents a portion of a double-stranded DNA molecule and on your knowledge of biology.

![Diagram of DNA molecule]

The base sequence of strand II is most likely

A) C-A-C-T-G-G  
B) G-G-T-C-A-C  
C) G-T-G-A-C-C  
D) G-T-G-U-C-C

49. The diagram below represents a segment of a gene on two chromosomes.

![Diagram of gene segment]

The change in the gene sequence is an example of

A) an insertion  
B) a deletion  
C) a substitution  
D) a replication

50. When bonded together chemically, deoxyribose, phosphate, and an adenine molecule make up

A) a DNA nucleotide  
B) an RNA nucleotide  
C) a DNA molecule  
D) an RNA molecule
51. The diagram below represents one process that might occur in cells.

![Diagram](image)

Which process is represented in the diagram?

A) cell reproduction  B) meiosis  
C) mutation  D) gene replication

52. The diagram below shows a normal gene sequence and three mutated sequences of a segment of DNA.

![Diagram](image)

Which correctly identifies the cause of each type of mutation?

<table>
<thead>
<tr>
<th>Row</th>
<th>Mutation A</th>
<th>Mutation B</th>
<th>Mutation C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>deletion</td>
<td>substitution</td>
<td>insertion</td>
</tr>
<tr>
<td>(2)</td>
<td>insertion</td>
<td>substitution</td>
<td>deletion</td>
</tr>
<tr>
<td>(3)</td>
<td>insertion</td>
<td>deletion</td>
<td>substitution</td>
</tr>
<tr>
<td>(4)</td>
<td>deletion</td>
<td>insertion</td>
<td>substitution</td>
</tr>
</tbody>
</table>

A) (1)  B) (2)  C) (3)  D) (4)

53. Base your answer to the following question on What is the complementary messenger-RNA sequence for the DNA sequence shown below?

![DNA sequence](image)

A) C-A-A-G-G-U  B) G-T-T-C-C-A  
54. Base your answer to the following question on the diagram below of a biochemical process and on your knowledge of biology.

![Diagram of biochemical process]

Which amino acid would be transferred to the position of codon CAC?

A) leucine  B) glycine  C) valine  D) histidine

55. Which nucleic acid carries instructions from the nucleus to the cytoplasm?

A) DNA, only
B) **Messenger RNA, only**
C) Transfer RNA, only
D) DNA, messenger RNA, and transfer RNA

56. Base your answer to the following question on The diagram below represents a portion of an organic molecule.

![Diagram of organic molecule]

This molecule controls cellular activity by directing the synthesis of

A) carbohydrates  B) minerals  C) fats  D) **proteins**

57. The photographs below show some physical similarities between John Lennon and his son Julian.

![Photographs of John Lennon and Julian](image)

Lewis, Ricki *Life* 3rd edition WCB/McGraw Hill

Which conclusion can be drawn regarding these similarities?

A) The DNA present in their body cells is identical.
B) **The percentage of their proteins with the same molecular composition is high.**
C) The base sequences of their genes are identical.
D) The mutation rate is the same in their body cells.
58. Base your answer to the following question on According to the table below, which amino acid sequence would most likely be determined by a section of a DNA molecule with the base sequence A-A-G-G-A-T-C-C-G?

<table>
<thead>
<tr>
<th>Messenger RNA Codon</th>
<th>Amino Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-G-A</td>
<td>arginine</td>
</tr>
<tr>
<td>C-U-A</td>
<td>leucine</td>
</tr>
<tr>
<td>G-G-C</td>
<td>glycine</td>
</tr>
<tr>
<td>U-U-C</td>
<td>phenylalanine</td>
</tr>
</tbody>
</table>

A) phenylalanine–arginine–glycine  
B) glycine–arginine–leucine  
C) glycine–leucine–arginine  
D) phenylalanine–leucine–glycine

59. Base your answer to the following question on the diagram below which represents a segment of a DNA molecule and on your knowledge of biology.

This DNA molecule acts as a template for RNA construction in the process of

A) gene replication  
B) protein synthesis  
C) osmosis  
D) synapsis

60. Base your answer to the following question on the diagram below and on your knowledge of biology.

The DNA code for structure 1 is

A) U–U–U  
B) T–T–T  
C) A–A–A  
D) P–H–E

61. In the past, humans developed varieties of dogs, such as the German shepherd and the bearded collie, using

A) selective breeding for particular traits  
B) recombination of genes during mitosis  
C) mutations present only in body cells  
D) natural selection of favorable traits

62. Selective breeding is a technique that is used to

A) give all organisms a chance to reproduce  
B) produce organisms from extinct species  
C) produce offspring with certain desirable traits  
D) keep farm crops free of all mutations
63. Which statement would most likely be used to describe the procedure represented in the diagram below?

![Diagram of DNA interaction](image)

A) Enzymes are used to assemble an insulin gene, which is then attached to bacterial DNA.
B) Bacterial DNA is cut from a human DNA strand and inserted into a human cell to form an insulin gene.
C) The insulin gene is cut out of a human DNA strand using an enzyme and inserted into bacterial DNA, resulting in a combination of different DNA segments.
D) A gene is deleted from bacterial DNA to produce an insulin gene, which is then inserted into human DNA.

64. Researchers Cohn and Boyer transferred a gene from an African clawed frog into a bacterium. To accomplish this, these scientists had to use

A) enzymes to cut out and insert the gene
B) hereditary information located in amino acids
C) radiation to increase the gene mutation rate of the bacterial cells
D) cancer cells to promote rapid cell division

65. The diagram below represents the cloning of a carrot plant.

![Diagram of carrot cloning](image)

Compared to each cell of the original carrot plant, each cell of the new plant will have

A) the same number of chromosomes and the same types of genes
B) the same number of chromosomes, but different types of genes
C) half the number of chromosomes and the same types of genes
D) half the number of chromosomes, but different types of genes

66. "Dolly" was a sheep developed from an egg cell of her mother that had its nucleus replaced by a nucleus from a body cell of her mother. As a result of this technique, Dolly was

A) no longer able to reproduce
B) genetically identical to her mother
C) able to have a longer lifespan
D) unable to mate

67. Scientists have successfully cloned sheep and cattle for several years. A farmer is considering the advantages and disadvantages of having a flock of sheep cloned from a single individual. Discuss the issues the farmer should take into account before making a decision. Your response should include:

- how a cloned flock would be different from a noncloned flock
- one advantage of having a cloned flock
- one disadvantage of having a cloned flock
- one reason that the farmer could not mate these cloned sheep with each other to increase the size of his flock
- one reason that the offspring resulting from breeding these sheep with an unrelated sheep would not all be the same
Homework 2

68. For many years, humans have used a variety of techniques that have influenced the genetic makeup of organisms. These techniques have led to the production of new varieties of organisms that possess characteristics that are useful to humans. Identify one technique presently being used to alter the genetic makeup of an organism, and explain how humans can benefit from this change. Your answer must include at least:

- the name of the technique used to alter the genetic makeup
- a brief description of what is involved in this technique
- one specific example of how this technique has been used
- a statement of how humans have benefited from the production of this new variety of organism

Base your answers to questions 69 and 70 on the information below and on your knowledge of biology.

A biologist at an agriculture laboratory is asked to develop a better quality blueberry plant. He is given plants that produce unusually large blueberries and plants that produce very sweet blueberries.

69. The biologist is successful in producing the new plant. State one method that can be used to produce many identical blueberry plants of this new type.

70. Describe one way the biologist could use these blueberry plants to develop a plant with blueberries that are both large and sweet.

Base your answers to questions 71 through 73 on the information and chart below and on your knowledge of biology.

In DNA, a sequence of three bases is a code for the placement of a certain amino acid in a protein chain. The table below shows some amino acids with their abbreviations and DNA codes.

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Abbreviation</th>
<th>DNA Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenylalanine</td>
<td>Phe</td>
<td>AAA, AAG</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>Try</td>
<td>ACC</td>
</tr>
<tr>
<td>Serine</td>
<td>Ser</td>
<td>AGA, AGG, AGT, AGC, TCA, TCG</td>
</tr>
<tr>
<td>Valine</td>
<td>Val</td>
<td>CAA, CAG, CAT, CAC</td>
</tr>
<tr>
<td>Proline</td>
<td>Pro</td>
<td>GGA, GGG, GGT, GGC</td>
</tr>
<tr>
<td>Glutamine</td>
<td>Gln</td>
<td>GTT, GTC</td>
</tr>
<tr>
<td>Threonine</td>
<td>Thr</td>
<td>TGA, TGG, TGT, TGC</td>
</tr>
<tr>
<td>Asparagine</td>
<td>Asn</td>
<td>TTA, TTG</td>
</tr>
</tbody>
</table>

71. Describe how a protein would be changed if a base sequence mutates from GGA to TGA.

72. Identify one environmental factor that could cause a base sequence in DNA to be changed to a different base sequence.

73. Which amino acid chain would be produced by the DNA base sequence below?

```
```

A) [Val Gln Phe Asn Thr Asn]
B) [Val Pro Phe Asn Asn Thr]
C) [Val Gln Phe Asn Asn Thr]
D) [Val Gln Phe Thr Asn Asn]
74. Base your answer to the following question on the table below, which represents the DNA codes for several amino acids.

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>DNA Code Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cysteine</td>
<td>ACA or ACG</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>ACC</td>
</tr>
<tr>
<td>Valine</td>
<td>CAA or CAC or CAG or CAT</td>
</tr>
<tr>
<td>Proline</td>
<td>GGA or GGC or GGG or GGT</td>
</tr>
<tr>
<td>Asparagine</td>
<td>TTA or TTG</td>
</tr>
<tr>
<td>Methionine</td>
<td>TAC</td>
</tr>
</tbody>
</table>

The original DNA sequence undergoes the following change:

TACACACAAACGGGG → TACACACAACGGGT

State one reason this mutation produces no change in the action of the final molecule that will be synthesized from this code.
1. A  
2. A  
3. D  
4. D  
5. A  
6. A  
7. D  
8. C  
9. C  
10. C  
11. C  
12. A  
13. A  
14. A  
15. B  
16. B  
17. B  
18. A  
19. A  
20. B  
21. B  
22. D  
23. C  
24. B  
25. B  
26. A  
27. D  
28. A  
29. B  
30. D  
31. B  
32. A  
33. C  
34. D  
35. A  
36. C  
37. B  
38. A  
39. D  
40. A  
41. B  
42. A  
43. C  
44. C  
45. A  
46. B  
47. A  
48. C  
49. C  
50. A  
51. C  
52. A  
53. C  
54. D  
55. B  
56. D  
57. B  
58. D  
59. B  
60. C  
61. A  
62. C  
63. C  
64. A  
65. A  
66. B  
67. (essay)  
68. (essay)  
69. Examples: — cloning  
— vegetative propagation — cuttings — asexual reproduction  
70. Examples: — Use selective breeding/artificial selection. — Cross sweet-berry blueberry plants with large-berry blueberry plants. — Use recombinant DNA to move the sweet gene into the large-berry plants.
67. • Acceptable responses include, but are not limited to:
  — There would be no variation.
  — All would be identical genetic copies, unlike noncloned herds, where much genetic diversity would be present. — All sheep would be the same.
  • Acceptable responses include, but are not limited to:
  — All sheep would have one or more desired traits (that the original individual possessed).
  • Acceptable responses include, but are not limited to:
  — Since all are the same, the entire flock could be lost if a disease to which they have no resistance were to infect them.
  — The sheep may have a genetic flaw.
  — shorter life span
  • They would all be the same sex, so they could not mate with each other.
  • Acceptable responses include, but are not limited to:
  — Both parents contribute genes to the offspring.
  — Different gene combinations will result.

68. • The name of the technique used to alter the genetic makeup (e.g., genetic engineering, genetic manipulation, selective breeding, gene therapy) [Note: Cloning is not acceptable because it represents duplication rather than alteration.]
  • a brief description of what is involved in this technique (e.g., a segment of DNA is moved from one organism to another organism)
  • one specific example of how this technique has been used (e.g., the gene for insulin production has been inserted into certain bacteria)
  • a statement of how humans have benefited from the production of this new variety of organism (e.g., more insulin is readily available from these bacteria than from extractions from pancreases of animals)