

**Big Idea 1.A Formatives****Multiple Choice**

Identify the letter of the choice that best completes the statement or answers the question.

- \_\_\_\_\_ 1. Natural selection is based on all of the following *except*
- variation exists within populations.
  - the fittest individuals tend to leave the most offspring.
  - there is differential reproductive success within populations.
  - populations tend to produce more individuals than the environment can support.
  - individuals must adapt to their environment.
- \_\_\_\_\_ 2. To observe natural selection's effects on a population, what must be true?
- One must observe more than one generation of the population.
  - The population must contain genetic variation.
  - Members of the population must increase or decrease the use of some portion of their anatomy.
  - A and C only
  - A and B only
- \_\_\_\_\_ 3. Which of the following *must* exist in a population before natural selection can act upon that population?
- genetic variation among individuals
  - variation among individuals caused by environmental factors
  - sexual reproduction
  - A and C only
  - A, B, and C
- \_\_\_\_\_ 4. The theory of evolution is most accurately described as
- an educated guess about how species originate.
  - one possible explanation, among several scientific alternatives, about how species have come into existence.
  - an opinion that some scientists hold about how living things change over time.
  - an overarching explanation, supported by much evidence, for how populations change over time.
  - an idea about how acquired characteristics are passed on to subsequent generations.

Use the information below to answer the following question.

A large population of laboratory animals has been allowed to breed randomly for a number of generations. After several generations, 36% of the animals display a recessive trait ( $aa$ ), the same percentage as at the beginning of the breeding program. The rest of the animals show the dominant phenotype, with heterozygotes indistinguishable from the homozygous dominants.

- \_\_\_\_\_ 5. What is the most reasonable conclusion that can be drawn from the fact that the frequency of the recessive trait ( $aa$ ) *has not changed over time*?
- The population is undergoing genetic drift.
  - The two phenotypes are about equally adaptive under laboratory conditions.
  - The genotype  $AA$  is lethal.
  - There has been a high rate of mutation of allele  $A$  to allele  $a$ .
  - There has been sexual selection favoring allele  $a$ .

- \_\_\_\_\_ 6. All of the following are criteria for maintaining Hardy-Weinberg equilibrium involving two alleles *except*
- the frequency of all genotypes must be equal.
  - there should be no natural selection.
  - matings must be random.
  - populations must be large.
  - gene flow from other populations must be zero.
- \_\_\_\_\_ 7. In a Hardy-Weinberg population with two alleles,  $A$  and  $a$ , that are in equilibrium, the frequency of allele  $a$  is 0.2. What is the frequency of individuals with  $Aa$  genotype?
- 0.20
  - 0.32
  - 0.42
  - 0.80
  - Genotype frequency cannot be determined from the information provided.
- \_\_\_\_\_ 8. Most copies of harmful recessive alleles in a sexual species are carried by individuals that are
- haploid.
  - polymorphic.
  - homozygous for the allele.
  - heterozygous for the allele.
  - B and C
- \_\_\_\_\_ 9. In a population with two alleles,  $A$  and  $a$ , the frequency of  $A$  is 0.2. Organisms that are homozygous for  $A$  die before reaching sexual maturity. In five generations, what would be the frequency of individuals with  $aa$  genotypes?
- less than 0.04
  - 0.04
  - 0.32
  - 0.64
  - greater than 0.64
- \_\_\_\_\_ 10. You sample a population of butterflies and find that 42% are heterozygous for a particular gene. What would be the frequency of the recessive allele in this population?
- 0.09
  - 0.30
  - 0.49
  - 0.70
  - Allele frequency cannot be estimated from this information.

*Use the information below to answer the following questions.*

In a hypothetical population of 1,000 people, tests of blood-type genes show that 160 have the genotype  $AA$ , 480 have the genotype  $AB$ , and 360 have the genotype  $BB$ .

- \_\_\_\_\_ 11. What is the frequency of the  $A$  allele?
- 0.001
  - 0.002
  - 0.100
  - 0.400
  - 0.600

- \_\_\_\_\_ 12. What percentage of the population has type O blood?
- 0
  - 10
  - 24
  - 48
  - 60
- \_\_\_\_\_ 13. If there are 4,000 children born to this generation, how many would be expected to have AB blood under the conditions of Hardy-Weinberg equilibrium?
- 100
  - 960
  - 1,920
  - 2,000
  - 2,400

*Refer to the information below to answer the following questions.*

You are studying three populations of birds. Population 1 has ten birds, of which one is brown (a recessive trait) and nine are red. Population 2 has 100 birds. In that population, ten of the birds are brown. Population 3 has 30 birds, and three of them are brown. Use the following options to answer the questions:

- Population 1
  - Population 2
  - Population 3
  - They are all the same.
  - It is impossible to tell from the information given.
- \_\_\_\_\_ 14. In which population is the frequency of the allele for brown feathers highest?
- A
  - B
  - C
  - D
  - E
- \_\_\_\_\_ 15. In modern terminology, diversity is understood to be a result of genetic variation. Sources of variation for evolution include all of the following *except*
- mistakes in translation of structural genes.
  - mistakes in DNA replication.
  - translocations and mistakes in meiosis.
  - recombination at fertilization.
  - recombination by crossing over in meiosis.

- \_\_\_\_\_ 16. In DNA molecules, A-T base pairs are held to each other by two hydrogen bonds, whereas the more stable G-C base pairs are held to each other by three hydrogen bonds. If DNA mutability increases as DNA stability decreases, then which of the five exons of a hypothetical gene should be most highly conserved over evolutionary time (assuming no selection and no transposition occurs)?

| Exon | % of A-T pairs | % of G-C pairs |
|------|----------------|----------------|
| A    | 50             | 50             |
| B    | 46             | 54             |
| C    | 40             | 60             |
| D    | 70             | 30             |
| E    | 62             | 38             |

- a. Exon A
  - b. Exon B
  - c. Exon C
  - d. Exon D
  - e. Exon E
- \_\_\_\_\_ 17. The following important concepts of population genetics are due to random events or chance *except*
- a. mutation.
  - b. the bottleneck effect.
  - c. the founder effect.
  - d. natural selection.
  - e. sexual recombination.
- \_\_\_\_\_ 18. Gene flow is a concept best used to describe an exchange between
- a. species.
  - b. males and females.
  - c. populations.
  - d. individuals.
  - e. chromosomes.

*Use the information below to answer the following questions.*

In the year 2500, five male space colonists and five female space colonists (all unrelated to each other) settle on an uninhabited Earthlike planet in the Andromeda galaxy. The colonists and their offspring randomly mate for generations. All ten of the original colonists had free earlobes, and two were heterozygous for that trait. The allele for free earlobes is dominant to the allele for attached earlobes.

- \_\_\_\_\_ 19. Which of these is closest to the allele frequency in the founding population?
- a. 0.1 *a*, 0.9 *A*
  - b. 0.2 *a*, 0.8 *A*
  - c. 0.5 *a*, 0.5 *A*
  - d. 0.8 *a*, 0.2 *A*
  - e. 0.4 *a*, 0.6 *A*

- \_\_\_\_\_ 20. If four of the original colonists died before they produced offspring, the ratios of genotypes could be quite different in the subsequent generations. This is an example of
- diploidy.
  - gene flow.
  - genetic drift.
  - disruptive selection.
  - stabilizing selection.

*Use the information below to answer the following questions.*

The restriction enzymes of bacteria protect the bacteria from successful attack by bacteriophages, whose genomes can be degraded by the restriction enzymes. The bacterial genomes are not vulnerable to these restriction enzymes because bacterial DNA is methylated. This situation selects for bacteriophages whose genomes are also methylated. As new strains of resistant bacteriophages become more prevalent, this in turn selects for bacteria whose genomes are not methylated and whose restriction enzymes instead degrade methylated DNA.

- \_\_\_\_\_ 21. Over the course of evolutionary time, what should occur?
- Methylated DNA should become fixed in the gene pools of bacterial species.
  - Nonmethylated DNA should become fixed in the gene pools of bacteriophages.
  - Methylated DNA should become fixed in the gene pools of bacteriophages.
  - Methylated and nonmethylated strains should be maintained among both bacteria and bacteriophages, with ratios that vary over time.
  - Both A and B are correct.
- \_\_\_\_\_ 22. Which of the following statements best summarizes evolution as it is viewed today?
- It is goal-directed.
  - It represents the result of selection for acquired characteristics.
  - It is synonymous with the process of gene flow.
  - It is the descent of humans from the present-day great apes.
  - It is the differential survival and reproduction of the most fit phenotypes.

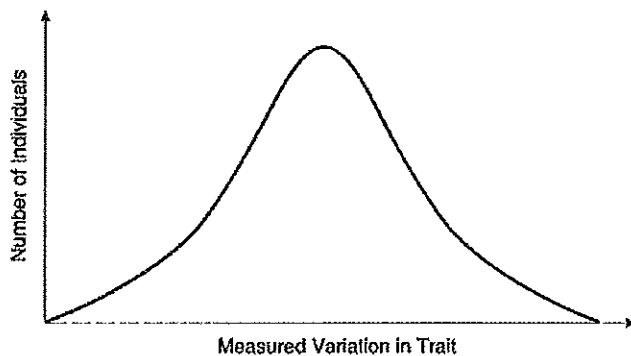
*Choose among these options to answer the following questions. Each option may be used once, more than once, or not at all.*

- random selection
- directional selection
- stabilizing selection
- disruptive selection
- sexual selection

- \_\_\_\_\_ 23. Most Swiss starlings produce four to five eggs in each clutch.
- A
  - B
  - C
  - D
  - E

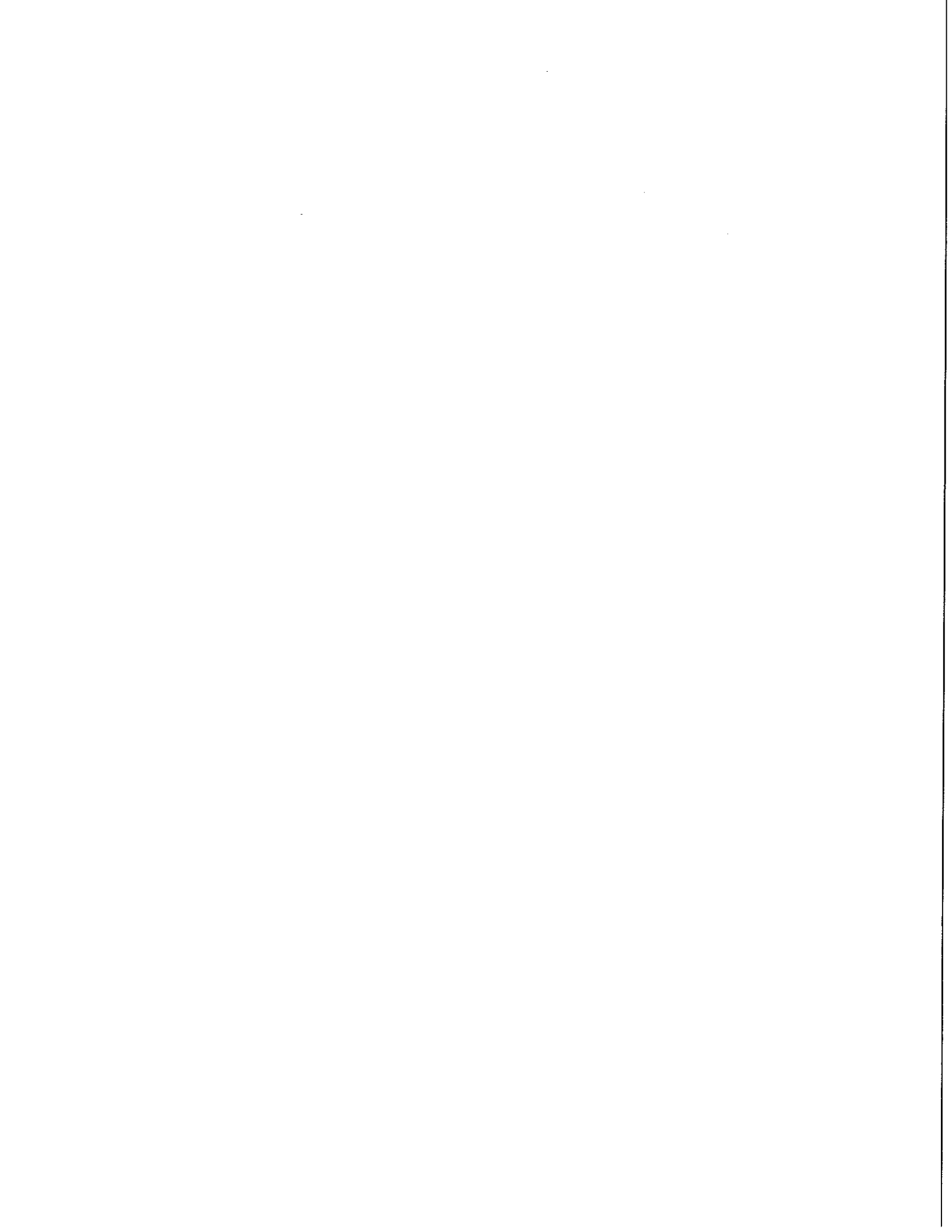
- \_\_\_\_\_ 24. The average birth weight for human babies is about 3 kg.
- A
  - B
  - C
  - D
  - E
- \_\_\_\_\_ 25. A certain species of land snail exists as either a cream color or a solid brown color. Intermediate individuals are relatively rare.
- A
  - B
  - C
  - D
  - E
- \_\_\_\_\_ 26. Pathogenic bacteria found in many hospitals are antibiotic resistant.
- A
  - B
  - C
  - D
  - E
- \_\_\_\_\_ 27. Cattle breeders have improved the quality of meat over the years by which process?
- artificial selection
  - directional selection
  - stabilizing selection
  - A and B
  - A and C

*In a very large population, a quantitative trait has the following distribution pattern:*



- \_\_\_\_\_ 28. What is true of the trait whose frequency distribution in a large population appears above? It has probably undergone
- directional selection.
  - stabilizing selection.
  - disruptive selection.
  - sexual selection.
  - random selection.

- \_\_\_\_\_ 29. A proficient engineer can easily design skeletal structures that are more functional than those currently found in the forelimbs of such diverse mammals as horses, whales, and bats. That the actual forelimbs of these mammals do not seem to be optimally arranged is because
- natural selection has not had sufficient time to create the optimal design in each case, but will do so given enough time.
  - natural selection operates in ways that are beyond the capability of the human mind to comprehend.
  - in many cases, phenotype is not merely determined by genotype, but by the environment as well.
  - though we may not consider the fit between the current skeletal arrangements and their functions excellent, we should not doubt that natural selection ultimately produces the best design.
  - natural selection is generally limited to modifying structures that were present in previous generations and in previous species.
- \_\_\_\_\_ 30. The existence of evolutionary trends, such as increasing body sizes among horse species, is evidence that
- a larger volume-to-surface area ratio is beneficial to all mammals.
  - an unseen guiding force is at work.
  - evolution always tends toward increased complexity or increased size.
  - in particular environments, similar adaptations can be beneficial in more than one species.
  - evolution generally progresses toward some predetermined goal.
- \_\_\_\_\_ 31. Broad-spectrum antibiotics inhibit the growth of most intestinal bacteria. Consequently, a hospital patient who is receiving broad-spectrum antibiotics is most likely to become \_\_\_\_\_, assuming that nothing is done to counter the reduction of intestinal bacteria.
- unable to fix carbon dioxide
  - antibiotic resistant
  - unable to fix nitrogen
  - unable to synthesize peptidoglycan
  - deficient in certain vitamins
- \_\_\_\_\_ 32. What is the effect of a nonsense mutation in a gene?
- It changes an amino acid in the encoded protein.
  - It has no effect on the amino acid sequence of the encoded protein.
  - It introduces a stop codon into the mRNA.
  - It alters the reading frame of the mRNA.
  - It prevents introns from being expressed.





Name: \_\_\_\_\_

ID: A

*Each of the following is a modification of the sentence THECATATETHERAT.*

- A. THERATATETHECAT
- B. THETACATETHERAT
- C. THECATARETHERAT
- D. THECATATTHERAT
- E. CATATETHERAT

- \_\_\_\_\_ 33. Which of the above is analogous to a frameshift mutation?
- a. A
  - b. B
  - c. C
  - d. D
  - e. E
- \_\_\_\_\_ 34. Which point mutation would be most likely to have a catastrophic effect on the functioning of a protein?
- a. a base substitution
  - b. a base deletion near the start of a gene
  - c. a base deletion near the end of the coding sequence, but not in the terminator codon
  - d. deletion of three bases near the start of the coding sequence, but not in the initiator codon
  - e. a base insertion near the end of the coding sequence, but not in the terminator codon

**Big Idea 1.A Formatives**  
**Answer Section**

**MULTIPLE CHOICE**

|            |        |                                  |
|------------|--------|----------------------------------|
| 1. ANS: E  | PTS: 1 | TOP: Concept 22.2                |
| 2. ANS: E  | PTS: 1 | TOP: Concept 22.2                |
| 3. ANS: D  | PTS: 1 | TOP: Concept 22.2                |
| 4. ANS: D  | PTS: 1 | TOP: Concept 22.3                |
| 5. ANS: B  | PTS: 1 | TOP: Concept 23.1                |
| 6. ANS: A  | PTS: 1 | TOP: Concept 23.1                |
| 7. ANS: B  | PTS: 1 | TOP: Concept 23.1                |
| 8. ANS: D  | PTS: 1 | TOP: Concept 23.1                |
| 9. ANS: E  | PTS: 1 | TOP: Concept 23.1                |
| 10. ANS: E | PTS: 1 | TOP: Concept 23.1                |
| 11. ANS: D | PTS: 1 | TOP: Concept 23.1                |
| 12. ANS: A | PTS: 1 | TOP: Concept 23.1                |
| 13. ANS: C | PTS: 1 | TOP: Concept 23.1                |
| 14. ANS: D | PTS: 1 | TOP: Concept 23.1                |
| 15. ANS: A | PTS: 1 | TOP: Concept 23.2                |
| 16. ANS: C | PTS: 1 | TOP: Concept 23.2                |
| 17. ANS: D | PTS: 1 | TOP: Concept 23.2   Concept 23.3 |
| 18. ANS: C | PTS: 1 | TOP: Concept 23.3                |
| 19. ANS: A | PTS: 1 | TOP: Concept 23.2                |
| 20. ANS: C | PTS: 1 | TOP: Concept 23.3                |
| 21. ANS: D | PTS: 1 | TOP: Concept 23.4                |
| 22. ANS: E | PTS: 1 | TOP: Concept 23.4                |
| 23. ANS: C | PTS: 1 | TOP: Concept 23.4                |
| 24. ANS: C | PTS: 1 | TOP: Concept 23.4                |
| 25. ANS: D | PTS: 1 | TOP: Concept 23.4                |
| 26. ANS: B | PTS: 1 | TOP: Concept 23.4                |
| 27. ANS: D | PTS: 1 | TOP: Concept 23.4                |
| 28. ANS: B | PTS: 1 | TOP: Concept 23.4                |
| 29. ANS: E | PTS: 1 | TOP: Concept 23.4                |
| 30. ANS: D | PTS: 1 | TOP: Concept 24.3                |
| 31. ANS: E | PTS: 1 | TOP: Concept 27.5                |
| 32. ANS: C | PTS: 1 | TOP: Concept 17.7                |
| 33. ANS: D | PTS: 1 | TOP: Concept 17.7                |
| 34. ANS: B | PTS: 1 | TOP: Concept 17.7                |