

Big Idea 2.A Formatives**Multiple Choice**

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

- _____ 1. Which of the following statements correctly describe(s) some aspect of energy in living organisms?
- Living organisms can convert energy among several different forms.
 - Living organisms can use energy to do work.
 - Organisms expend energy in order to decrease their entropy
 - A and B only
 - A, B, and C
- _____ 2. The organization of organisms has become increasingly complex with time. This statement
- is consistent with the second law of thermodynamics.
 - requires that due to evolution, the entropy of the universe increased.
 - is based on the fact that organisms function as closed systems.
 - A and B only
 - A, B, and C
- _____ 3. Which of the following properties or processes do we associate with living things?
- evolutionary adaptations
 - energy processing
 - responding to the environment
 - growth and reproduction
 - all of the above
- _____ 4. Which of the following is the main source of energy for producers such as plants and other photosynthetic organisms?
- sunlight or solar energy
 - carbon dioxide or kinetic energy
 - heat or thermal energy
 - chemicals or chemical energy
 - both B and D
- _____ 5. The dynamics of any ecosystem include the following major processes:
- the flow of energy from sunlight to producers
 - the flow of energy from sunlight to producers and then to consumers
 - the recycling of chemical nutrients
 - the flow of energy to producers and the recycling of nutrients
 - the flow of energy from sunlight to producers and then to consumers, and the recycling of chemical nutrients
- _____ 6. For most ecosystems _____ is (are) the ultimate source of energy, and energy leaves the ecosystem in the form of _____.
- sunlight; heat
 - heat; light
 - plants; animals
 - plants; heat
 - producers; consumers

- _____ 7. Which of the following are characteristics shared by members of both domain Bacteria and domain Archaea?
- cytosol
 - nucleus
 - DNA
 - A and C only
 - A, B, and C
- _____ 8. Which term most precisely describes the cellular process of breaking down large molecules into smaller ones?
- catalysis
 - metabolism
 - anabolism
 - dehydration
 - catabolism
- _____ 9. Which of the following is (are) *true* for anabolic pathways?
- They do not depend on enzymes.
 - They are highly regulated sequences of chemical reactions.
 - They consume energy to build up polymers from monomers.
 - They release energy as they degrade polymers to monomers.
 - both B and C
- _____ 10. Which of the following is a statement of the first law of thermodynamics?
- Energy cannot be created or destroyed.
 - The entropy of the universe is decreasing.
 - The entropy of the universe is constant.
 - Kinetic energy is stored energy that results from the specific arrangement of matter.
 - Energy cannot be transferred or transformed.
- _____ 11. According to the first law of thermodynamics,
- the universe loses energy because of heat production.
 - systems rich in energy are intrinsically unstable and will give up energy with time.
 - energy can be neither created nor destroyed.
 - A and B only
 - A, B, and C
- _____ 12. Which of the following shows the correct changes in thermodynamic properties for a chemical reaction in which amino acids are linked to form a protein?
- $+\Delta H, +\Delta S, +\Delta G$
 - $+\Delta H, -\Delta S, -\Delta G$
 - $+\Delta H, -\Delta S, +\Delta G$
 - $-\Delta H, -\Delta S, +\Delta G$
 - $-\Delta H, +\Delta S, +\Delta G$
- _____ 13. A chemical reaction that has a positive ΔG is *correctly described as*
- endergonic.
 - endothermic.
 - enthalpic.
 - spontaneous.
 - exothermic.

- _____ 14. ATP generally energizes a cellular process by
- releasing heat upon hydrolysis.
 - acting as a catalyst.
 - coupling free energy released by ATP hydrolysis to free energy needed by other reactions.
 - breaking a high-energy bond.
 - binding directly to the substrate(s) of the enzyme.
- _____ 15. Where does glycolysis take place?
- mitochondrial matrix
 - mitochondrial outer membrane
 - mitochondrial inner membrane
 - mitochondrial intermembrane space
 - cytosol
- _____ 16. Which of the following statements about glycolysis is *false*?
- Glycolysis has steps involving oxidation-reduction reactions.
 - The enzymes of glycolysis are located in the cytosol of the cell.
 - Glycolysis can operate in the complete absence of O₂.
 - The end products of glycolysis are CO₂ and H₂O.
 - Glycolysis makes ATP exclusively through substrate-level phosphorylation.
- _____ 17. During glycolysis, when glucose is catabolized to pyruvate, most of the energy of glucose is
- transferred to ADP, forming ATP.
 - transferred directly to ATP.
 - retained in the pyruvate.
 - stored in the NADH produced.
 - used to phosphorylate fructose to form fructose-6-phosphate.
- _____ 18. In addition to ATP, what are the end products of glycolysis?
- CO₂ and H₂O
 - CO₂ and pyruvate
 - NADH and pyruvate
 - CO₂ and NADH
 - H₂O, FADH₂, and citrate
- _____ 19. Starting with one molecule of glucose, the "net" products of glycolysis are
- 2 NAD⁺, 2 H⁺, 2 pyruvate, 2 ATP, and 2 H₂O.
 - 2 NADH, 2 H⁺, 2 pyruvate, 2 ATP, and 2 H₂O.
 - 2 FADH₂, 2 pyruvate, 4 ATP, and 2 H₂O.
 - 6 CO₂, 6 H₂O, 2 ATP, and 2 pyruvate.
 - 6 CO₂, 6 H₂O, 36 ATP, and 2 citrate.
- _____ 20. Which of the following occurs in the cytosol of the cell?
- glycolysis and fermentation
 - fermentation and chemiosmosis
 - oxidation of pyruvate to acetyl CoA
 - citric acid cycle
 - oxidative phosphorylation

- _____ 21. Which metabolic pathway is common to both cellular respiration and fermentation?
- the oxidation of pyruvate to acetyl CoA
 - the citric acid cycle
 - oxidative phosphorylation
 - glycolysis
 - chemiosmosis
- _____ 22. Why is glycolysis considered to be one of the first metabolic pathways to have evolved?
- It produces much less ATP than does oxidative phosphorylation.
 - It is found in the cytosol, does not involve oxygen, and is present in most organisms.
 - It is found in prokaryotic cells but not in eukaryotic cells.
 - It relies on chemiosmosis which is a metabolic mechanism present only in the first cells-prokaryotic cells.
 - It requires the presence of membrane-enclosed cell organelles found only in eukaryotic cells.
- _____ 23. Molecules that can potentially be converted to intermediates of glycolysis and/or the citric acid cycle include
- amino acids and proteins.
 - glycerol and fatty acids.
 - glucose and sucrose.
 - starch and glycogen.
 - all of the above
- _____ 24. Consider an ectotherm and an endotherm of equal body size. The ectotherm is more likely to survive an extended period of food deprivation than the endotherm because
- the ectotherm is sustained by a higher basal metabolic rate.
 - the ectotherm will expend less energy/kg body weight than the endotherm.
 - the ectotherm will invest little to no energy in temperature regulation.
 - actually, assuming equal size, the ectotherm and the endotherm will have the same energy expenditures.
 - both B and C
- _____ 25. Which of the following assertions about regulation of body temperature is *true*?
- Most animals are endotherms.
 - Endothermy involves production of heat through metabolism.
 - Ectothermic animals are cold-blooded.
 - Mammals are always ectothermic.
 - Insects are always ectothermic.
- _____ 26. Life history strategies usually result from
- environmental pressures.
 - natural selection.
 - conscious choice.
 - A and B only
 - A, B, and C
- _____ 27. Natural selection involves energetic trade-offs between or among life history traits such as
- number of offspring per reproductive episode.
 - number of reproductive episodes per lifetime.
 - age at first reproduction.
 - A and C only
 - A, B, and C

- _____ 28. In the logistic equation $dN/dt = rN, \frac{(K-N)}{K}$, r is a measure of the population's intrinsic rate of increase. It is determined by which of the following?
- birth rate
 - death rate
 - density
 - A and B only
 - A, B, and C

Use the following choices to answer the question below. Each choice may be used once, more than once, or not at all.

- $\frac{rN}{K}$
- rN
- $rN(K+N)$
- $rN \frac{(K-N)}{K}$
- $rN \frac{(N-K)}{K}$

- _____ 29. Exponential growth of a population is represented by $dN/dt =$
- A
 - B
 - C
 - D
 - E

- _____ 30. Logistic growth of a population is represented by $dN/dt =$
- A
 - B
 - C
 - D
 - E

- _____ 31. As N approaches K for a certain population, which of the following is predicted by the logistic equation?
- The growth rate will not change.
 - The growth rate will approach zero.
 - The population will show an Allee effect.
 - The population will increase exponentially.
 - The carrying capacity of the environment will increase.

- _____ 32. Subtraction of which of the following will convert gross primary productivity into net primary productivity?
- the energy contained in the standing crop
 - the energy used by heterotrophs in respiration
 - the energy used by autotrophs in respiration
 - the energy fixed by photosynthesis
 - all solar energy

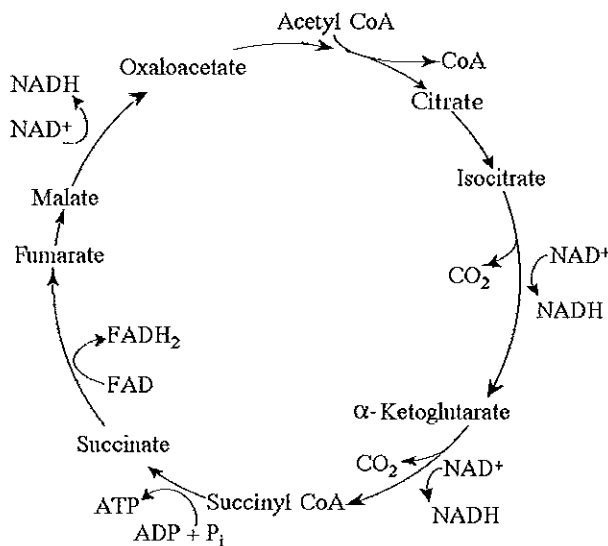
- _____ 33. Which of these ecosystems accounts for the largest amount of Earth's net primary productivity?
- tundra
 - savanna
 - salt marsh
 - open ocean
 - tropical rain forest
- _____ 34. Which of these ecosystems has the highest net primary productivity per square meter?
- savanna
 - open ocean
 - boreal forest
 - tropical rain forest
 - temperate forest
- _____ 35. How is it that the open ocean produces the highest net primary productivity of Earth's ecosystems, yet net primary productivity per square meter is relatively low?
- It contains greater concentrations of nutrients.
 - It receives a greater amount of solar energy per unit area.
 - It has the greatest total area.
 - It contains more species of organisms.
 - Its producers are generally much smaller than its consumers.
- _____ 36. How does inefficient transfer of energy among trophic levels influence the typically high risk of extinction shared by most top predators?
- Predators are sparsely distributed.
 - Predators have relatively small population sizes.
 - Predators are more disease-prone than animals at lower trophic levels.
 - A and B only
 - A, B, and C
- _____ 37. Trophic efficiency is
- the ratio of net secondary production to assimilation of primary production.
 - the percentage of production transferred from one trophic level to the next.
 - the ratio of net production at one trophic level to the net production at the level below, expressed as a percentage.
 - usually greater than production efficiencies.
 - both B and C
- _____ 38. Which of the following are products of the light reactions of photosynthesis that are utilized in the Calvin cycle?
- CO₂ and glucose
 - H₂O and O₂
 - ADP, P_i, and NADP⁺
 - electrons and H⁺
 - ATP and NADPH
- _____ 39. What is the primary function of the light reactions of photosynthesis?
- to produce energy-rich glucose from carbon dioxide and water
 - to produce ATP and NADPH
 - to produce NADPH used in respiration
 - to convert light energy to the chemical energy of PGAL
 - to use ATP to make glucose

- _____ 40. Where does the Calvin cycle take place?
- stroma of the chloroplast
 - thylakoid membrane
 - cytoplasm surrounding the chloroplast
 - chlorophyll molecule
 - outer membrane of the chloroplast
- _____ 41. Muscle cells in oxygen deprivation convert pyruvate to _____, and in this step gain _____.
- lactate; ATP
 - alcohol; CO_2
 - alcohol; ATP
 - ATP; NADH_2
 - lactate; NAD^+
- _____ 42. In the absence of oxygen, yeast cells can obtain energy by fermentation, resulting in the production of
- ATP, CO_2 and ethanol (ethyl alcohol).
 - ATP, CO_2 , and lactate.
 - ATP, NADH, and pyruvate.
 - ATP, pyruvate, and oxygen.
 - ATP, pyruvate, and acetyl CoA.
- _____ 43. The function of both alcohol fermentation and lactic acid fermentation is to
- reduce NAD^+ to NADH.
 - reduce FAD^+ to FADH_2 .
 - oxidize NADH to NAD^+ .
 - reduce FADH_2 to FAD^+ .
 - none of the above
- _____ 44. Which statement is *not* correct with regard to redox (oxidation-reduction) reactions?
- A molecule is reduced if it loses electrons.
 - A molecule is oxidized if it loses electrons.
 - An electron donor is called a reducing agent.
 - An electron acceptor is called an oxidizing agent.
 - Oxidation and reduction always go together.
- _____ 45. The molecule that functions as the reducing agent (electron donor) in a redox or oxidation-reduction reaction
- gains electrons and gains energy.
 - loses electrons and loses energy.
 - gains electrons and loses energy.
 - loses electrons and gains energy.
 - neither gains nor loses electrons, but gains or loses energy.
- _____ 46. When electrons move closer to a more electronegative atom, what happens?
- Energy is released.
 - Energy is consumed.
 - The more electronegative atom is reduced.
 - The more electronegative atom is oxidized.
 - A and C are correct.

- _____ 47. When a glucose molecule loses a hydrogen atom (not a hydrogen ion) as the result of an oxidation-reduction reaction, the molecule becomes
- dehydrogenated.
 - hydrogenated.
 - oxidized.
 - reduced.
 - an oxidizing agent.
- _____ 48. Where are the proteins of the electron transport chain located?
- cytosol
 - mitochondrial outer membrane
 - mitochondrial inner membrane
 - mitochondrial intermembrane space
 - mitochondrial matrix
- _____ 49. During aerobic respiration, which of the following directly donates electrons to the electron transport chain at the lowest energy level?
- NAD⁺
 - NADH
 - ATP
 - ADP + P_i
 - FADH₂
- _____ 50. During aerobic cellular respiration, a proton gradient in mitochondria is generated by _____ and used primarily for _____.
- the electron transport chain; ATP synthesis
 - the electron transport chain; substrate-level phosphorylation
 - glycolysis; production of H₂O
 - fermentation; NAD⁺ reduction
 - diffusion of protons; ATP synthesis
- _____ 51. Where is ATP synthase located in the mitochondrion?
- cytosol
 - electron transport chain
 - outer membrane
 - inner membrane
 - mitochondrial matrix
- _____ 52. What does the chemiosmotic process in chloroplasts involve?
- establishment of a proton gradient
 - diffusion of electrons through the thylakoid membrane
 - reduction of water to produce ATP energy
 - movement of water by osmosis into the thylakoid space from the stroma
 - formation of glucose, using carbon dioxide, NADPH, and ATP
- _____ 53. In a plant cell, where are the ATP synthase complexes located?
- thylakoid membrane
 - plasma membrane
 - inner mitochondrial membrane
 - A and C
 - A, B, and C

- _____ 54. In mitochondria, chemiosmosis translocates protons from the matrix into the intermembrane space, whereas in chloroplasts, chemiosmosis translocates protons from
- the stroma to the photosystem II.
 - the matrix to the stroma.
 - the stroma to the thylakoid space.
 - the intermembrane space to the matrix.
 - ATP synthase to NADP⁺ reductase.
- _____ 55. Where is the electron transport chain found in plant cells?
- thylakoid membranes of chloroplasts
 - stroma of chloroplasts
 - inner membrane of mitochondria
 - matrix of mitochondria
 - cytoplasm
- _____ 56. The ancestors of which free-living cells were the earliest autotrophs to contribute to the formation of Earth's oxidizing atmosphere?
- cyanobacteria
 - chloroplasts
 - mitochondria
 - seaweeds
 - endosymbionts

Refer to the figure below, showing the citric acid cycle, as a guide to answer the following questions.



- _____ 57. Starting with one molecule of isocitrate and ending with fumarate, what is the maximum number of ATP molecules that could be made through substrate-level phosphorylation?
- 1
 - 2
 - 11
 - 12
 - 24

- _____ 58. How many reduced dinucleotides would be produced with four turns of the citric acid cycle?
- 1 FADH₂ and 4 NADH
 - 2 FADH₂ and 8 NADH
 - 4 FADH₂ and 12 NADH
 - 1 FAD and 4 NAD⁺
 - 4 FAD⁺ and 12 NAD⁺
- _____ 59. Starting with citrate, how many of the following would be produced with three turns of the citric acid cycle?
- 1 ATP, 2 CO₂, 3 NADH, and 1 FADH₂
 - 2 ATP, 2 CO₂, 1 NADH, and 3 FADH₂
 - 3 ATP, 3 CO₂, 3 NADH, and 3 FADH₂
 - 3 ATP, 6 CO₂, 9 NADH, and 3 FADH₂
 - 38 ATP, 6 CO₂, 3 NADH, and 12 FADH₂
- _____ 60. During aerobic respiration, electrons travel downhill in which sequence?
- food → citric acid cycle → ATP → NAD⁺
 - food → NADH → electron transport chain → oxygen
 - glucose → pyruvate → ATP → oxygen
 - glucose → ATP → electron transport chain → NADH
 - food → glycolysis → citric acid cycle → NADH → ATP
- _____ 61. Energy released by the electron transport chain is used to pump H⁺ ions into which location?
- cytosol
 - mitochondrial outer membrane
 - mitochondrial inner membrane
 - mitochondrial intermembrane space
 - mitochondrial matrix
- _____ 62. The direct energy source that drives ATP synthesis during respiratory oxidative phosphorylation is
- oxidation of glucose to CO₂ and water.
 - the thermodynamically favorable flow of electrons from NADH to the mitochondrial electron transport carriers.
 - the final transfer of electrons to oxygen.
 - the difference in H⁺ concentrations on opposite sides of the inner mitochondrial membrane.
 - the thermodynamically favorable transfer of phosphate from glycolysis and the citric acid cycle intermediate molecules of ADP.

Match the terms below to the following questions. Each term may be used once, more than once, or not at all

- ectothermy
- endothermy
- evaporation
- torpor
- thermogenesis

- _____ 63. hibernation
- A
 - B
 - C
 - D
 - E

- _____ 64. estivation
- A
 - B
 - C
 - D
 - E
- _____ 65. process that occurs in the brown fat of some mammals
- A
 - B
 - C
 - D
 - E
- _____ 66. Nitrogen is available to plants only in the form of
- ammonium.
 - nitrite.
 - nitrate.
 - A and C only
 - A, B, and C
- _____ 67. In the nitrogen cycle, the bacteria that replenish the atmosphere with N_2 are
- Rhizobium* bacteria.
 - nitrifying bacteria.
 - denitrifying bacteria.
 - methanogenic protozoans.
 - nitrogen-fixing bacteria.
- _____ 68. Water is able to form hydrogen bonds because
- oxygen has a valence of 2.
 - the water molecule is shaped like a tetrahedron.
 - the bonds that hold together the atoms in a water molecule are polar covalent bonds.
 - the oxygen atom in a water molecule has a weak positive charge.
 - each of the hydrogen atoms in a water molecule is weakly negative in charge.
- _____ 69. Water's high specific heat is mainly a consequence of the
- small size of the water molecules.
 - high specific heat of oxygen and hydrogen atoms.
 - absorption and release of heat when hydrogen bonds break and form.
 - fact that water is a poor heat conductor.
 - inability of water to dissipate heat into dry air.
- _____ 70. Which bonds must be broken for water to vaporize?
- ionic bonds
 - nonpolar covalent bonds
 - polar covalent bonds
 - hydrogen bonds
 - covalent bonds

- _____ 71. Desert rabbits are adapted to the warm climate because their large ears aid in the removal of heat due to the
- high surface tension of water.
 - high heat of vaporization of water.
 - high specific heat of water.
 - buffering capacity of water.
 - dissociation of water molecules.
- _____ 72. Ice is lighter and floats in water because it is a crystalline structure in which each water molecule is bonded to a maximum of four other water molecules by which kind of bond?
- ionic
 - hydrogen
 - covalent
 - A and C only
 - A, B, and C
- _____ 73. An increase in which of the following parameters is most important in the evolution of specialized exchange surfaces such as the linings of the lungs or intestines?
- surface area
 - body thickness
 - number of cell layers
 - metabolic rate of component cells
 - volume of component cells
- _____ 74. Which of the following is true of interstitial fluid?
- It forms the extracellular matrix of connective tissue.
 - It is the internal environment found in animal cells.
 - It is composed of blood.
 - It provides for the exchange of materials between blood and body cells.
 - It is found inside the small intestine.

**Big Idea 2.A Formatives
Answer Section****MULTIPLE CHOICE**

- | | |
|------------|-------------------------------|
| 1. ANS: E | TOP: Concept 8.1 |
| 2. ANS: A | TOP: Concept 8.1 |
| 3. ANS: E | TOP: Overview |
| 4. ANS: A | TOP: Concept 1.1 |
| 5. ANS: E | TOP: Concept 1.1 |
| 6. ANS: A | TOP: Concept 1.1 |
| 7. ANS: D | TOP: Concept 1.3 |
| 8. ANS: E | TOP: Concept 8.1 |
| 9. ANS: E | TOP: Concept 8.1 |
| 10. ANS: A | TOP: Concept 8.1 |
| 11. ANS: C | TOP: Concept 8.1 |
| 12. ANS: C | TOP: Concept 8.2 |
| 13. ANS: A | TOP: Concept 8.2 |
| 14. ANS: C | TOP: Concept 8.3 |
| 15. ANS: E | TOP: Concept 9.1 |
| 16. ANS: D | TOP: Concept 9.1, Concept 9.2 |
| 17. ANS: C | TOP: Concept 9.2 |
| 18. ANS: C | TOP: Concept 9.2 |
| 19. ANS: B | TOP: Concept 9.2 |
| 20. ANS: A | TOP: Concept 9.2, Concept 9.5 |
| 21. ANS: D | TOP: Concept 9.5 |
| 22. ANS: B | TOP: Concept 9.5 |
| 23. ANS: E | TOP: Concept 9.6 |
| 24. ANS: E | TOP: Concept 40.5 |
| 25. ANS: B | TOP: Concept 40.5 |
| 26. ANS: D | TOP: Concept 52.2 |
| 27. ANS: E | TOP: Concept 52.2 |
| 28. ANS: D | TOP: Concept 52.3 |
| 29. ANS: B | TOP: Concept 52.3 |
| 30. ANS: D | TOP: Concept 52.4 |
| 31. ANS: B | TOP: Concept 52.4 |
| 32. ANS: C | TOP: Concept 54.2 |
| 33. ANS: D | TOP: Concept 54.2 |
| 34. ANS: D | TOP: Concept 54.2 |
| 35. ANS: C | TOP: Concept 54.2 |
| 36. ANS: D | TOP: Concept 54.3 |
| 37. ANS: E | TOP: Concept 54.3 |
| 38. ANS: E | TOP: Concept 10.1 |
| 39. ANS: B | TOP: Concept 10.1 |

40. ANS: A	TOP: Concept 10.1
41. ANS: E	TOP: Concept 9.5
42. ANS: A	TOP: Concept 9.5
43. ANS: C	TOP: Concept 9.5
44. ANS: A	FOP: Concept 9.1
45. ANS: B	TOP: Concept 9.1
46. ANS: E	TOP: Concept 9.1
47. ANS: C	TOP: Concept 9.1
48. ANS: C	TOP: Concept 9.4
49. ANS: E	TOP: Concept 9.4
50. ANS: A	TOP: Concept 9.4
51. ANS: D	TOP: Concept 9.4
52. ANS: A	TOP: Concept 10.2
53. ANS: D	TOP: Concept 10.2
54. ANS: C	TOP: Concept 10.2
55. ANS: A	TOP: Concept 10.2
56. ANS: A	TOP: Concept 26.3
57. ANS: A	TOP: Concept 9.3
58. ANS: C	TOP: Concept 9.3
59. ANS: D	TOP: Concept 9.3
60. ANS: B	TOP: Concept 9.3
61. ANS: D	TOP: Concept 9.4
62. ANS: D	TOP: Concept 9.4
63. ANS: D	TOP: Concept 40.5
64. ANS: D	TOP: Concept 40.5
65. ANS: E	TOP: Concept 40.5
66. ANS: D	TOP: Concept 54.4
67. ANS: C	TOP: Concept 54.4
68. ANS: C	TOP: Concept 3.1
69. ANS: C	TOP: Concept 3.2
70. ANS: D	TOP: Concept 3.2
71. ANS: B	TOP: Concept 3.2
72. ANS: B	TOP: Concept 3.2
73. ANS: A	TOP: Concept 40.1
74. ANS: D	TOP: Concept 40.1