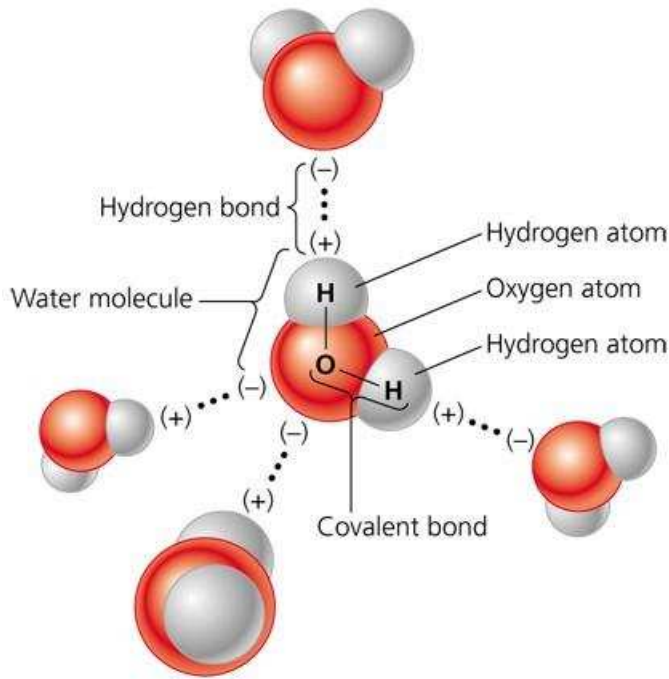


**Environment: Science Behind Stories, 6e (Withgott/Laposata)**  
**Chapter 2 Earth's Physical Systems: Matter, Energy, and Geology**

1 Graph and Figure Interpretation Questions



*Use the accompanying figure to answer the following questions.*

1) Within each water molecule, \_\_\_\_\_ connect(s) two hydrogens to every oxygen.

- A) covalent bonds
- B) magnetic force
- C) hydrogen bonds
- D) isotopes
- E) ionic bonds

Answer: A

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

2) Why are both ends of each water molecule positive and the middle negative?

- A) Electrons are more attracted to oxygen than they are to hydrogen.
- B) Protons are more attracted to oxygen than they are to hydrogen.
- C) Electrons are more attracted to hydrogen than they are to oxygen.
- D) Protons are more attracted to hydrogen than they are to oxygen.
- E) Hydrogen bonds create a charge difference.

Answer: A

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Hydrogen bonds give water which of the following properties?

- A) high pH
- B) low pH
- C) the ability to resist temperature changes
- D) the ability to dissolve lipids
- E) the ability to freeze into ice, which is denser than liquid water

Answer: C

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

4) A hydrogen bond connects \_\_\_\_\_.

- A) a hydrogen atom to an oxygen atom within a water molecule
- B) an oxygen atom in one water molecule to an oxygen atom in another water molecule
- C) a positive region of one water molecule to a negative region of another water molecule
- D) a hydrogen atom to another hydrogen atom
- E) the nuclei of adjacent water molecules

Answer: C

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

## 2 Matching Questions

*Match the following.*

- A) neutrons
- B) electrons
- C) protons
- D) ions
- E) molecules
- F) isotopes
- G) atoms

1) The smallest components of elements that still maintain the chemical properties of the elements

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

2) Negatively charged particles

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Elements with the same atomic number but different atomic masses

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

4) Atoms or molecules with a charge

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

5) Uncharged particles that contribute to an atom's mass number

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

6) Combinations of elements held together with bonds

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

Answers: 1) G 2) B 3) F 4) D 5) A 6) E

### 3 Multiple Choice Questions

1) \_\_\_\_\_ is defined as the number of protons plus the number of neutrons.

- A) Mass number
- B) Ionic number
- C) Atomic number
- D) Isotopic number
- E) Nuclear number

Answer: A

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

2) An atom has 2 electrons, 3 protons, and 3 neutrons. What is the atom's mass number?

- A) 3
- B) 5
- C) 6
- D) 8
- E) Cannot be determined from the information given

Answer: C

Section: 2.1

Bloom's Taxonomy: Application/Analysis

3) An atom has 2 electrons, 3 protons, and 3 neutrons. What is the atom's charge?

- A) +1
- B) -1
- C) +3
- D) -2
- E) +8

Answer: A

Section: 2.1

Bloom's Taxonomy: Application/Analysis

4) \_\_\_\_\_ are composed of amino acids.

- A) Proteins
- B) Nucleic acids
- C) Carbohydrates
- D) Lipids
- E) Bases

Answer: A

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

5) \_\_\_\_\_ are the main water-insoluble components of cell membranes.

- A) Proteins
- B) Nucleic acids
- C) Carbohydrates
- D) Acids
- E) Phospholipids

Answer: E

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

6) Reddish hair in children is often a sign of malnourishment in developing nations such as Haiti. What biomolecule is needed for hair growth and is probably lacking in the diets of these children?

- A) nucleic acids
- B) proteins
- C) carbohydrates
- D) lipids
- E) DNA

Answer: B

Section: 2.1

Bloom's Taxonomy: Application/Analysis

7) Plastics are \_\_\_\_\_.

- A) naturally occurring macromolecules
- B) unstable and break down easily
- C) moldable, petroleum-based hydrocarbons
- D) assembled by enzymes in cells
- E) synthetic proteins

Answer: C

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

8) Which of the following reactions represents cellular respiration?

- A)  $\text{water} + \text{carbon dioxide} + \text{energy} \rightarrow \text{sugar} + \text{oxygen} + \text{water}$
- B)  $\text{sugar} + \text{oxygen} \rightarrow \text{water} + \text{carbon dioxide} + \text{energy}$
- C)  $\text{water} + \text{carbon dioxide} \rightarrow \text{sugar} + \text{oxygen} + \text{water} + \text{energy}$
- D)  $\text{sugar} + \text{carbon dioxide} + \text{energy} \rightarrow \text{water} + \text{oxygen}$
- E)  $\text{nitrogen} + \text{oxygen} + \text{sugar} \rightarrow \text{methane} + \text{carbon dioxide}$

Answer: B

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

9) Which of the following describes a property of pure water?

- A) changes temperature rapidly
- B) molecules are noncohesive
- C) more dense as a solid
- D) acidic pH
- E) can hold many molecules in solution

Answer: E

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

10) Many organisms that undergo chemosynthesis use \_\_\_\_\_ instead of \_\_\_\_\_ to fuel the processes that convert carbon dioxide into sugars.

- A) sunlight; water
- B) hydrogen sulfide (H<sub>2</sub>S); sunlight
- C) sunlight; carbohydrates
- D) energy; sunlight
- E) sunlight; sulfuric acid

Answer: B

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

11) We use \_\_\_\_\_ to catalyze the chemical reactions of digestion.

- A) nucleic acids
- B) polycyclic aromatic hydrocarbons
- C) isotopes
- D) enzymes
- E) alcohol molecules

Answer: D

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

12) What compound is the primary structural constituent of plant tissue, forming the cell walls of stems, leaves, and roots?

- A) chlorophyll
- B) starch
- C) cellulose
- D) enzymes
- E) protein

Answer: C

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

- 13) Which of the following describes mass wasting?
- A) deterioration of an atom because of radioactivity
  - B) the destruction of sedimentary rock by earthquakes
  - C) blockage of sunlight by volcanic ash
  - D) downslope movement of soil and rock due to gravity
  - E) flood damage resulting from a tsunami

Answer: D

Section: 2.4

Bloom's Taxonomy: Knowledge/Comprehension

- 14) River water stored behind a dam is best described as a form of \_\_\_\_\_.

- A) kinetic energy
- B) potential energy
- C) chemical energy
- D) entropy
- E) thermodynamics

Answer: B

Section: 2.2

Bloom's Taxonomy: Application/Analysis

- 15) During photosynthesis within plants, \_\_\_\_\_.

- A) the high-quality energy from sugar is converted to heat and light
- B) sugars and carbon dioxide are produced
- C) carbon dioxide and oxygen are produced
- D) oxygen and carbon dioxide are consumed
- E) water and carbon dioxide are consumed

Answer: E

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

- 16) Cellular respiration \_\_\_\_\_.

- A) releases carbon dioxide and water
- B) results in a net consumption of energy
- C) represents a decrease in entropy
- D) requires the green pigment chlorophyll
- E) involves a net consumption of water

Answer: A

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

17) Undersea earthquakes and volcanic eruptions may produce \_\_\_\_\_.

- A) mudslides
- B) pyroclastic flow
- C) tsunamis
- D) hurricanes
- E) lahars

Answer: C

Section: 2.4

Bloom's Taxonomy: Knowledge/Comprehension

18) Earthquakes result from \_\_\_\_\_.

- A) energy released from movement at plate boundaries and faults
- B) surges of magma from the earth's core
- C) global climate change
- D) separation of layers within sedimentary rock
- E) release of gases from the underlying mantle

Answer: A

Section: 2.4

Bloom's Taxonomy: Knowledge/Comprehension

19) What is the type of rock formed when magma or lava cools?

- A) igneous
- B) sedimentary
- C) lithospheric
- D) metamorphic
- E) geothermal

Answer: A

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

20) Which of the following statements about the rock cycle is TRUE?

- A) Sedimentary rock forms metamorphic and igneous rock via the process of lithification.
- B) The cooling of magma forms metamorphic rock.
- C) Weathering and erosion can cause all three rock types to become sediments.
- D) Sediments form igneous rock via lithification.
- E) Sedimentary rock forms metamorphic rock as it erodes.

Answer: C

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension



- 21) The force driving plate tectonics is \_\_\_\_\_.
- A) solar radiation
  - B) freezing and thawing of water in the earth's crust
  - C) gravity
  - D) nuclear reactions in magma
  - E) heat in the inner layers of the earth

Answer: E

Section: 2.2 and 2.3

Bloom's Taxonomy: Knowledge/Comprehension

- 22) Consider the following processes: respiration, chemosynthesis, combustion of firewood, and photosynthesis. How many of these result in the release of oxygen into the atmosphere?
- A) none
  - B) 1
  - C) 2
  - D) 3
  - E) all 4

Answer: B

Section: 2.2

Bloom's Taxonomy: Application/Analysis

- 23) When you burn a log in your fireplace you are converting \_\_\_\_\_.
- A) chemical to thermal energy
  - B) thermal to electromagnetic energy
  - C) electromagnetic to chemical
  - D) chemical to nuclear energy
  - E) proteins to amino acids

Answer: A

Section: 2.2

Bloom's Taxonomy: Application/Analysis

- 24) \_\_\_\_\_ rock has undergone heat or pressure, causing it to change form.
- A) Conglomerate
  - B) Igneous
  - C) Sedimentary
  - D) Metamorphic
  - E) Deformative

Answer: D

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

25) Geologists have divided the geologic time scale using evidence compiled using stratigraphy, which is the study of \_\_\_\_\_.

- A) layers of igneous rock
- B) layers of sedimentary rock
- C) tree rings
- D) ancient cave drawings
- E) plate tectonics

Answer: B

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

26) What are the three distinct layers of the earth?

- A) core, mantle, crust
- B) mantle, magma, crust
- C) core, mantle, lithosphere
- D) mantle, crust, lithosphere
- E) oceanic crust, continental crust, mantle

Answer: A

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

27) At a \_\_\_\_\_, tectonic plates push apart from one another as magma rises upward to the surface.

- A) subduction fault
- B) transform boundary
- C) strike-slip fault
- D) divergent boundary
- E) convergent boundary

Answer: D

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

28) A solution of pH 5 has \_\_\_\_\_ times \_\_\_\_\_ hydrogen ions than a solution of pH 7.

- A) 20; more
- B) 20; fewer
- C) 100; more
- D) 100; fewer
- E) Cannot be determined from the information given

Answer: C

Section: 2.1

Bloom's Taxonomy: Application/Analysis

29) The "ring of fire" is \_\_\_\_\_.

- A) the underground layer of the earth's crust that is most prone to volcanic activity
- B) the "wing" of the supervolcano found in Yellowstone National Park
- C) the region around the Pacific Ocean most prone to catastrophic wildfires
- D) the most visible, major ring of Saturn
- E) a belt of earthquakes and volcanoes that occur around the Pacific Ocean

Answer: E

Section: 2.4

Bloom's Taxonomy: Knowledge/Comprehension

30) Why was the earthquake that struck Haiti in 2010 so much more deadly than the earthquake that struck Tohoku, Japan, in 2011?

- A) The Tohoku earthquake struck a rural area, whereas the Haiti earthquake centered on the capital city.
- B) The Haiti earthquake was much more powerful than the Tohoku quake.
- C) Japan has a stricter building code.
- D) Buildings in Japan are more rigidly built and less flexible than those in Haiti.
- E) The Haiti earthquake created a tsunami that killed tens of thousands of people.

Answer: C

Section: 2.4

Bloom's Taxonomy: Knowledge/Comprehension

31) You live in the Pacific Northwest and hear a news story about the dangers associated with pyroclastic flow. Which of the following is the news story about?

- A) geysers
- B) mudslides
- C) tsunamis
- D) volcanic eruptions
- E) floods

Answer: D

Section: 2.4

Bloom's Taxonomy: Application/Analysis

32) Approximately 40 grams of the radioisotope iodine-131 were accidentally released into the atmosphere during the Fukushima nuclear accident. The half-life of iodine-131 is 8 days. How long would it take for there to be 10 grams of iodine-131 left in the environment?

- A) 8 days
- B) 12 days
- C) 14 days
- D) 16 days
- E) 23.7 days

Answer: D

Section: 2.1

Bloom's Taxonomy: Application/Analysis

33) All of the following are compounds EXCEPT \_\_\_\_\_.

- A) water
- B) methane
- C) oxygen gas
- D) glucose
- E) table salt

Answer: C

Section: 2.1

Bloom's Taxonomy: Application/Analysis

#### 4 Essay Questions

1) Briefly explain the concept of plate tectonics and why it is important for the study of geography.

Answer: Plate tectonics is "fueled" by heat from Earth's core, which creates convection currents that flow in the mantle, pushing the soft rock upward as it heats up and downward as it cools. As the mantle moves along these giant "conveyor belts," it moves large plates of lithosphere (continental plates) along its surface. Plate tectonics make up the processes that underlie earthquakes and volcanoes, create mountain ranges, and shape shorelines. They determine much of the geography of Earth's surface.

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

2) In what ways are macromolecules essential to life? Describe the structures of three macromolecules, and describe their major role(s) in organisms.

Answer: Macromolecules provide critical components of organismal structure, energy storage and mobilization, and genetic coding, to name just a few of their many roles. Carbohydrates are made of carbon, hydrogen, and oxygen and have the general formula  $CH_2O$ . Carbohydrates are the primary components of plant cell walls and are the preferred energy source for many organisms. Proteins are chains of amino acids that form structural molecules, aid in the function of the immune system, serve as hormones, and act as enzymes, which promote metabolic reactions. Nucleic acids are made of chains of nucleotides (phosphate + sugar + nitrogenous bases). They carry genetic information (genes) that coordinates all organismal functions and passes traits from generation to generation. DNA is a double-stranded form of nucleic acid.

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) What is the first law of thermodynamics, and what are its implications for natural resource management?

Answer: This law says that the total energy and matter in the universe are constant and conserved. This law is important because it says that there is a finite amount of energy on Earth. Humans cannot make new energy or create new mass, and the energy and mass in all chemical reactions are equal between reactants and products (reactants = products). Matter and energy change form in chemical reactions, but they are neither created nor destroyed in those reactions. In terms of our management of resources, especially those that are nonrenewable, it implies that efficient and sustainable use of energy and materials is extremely important since their abundance is limited.

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

4) Compare and discuss the first and second laws of thermodynamics.

Answer: The first law states that energy can change from one form to another but cannot be created or destroyed. The total energy in the universe remains constant. However, the second law states that the universe will change from a more ordered state to a less ordered state. Entropy in the universe is increasing as energy is converted from high to low quality. Organisms must consume energy to maintain structure and keep internal entropy at bay. Low-quality energy from organisms is usually released into the environment as heat. For example, if you had a bowl of oatmeal for breakfast, your digestive systems digests the starch to glucose and your cells then burn the glucose to produce energy to run your body, but most of it is released to the environment as heat. The low-quality exhaust products of this process are carbon dioxide and water, neither of which has any potential energy for you to use. Therefore, you have to keep taking in more chemical energy in food to keep your system running.

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

5) Briefly explain the overall processes of photosynthesis and cellular respiration. Include a brief explanation of autotrophs and heterotrophs in your answer.

Answer: Photosynthesis is performed by autotrophs. In photosynthesis, light energy is converted into chemical energy (stored within the bonds of glucose). Water and carbon dioxide are consumed, and oxygen is released. In most autotrophs, photosynthesis occurs in the chloroplasts. Cellular respiration represents the reverse chemical process. It is performed by both autotrophs and heterotrophs to meet their energy needs. In cellular respiration, oxygen is consumed and the bonds of glucose are broken to release energy, much of which is then used for work within the cell. Along with the energy, carbon dioxide and water are end products, and heat is produced. In most autotrophs and heterotrophs, cellular respiration takes place in organelles called mitochondria.

Section: 2.2

Bloom's Taxonomy: Knowledge/Comprehension

6) Why does chemistry play a central role in our study of environmental issues? Provide an example from the text that illustrates how chemistry helps solve environmental problems.

Answer: Chemistry is the study of matter, including how matter interacts with other matter. An understanding of chemistry is crucial in understanding how gases such as carbon dioxide and methane contribute to global climate change, how pollutants such as sulfur dioxide and nitric oxides cause acid rain, and how pesticides and other artificial compounds we release into the environment affect the health of wildlife and people. Chemistry is also central in understanding water pollution and sewage treatment, atmospheric ozone depletion, hazardous waste and its disposal, and energy issues. An understanding of nuclear chemistry has been crucial in the remediation efforts at the Fukushima Daiichi nuclear power plant to minimize ongoing effects of the radiation released as a result of the nuclear accident in 2011.

Section: 2.1

Bloom's Taxonomy: Synthesis/Evaluation

7) Describe the rock cycle, explaining how the three major types of rock form and break down.

Answer: All rocks can melt. At sufficiently high temperatures, rocks liquefy into magma.

Magma may cool back into rock underground or may be released above ground through a volcano or vent in the form of ash or lava, which may then cool into rock on Earth's surface.

Rock formed from the various types of magma is called igneous rock. Over time, wind, weather, and physical damage can erode rock into gravel, sand, silt, and clay particles. Once rock has been broken down into small components it can be deposited, often in or along water features in layers. Over time, these are compressed into layered rock, called sedimentary rock. This, too, can erode back into smaller fragments. Igneous or sedimentary rock buried underground and exposed to extreme forces of heat or pressure can change form into metamorphic rock, which may be quite different from its original form. This process occurs at temperatures below the melting point of the rock.

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

## 5 Scenario-Based Questions

***Read the following scenario and answer the questions below.***

Many geologists have proposed naming the current time period of Earth's history the Anthropocene epoch. The rationale for doing so includes the fact that erosion rates and greenhouse gas levels in the atmosphere have increased rapidly over the past 300 years. Almost all environmental scientists agree that increases in greenhouse gases contribute to global climate change. Carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons, and water vapor are the main culprits. Human activities, chief among them the extraction and burning of fossil fuels for energy, have significantly increased these "greenhouse gases" in our atmosphere in the last 300 years. With rising standards of living in developing countries, emissions of carbon dioxide and other greenhouse gases are expected to continue to rise. If unchecked, carbon dioxide levels will reach twice preindustrial levels by midcentury and double again by the end of the century. Computer models have shown that this rise alone could raise Earth's temperatures by 3 to 10 degrees Fahrenheit by 2100.

1) Which of the following is the most logical explanation for water being a greenhouse gas?

- A) The ionic bonds holding water vapor together help it trap heat.
- B) Hydrogen-containing compounds trap the most heat, and water contains hydrogen.
- C) Water is a good conductor of electricity, and electricity contains heat.
- D) The hydrogen bonds holding molecules of water vapor together help it trap heat.
- E) Water is acidic, and acids retain heat.

Answer: D

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

2) Besides contributing to global warming, nitrous oxide contributes indirectly to acid precipitation because of \_\_\_\_\_.

- A) its ability to form compounds that raise the pH of rainwater
- B) its ability to form compounds that lower the pH of rainwater
- C) the ability of acids to raise the temperature of the substances which dissolve them
- D) the airborne nature of all compounds containing nitrogen
- E) the hydrogen bonds connecting the nitrogen and oxygen atoms in the molecule

Answer: B

Section: 2.1

Bloom's Taxonomy: Application/Analysis

3) Overpopulation contributes to global warming when \_\_\_\_\_.

- A) most of the population is vegetarian
- B) it leads to deforestation, increased agriculture, and increased use of fossil fuels
- C) we compromise our living standards in order to protect the environment
- D) most people use public transportation
- E) solar energy is used as the primary source of energy, since it is a renewable resource

Answer: B

Section: 2.1

Bloom's Taxonomy: Knowledge/Comprehension

4) The primary source of increased levels of greenhouse gases on Earth is \_\_\_\_\_.

- A) increased photosynthetic activity
- B) loss of heterotrophs
- C) modern human lifestyles
- D) aerosol spray cans
- E) asteroids falling to Earth

Answer: C

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

5) Climatic change is a major concern for environmentalists because it can directly lead to \_\_\_\_\_.

- A) an increase in the diameter of the ozone hole
- B) more biodiversity on Earth
- C) an decrease in the amount of geothermal energy
- D) a decrease in the amount of photosynthesis on Earth
- E) extinctions

Answer: E

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

6) How does burning fossil fuels contribute to global warming?

- A) Fossils, if left untouched, cool Earth.
- B) New energy is created on Earth when fossil fuels are burned.
- C) Burning fossil fuels creates increased plate tectonic movement.
- D) Carbon present in coal, oil, and natural gas becomes carbon dioxide when these fuels burn.
- E) Burning fossil fuels removes water vapor from the atmosphere.

Answer: D

Section: 2.3

Bloom's Taxonomy: Knowledge/Comprehension

7) Preindustrial levels of atmospheric carbon dioxide have been estimated to be approximately 275 ppm (parts per million). If unchecked, carbon dioxide levels are expected to reach \_\_\_\_\_ ppm by the year 2100.

- A) 550
- B) 775
- C) 1100
- D) 2750
- E) 825

Answer: C

Section: 2.3

Bloom's Taxonomy: Application/Analysis