Principles of Biology 2nd edition Brooker Test Bank

SKU: 9781259875120-TEST-BANK

Principles of Biology, 2e, (Brooker)
Chapter 2 The Chemical Basis of Life I: Atoms, Molecules, and Water

1) The atomic number of an atom is
A) the number of protons in the atom.
B) the number of neutrons in the atom.
C) the number of protons and electrons in the atom.
D) the number of protons and neutrons in the atom.
E) None of these choices are correct.

Answer: A
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.01 Describe the general structure of atoms.
Section: 02.01
Gradable: automatic

2) The smallest functional unit and associated structures of a living organism are
A) atoms and their protons, neutrons, and electrons.
B) molecules and their atoms, bonds, and electrons.
C) proteins and amino acids.
D) cells with nucleus, mitochondria, and ER.
E) water made of hydrogen and oxygen.

Answer: A
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.01 Describe the general structure of atoms.
Section: 02.01
Gradable: automatic

3) With an atomic mass of 16 and an atomic number of 8, it follows that oxygen
A) has eight electrons.
B) has 16 neutrons.
C) can readily form bonds with 2 other atoms.
D) weighs 16 grams.

Answer: A, C
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.03 Relate atomic structure to the periodic table of the elements.
Section: 02.01
Gradable: automatic

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4) The nucleus of an atom is composed of
A) protons.
B) neutrons.
C) electrons.
D) protons and neutrons.
E) protons and electrons.

Answer: D
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.01 Describe the general structure of atoms.
Section: 02.01
Gradable: automatic

5) The first, innermost energy shell of an atom
A) can have a maximum of 8 electrons.
B) can have a maximum of 2 electrons.
C) is called the 2p orbital.
D) is called the 1s orbital and can have a maximum of 8 electrons.
E) is called the 2p orbital and can have a maximum of 2 electrons.

Answer: B
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.02 Define orbital and electron shell.
Section: 02.01
Gradable: automatic

6) Tritiated hydrogen (^{3}H) differs from hydrogen (^{1}H) in that
A) ^{3}H has 2 more protons than ^{1}H.
B) ^{3}H has 2 more electrons than ^{1}H.
C) ^{3}H has 2 more neutrons than ^{1}H.
D) ^{3}H has the same number of neutrons as ^{1}H.
E) ^{3}H has a different electron configuration than ^{1}H.

Answer: C
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.05 Explain how a single element may exist in two or more forms, called isotopes.
Section: 02.01
Gradable: automatic

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7) Isotopes are different forms of the same element that
A) differ in their number of neutrons.
B) differ in their number of protons.
C) are all produced artificially.
D) cannot form covalent bonds.
E) cannot form ions.

Answer: A
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.05 Explain how a single element may exist in two or more forms, called isotopes.
Section: 02.01
Gradable: automatic

8) The most abundant element in living organisms is
A) calcium.
B) iron.
C) iodine.
D) hydrogen.
E) sodium.

Answer: D
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.06 List the elements that make up most of the mass of all living organisms.
Section: 02.01
Gradable: automatic

9) Nitrogen has 7 electrons and can form a maximum of _____ bonds with other elements.
A) 1
B) 2
C) 3
D) 4
E) 5

Answer: C
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

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10) Molecules
A) are derived from the ionic bonding of two or more atoms.
B) have the same physical properties as the atoms from which they were derived.
C) are not important in biological processes.
D) can form from the covalent bonding of two or more atoms.
E) cannot have a charge.

Answer: D
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

11) Carbon has 4 electrons and hydrogen has 1 electron in its outermost electron shell. A carbon atom can form covalent bonds with how many hydrogen atoms?
A) 0.
B) 1.
C) 2.
D) 3.
E) 4.

Answer: E

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about covalent bonds with carbon.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of covalent bonds to predict how many can form.

Gather Content

• *What do you know about covalent bonds? What other information is related to the question?*
  o Covalent bonds form by sharing a pair of electrons between two atoms.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o Carbon has four unpaired electrons, and each of these can pair with an electron from a hydrogen atom. So carbon can form covalent bonds with four hydrogen atoms.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your understanding of covalent bonds. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that the carbon atoms would pair with each other and not form covalent bonds with hydrogen? Did you think that each hydrogen could form more than one bond with carbon?
Bloom's: 3. Apply
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

12) When one atom loses an electron to another atom, it results in the formation of
A) a polar covalent bond and a new molecule.
B) cations and anions that can form ionic bonds.
C) a covalent bond between the two.
D) many hydrogen bonds.
E) a nonpolar covalent bond that is difficult to break.

Answer: B
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

13) The strongest chemical bonds are
A) hydrogen bonds.
B) Van der Waal forces.
C) hydrophobic interactions.
D) ionic bonds.
E) covalent bonds.

Answer: E
Bloom's: 1. Remember
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

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14) What type of bonding is likely to occur between two water molecules or strands of DNA?
A) covalent
B) ionic
C) hydrogen
D) both hydrogen and covalent
E) both hydrogen and ionic

Answer: C
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

15) Carbon and hydrogen have similar electronegativities and combine together to form hydrocarbon molecules. What type of bonds form between these atoms?
A) hydrogen
B) ionic
C) polar covalent
D) nonpolar covalent
E) electrostatic

Answer: D
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

16) What type of bonds form from the unequal sharing of electrons?
A) hydrogen
B) ionic
C) polar covalent
D) nonpolar covalent
E) electrostatic

Answer: C
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

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17) In water, $MgCl_2$ dissociates into Mg^{2+} and Cl^-. Based on this information what type of bond is involved in the formation of $MgCl_2$?
A) hydrogen
B) ionic
C) polar covalent
D) nonpolar covalent
E) electrostatic

Answer: B
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

18) When one oxygen atom shares two pairs of electrons with another oxygen atom, O_2 is formed via a(n)
A) single covalent bond.
B) double covalent bond.
C) triple covalent bond.
D) ionic bond.
E) hydrogen bond.

Answer: B
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

19) The LEAST hydrophilic substance is
A) salt.
B) an ion.
C) oil.
D) an amphipathic molecule.
E) a gas.

Answer: C
Bloom's: 2. Understand
Topic: Properties of Water
Learning Outcome: 02.04.02 Compare and contrast hydrophilic and hydrophobic substances.
Section: 02.04
Gradable: automatic

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20) For water to vaporize
A) energy must be supplied.
B) energy must be released.
C) hydrogen bonds are broken.
D) both energy must be supplied and hydrogen bonds broken.
E) both energy must be released and hydrogen bonds broken.

Answer: D
Bloom's: 2. Understand
Topic: Properties of Water
Learning Outcome: 02.04.04 Describe the three states of H2O.
Section: 02.04
Gradable: automatic

21) The molarity of a solution is
A) a measure of solute concentration.
B) the weight of a solid substance.
C) often expressed as grams per unit volume.
D) reflects a measure of the amount of oil dissolved in water.
E) a scientific term for determining the solubility of a substance in water.

Answer: A
Bloom's: 1. Remember
Topic: Properties of Water
Learning Outcome: 02.04.03 SciSkills: Calculate the molarity of a solution, and explain its meaning.
Section: 02.04
Gradable: automatic

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22) Based on the properties of water, what would happen if one were to add a solute to water?
A) The freezing point of water would decrease.
B) The freezing point of water would increase.
C) The boiling point of water would increase.
D) Both the freezing point of water would decrease and the boiling point of water would increase.
E) Nothing would change with respect to the freezing point or boiling point of water.

Answer: D

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about the effect of a solute on the freezing and boiling points of water.
• *What type of thinking is required?*
o You are being asked to apply your knowledge to predict the effect of a solute on the freezing and boiling points of water.

Gather Content

• *What do you know about the effect of a solute on the freezing and boiling points of water? What other information is related to the question?*
o Adding a solute, such as a salt, to water causes the water molecules to orient themselves around the salt molecules which makes it harder to move them into a vapor. Salt also disrupts the hydrogen bonds in water preventing them from forming ice crystals.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o Adding salt to water makes it more difficult for water molecules to go into a vapor state. So more heat needs to be added to cause water to boil, raising the boiling point. Adding salt to water interferes with the formation of hydrogen bonds between water molecules which makes it harder for ice crystals to form. As a result the temperature needed for freezing is lowered.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*

o This question asked you to apply your understanding of the properties of water to predict the effect on the boiling and freezing points of water. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you know that salt would cause water molecules to bind to the salt? Did you realize that salt would interfere with the formation of ice cyrstals?

Bloom's: 3. Apply
Topic: Properties of Water
Learning Outcome: 02.04.04 Describe the three states of H2O.
Section: 02.04
Gradable: automatic

23) Water
A) is nonpolar.
B) has a low heat of vaporization.
C) has cohesive properties.
D) evaporates and increases body temperature.
E) is a relatively poor solvent.

Answer: C
Bloom's: 2. Understand
Topic: Properties of Water
Learning Outcome: 02.04.04 Make a list of the roles of water that are critical for the survival of living organisms.
Section: 02.04
Gradable: automatic

24) If orange juice has a pH of 4 then it can be described as
A) having a H^+ concentration is 4.
B) an acidic solution.
C) an alkaline solution.
D) an acidic solution with a H^+ concentration of 4.
E) None of these choices are correct.

Answer: B
Bloom's: 2. Understand
Topic: pH and Buffers
Learning Outcome: 02.05.01 SciSkills: Explain how H2O has the ability to ionize into hydroxide ions (OH−) and hydrogen ions (H), and calculate the concentration of hydrogen and hydroxide ions at a given pH.
Section: 02.05
Gradable: automatic

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25) A significant role played by pH buffers is to
A) prevent fluctuations in the acidity of solutions.
B) increase the strength of acids and bases.
C) prevent fluctuations in the salinity of solutions.
D) limit major shifts in the amount of H^+ and OH^- in solution.
E) keep pH low.

Answer: D
Bloom's: 2. Understand
Topic: pH and Buffers
Learning Outcome: 02.05.02 Give examples of how buffers maintain a stable environment in an animal's body fluids.
Section: 02.05
Gradable: automatic

26) An example of one of the ways a pH buffer helps to maintain homeostasis is to
A) increase the H^+ concentration if pH decreases.
B) reduce the H^+ concentration if pH decreases.
C) reduce the H^+ concentration if pH increases.
D) increase the OH^- concentration if pH increases.
E) reduce the OH^- concentration if pH decreases.

Answer: B

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about buffers.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of buffers to predict how one would respond to a change in pH.

Gather Content

• *What do you know about buffers? What other information is related to the question?*
  o Buffers keep pH relatively constant by increasing either the H+ or OH- concentration. pH is inversely related to the acidity, so the higher the H+ concentration, the lower the pH. If pH decreases then either the H+ concentration can be reduced or the OH- concentration increased. If pH increases then either the H+ concentration can be increased or the OH- concentration reduced.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o Of the answers the only one that is consistent is that if the pH decreases then the amount of H+ ions should be reduced.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*

o This question asked you to apply your understanding of buffers to explain what would happen if the pH changed. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall that as pH goes down the H+ ion concentration goes up? Did you realize that the buffer would be countering the direction the pH was changing?

Bloom's: 3. Apply
Topic: pH and Buffers
Learning Outcome: 02.05.02 Give examples of how buffers maintain a stable environment in an animal's body fluids.
Section: 02.05
Gradable: automatic

27) The addition of a strong acid like HCl to an aqueous solution would result in
A) the release of H^+ into the solution.
B) an increase in pH.
C) a decrease in pH.
D) both the release of H^+ and an increase in pH.
E) both the release of H^+ and a decrease in pH.

Answer: E
Bloom's: 2. Understand
Topic: pH and Buffers
Learning Outcome: 02.05.01 SciSkills: Explain how H2O has the ability to ionize into hydroxide ions (OH−) and hydrogen ions (H), and calculate the concentration of hydrogen and hydroxide ions at a given pH.
Section: 02.05
Gradable: automatic

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28) One gram of hydrogen, which has an atomic mass of 1, would have fewer atoms than 1 gram of carbon that has an atomic mass of 12.

Answer: FALSE
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about the number of atoms in different masses.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of atomic mass.

Gather Content

• *What do you know about atomic mass to calculate the number of atoms? What other information is related to the question?*
  o Hydrogen has an atomic mass of 1 gram/mole while carbon has an atomic mass of 12 grams/mole. Each mole has the same number of atoms. So we can compare the numbers of moles in each sample to see if they have the same numbers of atoms.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o Since we have 1 gram of each sample simply divide the 1 gram by the atomic mass to see how many moles of each are in the sample. For hydrogen this is 1 gram/ 1gram/mole = 1 mole. For hydrogen this is 1 gram/ 12grams/mole = 1/12 mole. So the hydrogen sample will contain 12 times as many atoms as the carbon sample.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
  o This question asked you to apply the definition of atomic mass and moles to calculate the relative numbers of atoms in a sample. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that 1 gram of each sample meant the samples had the same number of atoms? Did you think that with an atomic mass of 12, the carbon samples would have more atoms per gram instead of fewer?

Bloom's: 3. Apply
Topic: Atoms
Learning Outcome: 02.01.04 SciSkills: Quantify atomic mass using units such as daltons and moles.
Section: 02.01
Gradable: automatic

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29) Isotopes are different forms of the same element.

Answer: TRUE
Bloom's: 1. Remember
Topic: Atoms
Learning Outcome: 02.01.05 Explain how a single element may exist in two or more forms, called isotopes.
Section: 02.01
Gradable: automatic

30) Sulfur 35 (^{35}S) is an isotope of ^{32}S. These elements differ in their number of neutrons.

Answer: TRUE
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.05 Explain how a single element may exist in two or more forms, called isotopes.
Section: 02.01
Gradable: automatic

31) Helium is an inert gas that rarely reacts with other elements because it has the maximum number of valence electrons in its outer shell.

Answer: TRUE
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.03 Relate atomic structure to the periodic table of the elements.
Section: 02.01
Gradable: automatic

32) If lithium has an atomic number of 3 then it will have 1 valence electron.

Answer: TRUE
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.02 Define orbital and electron shell.
Section: 02.01
Gradable: automatic

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33) The electronegativity of an atom is a measure of its ability to attract electrons to its outer shell from another atom.

Answer: TRUE
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

34) Table salt forms from sodium and chloride via hydrogen bonding.

Answer: FALSE
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

35) Molecules are generally rigid structures and rarely change shape.

Answer: FALSE
Bloom's: 2. Understand
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.03 Describe how a molecule's shape is important for its ability to interact with other molecules.
Section: 02.02
Gradable: automatic

36) A dehydration reaction that builds larger molecules from smaller units requires the addition of a water molecule.

Answer: FALSE
Bloom's: 2. Understand
Topic: Properties of Water
Learning Outcome: 02.04.04 Make a list of the roles of water that are critical for the survival of living organisms.
Section: 02.04
Gradable: automatic

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37) The hydroxyl (OH^-) concentration of a solution with a pH of 8 would be 10^{-6} molar.

Answer: TRUE
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about pH.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of pH to calculate OH- concentration.

Gather Content

• *What do you know about pH? What other information is related to the question?*
  o pH is equal to –log[H+]. So a sample with a pH of 8 would have a H+ concentration of 10-8 molar. Pure water is pH 7, and the concentration of both H+ and OH- are equal at concentration of 10-7 molar. As the H+ concentration decreases the OH- concentration will increase proportionally.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o The H+ concentration of H+ has decreased 10-fold from 10-7 molar in pure water to 10-8 molar. In response the OH- concentration will increase 10-fold from 10-7 molar in pure water to 10-6 molar.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
  o This question asked you to apply your understanding of pH to calculate the OH- concentration. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did think that as pH increases the H+ concentration increases? Did you think that as the H+ concentration increases the OH- concentration also increases? Did you realize that 10-7 molar is less than 10-6 molar?

Bloom's: 3. Apply
Topic: pH and Buffers
Learning Outcome: 02.05.01 SciSkills: Explain how H2O has the ability to ionize into hydroxide ions (OH−) and hydrogen ions (H), and calculate the concentration of hydrogen and hydroxide ions at a given pH.
Section: 02.05
Gradable: automatic

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38) Most enzymes or bioactive molecules work effectively within a broad range of pH.

Answer: FALSE
Bloom's: 2. Understand
Topic: pH and Buffers
Learning Outcome: 02.05.02 Give examples of how buffers maintain a stable environment in an animal's body fluids.
Section: 02.05
Gradable: automatic

39) You notice that the majority of the electrons in NaCl spend their time around the chlorine. You also notice that the electrons in H_2 are evenly distributed among the two atoms. Which two types of bonds are represented in these molecules?
A) Covalent bonds in NaCl; ionic bonds in H_2.
B) Covalent bonds in NaCl; covalent bonds in H_2.
C) Ionic bonds in NaCl; ionic bonds in H_2.
D) Ionic bonds in NaCl; covalent bonds in H_2.

Answer: D

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about different types of bonds.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of covalent and ionic bonds to a specific example.

Gather Content

• *What do you know about covalent and ionic bonds? What other information is related to the question?*
  o In covalent bonds two atoms share a pair of electrons. In an ionic bond one atom has a positive charge and has lost an electron, the other atom has a negative charge and has gained an electron.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o Because electrons spend more time around Cl than Na, the Cl has a negative charge and the Na has a positive charge. These two ions then form an ionic bond. The two hydrogen atoms have the same pull on electrons and share them to form a covalent bond.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply to your understanding of different types of bonds to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that electrons were equally shared in an ionic bond? Did you think that if one atom had more pull on electrons than another atom this would form a covalent bond?
Bloom's: 3. Apply
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

40) A bottle of Na in solution and a bottle of Cl in solution are mixed together and the water evaporated. What type of bond will be created between the atoms, and what will be the product?
A) Covalent bonds; sodium chlorine.
B) Ionic bonds; table salt.
C) Hydrogen bonds; sodium hydroxide.
D) Carbon bonds; carboxyl groups.

Answer: B
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about NaCl.
• *What type of thinking is required?*
o You are being asked to apply your knowledge of different bonds to predict what bonds NaCl would form.

Gather Content

• *What do you know about NaCl? What other information is related to the question?*
o In solution Na would be positively charged and Cl would be negatively charged. As the water is removed the Na and Cl ions will be attracted to each other forming ionic bonds.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o Na+ and Cl- form ionic bonds with each other. The common name for these NaCl crystals is table salt.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your understanding of chemical bonds to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that Na or Cl would form hydrogen or covalent bonds with each other? Did you realize that NaCl is table salt?

Bloom's: 3. Apply
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.02 Explain the concept of electronegativity and how it contributes to the formation of polar and nonpolar covalent bonds.
Section: 02.02
Gradable: automatic

41) You've been asked to stabilize a compound whose general state is altered by excess electrons. The element you would add to the compound to most effectively stabilize the compound would be? Why?
A) Carbon, because it is capable of neutralizing electrons.
B) Nitrogen, because it have five electrons on its outer shell.
C) Fluorine, because it is has seven electrons in its outer shell.
D) Oxygen, because it can easily bind with the compound.

Answer: C

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about stable outer shells of electrons.
• *What type of thinking is required?*
o You are being asked to apply your knowledge of stable outer shells to a specific example.

Gather Content

• *What do you know about outer shells of electrons? What other information is related to the question?*
o An atom is most stable with a full outer shell of electrons. If you have a molecule with excess electrons then adding atoms that can accept these electrons would help to stabilize the molecule. An atom with 7 electrons in the outer shell would become more stable by gaining one electron and having a full outer shell.

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Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o Among the choices fluorine has 7 valence electrons in its outer shell. By gaining one one electron it becomes more stable.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your knowledge of stable outer shells to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that an atom like carbon could neutralize an electron? Did you realize that an atom that could gain an electron would stabilize the molecule?
Bloom's: 3. Apply
Topic: Chemical Bonds and Molecules
Learning Outcome: 02.02.01 Compare and contrast the types of atomic interactions that lead to the formation of molecules.
Section: 02.02
Gradable: automatic

42) Five unknown compounds are added to water. Four of the compounds go into solution while one does not. What property does water possess that allows these four compounds to dissolve? Why might the fifth compound not dissolve?
A) The positive and negative charge in water will dissolve many substances; the substance is not structurally similar to water.
B) The negative charge of water dissolves many substances; the substance is too structurally similar to water.
C) The positive charge of water dissolves many substances; the substance is too structurally similar to water.
D) The nonpolar quality of water dissolves many substances; the substance is not structurally similar to water.

Answer: A

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about solubility in water.
• *What type of thinking is required?*
o You are being asked to apply your knowledge of solubility in water to specific examples.

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Gather Content

• *What do you know about solubility in water? What other information is related to the question?*
o Water is a polar molecule with partial positive and negative charges, this allows many charged and polar molecules to dissolve in water. Water can also form hydrogen bonds, so other molecules with structures similar to water can form hydrogen bonds with water and dissolve more easily.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o The partial charges on water allow many substances to dissolve in water. If something does not dissolve in water, it is probably nonpolar and uncharged.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your knowledge of solubility in water to specific examples. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that water was nonpolar? Did you think that water only has positive or negative charges? Did you think that molecules with structures different from water dissolve well in water?
Bloom's: 3. Apply
Topic: Properties of Water
Learning Outcome: 02.04.04 Make a list of the roles of water that are critical for the survival of living organisms.
Section: 02.04
Gradable: automatic

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43) 1 mole = 1000 millimoles (mmol); 1 millimole = 1000 micromoles (µmol). If a solution contains 38231 µmol, what is that amount in mmol?
A) 382.31 mmol.
B) 38.231 mmol.
C) 3.8231 mmol.
D) 3823.1 mmol.

Answer: B
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about conversion from micromole to millimole.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of metric conversions.

Gather Content

• *What do you know about metric conversions? What other information is related to the question?*
  o Micro- is 1/1000th of milli, so to convert from micromoles to millimoles simply divide by 1000.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o 38231 micromoles divided by 1000 = 38.231 millimoles.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
  o This question asked you to apply metric conversions. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall that micro is 1/1000th of milli, so you need to divide by 1000?
Bloom's: 3. Apply
Topic: Atoms
Learning Outcome: 02.01.04 SciSkills: Quantify atomic mass using units such as daltons and moles.
Section: 02.01
Gradable: automatic

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44) If 1000 millimoles make up a mole, how many grams of magnesium (Mg), which has an atomic mass of 24.305, will make a solution that contains 150 µmol of Mg?
A) 3.6mg.
B) 2.4mg.
C) 0.24mg.
D) 36mg.

Answer: A
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about molecular weights.
• *What type of thinking is required?*
o You are being asked to apply your knowledge of molecular weight to convert from grams to moles.

Gather Content

• *What do you know about molecular weight? What other information is related to the question?*
o Molecular weight has units of grams/mole. Using metric conversions this can be rewritten as mg/mmole. Metric units change by 1000-fold. So there are 1000 micrograms in 1 milligram, and 1000 milligrams in 1 gram.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o 150. µmol = 0.15 mmole. The atomic mass of Mg is about 24 gm/mole = 24 mg/mmole.
o 0.15 mmole x 24 mg/mmole = 3.6 mg.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply metric conversions. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that 1 µmol was 1/10th of a millimole? Could you use the molecular weight to convert from mg to mmoles?

Bloom's: 3. Apply
Topic: Atoms
Learning Outcome: 02.01.04 SciSkills: Quantify atomic mass using units such as daltons and moles.
Section: 02.01
Gradable: automatic

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45) Using the periodic table as a tool, identify the atomic characteristic that would most quickly and efficiently identify any single element.
A) number of shells
B) number of neutrons
C) number of protons and electrons
D) number of neutrons and electrons

Answer: C
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.03 Relate atomic structure to the periodic table of the elements.
Section: 02.01
Gradable: automatic

46) In the periodic table, the value that refers to the number of protons and neutrons is
A) atomic mass.
B) molecular molarity.
C) atomic molarity.
D) molecular number.

Answer: A
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.03 Relate atomic structure to the periodic table of the elements.
Section: 02.01
Gradable: automatic

47) You have been asked to synthesize a new isotope for cadmium. Which part of the original atom would you need to manipulate in order to create an isotope?
A) Neutrons
B) Protons
C) Protons and neutrons
D) Electrons

Answer: A
Bloom's: 2. Understand
Topic: Atoms
Learning Outcome: 02.01.05 Explain how a single element may exist in two or more forms, called isotopes.
Section: 02.01
Gradable: automatic

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48) The single atom you would choose to remove from living organisms in order to remove the highest percentage of atoms would be:
A) Oxygen.
B) Nitrogen.
C) Hydrogen.
D) Carbon.

Answer: C

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about the most common atom in biological molecules.
• What type of thinking is required?
o You are being asked to apply your knowledge of biological molecules to predict the most common atom.

Gather Content

• *What do you know about the most common element in biological molecules? What other information is related to the question?*
o The backbone of biological molecules is carbon. Oxygen and nitrogen are common atoms attached to this backbone.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o The most abundant atom is hydrogen, it is attached to carbon, oxygen and nitrogen in biological molecules.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your understanding of biological molecules to identify the most common element. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that carbon was more common than hydrogen because it is the backbone of organic molecules? Did you think that oxygen or nitrogen were more abundant because their mass is larger?
Bloom's: 3. Apply
Topic: Atoms
Learning Outcome: 02.01.06 List the elements that make up most of the mass of all living organisms.
Section: 02.01
Gradable: automatic

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49) Water has fewer hydrogen atoms than lemon juice and a pH of around 7. Predict what will happen to the pH level of water when lemon juice is added.
A) The pH will become higher.
B) The pH will become lower.
C) The pH will remain the same.
D) There is not enough information to decide.

Answer: B
Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
o The question asks about how adding an acid to water will affect pH.
• *What type of thinking is required?*
o You are being asked to apply your knowledge of acids on pH.

Gather Content

• *What do you know about pH? What other information is related to the question?*
o pH is inversely related to acid concentration. If lemon juice has more hydrogen ions than water, it would have a lower pH.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
o Adding lemon juice to water would add more hydrogen ions and would lower the pH.

Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*
o This question asked you to apply your understanding of pH. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that increasing hydrogen ions in water would increase pH? Did you think that lower hydrogen ions meant a lower pH?

Bloom's: 3. Apply
Topic: pH and Buffers
Learning Outcome: 02.05.01 SciSkills: Explain how H2O has the ability to ionize into hydroxide ions (OH−) and hydrogen ions (H), and calculate the concentration of hydrogen and hydroxide ions at a given pH.
Section: 02.05
Gradable: automatic

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50) Select the statement that is true when comparing solutions with a pH of 6 and a pH of 8.
A) The solution with a pH of 8 has a 100 times higher concentration of hydrogen ions than a solution with a pH of 6.
B) The solutions with a pH of 8 has a 2 times lower concentration of hydrogen ions than a solution with a pH of 6.
C) The solution with a pH of 6 has a 100 times higher concentration of hydrogen ions than a solution with a pH of 8.
D) The solution with a pH of 6 has a 100 times lower concentration of hydrogen ions than a solution with a pH of 8.
E) The solution with a pH of 6 has a 2 times higher concentration of hydrogen ions than a solution with a pH of 8.

Answer: C

Explanation: **Clarify Question**

• *What is the key concept addressed by the question?*
  o The question asks about pH.
• *What type of thinking is required?*
  o You are being asked to apply your knowledge of pH to a specific example.

Gather Content

• *What do you know about pH? What other information is related to the question?*
  o pH is the –log[H+]. So a decrease in pH of 1 is equal to a 10-fold increase in hydrogen ion concentration.

Choose Answer

• *Given what you now know, what information is most likely to produce the correct answer?*
  o A solution with a pH of 6 is more acidic than a solution with a pH of 8. Because the difference is 2 pH units, this is 10x10 = 102 = 100-fold more hydrogen ions in the pH 6 solution.

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Reflect on Process

• *Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?*

o This question asked you to apply your understanding of pH to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that a lower pH corresponded to a lower hydrogen ion concentration? Did you think that each change in pH was not a 10-fold change in hydrogen ion concentration?
Bloom's: 3. Apply
Topic: pH and Buffers
Learning Outcome: 02.05.01 SciSkills: Explain how H2O has the ability to ionize into hydroxide ions (OH−) and hydrogen ions (H), and calculate the concentration of hydrogen and hydroxide ions at a given pH.
Section: 02.05
Gradable: automatic

51) During photosynthesis the reactants, carbon dioxide and water, can become glucose and oxygen. Glucose and oxygen can also be reactants to form water and carbon dioxide. If the two reactions are working at a constant rate this would form a
A) chemical equilibrium.
B) constant polarity.
C) universal balance.
D) homeostasis.

Answer: A
Bloom's: 2. Understand
Topic: Chemical Reactions
Learning Outcome: 02.03.01 Relate the concept of a chemical reaction to the concept of chemical equilibrium.
Section: 02.03
Gradable: automatic

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52) How do the detergents found in dish soap help clean cooking oils off of dirty dishes?
A) Detergents change the chemical structure of oils to make them hydrophilic.
B) The hydrophilic portion of a detergent molecule interacts with the oil to increase solubility.
C) Oil dissolves in the hydrophobic center of a sphere formed by many detergent molecules.
D) Both water and oil dissolve in the detergent because it has both hydrophilic and hydrophobic regions.

Answer: C
Explanation: Detergents are amphipathic. When placed in water, detergents form micelles (spheres) with the hydrophilic region on the outside and the hydrophobic region on the inside. Oils can dissolve in the hydrophobic interior of micelles.
Bloom's: 2. Understand
Topic: Properties of Water
Learning Outcome: 02.04.02 Compare and contrast hydrophilic and hydrophobic substances.
Section: 02.04
Gradable: automatic

53) When table salt dissolves in water, the salt is called the solute.

Answer: TRUE
Bloom's: 1. Remember
Topic: Properties of Water
Learning Outcome: 02.04.01 Define solute and solvent.
Section: 02.04
Gradable: automatic

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