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Chapter 02
The Nature of Molecules and the Properties of Water

Multiple Choice Questions

1. Matter is composed of:
A. molecules
B. mass
C. energy
D. atoms

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

2. All atoms possess the ability to do work. The term that is defined as the ability to do work is:
A. matter
B. energy
C. molecules
D. space

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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3. The number of protons in a given atom is equal to its:
A. neutron number
B. mass
C. atomic number
D. molecular number

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

4. Isotopes that are unstable and decay when their nucleus breaks up into elements with lower atomic numbers, emitting significant amounts of energy in the process, are called:
A. energetic
B. ionic
C. radioactive
D. isometric

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

5. Atoms containing a specific number of protons are called:
A. molecules
B. minerals
C. metals
D. elements

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.02.01 Relate atomic structure to the periodic table of the elements.
Section: 02.02
Topic: Elements Found in Living Systems

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6. Sugars dissolve well in water because of water's _____.
A. polarity
B. ionic bonds
C. hydrophobic exclusion
D. cohesiveness

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.03.03 Contrast polar and nonpolar covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

7. The negative logarithm of the hydrogen ion concentration in the solution is referred to as:
A. pH
B. atomic mass
C. -OH concentration
D. electronegativity
E. specific heat

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.06.01 Define acids, bases, and the pH scale.
Section: 02.06
Topic: Acids and Bases

8. Bicarbonate ions in the blood can absorb hydrogen ions, keeping pH balanced. Bicarbonate is acting as a ____ in blood.
A. acid
B. alkaline
C. buffer
D. base

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.06.01 Define acids, bases, and the pH scale.
Section: 02.06
Topic: Acids and Bases

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9. Atomic nuclei contain protons and _____.
A. moles
B. neutrons
C. isomers
D. ions

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

10. Carbon-12, Carbon-13 and Carbon-14 are examples of:
A. ions
B. isomers
C. molecules
D. isotopes

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

11. Organisms are composed of molecules, which are collections of smaller units, termed:
A. monomers.
B. atoms.
C. electrons.
D. polymers.
E. ions.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

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12. Negatively charged subatomic particles that have almost no mass are called:
A. electrons.
B. protons.
C. neutrons.
D. ions.
E. polymers.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

13. Atoms of a single element that possess different numbers of neutrons are called:
A. isomers.
B. polymers.
C. ions.
D. isotopes.
E. monomers.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

14. $Cl + e^- \rightarrow Cl^-$ is an example of a:
A. polymerization.
B. ionization.
C. reduction.
D. oxidation.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

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15. When atoms gain or lose electrons, they become negatively or positively charged. These negatively or positively charged atoms are known as
A. isotopes.
B. ions.
C. isomers.
D. unstable atoms.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.03.01 Predict which elements are likely to form ions.
Section: 02.03
Topic: The Nature of Chemical Bonds

16. When two atoms share a pair of electrons, the bonding is referred to as:
A. ionic.
B. covalent.
C. unstable.
D. hydrogen.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.03.02 Explain how molecules can be built from atoms joined by covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

17. Water molecules are polar with ends that exhibit partial positive and negative charges. These opposite charges allow water molecules to attract each other through:
A. ionic bonds.
B. covalent bonds.
C. hydrogen bonds.
D. peptide bonds.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.04.01 Relate how the structure of water leads to hydrogen bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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18. An atom has 20 electrons and 20 neutrons. What is the mass of this atom?
A. 10
B. 20
C. 40
D. 80

Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about calculating the mass of an atom.
• ***What type of thinking is required?*** You are being asked to apply the definition of atomic mass to calculate an atomic mass.

• ***What key words does the question contain and what do they mean?***
o Atomic mass is the sum of the masses of protons and neutrons in an atom. We assume the mass of electrons is so small it doesn't contribute to total mass.

Gather Content

• ***What do you know about atomic mass? How does it relate to the question?***
o The masses of a proton and of a neutron are both 1.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o There are 20 protons and 20 neutrons each with a mass of 1 in this atom.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o 20 protons + 20 neutrons = an atomic mass of 40..

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 to calculate an atomic mass. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you confuse atomic number (the number of protons alone) with the atomic mass (the sum of protons and neutrons)?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.02.01 Relate atomic structure to the periodic table of the elements.
Section: 02.02
Topic: Elements Found in Living Systems

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19. Sue was monitoring the oil spill into the Gulf of Mexico from an oil tanker. From her observations, she noted that the oil was moving as large patches in the water. It did not appear as though the oil was dissolving into the water. Why did the oil not dissolve into the water?

A. Hydrophobic interactions
B. Surface tension
C. Sea water acts as a solvent
D. Water forms hydration shells
E. Water has a high heat of vaporization

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Clarify Question

• **What is the key concept addressed by the question?** The question asks why oil and water don't mix.

• **What type of thinking is required?** You are being asked to apply your knowledge of the properties of water and oil to explain why the oil does not dissolve in water.

• **What key words does the question contain and what do they mean?**
o Dissolve – this means one compound mixes completely with a solvent like water.

Gather Content

• ***What do you know about water as a solvent? How does it relate to the question?***
o Water is a polar molecule, this means that other polar molecules or ions will dissolve in it. These water loving molecules are called hydrophilic.
o Oil is a non-polar molecule and will dissolve better in a non-polar solvent. These molecules are called hydrophobic, or water fearing.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Water is a solvent with a high heat of vaporization and surface tension. Water also forms surface tension. However, none of these properties explain why oil does not dissolve in water.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The best answer is that oil is hydrophobic, meaning it does not interact well with water. This is because water is a polar molecule and oil is non-polar. Water has O-H bonds which do not share electrons equally giving the O a partial negative charge and the H a partial positive charge. In contrast oil is made up of C-H bonds and the electrons are shared more equally leading to no partial charges. Because oil does not have these charges it is not attracted to the charges in water and does not dissolve well in water.

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 properties of water to explain why oil and water do not mix well. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you know what the word hydrophobic meant? Did you have difficulty remembering which properties of water make it a good solvent for other polar molecules?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Properties of Water

20. The atomic number of an element is equal to the number of:
A. protons plus neutrons.
B. neutrons plus electrons.
C. neutrons only.
D. protons only.
E. protons plus electrons.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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21. Oxygen has an atomic mass of 16 and an atomic number of 8. How many neutrons are present?

A. 8
B. 16
C. 4
D. 24

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks you to calculate the number of neutrons from the atomic mass and number of an atom.

• **What type of thinking is required?** You are being asked to apply your knowledge of how atomic mass and atomic number are calculated.

• ***What key words does the question contain and what do they mean?***
  o Atomic mass – the number of neutrons plus protons in an atom.
  o Atomic number – the number of protons in an atom.

Gather Content

• ***What do you know about the number of neutrons in an atom? How does it relate to the question?***
  o Atomic mass contains both the neutrons and protons in an atom.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
  o Atomic number is defined by the number of protons in an atom.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  o To calculate the number simply take Atomic mass (P + N) minus Atomic number (P).
  o In this example this is 16 – 8 = 8 neutrons

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 structure of an atom to predict some of its properties. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you know the definitions of how atomic mass and atomic numbers? Did you have difficulty figuring out how to calculate the number of neutrons by subtracting atomic mass from atomic number?

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Blooms Level: 3. Apply
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LO: 02.02.01 Relate atomic structure to the periodic table of the elements.
Section: 02.02
Topic: Elements Found in Living Systems

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22. The pH of your small intestines is around 7.5 and the pH of your large intestine can be 5.5. As substances travel from the small intestines to the large intestine, what would happen to the H^+ ion concentration?

A. It decreases 100 fold.
B. It increases by 100 fold.
C. It increases 10 fold.
D. It increases 2 fold.
E. It decreases 10 fold.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about relating pH to H+ concentration.

• ***What type of thinking is required? You are being asked to apply the definition of pH to a specific example.***

• ***What key words does the question contain and what do they mean?***
o pH – this is the –log[H+]

Gather Content

• ***What do you know about the link between H+ concentration and pH? How does it relate to the question?***
o Because the relationship between H+ concentration and pH is a log scale, a change in pH of 1 is a change in H+ concentration of 10-fold.
o Because the relationship between is negative, an increase in pH of 1 is a decrease in H+ concentration by 10-fold.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o In moving from the small intestines to the large intestines the pH goes from 7.5 to 5.5, which means the substance is moving to a more acidic environment. This means that the H+ concentration will increase.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Because the pH drops by 2 pH units, the H+ concentration increases by 10x10 or 10^2 or 100 fold.

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 pH to calculate H+ concentration. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall that pH is a log scale? Did you recall that pH has a negative relationship to H+ concentration, so an increase in pH leads to a decrease in H+ concentration?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.06.02 Relate changes in pH to changes in [H].
Section: 02.06
Topic: Acids and Bases

23. Oxygen-16 is abundant and has 8 protons and 8 neutrons. Oxygen-18 has two extra neutrons. These two forms are:
A. oxygen ions.
B. oxygen dimers.
C. oxygen isomers.
D. oxygen isotopes.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

24. Which element's isotope is commonly used to determine when biological samples such as fossils, were formed?
A. oxygen
B. hydrogen
C. carbon
D. nitrogen
E. sulfur

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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25. Atoms in which the number of electrons does not equal the number of protons are known as:
A. valences.
B. ions.
C. isotopes.
D. isomers.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.02
Topic: Elements Found in Living Systems

26. The area around a nucleus where an electron is most likely to be found is the:
A. electrical space.
B. energy level.
C. polar space.
D. orbital.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

27. Regardless of its shape, a given orbital may contain no more than:
A. 1 electron.
B. 4 electrons.
C. 8 electrons.
D. 2 electrons.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

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28. All atoms tend to fill their outer energy levels with the maximum number of electrons, usually eight. Depending on whether atoms satisfy the octet rule will predict:
A. the chemical behavior of the atoms.
B. whether they will be found in nature.
C. whether they will dissolve in water.
D. their radioactive energy.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

29. Mendeleev found that when he arranged the known elements according to their atomic mass, the entries in the table exhibited a pattern of chemical properties that repeated itself in groups of eight elements. This led to the generalization now known as:
A. an atomic model.
B. valance electrons.
C. the periodic table.
D. the octet rule.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.02.01 Relate atomic structure to the periodic table of the elements.
Section: 02.02
Topic: Elements Found in Living Systems

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30. Sodium has 11 electrons arranged in three energy levels. In order to become stable, sodium forms an ion with:
A. no charge.
B. -1 charge.
C. +8 charge.
D. +1 charge.
E. -8 charge.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about predicting if an atom will form an ion.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of the structure of an atom to predict ion formation.

• ***What key words does the question contain and what do they mean?***
o Energy levels – the first level holds 2 electrons and each higher level holds 8 electrons.

Gather Content

• ***What do you know about the structure of atoms? How does it relate to the question?***
o If you make a diagram of the structure of a sodium atom there are 2 electrons in the first shell, 8 in the second shell and 1 in the outer (valence) shell.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o If there is one valence electron then the atom could lose that electron or gain 7 more to have a full outer shell.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The atom will lose its single valence electron, losing a -1 charge carried by the electron. This will give the Na ion a +1 charge.

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 structure of an atom to predict if it will form an ion. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble drawing the structure of a sodium ion? Did you recognize that the sodium atom would lose an electron to have a stable outer shell?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.03.01 Predict which elements are likely to form ions.
Section: 02.03
Topic: The Nature of Chemical Bonds

31. In the crystal matrix of ordinary salt, the sodium and chlorine are held together by:
A. peptide bonds.
B. covalent bonds.
C. ionic bonds.
D. hydrogen bonds.
E. nonpolar bonds.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.03.01 Predict which elements are likely to form ions.
Section: 02.03
Topic: The Nature of Chemical Bonds

32.

Two oxygen atoms joined to each other by the sharing of two pairs of electrons form a(n):

A. double covalent bond.
B. single bond.
C. hydrogen bond.
D. ionic bond.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.03.02 Explain how molecules can be built from atoms joined by covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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33. In a chemical analysis of an animal tissue sample, which element would be in the least quantity?
A. carbon
B. oxygen
C. hydrogen
D. nitrogen
E. iodine

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.02.02 List the important elements found in living systems
Section: 02.02
Topic: Elements Found in Living Systems

34. Life is thought to have evolved from complex molecules formed by the interaction of smaller molecules in oceans and the atmosphere. The substance which brought these molecules together to interact is
A. buffers.
B. acids.
C. water.
D. salts.
E. hydrogen.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.04.01 Relate how the structure of water leads to hydrogen bonds.
Section: 02.04
Topic: Water: A Vital Compound

35. Because oxygen is more electronegative than hydrogen, the water molecule is:
A. hydrophobic.
B. hydrophilic.
C. nonpolar.
D. ionic.
E. polar.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.04.01 Relate how the structure of water leads to hydrogen bonds.
Section: 02.04
Topic: Water: A Vital Compound

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36. Water molecules are attracted to each other due to the opposite charges created by partial charge separations within the molecules. These attractions are called:
A. peptide bonds.
B. covalent bonds.
C. ionic bonds.
D. hydrogen bonds.
E. double bonds.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.04.01 Relate how the structure of water leads to hydrogen bonds.
Section: 02.04
Topic: Water: A Vital Compound

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37. How many hydrogen bonds can a water molecule form?
A. 1
B. 2
C. 3
D. 4
E. 5

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Clarify Question

• **What is the key concept addressed by the question?** The question asks about the formation of hydrogen bonds in water.

• **What type of thinking is required?** You are being asked to apply your knowledge of the structure of water to predict the formation of hydrogen bonds.

• **What key words does the question contain and what do they mean?**
o Hydrogen bonds – these are weak ionic interactions between a partial positive charge on one atom and partial negative charge on another atom.
o Water has the structure H-O-H

Gather Content

• ***What do you know about hydrogen bonds? How does it relate to the question?***
o Oxygen has a stronger attraction for electrons than hydrogen and ends up with two partial negative charges.
o Hydrogen has a weaker attraction for electrons than oxygen and ends up with a partial positive charge.
o Hydrogen bonds will form between the H atom on one water molecule and the O atom on a second water molecule.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Water has the structure H-O-H.
o Each H atom can form one hydrogen bond with an O atom on another water molecule.
o Each O atom can form hydrogen bonds with two H atoms on other water molecules.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Water can form hydrogen bonds with 4 water molecules. Two bonds will be through the H atoms and two through the O atom.

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 structure of a water molecule to predict how many hydrogen bonds it can form. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Could you draw the structure of a water

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molecule? Could you identify which atoms would be involved in forming a hydrogen bond?

Blooms Level: 3. Apply
Gradable: automatic
LO: 02.04.01 Relate how the structure of water leads to hydrogen bonds.
Section: 02.04
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38. Nitrogen has a higher electronegativity than hydrogen. As a result you would expect that ammonia (NH_3) molecules can form ____ with each other.
A. ionic bonds
B. hydrophilic bonds
C. hydrogen bonds
D. cohesive bonds
E. covalent bonds

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Clarify Question

• ***What is the key concept addressed by the question? The question asks about electronegativity.***

• **What type of thinking is required?** You are being asked to apply your knowledge of electronegativity to predict what types of bonds a molecule could form.

• ***What key words does the question contain and what do they mean?***
o Electronegativity – the pull of an atom on an electron.

Gather Content

• ***What do you know about electronegativity? How does it relate to the question?***
o Nitrogen has a higher electronegativity than hydrogen. This means that the nitrogen atoms will have a partial negative charge and the hydrogen atoms will have a partial positive charge.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o The partial charges on N and H atoms on adjacent NH3 molecules will be attracted to each other.
o These are not covalent bonds which share electrons.
o These are partial charges, so they are not ionic bonds.
o Because these are charged they are hydrophilic and not hydrophobic.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The best answer is that the attraction through partial charges is a hydrogen bond between the N on one NH3 and the H on another.

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 structure of a molecule to predict some of its properties. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Could you draw the structure of an NH3 molecule? Did you realize how hydrogen bonds form?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Properties of Water

39. When water ionizes, it produces equal amounts of hydrogen and hydroxide ions that can reassociate with each other. The pH of water is:
A. 3
B. 4
C. 5
D. 6
E. 7

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.05.03 Identify the dissociation products of water.
Section: 02.05
Topic: Properties of Water

40. A scientist conducts a procedure that causes nitrogen atoms to gain neutrons. The resulting atoms will be:
A. ions of nitrogen.
B. positively charged.
C. negatively charged.
D. isotopes of nitrogen.
E. new elements with higher atomic numbers.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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41. The half-life of Carbon-14 is approximately 5,700 years. Using this information scientists have been able to determine the age of some artifacts left by humans. A scientist wants to know approximately how old a piece of wood was that she found on the floor in an old cave that had recently been discovered. She removed the wood (with permission) to her laboratory. Her wood sample contained 2 grams of Carbon-14. If the age of the wood was determined to be 22,800 years old, how much Carbon-14 originally existed in this piece of wood?

A. 32 grams
B. 16 grams
C. 12 grams
D. 8 grams
E. 4 grams

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about radioactive.

• ***What type of thinking is required?*** You are being asked to analyze data on radioactive decay.

• ***What key words does the question contain and what do they mean?***
o Half-life – this is the amount of time in which half of a dose of radioactivity in a sample will be lost to decay.

Gather Content

• ***What do you know about half life? How does it relate to the question?***
o The first step is to figure out how many half-lives have occurred. 22,800 ÷ 5,700 = 4.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o In 4 half-lives the amount of radiation will have been cut in half 4 times.
o 2x2x2x2 = 2^4 = 16, which means that the total amount of radiation will be decreased 16-fold.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o If 2 grams of Carbon-14 remain now and this represents the amount left after a 16-fold decrease, the original amount would be 2 grams x 16 = 32 grams.

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 analyze radioactive decay data to calculate the amount of radioactive carbon in an initial sample. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall that the amount of sample could be cut in half with each decay? One common misconception is to think that 4 rounds of decay would decrease the radioactivity 4-fold. Each round cuts the amount of radioactivity in half, so this leads to a 16-fold decrease.

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Blooms Level: 4. Analyze
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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42. Plants transport water to their leaves through the xylem when water evaporates from the leaves. The evaporating water pulls other water molecules up the xylem through ____ .
A. Hydrophobic interactions
B. Ionic bonds
C. Covalent bonds
D. Hydrogen bonds

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about attractive interactions between water molecules.

• ***What type of thinking is required?*** You are being asked to apply your knowledge about the properties of water.

• ***What key words does the question contain and what do they mean?***
o Ionic bonds – a full positive charge on one molecule attracted to a full negative charge on another
o Hydrophobic interactions – hydrophobic groups repel water and clump together
o Hydrogen bonds – a partial negative charge on one atom is attracted to a partial positive charge on a hydrogen atom
o Covalent bonds – sharing a pair of electrons between two atoms **Gather Content**

• ***What do you know about the properties of water? How does it relate to the question?***
o Water is a polar molecule with partial negative charges on oxygen atoms and partial positive charges on hydrogen atoms.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Covalent bonds form between atoms within a molecule, the question refers to interactions between water molecules, so these cannot be covalent.
o Ionic bonds involve full charges, water has partial charges.
o Hydrophobic interactions are found in non-polar molecules, water is polar.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The best answer is that hydrogen bonds form between water molecules. As one water molecule evaporates it pulls the next water molecule up, moving water through the xylem.

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 principles of hydrogen bonding to the properties of water. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall the structure of water and types of bonds it forms?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.04.02 Describe waters cohesive and adhesive properties.
Section: 02.04
Topic: Water: A Vital Compound

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43. Water is most dense and thus heaviest at 4°C. At 0°C, ice forms and the ice can float on liquid water. Suppose ice were more dense than water at 0°C. What would happen in a lake at this temperature?

A. The ice would cover the bottom of the aquatic system and would build up in layers over time.

B. Ice would not form because solids are always less dense than liquids.

C. The ice would cover the surface of the aquatic system and would never melt.

D. The cold temperatures and the subsequent ice formation would prevent hydrogen bonds from forming between the water molecules, thus causing the existing ice crystals to become disassociated from each other.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the properties of liquid water and ice.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of the relative densities of liquid water and ice to what happens in a lake in the winter.

• ***What key words does the question contain and what do they mean?***
o Density – this is the measure of mass/volume.

Gather Content

• ***What do you know about ice? How does it relate to the question?***
o Because ice has more rigid structure than liquid water it occupies more volume. Thus the same mass of liquid water and ice vary in their density. Because liquid water occupies less volume it has a larger density than ice. This is why ice floats on top of liquid water.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o With many molecules solids are denser than liquids. The question asks you to predict what would happen if ice was denser than liquid water.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o If ice were denser than water it would sink to the bottom of a lake during the winter. Over time the ice would fill in the lake from the bottom up, freezing everything in the lake.

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 properties of water to predict what would happen if ice was denser than water. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that if ice was denser than liquid water it would sink? The density would not affect the ability to form or break hydrogen bonds.

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Blooms Level: 2. Understand
Gradable: automatic
LO: 02.05.01 Illustrate how hydrogen bonding affects the properties of water.
Section: 02.05
Topic: Chemistry

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44. Your dog becomes ill and you rush him to the veterinarian's office. A technician draws blood from your dog's leg for a vet-ordered lab test. After a few minutes the lab results are given to the vet, who immediately grabs a bottle from a shelf and begins to fill a syringe with an unknown fluid. You inquire about the fluid, and the vet informs you that the fluid is necessary to manage your dog's metabolic acidosis. Based on the information provided, what is acidosis, and what is the likely effect of the veterinarian's injection?
A. Acidosis means that your dog's blood pH has dropped from its normal level, and an injection of saline is required to reverse the condition.
B. Acidosis means that your dog's blood pH has increased from its normal level, and an injection of saline is required to reverse the condition.
C. Acidosis means that your dog's blood pH has decreased from its normal level, and an injection of buffering solution is required to reverse the condition.
D. Acidosis means that your dog's blood pH has increased from its normal level, and an injection of buffering solution is required to reverse the condition.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the treatment of acidosis.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of acids to explain how acidosis is treated.

• ***What key words does the question contain and what do they mean?***
  o Acidosis – this means that the blood is more acidic.
  o Buffers – these are used to adjust the pH of a solution.
  o Saline – this is a salt solution with the same osmolarity as blood.

Gather Content

• ***What do you know about acids and buffers? How does it relate to the question?***
  o Acids will lower the pH of a solution.
  o Buffers can be used to neutralize acids.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
  o Saline is a salt solution and will not affect pH.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  o If your dog has acidosis then the pH of his blood is too low. A buffer will be used to neutralize the acid and raise the pH back to a healthy level.

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 properties of a buffer to neutralize an acid. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall that acids will lower pH? Did you recall that buffers will neutralize a pH?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.06.01 Define acids, bases, and the pH scale.
Section: 02.06
Topic: Acids and Bases

45. As you and a friend are entering a chemistry laboratory at your university, you see a sign that states: DANGER—RADIOACTIVE ISOTOPES IN USE. Your friend is an accounting major and has not had any science courses yet. She asks you what a radioactive isotope is and you respond correctly with:
A. Radioactive isotopes are atoms that are unstable and as a result emit energy in a process called radioactive decay.
B. Radioactive isotopes are atoms that are stable and as a result emit energy in a process called radioactive decay.
C. Radioactive isotopes are atoms that are stable and as a result only emit energy if they are exposed to higher temperatures.
D. Radioactive isotopes are atoms that are unstable but unless actively disturbed by some chemical process will remain intact and pose no problems.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

46. To increase the rate of a reaction you could:
A. Add more products.
B. Decrease the temperature.
C. Add more reactants.
D.

remove a catlyst

Blooms Level: 2. Understand
General LO: Apply scientific principles to energy, matter, and information transformations in biological systems.
Gradable: automatic
Section: 02.03
Topic: The Nature of Chemical Bonds

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47. The two nitrogen atoms in nitrogen gas (N_2) share six electrons forming a _____.
A. hydrogen bond
B. double bond
C. single covalent bond
D. double covalent bond
E. triple covalent bond

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the formation of covalent bonds.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of covalent bonds to predict how many bonds are present in N3.

• ***What key words does the question contain and what do they mean?***

o Covalent bonds – two atoms share a pair of electrons to form a covalent bond.

Gather Content

• ***What do you know about covalent bonds? How does it relate to the question?***
o Two atoms share a pair of electrons to form a covalent bond.
o Atoms can form more than one covalent bond.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o If the two N atoms are sharing 6 electrons, and there are 2 electrons shared in one covalent bond, then there are $6 \div 2 = 3$ covalent bonds.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o There are 3 covalent bonds between the two N atoms in N3.

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 structure of a covalent bond to predict the number formed in N3. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that a covalent bond contains 2 shared electrons? Did you realize that two atoms can have more than one covalent bond?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.03.02 Explain how molecules can be built from atoms joined by covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

48. Capillary action is one of the forces that aids water's upward movement in plants. The narrower the diameter of the tube, the farther the water column will rise. Capillary action is a result of water molecules:
A. producing sufficient surface tension to overcome the pull of gravity.
B. having a strong cohesive force and attaching to the surrounding vessel walls.
C. storing heat and thus moving faster because of heat of vaporization.
D. having an adhesive force, which allows them to attach to the vessel walls.
E. being associated with hydrophobic molecules, which can result in upward movement.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.04.02 Describe waters cohesive and adhesive properties.
Section: 02.04
Topic: Water: A Vital Compound

49. Which atomic particle has no charge and is located in the nucleus?
A. proton
B. electron
C. neutron
D. ion
E. isotope

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

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50. The sub-atomic particle with a positive charge is _____.
A. a neutron
B. an isotope
C. an electron
D. a proton
E. an ion

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

51. The smallest sub-atomic particle is the _____.
A. ion
B. electron
C. proton
D. isotope
E. neutron

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.01 Define an element based on its composition.
Section: 02.01
Topic: The Nature of Atoms

52. An atom that is negatively charged because it has accepted an electron is a(n):
A. isotope.
B. isomer.
C. ion.
D. monomer.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.02.01 Relate atomic structure to the periodic table of the elements.
Section: 02.02
Topic: Elements Found in Living Systems

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53. One mole of a substance contains 6.02×10^{23} molecules. The atomic number of Li is 3 and the atomic mass is approximately 7. If you have three moles of Li, how many grams does it weigh?

A. 9
B. 21
C. $7 \times 6.02 \times 10^{23}$
D. $3 \times 6.02 \times 10^{23}$

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about calculating the mass of 3 moles of Li.

• ***What type of thinking is required?*** You are being asked to apply the atomic mass of a compound to calculate the mass of 3 moles.

• ***What key words does the question contain and what do they mean?***
  o Atomic mass – the mass (grams) in one mole of an element
  o Atomic number – the number of protons in an atom
  o 6.02 x 10^{23} atoms/mole – this is Avagadro's number, and is universal for each atom.

Gather Content

• ***What do you know about converting from moles to mass? How does it relate to the question?***
  o If you have 3 moles of Li you want to multiply that by a factor with the units grams/mole so the moles cancel and you are left with grams.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
  o Atomic number has the units protons/atom and won't be useful in calculating grams.
  o Avagadro's number has the units atoms/mole and won't be useful in calculating grams.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  o Atomic mass has the units grams/mole.
  o 3 moles of Li x 7 grams/mole = 21 grams of Li

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 concept of moles and atomic mass to calculate the mass of 3 moles of Li. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall the units for atomic mass, atomic number, and Avagadro's number? Were you able to set up the calculation properly?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.03 Identify the dissociation products of water.
Section: 02.05
Topic: Properties of Water

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54. One mole of a substance contains 6.02×10^{23} molecules. The atomic number of Li is 3 and the atomic mass is approximately 7. If you have three moles of Li, how many grams does it weigh?

A. 9
B. 21
C. $7 \times 6.02 \times 10^{23}$
D. $3 \times 6.02 \times 10^{23}$

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about calculating the mass of 3 moles of Li.

• ***What type of thinking is required?*** You are being asked to apply the atomic mass of a compound to calculate the mass of 3 moles.

• ***What key words does the question contain and what do they mean?***
  o Atomic mass – the mass (grams) in one mole of an element
  o Atomic number – the number of protons in an atom
  o 6.02 x 10^{23} atoms/mole – this is Avagadro's number, and is universal for each atom.

Gather Content

• ***What do you know about converting from moles to mass? How does it relate to the question?***
  o If you have 3 moles of Li you want to multiply that by a factor with the units grams/mole so the moles cancel and you are left with grams.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
  o Atomic number has the units protons/atom and won't be useful in calculating grams.
  o Avagadro's number has the units atoms/mole and won't be useful in calculating grams.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  o Atomic mass has the units grams/mole.
  o 3 moles of Li x 7 grams/mole = 21 grams of Li

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 concept of moles and atomic mass to calculate the mass of 3 moles of Li. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recall the units for atomic mass, atomic number, and Avagadro's number? Were you able to set up the calculation properly?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.06.01 Define acids, bases, and the pH scale.
Section: 02.06
Topic: Acids and Bases

55. The amino acid glycine ($C_3NO_2H_6$) is a(an):
A. element
B. organic molecule
C. inorganic molecule
D. vitamin

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.02.02 List the important elements found in living systems
Section: 02.02
Topic: Elements Found in Living Systems

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56. Consider the following electronegativity values:
Boron (B) = 1.8
Carbon (C) = 2.5
Chlorine (Cl) = 3.2
Selenium (Se) = 2.6
Which of the following bonds is the most polar?
A. Se-Cl
B. C-Cl
C. B-Cl
D. cannot determine from the information provided

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Clarify Question

• **What is the key concept addressed by the question?** The question asks about the link between electronegativity and polar bonds.

• **What type of thinking is required?** You are being asked to analyze the relative electronegativities of two atoms in a bond to predict which would be the most polar.

• **What key words does the question contain and what do they mean?**
o Electronegativity – the attraction of an atom for an electron.
o Polar bond – a covalent bond in which the electrons are not shared equally.

Gather Content

• **What do you know about polar bonds? How does it relate to the question?**
o The greater the difference in electronegativity between two atoms in a covalent bond the more polar the bond will be.

Consider Possibilities

• **What other information is related to the question? Which information is most useful?**
o To calculate the relative polarity of the bonds, simply subtract the electronegativities of each atom in the bond.

Choose Answer

• **Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?**
o Se-Cl; 3.2-2.6 = 0.6
o C-Cl; 3.2-2.5 = 0.7
o B-Cl; 3.2-1.8 = 1.4
o The largest difference is between B and Cl, so the B-Cl bond will be the most polar with Cl pulling the electrons away from B.

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 electronegativity to predict the polarity of a covalent bond. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you know what electronegativity and polar bonds were? Did you know to compare the difference in electronegativity between the two atoms to determine the polarity of the bond?

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Blooms Level: 4. Analyze
Gradable: automatic
LO: 02.03.03 Contrast polar and nonpolar covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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57. The reaction ($H_2 + F_2 \rightarrow 2HF$) is an example of a redox reaction. In reality, two half reactions are occurring. The half reaction ($H_2 \rightarrow 2H^+ + 2e^-$) is a(n):
A. potential energy reaction
B. redox reaction
C. oxidation reaction
D. reduction reaction

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about redox reactions.

• ***What type of thinking is required?*** You are being asked to apply the definition of reactions that lose an electron.

• ***What key words does the question contain and what do they mean?***
o Redox reaction – contains an oxidation and a reduction reaction.
o Oxidation – loss of an electron
o Reduction – gain of an electron (the charge of the atom or molecule gaining the electron is reduced)

Gather Content

• ***What do you know about redox reactions? How does it relate to the question?***
o In a redox reaction electron(s) are transferred from one atom or molecule to another.
o This is made up of an oxidation half reaction where the electrons are lost by one reactant, and a reduction half reaction where the electrons are gained by the second reactant.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o In the half reaction $H_2 \rightarrow 2H^+ + 2e^-$, H2 is losing 2 electrons

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Because H_2 is losing 2 electrons this is an oxidation half reaction.
o This would be balanced by the reduction half reaction $F_2 + 2e^- \rightarrow 2F^-$
o Finally the $2H^+ + 2F^- \rightarrow 2HF$
o Putting this all together you get the reaction: $H_2 + F_2 \rightarrow 2HF$

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 an oxidation reaction. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble recognizing that an oxidation half reaction was being shown? Did the mention of a redox reaction confuse the problem for you?

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Biology 11th edition Raven Test Bank

Blooms Level: 3. Apply
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

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Biology 11th edition Raven Test Bank

58. The electronic configuration of the noble gas Neon, which has an atomic number of 10, can be written as follows: $1s^2 2s^2 2p^6$. What is the electronic configuration of the noble gas Argon, which has an atomic number of 18?

A. $1s^2 2s^2 2p^6 3s^2 3p^6$
B. $1s^2 2s^6 2p^2 3s^6 3p^2$
C. $1s^2 2s^8 3p^8$
D. $1s^2 2s^2 3p^6 4s^2 5p^6$

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the configuration of electrons in an atom.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of electron configuration to create one for Argon.

• ***What key words does the question contain and what do they mean?***
o Electron configuration – the occupancy of electrons in different shells.
o Atomic number – number of protons in an atom, and thus also the number of electrons.

Gather Content

• ***What do you know about electron configuration? How does it relate to the question?***
o The first shell contains 2 electrons in an "s" orbital. A full first shell is represented $1s^2$.
o The next shells each contain 8 electrons, 2 electrons in an "s" orbital and 6 electrons in a "p" orbital. A full second shell is represented $2s^2 2p^6$.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Argon has an atomic number 18 and Neon is 10. Thus Argon has 8 more electrons than Neon, which adds one more shell.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Adding a third shell to Neon will add 8 more electrons, 2 electrons in an "s" orbital and 6 electrons in a "p" orbital.
o Following the same numbering as with Neon this would add $2s^2 2p^6$.
o The complete electron configuration for Argon will be $1s^2 2s^2 2p^6 3s^2 3p^6$.

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 orbitals of electrons in an atom to write an electron configuration. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble understanding what was being represented in the numbering system of an electron configuration? Did you realize that the 8 electrons in shells 2 and 3 were split between "s" and "p" orbitals.

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Biology 11th edition Raven Test Bank

Blooms Level: 3. Apply
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

59. You identify an enzyme involved in a cellular reaction. How does the enzyme affect the reaction equilibrium between reactants and products and the time needed to reach equilibrium?
A. It alters the reaction equilibrium and shortens the time needed to reach equilibrium.
B. The reaction equilibrium is unaffected, but it shortens the time needed to reach equilibrium.
C. It alters the reaction equilibrium and lengthens the time needed to reach equilibrium.
D. The reaction equilibrium is unaffected, but it lengthens the time needed to reach equilibrium.

Blooms Level: 2. Understand
General LO: Apply scientific principles to energy, matter, and information transformations in biological systems.
Gradable: automatic
Section: 02.03
Topic: The Nature of Chemical Bonds

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Biology 11th edition Raven Test Bank

60. The electronic configuration of the noble gas Neon, which has an atomic number of 10, can be written as follows: $1s^2 2s^2 2p^6$. What is the electronic configuration of the noble gas Argon, which has an atomic number of 18?

A. $1s^2 2s^2 3p^6 4s^2 5p^6$
B. $1s^2 2s^8 3p^8$
C. $1s^2 2s^2 2p^6 3s^2 3p^6$
D. $1s^2 2s^6 2p^2 3s^6 3p^2$

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the configuration of electrons in an atom.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of electron configuration to create one for Argon.

• ***What key words does the question contain and what do they mean?***
o Electron configuration – the occupancy of electrons in different shells.
o Atomic number – number of protons in an atom, and thus also the number of electrons.

Gather Content

• ***What do you know about electron configuration? How does it relate to the question?***
o The first shell contains 2 electrons in an "s" orbital. A full first shell is represented $1s^2$.
o The next shells each contain 8 electrons, 2 electrons in an "s" orbital and 6 electrons in a "p" orbital. A full second shell is represented $2s^2 2p^6$.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Argon has an atomic number 18 and Neon is 10. Thus Argon has 8 more electrons than Neon, which adds one more shell.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Adding a third shell to Neon will add 8 more electrons, 2 electrons in an "s" orbital and 6 electrons in a "p" orbital.
o Following the same numbering as with Neon this would add $2s^2 2p^6$.
o The complete electron configuration for Argon will be $1s^2 2s^2 2p^6 3s^2 3p^6$.

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 orbitals of electrons in an atom to write an electron configuration. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble understanding what was being represented in the numbering system of an electron configuration? Did you realize that the 8 electrons in shells 2 and 3 were split between "s" and "p" orbitals.

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.04.02 Describe waters cohesive and adhesive properties.
Section: 02.04
Topic: Water: A Vital Compound

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61. You recently discovered a new element, and find that this particular element has one electron its outer energy level. What would you expect will happen to an atom of this element if placed in water?

A. It will gain an electron forming a positive ion.
B. It will lose an electron forming a negative ion.
C. It will lose an electron forming a positive ion.
D. It will gain an electron forming a negative ion.

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Clarify Question

• ***What is the key concept addressed by the question? The question asks about the formation of ions.***

• ***What type of thinking is required?*** You are being asked to apply your knowledge of electron energy levels to the formation of ions.

• ***What key words does the question contain and what do they mean?***
o Outer energy level – an atom is most stable when it's outer energy level is full.

Gather Content

• ***What do you know about ions? How does it relate to the question?***
o To be most stable, an atom may gain or lose electrons to end up with a full outer shell of electrons.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o This atom has one extra electron in its outer shell.
o If it gains an electron it will still have a partially full shell (2 electrons).
o If the atom loses an electron it will have a full outer shell (8 electrons).

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Losing an electron will give the atom a full outer shell.
o Because an electron has a -1 charge, losing the electron will give the atom a +1 charge, forming a positive ion.

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 structure of an atom to predict the formation of an ion. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that the atom would be most stable if it lost an electron? Did you recognize that losing an electron would lead to the formation of a positively charged ion?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

62. In the Hershey-Chase experiment, bacterial viruses, called phage, were used to demonstrate that DNA is the genetic material. The phage that were used for this experiment consisted of DNA surrounded by a protein coat. Phage will attach to specific types of bacteria and inject their DNA into the bacterial cell. To scientifically determine whether DNA is the genetic material, Hershey and Chase made phage in a medium containing radioactive sulfur-35 (S^{35}). Why was S^{35} used in this experiment?
A. Only amino acids contain sulfur.
B. Only nucleic acids contain sulfur.
C. Both nucleic acids and amino acids contain sulfur.
D. The radioactive sulfur labels peptide bonds.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

63. Why is it necessary to take special safety precautions when using radioactivity?
A. Radioactive substances will ionize cells.
B. Radioactive substances have the potential to cause damage to living cells.
C. Radioactive substances decay.
D. Radioactive substances will perforate plasma membranes.

Blooms Level: 1. Remember
Gradable: automatic
LO: 02.01.02 Describe how atomic structure produces chemical properties.
Section: 02.01
Topic: The Nature of Atoms

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64. The high heat of vaporization of water helps you to feel cooler when you sweat because the transition of water from a liquid to a gas requires a _____ of energy to break hydrogen bonds. The energy is _____ from heat produced by your body, thus helping to lower the surface temperature of your body.

A. release; released
B. release; obtained
C. input; obtained
D. input; released

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.05.01 Illustrate how hydrogen bonding affects the properties of water.
Section: 02.05
Topic: Properties of Water

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65. Salt is often used to melt ice on roads during the winter because it lowers the freezing/melting point of water. When salt dissolves in water, individual Na^+ and Cl^- ions break away from the salt lattice and become surrounded by water molecules. Why would this cause ice to melt?

A. Hydrogen bonds are broken, and the salt ions interfere with interactions between H and O. As a result, it is more difficult for water molecules to bond and form ice.

B. Hydrogen bonds are formed, and the salt ions bond with O. As a result, it is more difficulty for water molecules to bond and form ice.

C. Hydrogen bonds are broken, and the salt ions bond with O and H respectively. As a result, it is more difficult for water molecules to bond and form ice.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about how salt would prevent ice from forming.
• ***What type of thinking is required?*** You are being asked to apply your knowledge of the properties of water to explain how salt melts ice.

• ***What key words does the question contain and what do they mean?***
o Freezing point – the temperature below which water molecules hydrogen bond to each other in a solid lattice commonly known as ice

Gather Content

• ***What do you know about ice? How does it relate to the question?***
o Ice forms because the water molecules are in a 3-dimensional lattice with each water molecule hydrogen bonded to 4 other water molecules.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o When salt dissolves in water the NaCl dissociates into Na^+ and Cl^- ions. Each of these ions interact with water molecules. The Na^+ will be attracted to the partial negative charge on O in water and the Cl^- ions will be attracted to the partial positive charge on H in water.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Because the Na^+ and Cl^- ions interact with water molecules through the partial charges on water, these interfere with the ability of water molecules to hydrogen bond with each other.
o Because water molecules can no longer form hydrogen bonds with each other, they cannot form a lattice and ice does not form.

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 properties of water to explain why salt melts ice. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that ice forms because of hydrogen bonding between water molecules? Did you understand that salt ions interfere with this hydrogen bonding, reducing water's ability to form ice?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.01 Illustrate how hydrogen bonding affects the properties of water.
Section: 02.05
Topic: Properties of Water

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66. A chemist adds a chemical to pure water and there is a 100 fold increase in the concentration of hydrogen ions. What is the best approximation of the new pH value?

A. 0
B. 5
C. 7
D. 9
E. 14

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the relationship between pH and hydrogen ion concentration.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of pH to predict what would happen to water when the hydrogen ion concentration is increased.

• ***What key words does the question contain and what do they mean?***
o pH – this is the –log[H+]

Gather Content

• **What do you know about pH? How does it relate to the question?**
o Because pH is the –log[H+] as the H+ concentration goes up the pH goes down.
o Because it is a log scale, each 10-fold change in H+ concentration is a change in pH of 1.
o In this case a 100-fold increase in H+ concentration would lead to a decrease in pH of 2.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Next we need to figure out what the pH was before the chemical was added to water. Pure water has a pH of 7.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Pure water has a pH of 7 and the chemical dropped the pH by 2, so the new pH will be about 5.

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 pH to predict what would happen if a chemical was added that raised the H+ concentration. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble using the equation of pH? Did you recall that this was a negative log relationship between pH and H+ concentration, so the pH decreased? Did you recall that the pH of water is 7?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.06.01 Define acids, bases, and the pH scale.
Section: 02.06
Topic: Acids and Bases

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67. The electronegativity of nitrogen (N) is 3.0, while the electronegativity of hydrogen (H) is 2.1. Knowing this, consider how the electrons will be shared in ammonia (NH_3). What do you predict about the polarity of ammonia?

A. Each H atom has a partial positive charge
B. The N atom has a partial positive charge
C. Each H atom has a partial negative charge
D. The N atom has a strong positive charge

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about electronegativity.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of electronegativity to predict the effect on the partial charge of an atom.

• ***What key words does the question contain and what do they mean?***
o Electronegativity – the attraction of an atom for an electron.
o Partial charges – if two atoms in a covalent bond have different attractions for an electron this is called a polar covalent bond.
o The atom with the stronger attraction will have a partial negative charge and the atom with the weaker attraction will have a partial positive charge.

Gather Content

• ***What do you know about electronegativity? How does it relate to the question?***
o The electronegativity of N is 3.0 and that of H is 2.1.
o N has a stronger attraction for the electrons in its covalent bond with H.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Because electrons have a negative charge, the N will have a partial negative charge.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o Based on the same logic, each H atom will have a partial positive charge as the electrons are pulled towards N.

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 electronegativity to predict the partial charges on atoms in a polar covalent bond. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you recognize that the higher electronegativity on N meant it had more attraction for electrons than H? Did you realize that a stronger pull for electrons gave N a partial negative charge, while this led to a partial positive charge on each H?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.03.03 Contrast polar and nonpolar covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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68. Magnesium chloride is a salt formed with ionic bonds between one magnesium ion and two chloride ions. Magnesium has two electrons in its outer shell and chlorine has seven electrons in its outer shell. How are the electrons transferred between these atoms?

A. Both magnesium and chlorine are reduced.
B. Magnesium is oxidized and chlorine is reduced.
C. Chlorine is oxidized and magnesium is reduced.
D. Both magnesium and chlorine are oxidized.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about reduction and oxidations.

• ***What type of thinking is required?*** You are being asked to apply your knowledge to the formation of ions through reduction and oxidation.

• ***What key words does the question contain and what do they mean?***

o Outer shell of electrons – an atom is most stable with a full outer shell of electrons. It can obtain this by gaining or losing electrons.

Gather Content

• ***What do you know about oxidations and reductions? How does it relate to the question?***

o If an atom loses an electron it becomes oxidized and forms a positive charge.

o If an atom gains an electron it becomes reduced and forms a negative charge.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***

o Mg has 2 extra electrons in its outer shell, so it will be most stable losing two electrons.

o Cl has 7 electrons in its outer shell, so it will be most stable gaining one electron.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***

o Mg will lose two electrons, forming Mg^{2+} and be oxidized in the process.

o Cl will gain one electron, forming Cl^{-} and be reduced in the process.

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 structure of an atom to predict if it would become reduced or oxidized in forming an ion. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that Mg would lose electrons and Cl would gain them? Did you remember that oxidations lose electrons and reductions gain electrons?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.01.03 Explain where electrons are found in an atom.
Section: 02.01
Topic: The Nature of Atoms

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Biology 11th edition Raven Test Bank

69. Magnesium chloride is a salt formed with ionic bonds between one magnesium ion and two chloride ions. Magnesium has two electrons in its outer shell and chlorine has seven electrons in its outer shell. How are the electrons transferred between these atoms?
A. Chlorine is oxidized and magnesium is reduced.
B. Both magnesium and chlorine are oxidized.
C. Both magnesium and chlorine are reduced.
D. Magnesium is oxidized and chlorine is reduced.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about reduction and oxidations.

• ***What type of thinking is required?*** You are being asked to apply your knowledge to the formation of ions through reduction and oxidation.

• ***What key words does the question contain and what do they mean?***

o Outer shell of electrons – an atom is most stable with a full outer shell of electrons. It can obtain this by gaining or losing electrons.

Gather Content

• ***What do you know about oxidations and reductions? How does it relate to the question?***

o If an atom loses an electron it becomes oxidized and forms a positive charge.

o If an atom gains an electron it becomes reduced and forms a negative charge.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***

o Mg has 2 extra electrons in its outer shell, so it will be most stable losing two electrons.

o Cl has 7 electrons in its outer shell, so it will be most stable gaining one electron.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***

o Mg will lose two electrons, forming Mg^{2+} and be oxidized in the process.

o Cl will gain one electron, forming Cl^{-} and be reduced in the process.

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 structure of an atom to predict if it would become reduced or oxidized in forming an ion. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that Mg would lose electrons and Cl would gain them? Did you remember that oxidations lose electrons and reductions gain electrons?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.06.02 Relate changes in pH to changes in [H].
Section: 02.06
Topic: Acids and Bases

70. The common basilisk lizard will run across water on its hind legs in an erect position when startled by predators. This lizard has large feet and flaps of skin along its toes. What properties of water allow this lizard to walk on water?
A. Hydrogen bonds absorb heat when they break and release heat when they form. This helps to minimize temperature changes.
B. The surface tension created by hydrogen bonds is greater than the weight of the lizard initially.
C. Polar molecules are attracted to ions and polar compounds, making these compounds soluble.
D. Hydrogen bonds hold water molecules together; many hydrogen bonds must be broken for water to evaporate.

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Properties of Water

71. How is the bond in F_2 different from the bond in KCl?
A. F_2 is covalent and KCl is ionic
B. F_2 and KCl are both ionic
C. F_2 is ionic and KCl is covalent

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.03.02 Explain how molecules can be built from atoms joined by covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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72. Carbon has 4 valence electrons and oxygen has 6. Carbon dioxide would contain _____.
A. four hydrogen bonds
B. two single covalent bonds
C. two double covalent bonds
D. one single covalent bond

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the formation of covalent bonds.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of the structure of atoms to predict how many covalent bonds carbon dioxide could form.

• ***What key words does the question contain and what do they mean?***
o Valence electrons – these are the electrons in the outer shell of an atom.

Gather Content

• ***What do you know about covalent bonds? How does it relate to the question?***
o Typically an atom is most stable if it has a full outer shell. This can be accomplished by gaining, losing, or sharing electrons. When two electrons are shared between two atoms this forms a covalent bond.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o The name carbon dioxide indicates that there are one carbon atom and two oxygen atoms in this molecule.
o Carbon has 4 valence electrons, so it needs to share 4 more electrons to get a full outer shell. This means it can form 4 covalent bonds.
o Oxygen has 6 valence electrons, so it needs to share 2 more electrons to get a full outer shell. This means each oxygen atom can form 2 covalent bonds

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The carbon atom can form a double bond with each of the oxygen atoms. That will give the carbon atom 4 bonds and each oxygen atom 2 bonds needed to fill their outer shells. The structure O=C=O would thus contain two double covalent bonds.

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 structure of an atom to predict how many bonds would form in carbon dioxide. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you have trouble figuring out how many bonds carbon and oxygen each needed to form to be stable? Were you confused on whether

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all of the bonds were between C and O or did you try to make some O-O bonds?

Blooms Level: 3. Apply
Gradable: automatic
LO: 02.03.03 Contrast polar and nonpolar covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

73. If water were non-polar it would not form hydrogen bonds. At normal room temperatures this non-polar water would be _____.
A. a gas
B. a liquid
C. a solid

Blooms Level: 2. Understand
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Properties of Water

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74. Proteins are three dimensional molecules made of strands of amino acids (imagine a ball of string). There are 20 different amino acids used in proteins found in living organisms. Some of these amino acids are polar and others are non-polar. Where would a series of non-polar amino acids most likely be located in a protein that is found in the cytosol of an animal cell?

A. On the surface of the protein
B. In the interior of the protein
C. At the very top of the protein
D. At the very bottom of the protein

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about non-polar amino acids.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of polarity to predict how this would affect the structure of a protein.

• ***What key words does the question contain and what do they mean?***
o Polar – these are molecules in which electrons are not shared equally between atoms, leading to partial charges on the atoms.
o Non-polar – these are molecules in which electrons are shared equally between atoms, leading to no partial charges.

Gather Content

• ***What do you know about non-polar molecules? How does it relate to the question?***
o Non-polar molecules do not interact well with water, which is a polar molecule. These non-polar molecules actually interfere with the formation of hydrogen bonds between water molecules.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o The inside of an animal cell contains cytoplasm which is made up of a lot of water. Thus the inside of the cell is a polar environment.
o Non-polar amino acids in the inside of a cell do not interact well with the water and are repelled by the water.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The repulsion of non-polar amino acids by water will cause them to cluster in the center of the protein where they are shielded from water. This is why most proteins are ball shaped, with the non-polar or hydrophobic amino acids in the center of the ball.

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 polar and non-polar definitions to predict the structure of a protein. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you understand the difference between polar and non-polar

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amino acids? Did you realize that the inside of the cell would be a polar environment? Did you know that non-polar groups will cluster near each other to be shielded from water?

Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Chemistry

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75. According to most car mechanics, plain water is the best coolant to use in an engine provided the engine is not being exposed to freezing temperatures. If the car is subject to freezing temperatures then a mixture of water and ethylene glycol (antifreeze) is recommended but it does not cool as efficiently as plain water. Why would ethylene glycol reduce the cooling efficiency of water?

A. Hydrogen bonds in water allow high levels of heat absorption and a large increase in temperature.
B. Ethylene glycol raises the freezing point of water.
C. Ethylene glycol has a lower heat capacity than water.
D. Ethylene glycol has a higher heat capacity than water.

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about the ability of water to absorb heat.

• ***What type of thinking is required?*** You are being asked to apply your understanding of the properties of water to explain the effect of adding antifreeze.

• ***What key words does the question contain and what do they mean?***
o Cooling efficiency – this is a measure of how well a solution can absorb heat.

Gather Content

• ***What do you know about the properties of water? How does it relate to the question?***
o Water has a very high heat capacity. This means that it can absorb a lot of heat.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o Adding ethylene glycol decreases the cooling efficiency of the water in the radiator. This is done to lower the freezing point of water, which keeps the radiator from freezing solid in the winter.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o The ethylene glycol has a lower heat capacity than water, so adding ethylene glycol to the radiator decreases the amount of heat that the water can absorb.

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 properties of water to explain the ability of water to absorb heat. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you realize that the property of water relevant to cooling efficiency was its heat capacity? Did you recognize that the question was not asking about changes in the freezing point?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.05.02 Explain the relevance of waters unusual properties for living systems.
Section: 02.05
Topic: Properties of Water

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76. Dennis had a history of heart disease in his family and was reducing his intake of saturated fats. Saturated means each carbon atom is bonded to as many hydrogen atoms as it can accept. If a carbon were bonded to two carbons, how many hydrogens could it accept?

A. 0
B. 1
C. 2
D. 3
E. 4

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Clarify Question

• ***What is the key concept addressed by the question?*** The question asks about forming covalent bonds.

• ***What type of thinking is required?*** You are being asked to apply your knowledge of the structure of an atom to predict how many bonds it can form.

• ***What key words does the question contain and what do they mean?***
o Saturated fat – these fats have a backbone of C-C bonds with as many C-H bonds as possible.

Gather Content

• ***What do you know about covalent bonds? How does it relate to the question?***
o Carbon has 4 valence electrons, and needs to share an additional 4 electrons to have a full outer shell. This means it needs to form 4 covalent bonds.

Consider Possibilities

• ***What other information is related to the question? Which information is most useful?***
o In a saturated fat there is a backbone of C atoms attached by covalent bonds giving a structure like: -C-C-C-
o These covalent bonds provide 2 additional electrons, leaving a need for 2 more for carbon to have a full outer shell.

Choose Answer

• ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
o To obtain the remaining 2 electrons, each C atom forms covalent bonds with two H atoms.

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 structure of an atom to predict how many bonds would form in a saturated fat. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you understand what was meant by a saturated fat? Could you figure out how many total covalent bonds each C atom would form?

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Blooms Level: 3. Apply
Gradable: automatic
LO: 02.03.02 Explain how molecules can be built from atoms joined by covalent bonds.
Section: 02.03
Topic: The Nature of Chemical Bonds

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