General Chemistry 2 1 Principles Patterns and Applications 2nd edition Averill Test Bank

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Chapter 2
Molecules, Ions, and Chemical Formulas

Section 2.1

True/False Questions

1. In an ionic bond, the atoms are held together by the electrostatic attraction between the positively charged nuclei of the bonded atoms and the negatively charged electrons they share.
   False; Easy

2. There is a triple bond between the two oxygen atoms in a molecule of O_2.
   False; Easy

3. Methane (CH_4) is a covalent molecule, where electrons are shared between the carbon and hydrogen atoms.
   True; Easy

4. A Ca^{2+} ion has the same number of electrons as the noble gas Argon.
   True; Easy

5. Ions that contain fewer electrons than protons have a net positive charge and are called anions.
   False; Easy

Multiple Choice Questions

1. Which of the following is an elemental-polyatomic molecule?
   a. Carbon tetrachloride
   b. Nitrogen
   c. Phosphorous
   d. Sodium chloride
   e. Chlorine
   c; Easy

2. How many electrons are shared between two atoms joined by a double bond?
   a. One
   b. Two
   c. Four
   d. Six
   e. Eight
   c; Easy

3. Which of the following is an organic compound?
   a. FeO
   b. $NaHCO_3$
   c. CH_4
   d. SF_6

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e. H_2CO_3

c; Easy

4. Which of the following compounds has only covalent bonding?
   a. H_2O
   b. NaOH
   c. NaCl
   d. $Al_2(SO_3)_3$
   e. Fe_2O_3

   a; Easy

5. Which of the following molecules has a tetrahedral geometry?
   a. H_2O
   b. CO_2
   c. CH_4
   d. NO_2
   e. NH_3

   c; Easy

6. Which molecular representation method uses wedges and dashes to sketch the structure of a molecule in three dimensions?
   a. Ball-and-stick model
   b. Perspective drawing
   c. Space filling model
   d. Condensed structural formula
   e. Molecular formula

   b; Easy

7. If two charged particles, Q_1 and Q_2, are separated by the distance r, the electrostatic energy between the particles is $\propto$ _____
   a. $Q_1 \times Q_2 + r$
   b. $Q_1 \times Q_2 \times r$
   c. $\frac{r^2}{Q_1 \times Q_2}$
   d. $\frac{Q_1 Q_2}{r}$
   e. $\frac{r}{Q_1 \times Q_2}$

   d; Easy

8. The most common monoatomic ion formed by magnesium is _____.
   a. Mg^-
   b. Mg^{2-}
   c. Mg^{3+}
   d. Mg^{2+}
   e. Mg^{3-}

   d; Easy

9. What is the total number of electrons present in an Mg^{2+} ion?

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a. 8
b. 10
c. 12
d. 14
e. 16
b; Easy

Essay Questions

1. Briefly define the term chemical bond and then describe the types of chemical bonds.

Atoms form chemical compounds when the attractive electrostatic interactions between them are stronger than the repulsive interactions. Collectively, we refer to the attractive interactions between atoms as chemical bonds. Chemical bonds are generally divided into two fundamentally different kinds: ionic and covalent. In reality, however, the bonds in most substances are neither purely ionic nor purely covalent, but they are closer to one of these extremes. Ionic compounds consist of positively and negatively charged ions held together by strong electrostatic forces, whereas covalent compounds generally consist of molecules, which are groups of atoms in which one or more pairs of electrons are shared between bonded atoms.
Easy

2. Differentiate between organic and inorganic compounds.

Covalent compounds that contain predominantly carbon and hydrogen are called organic compounds. Compounds that consist primarily of elements other than carbon and hydrogen are called inorganic compounds; they include both covalent and ionic compounds.
Easy

Fill in the Blank

1. In a(n) _____, the atoms are held together by the electrostatic attraction between the positively charged nuclei of the bonded atoms and the negatively charged electrons they share.
covalent bond; Easy

2. Each covalent compound is represented by a(n) _____ , which gives the atomic symbol for each component element, in a prescribed order, accompanied by a subscript indicating the number of atoms of that element in the molecule.
molecular formula; Easy

3. Ions that contain more electrons than protons have a net negative charge and are called _____.
anions; Easy

4. Cl^- is a(n) _____ ion.
monoatomic; Moderate

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5. Chlorine with atomic number 17 would most likely _____ an electron, during ionic bonding, to attain the noble gas configuration of Argon.
gain; Easy

Section 2.2

True/False Questions

1. The formula unit of a compound is the relative numbers of atoms of the elements in a compound, reduced to the smallest whole numbers.
False; Easy

2. Sodium oxide (Na_2O) is a binary ionic compound.
True; Easy

3. The thiocyanate ion (SCN^-) is an example of a polyatomic anion.
True; Easy

4. The dichromate ion ($Cr_2O_7^-$) is an example of a polyatomic cation.
False; Easy

5. The ion pair Na^+ and SO_4^{2-} forms the compound Na_4SO.
False; Easy

Multiple Choice Questions

1. The compound formed from Fe^{3+} and O^{2-} is_____.
   a. FeO
   b. Fe_2O
   c. FeO_2
   d. FeO_3
   e. Fe_2O_3
   e; Easy

2. Which of the following is the compound formed from the ions Pb^{2+} and S^{2-}?
   a. PbS
   b. Pb_2S
   c. PbS_2
   d. $2Pb_2S$
   e. Pb_2S_2
   a; Easy

3. The empirical formula for the compound formed from an aluminum ion and a sulfate ion is _____.
   a. $AlSO_4$
   b. $Al(SO_4)_2$
   c. Al_2SO_4
   d. $(AlSO_4)_2$
   e. $Al_2(SO_4)_3$

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e; Easy

4. Which of the following is the compound formed from the ions Cu^{+} and O^{2-}?
   a. CuO
   b. Cu_2O
   c. CuO_2
   d. CuO_3
   e. Cu_2O_3
   b; Easy

5. Which of the following is the formula of the polyatomic ion peroxide?
   a. O_2^{2-}
   b. CN^{-}
   c. HPO_4^{2-}
   d. HPO_4^{2-}
   e. HPO_3^{2-}
   a; Easy

6. Which of the following is the compound formed from the ions NH_4^{+} and NO_3^{-}?
   a. $N_2O_2H_2$
   b. HNO_3
   c. NO_4NH_3
   d. NH_3NO_4
   e. NH_4NO_3
   e; Easy

Essay Questions

1. **What are polyatomic ions? Give an example of a polyatomic anion and a polyatomic cation.**

   Polyatomic ions are groups of atoms that bear a net electrical charge, although the atoms in a polyatomic ion are held together by the same covalent bonds that hold atoms together in molecules. Just as there are many more kinds of molecules than simple elements, there are many more kinds of polyatomic ions than monatomic ions. An example of a polyatomic cation is the ammonium ion with formula NH_4^{+}. An example of a polyatomic anion is the sulfate ion with formula SO_4^{2-}.
   Easy

Fill in the Blank

1. The _____ of a compound is the relative number of atoms of the elements in a compound, reduced to the smallest whole numbers.
   empirical formula; Easy

2. An ionic compound that contains only two elements, one present as a cation and one as an anion, is called a(n) _____.
   binary ionic compound; Easy

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3. HSO_4^- is an example of a polyatomic _____.
anion; Easy

4. A dichromate ion, $Cr_2O_7^{2-}$, will react with _____ potassium ions to form potassium dichromate.
two; Easy

5. _____ are compounds that contain specific ratios of loosely bound water molecules.
Hydrates; Easy

Section 2.3

True/False Questions

1. The systematic name for cuprous chloride is copper (II) chloride.
False; Easy

2. Two chlorine ions react with one chromium (II) ion to form chromic chloride.
False; Easy

3. $NaClO_4$ is referred to as sodium hypochlorite.
False; Easy

4. $NaC_2H_3O_2$ is called sodium acetate.
True; Easy

Multiple Choice Questions

1. The common name for the compound $Fe_2(SO_4)_3$ is _____.
   a. iron sulfate
   b. ferric sulfate
   c. iron-two sulfate
   d. ferrous sulfate
   e. iron-three sulfate
   b; Easy

2. What is the systematic name of NH_4ClO_4?
   a. Chlorine nitride
   b. Ammonium chlorate
   c. Ammonium chloride
   d. Chlorammonium hydride
   e. Ammonium perchlorate
   e; Easy

3. What is the systematic name for FeS?
   a. Ferric sulfide
   b. Iron(I) sulfide
   c. Iron (II) sulfide

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d. Ferrous sulfide
e. Iron (III) sulfide
c; Easy

4. The formula for sodium bicarbonate is _____.
   a. $NaCO_2$
   b. Na_2CO_3
   c. Na_2HCO_3
   d. $NaHCO_3$
   e. $Na_2(CO_3)_2$
   d; Easy

5. The ion $Cr_2O_7^{2-}$ is called _____.
   a. per chromate
   b. chromite
   c. chromium oxate
   d. chromate
   e. dichromate
   e; Easy

6. The formula for the sulfite ion is _____.
   a. SO_3^{2-}
   b. SO_4^{2-}
   c. SO_2^{-}
   d. SO_2^{3-}
   e. SO_2^{4-}
   a; Easy

7. The systematic name of $Mg(HCO_3)_2$ is _____.
   a. magnesium carbonate
   b. magnesium bicarbonate
   c. magnesium formate
   d. magnesium acetate
   e. manganese (II) bicarbonate
   b; Easy

8. The formula for aluminum sulfite is _____.
   a. $AlSO_3$
   b. $Al_2(SO_3)_2$
   c. $Al_2(SO_4)_3$
   d. $Al_3(SO_3)_2$
   e. $Al_2(SO_3)_3$
   e; Easy

Essay Questions

1. **Explain the different conventions involved in naming a polyatomic anion.**

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Polyatomic anions that contain a single metal or nonmetal atom plus one or more oxygen atoms are called oxoanions. In cases where only two oxoanions are known for an element, the name of the oxoanion with more oxygen atoms ends in -ate, and the name of the oxoanion with fewer oxygen atoms ends in -ite. For example, NO_3^- is nitrate and NO_2^- is nitrite.The halogens and some of the transition metals form more extensive series of oxoanions with as many as four members. In the names of these oxoanions, the prefix per- is used to identify the oxoanion with the most oxygen (so that ClO_4^- is perchlorate and ClO_3^- is chlorate), and the prefix hypo- is used to identify the anion with the fewest oxygen (ClO_2^- is chlorite and ClO^- is hypochlorite).
Moderate

Fill in the Blank

1. Polyatomic anions that contain a single metal or nonmetal atom plus one or more oxygen atoms are called _____.
   oxyanions; Easy

2. The common or old name for iron (II) sulfide is _____.
   ferrous sulfide; Easy

3. $(NH_4)_2SO_4$ is called _____ in the systematic nomenclature.
   ammonium sulfate; Easy

4. The formula for calcium formate is ____.
   $Ca(HCO_2)_2$; Easy

Section 2.4

True/False Questions

1. The formula of nitrogen dioxide is N_2O_2.
   False; Easy

2. The systematic name for OF_2 is oxygen difluoride.
   True; Easy

3. Cyclohexane is a saturated hydrocarbon.
   True; Easy

4. Cyclopropane has four carbon atoms in its structure.
   False; Easy

5. $C_6H_5CH_2OH$ is the condensed molecular formula of phenol.
   False; Easy

Multiple Choice Questions

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1. What is the name of RbS?
   a. Sulfo rhenium
   b. Rhodium sulfide
   c. Sulfo ruthenium
   d. Ruthenium sulfide
   e. Rubidium sulfide
   e; Easy

2. What is the name of Tl_2Se?
   a. Titanium (II) sulfate
   b. Titanium (I) sulfite
   c. Terillium (II) selenide
   d. Thallium (I) selenide
   e. Tungsten (II) sulfide
   d; Moderate

3. Which of the following is the formula of niobium (IV) oxide?
   a. Nb_4O
   b. Ni_4O
   c. NO_2
   d. N_2O_2
   e. NbO_2
   e; Easy

4. The formula of copper (I) oxide is _____.
   a. CuO
   b. Cu_2O
   c. Co_2O_2
   d. Cu_3O_2
   e. CoO
   b; Easy

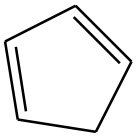
5. Which of the following is the condensed structural formula for isobutane?
   a. $CH_3CH_2CH_2CH_3$
   b. $CH_3CH_3CH_2CH_2$
   c. $CH_3CH_2CH_2CH_3$
   d. $(CH_3)_3CH_2$
   e. $(CH_3)_2CHCH_3$
   e; Easy

6. Which of the following is the simplest alkene?
   a. C_2H_6
   b. C_6H_6
   c. C_2H_4
   d. C_2H_2
   e. C_6H_{12}
   c; Moderate

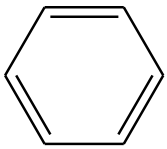
7. Which of the following is the structure of cyclobutane?
   a.

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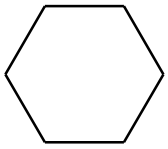
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b.



c.



d.



e.

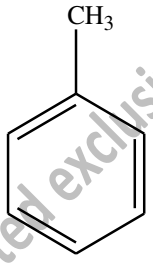


d; Moderate

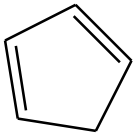
8. What is the name of $CH_3C{\equiv}CCH_3$?
   a. 2-butane
   b. 2-butene
   c. 2-pentene
   d. 2-butyne
   e. 2-cyclobutane

   d; Easy

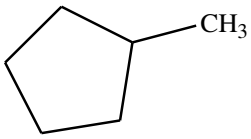
9. Which of the following is the structure of toluene?
   a.



   b.



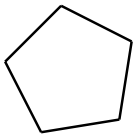
   c.



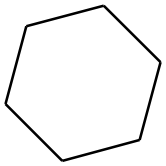
   d.

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e.



a; Moderate

Essay Questions

1. **Briefly describe the four major classes of hydrocarbons. What are saturated and unsaturated hydrocarbons?**

   The four major classes of hydrocarbons are the alkanes, which contain only carbon–hydrogen and carbon–carbon single bonds; the alkenes, which contain at least one carbon–carbon double bond; the alkynes, which contain at least one carbon–carbon triple bond; and the aromatic hydrocarbons, which usually contain rings of six carbon atoms that can be drawn with alternating single and double bonds. Alkanes are also called saturated hydrocarbons, whereas hydrocarbons that contain multiple bonds (alkenes, alkynes, and aromatics) are unsaturated.
   Easy

2. **What are cyclic hydrocarbons? Provide examples of cyclic hydrocarbons, and then explain how to draw cyclic hydrocarbons**.

   In a cyclic hydrocarbon, the ends of a hydrocarbon chain are connected to form a ring of covalently bonded carbon atoms. Cyclic hydrocarbons are named by attaching the prefix cyclo- to the name of the alkane, the alkene, or the alkyne. The simplest cyclic alkanes are cyclopropane (C_3H_6) a flammable gas that is also a powerful anesthetic, and cyclobutane (C_4H_8). The most common way to draw the structures of cyclic alkanes is to sketch a polygon with the same number of vertices as there are carbon atoms in the ring; each vertex represents a CH_2 unit.
   Easy

Fill in the Blank

1. _____ are the simplest class of organic compounds, consisting entirely of carbon and hydrogen.
   Hydrocarbons; Easy

2. Unsaturated hydrocarbons are those which contain multiple bonds such as alkenes and _____.
   alkynes; Easy

3. $CH_3CH_2CH_2CH_2CH_3$ is called _____.
   n-pentane; Easy

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4. The molecular formula for cyclobutane is _____.
C_4H_8; Easy

5. The molecular formula of ethanol is _____.
CH_3CH_2OH; Easy

Section 2.5

True/False Questions

1. Sulfuric acid is an example of an oxoacid.
True; Easy

2. HClO is the formula of perchloric acid.
False; Easy

3. Chlorous acid is the acid formed by adding one proton to the chlorite ion (ClO_2^-).
True; Easy

4. Calcium oxide when dissolved in water results in a basic solution.
True; Easy

5. C_2H_5CHO is an example of carboxylic acids.
False; Easy

Multiple Choice Questions

1. Which of the following is an oxoacid?
   a. Hydrochloric acid
   b. Hypochlorous acid
   c. Hydrocyanic acid
   d. Hydrosulphuric acid
   e. Hydroiodic acid
   b; Easy

2. H_2SO_3 is the formula of _____.
   a. persulfuric acid
   b. hyposulfurous acid
   c. sulfurous acid
   d. hydrosulfuric acid
   e. sulfuric acid
   c; Easy

3. Chloric acid is represented by the formula _____.
   a. HClO
   b. $HClO_2$
   c. $HClO_3$
   d. $HClO_4$
   e. HCl

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c; Easy

4. Which of the following acids is a carboxylic acid?
   a. HClO
   b. HCOOH
   c. HCN
   d. HBr
   e. H_2S
   b; Easy

5. HNO_3 is the name of _____.
   a. hydronitric acid
   b. hyponitrous acid
   c. nitrous acid
   d. pernitric acid
   e. nitric acid
   e; Easy

6. Which of the following when added to water would result in a strongly basic solution?
   a. HClO
   b. NaCl
   c. HCN
   d. MgO
   e. CH_3OH
   d; Easy

7. Which of the following forms a neutral solution when added to water?
   a. NaOH
   b. CH_3OH
   c. HCN
   d. $Mg(OH)_2$
   e. H_2S
   b; Easy

8. Which of the following contains a carbonyl group?
   a. HClO
   b. $Ca(OH)_2$
   c. HCN
   d. CH_3COOH
   e. H_2SO_4
   d; Easy

Essay Questions

1. **Explain the naming of acids in which the proton is attached to an element other than oxygen, and then provide examples of those types of acids.**

   In acids where the H^+ ion is attached to some element (other than oxygen), the name of the acid begins with hydro- and ends in -ic, with the root of the name of

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the other element or ion in between. The name of the anion derived from this kind of acid always ends in -ide. Thus hydrogen chloride (HCl) gas dissolves in water to form hydrochloric acid (which contains H^+ and Cl^- ions), hydrogen cyanide (HCN) gas forms hydrocyanic acid (which contains H^+ and CN^- ions), and so forth. Examples of this kind of acid are commonly encountered and very important. For instance, your stomach contains a dilute solution of hydrochloric acid to help digest food.
Easy

2. **How do amines form, and what is their physiological importance?**

   Replacing a hydrogen atom of NH_3 with an alkyl group results in an amine (RNH_2), which is also a base. Amines have pungent odors—for example, methylamine (CH_3NH_2) is one of the compounds responsible for the foul odor associated with spoiled fish. The physiological importance of amines is suggested in the word vitamin, which is derived from the phrase vital amines. The word was coined to describe dietary substances that were effective at preventing scurvy, rickets, and other diseases because these substances were assumed to be amines. Subsequently, some vitamins have indeed been confirmed to be amines.
   Easy

Fill in the Blank

1. A base is a substance which produces one or more _____ ions and a cation when dissolved in aqueous solutions.
   hydroxide; Easy

2. The common name for the acid with the condensed molecular formula HCO_2H is _____ acid.
   formic; Easy

3. When a proton is added to the sulfite ion (SO_3^{2-}) _____ acid is formed.
   sulfurous acid; Easy

4. Replacing a hydrogen atom of NH_3 with an alkyl group results in a(n) _____.
   amine; Easy

Section 2.6

True/False Questions

1. In a refining tower, the less volatile fractions in petroleum condense near the top of the tower where it is cooler.
   False; Easy

2. During cracking, less volatile, lower-value fractions are converted to more volatile, higher-value mixtures.
   True; Easy

3. The higher the octane rating, the higher quality the fuel.

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True; Easy

4. In the Frasch process, sulfur is extracted from the ground in the form of sulfur dioxide.
False; Easy

Multiple Choice Questions

1. _____ is a process in petroleum refining in which the larger and heavier hydrocarbons in kerosene and higher-boiling-point fractions are heated to high temperatures, causing the carbon–carbon bonds to break, thus producing a more volatile mixture.
a. Reforming
b. Esterificaition
c. Cracking
d. Neutralization
e. Rolling
c; Easy

2. _____ is the second process used in petroleum refining, which is the chemical conversion of straight-chain alkanes to either branched-chain alkanes or mixtures of aromatic hydrocarbons.
a. Curing
b. Volatilization
c. Chromatography
d. Reforming
e. Cracking
d; Easy

3. _____ is a measure of a fuel's ability to burn in a combustion engine without knocking or pinging.
a. Grade level
b. Viscosity
c. Calorific value
d. Purity level
e. Octane rating
e; Easy

4. A fuel has an octane rating of 67. What percentage of MTBE (octane rating 116) must be mixed with this fuel to bring the overall rating of the fuel to 87?
a. 67%
b. 116%
c. 41%
d. 87%
e. 55%
c; Moderate

5. A fuel mixture contains 24% MTBE (octane rating 116) and has an octane rating of 87. What is the octane rating of the fuel without MTBE?
a. 116

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b. 87
c. 58
d. 78
e. 190
d; Moderate

6. In the _____ process, water at high temperature (160°C) and high pressure is pumped underground to melt the sulfur, and compressed air is used to force the liquid sulfur-water mixture to the surface.
   a. contact
   b. lead-chamber
   c. Frasch
   d. Haber's
   e. fuming
   c; Easy

Essay Questions

1. **What is the octane scale, and how are fuels assigned octane ratings?**

   The octane scale was established in 1927 using a standard test engine and two pure compounds: *n*-heptane and isooctane (2, 2, 4-trimethylpentane). *n*-Heptane, which causes a great deal of knocking on combustion, was assigned an octane rating of 0, whereas isooctane, a very smooth-burning fuel, was assigned an octane rating of 100. Chemists assign octane ratings to different blends of gasoline by burning a sample of each in a test engine and comparing the observed knocking with the amount of knocking caused by specific mixtures of *n*-heptane and isooctane. For example, the octane rating of a blend of 89% isooctane and 11% *n*-heptane is simply the average of the octane ratings of the components weighted by the relative amounts of each in the blend. Converting percentages to decimals, we obtain the octane rating of the mixture:
   0.89(100) + 0.11(0) = 89
   A gasoline that performs at the same level as a blend of 89% isooctane and 11% *n*-heptane is assigned an octane rating of 89.
   Moderate

2. **Explain the production of sulfuric acid using elemental sulfur as the starting material.**

   If sulfur is the starting material, the first step in the production of sulfuric acid is the combustion of sulfur with oxygen to produce SO_2. Next, SO_2 is converted to SO_3 by the contact process, in which SO_2 and O_2 react in the presence of V_2O_5 to achieve about 97% conversion to SO_3. The SO_3 can then be treated with a small amount of water to produce sulfuric acid. Usually, however, the SO_3 is absorbed in concentrated sulfuric acid to produce oleum, a more potent form called fuming sulfuric acid. Because of its high SO_3 content (approximately 99% by mass), oleum is cheaper to ship than concentrated sulfuric acid. At the point of use, the oleum is diluted with water to give concentrated sulfuric acid (very carefully because dilution generates enormous amounts of heat). Because SO_2 is a pollutant,

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the small amounts of unconverted SO_2 are recovered and recycled to minimize the amount released into the air.
Easy

Fill in the Blank

1. Fuels having a(n) _____ octane rating combust prematurely causing engine knocking or pinging.
   low; Easy

2. A mixture of 77% isooctane and 23% *n*-heptane has an octane rating of _____.
   77; Easy

3. In the _____ process, sulfur was burned in a large room lined with lead, and the resulting fumes were absorbed in water.
   lead-chamber; Easy

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