

- 1 A weather balloon with a 2-meter diameter at ambient temperature holds 525 grams of helium. What type of electronic probe could be used to determine the pressure inside the balloon?

A barometric
B thermometric
C calorimetric
D spectrophotometric

CSC10177

- 2 Which would be *most* appropriate for collecting data during a neutralization reaction?

A a pH probe
B a statistics program
C a thermometer
D a graphing program

CSC20124

- 3 A scientist observed changes in the gas pressure of one mole of a gas in a sealed chamber with a fixed volume. To identify the source of the changes, the scientist should check for variations in the

A air pressure outside the chamber.
B molecular formula of the gas.
C temperature of the chamber.
D isotopes of the gas.

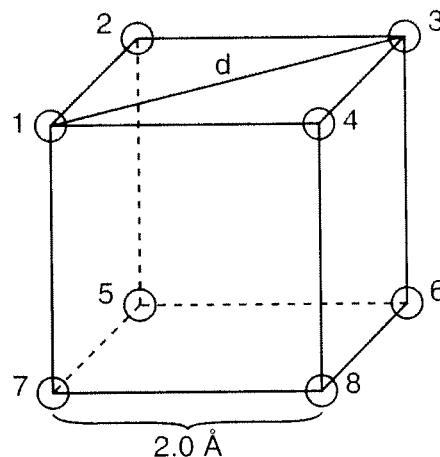
CSC10120

- 4 Electrical fires cannot be safely put out by dousing them with water. However, fire extinguishers that spray solid carbon dioxide on the fire work very effectively. This method works because carbon dioxide

A displaces the oxygen.
B renders the fire's fuel non-flammable.
C forms water vapor.
D blows the fire out with strong wind currents.

CSC00005

5



In the cubic crystal shown, if each edge is 2.0 angstroms in length, what is the diagonal distance, d , between atoms 1 and 3? (Assume that the Pythagorean theorem can be used to solve this problem.)

A 2.5 \AA
B $2\sqrt{2.0} \text{ \AA}$
C $2\sqrt{3.0} \text{ \AA}$
D $3\sqrt{2.0} \text{ \AA}$

CSC00127

- 6 In order to advance to the level of a theory, a hypothesis should be

A obviously accepted by most people.
B a fully functional experiment.
C in alignment with past theories.
D repeatedly confirmed by experimentation.

CSC00144

7 Matter is made of atoms that have positive centers of neutrons and protons surrounded by a cloud of negatively charged electrons. This statement is

- A** a theory.
B a hypothesis.
C an inference.
D an observation.

CSC20129

8

Model of an Ideal Gas	
No.	Corollary
1	Molecules have insignificant volume (point particles).
2	Molecules are very far apart from each other.
3	Molecules are not attracted to each other.
4	Molecules are in continuous, completely random motion in all directions with varying speeds.
5	Molecules bounce off walls and each other perfectly elastically.

The model of ideal gases shown above is useful because it

- A** accurately approximates the properties of most gas molecules.
- B** predicts the behavior of other phases of matter.
- C** gives precise explanations for nonideal gas behavior.
- D** shows a linear relation between gas pressure and volume.

CSC20474

9 When a metal is heated in a flame, the flame has a distinctive color. This information was eventually extended to the study of stars because

- A** the color spectra of stars indicate which elements are present.
- B** a red shift in star color indicates stars are moving away.
- C** star color indicates absolute distance.
- D** it allows the observer to determine the size of stars.

CONCLUSION

10

Periodic Table of the Elements

A schematic representation of the periodic table. The main body is a grid of squares. The first two columns on the left are the s-block. The next six columns are the d-block, containing the elements Cr, Co, Ni, Cu, Zn, and Ga in the fourth period, and Mo, Pd, Ag, Cd, Hg, and Tl in the fifth period. The last two columns on the right are the p-block, containing Ge, As, Se, Br, Kr in the fourth period, and Sn, Sb, Te, I, Xe in the fifth period. A bracket on the left side of the grid, spanning the fourth and fifth periods, indicates the insertion point for the lanthanide and actinide series.

Which of the following ordered pairs of elements shows an increase in atomic number but a decrease in average atomic mass?

- A** Ag to Pd
B Co to Ni
C Ge to Sn
D Cr to Mo

CS(38)149

- CSC20049

- CSC20136

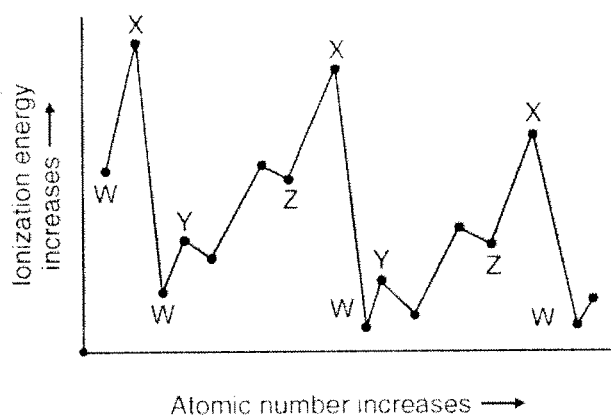
- CSC00028

Chemistry

- 14** Which of the following elements is classified as a metal?

A bromine
 B helium
 C sulfur
 D lithium

CSC20170

15

The chart above shows the relationship between the first ionization energy and the increase in atomic number. The letter on the chart for the alkali family of elements is

A W.
 B X.
 C Y.
 D Z.

CSC00206

- 16** Which of the following atoms has the largest atomic radius?

A barium (Ba)
 B chlorine (Cl)
 C iodine (I)
 D magnesium (Mg)

CSC10393

- 17** Which of the following atoms has six valence electrons?

A magnesium (Mg)
 B silicon (Si)
 C sulfur (S)
 D argon (Ar)

CSC00185

- 18** Which statement *best* describes the density of an atom's nucleus?

A The nucleus occupies most of the atom's volume but contains little of its mass.
 B The nucleus occupies very little of the atom's volume and contains little of its mass.
 C The nucleus occupies most of the atom's volume and contains most of its mass.
 D The nucleus occupies very little of the atom's volume but contains most of its mass.

CSC10304

19

Results of Firing Alpha Particles at Gold Foil

Observation:	Proportion:
Alpha particles went straight through gold foil.	> 98%
Alpha particles went through gold foil but were deflected at large angles.	≈ 2%
Alpha particles bounced off gold foil.	≈ 0.01%

What information do the experimental results above reveal about the nucleus of the gold atom?

- A The nucleus contains less than half the mass of the atom.
- B The nucleus is small and is the densest part of the atom.
- C The nucleus contains small positive and negative particles.
- D The nucleus is large and occupies most of the atom's space.

CSC20056

20

Why are enormous amounts of energy required to separate a nucleus into its component protons and neutrons even though the protons in the nucleus repel each other?

- A The force of the protons repelling each other is small compared to the attraction of the neutrons to each other.
- B The electrostatic forces acting between other atoms lowers the force of repulsion of the protons.
- C The interactions between neutrons and electrons neutralize the repulsive forces between the protons.
- D The forces holding the nucleus together are much stronger than the repulsion between the protons.

CSC00136

21

The most abundant isotope of lead contains 82 protons and 124 neutrons packed closely together in the nucleus. Why do the protons stay together in the nucleus rather than fly apart?

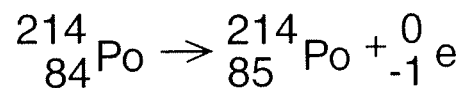
- A Electrons in neighboring atoms neutralize repulsive forces between protons.
- B Neutrons effectively block the protons and keep them far apart to prevent repulsion.
- C Electrostatic forces between neutrons and protons hold the nucleus together.
- D Nuclear forces overcome repulsive forces between protons in the nucleus.

CSC20451

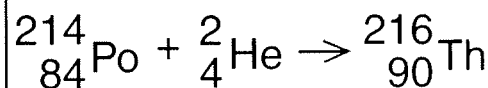
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Which equation correctly represents the alpha decay of polonium-214?

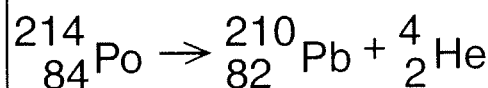
A



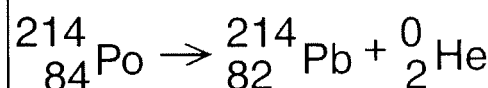
B



C



D



CSC10110

Chemistry

- 23 A 2-cm-thick piece of cardboard placed over a radiation source would be *most* effective in protecting against which type of radiation?

A alpha
B beta
C gamma
D x-ray

CSC00299

- 24 Which of the following is a monatomic gas at STP?

A chlorine
B fluorine
C helium
D nitrogen

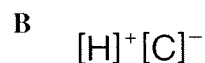
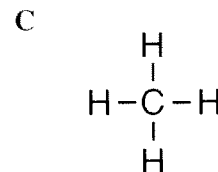
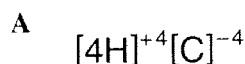
CSC10387

- 25 When cations and anions join, they form what kind of chemical bond?

A ionic
B hydrogen
C metallic
D covalent

CSC20314

- 26 Which of the following correctly shows how carbon and hydrogen bond to form a compound?



CSC00237

- 27 Some of the molecules found in the human body are $\text{NH}_2\text{CH}_2\text{COOH}$ (glycine), $\text{C}_6\text{H}_{12}\text{O}_6$ (glucose), and $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ (stearic acid). The bonds they form are

A nuclear.
B metallic.
C ionic.
D covalent.

CSC10230

28

Table of Common Molecules				
Name	Hydrogen	Chlorine	Ammonia	Methane
Molecular Formula	H_2	Cl_2	NH_3	CH_4

What type of bond do all of the molecules in the table above have in common?

A covalent
B ionic
C metallic
D polar

CSC00334

CSC00150

CSC20144

CSC10388

6780

CS030323

CSC 10080

Chemistry

35 Which element is capable of forming stable, extended chains of atoms through single, double, or triple bonds with itself?

- A carbon
- B oxygen
- C nitrogen
- D hydrogen

CSC20155

36 Proteins are large macromolecules composed of thousands of subunits. The structure of the protein depends on the sequence of

- A lipids.
- B monosaccharides.
- C amino acids.
- D nucleosides.

CSC00062

37 When a cold tire is inflated to a certain pressure and then is warmed up due to friction with the road, the pressure increases. This happens because the

- A air molecules hit the walls of the tire less frequently.
- B rubber in the tire reacts with oxygen in the atmosphere.
- C air molecules speed up and collide with the tire walls more often.
- D air molecules diffuse rapidly through the walls of the tire.

CSC00183

38 When someone standing at one end of a large room opens a bottle of vinegar, it may take several minutes for a person at the other end to smell it. Gas molecules at room temperature move at very high velocities, so what is responsible for the delay in detection of the vinegar?

- A the increase in the airspace occupied by vinegar molecules
- B the chemical reaction with nerves, which is slower than other sensory processes
- C attractive forces between the air and vinegar molecules
- D random collisions between the air and vinegar molecules

CSC00125

39 Methane (CH_4) gas diffuses through air because the molecules are

- A moving randomly.
- B dissolving quickly.
- C traveling slowly.
- D expanding steadily.

CSC20840

40 The volume of 400 mL of chlorine gas at 400 mm Hg is decreased to 200 mL at constant temperature. What is the new gas pressure?

- A 400 mm Hg
- B 300 mm Hg
- C 800 mm Hg
- D 650 mm Hg

CSC00239

41 Under what circumstance might a gas decrease in volume when heated?

- A The gas is held constant at STP.
- B The gas remains under uniform temperature.
- C The gas is placed under increasing pressure.
- D The gas undergoes a decrease in pressure.

CSC20333

42 A sample of carbon dioxide gas occupies a volume of 20 L at standard temperature and pressure (STP). What will be the volume of a sample of argon gas that has the same number of moles and pressure but twice the absolute temperature?

- A 10 L
- B 20 L
- C 40 L
- D 80 L

CSC10250

43 Standard temperature and pressure (STP) are defined as

- A 0 °C and 1.0 atm pressure.
- B 0 °C and 273 mm Hg pressure.
- C 0 K and 1.0 atm pressure.
- D 0 K and 760 mm Hg pressure.

CSC00285

44 Under which of the following sets of conditions will a 0.50 mole sample of helium occupy a volume of 11.2 liters?

- A 298 K and 0.90 atm
- B 273 K and 1.10 atm
- C 373 K and 0.50 atm
- D 273 K and 1.00 atm

CSC10234

45 What is the equivalent of 423 kelvin in degrees Celsius?

- A -223 °C
- B -23 °C
- C 150 °C
- D 696 °C

CSC00089

46 Theoretically, when an ideal gas in a closed container cools, the pressure will drop steadily until the pressure inside is essentially that of a vacuum. At what temperature should this occur?

- A 0 °C
- B -460 °C
- C -273 K
- D 0 K

CSC10216

47 The temperature at which all molecular motion stops is

- A -460 °C.
- B -273 K.
- C 0 K.
- D 0 °C.

CSC20088

Chemistry

48

SOLUBILITY OF SUBSTANCES IN WATER @ 20 °C		
Substance	Formula/State	Solubility (g/100g H ₂ O)
Magnesium chloride	MgCl ₂ / solid	54.6
Ammonia	NH ₃ / gas	34.0
Ethanol	CH ₃ CH ₂ OH / liquid	infinite
Benzoic Acid	C ₆ H ₅ COOH / solid	0.29

Which of the substances in the table can act as either the solute or the solvent when mixed with 100 grams of water at 20 °C?

- A NH₃
- B C₆H₅COOH
- C MgCl₂
- D CH₃CH₂OH

CSC10055

49

A teaspoon of dry coffee crystals dissolves when mixed in a cup of hot water. This process produces a coffee solution. The original crystals are classified as a

- A solute.
- B solvent.
- C reactant.
- D product.

CSC20256

50

If the attractive forces among solid particles are less than the attractive forces between the solid and a liquid, the solid will

- A probably form a new precipitate as its crystal lattice is broken and re-formed.
- B be unaffected because attractive forces within the crystal lattice are too strong for the dissolution to occur.
- C begin the process of melting to form a liquid.
- D dissolve as particles are pulled away from the crystal lattice by the liquid molecules.

CSC10058

51

Water is a polar solvent, while hexane is a nonpolar solvent.

Solute	Water	Hexane
NH ₄ Cl, ammonium chloride	Soluble	Insoluble
C ₁₀ H ₈ , naphthalene	Insoluble	Soluble
C ₂ H ₅ OH, ethanol	Soluble	Soluble
CO(NH ₂) ₂ , urea	Soluble	Insoluble

Which of the examples above illustrates a nonpolar solute in a polar solvent?

- A NH₄Cl in water
- B C₁₀H₈ in water
- C C₂H₅OH in hexane
- D CO(NH₂)₂ in hexane

CSC20958

- 52** A technician prepared a solution by heating 100 milliliters of distilled water while adding KCl crystals until no more KCl would dissolve. She then capped the clear solution and set it aside on the lab bench. After several hours she noticed the solution had become cloudy and some solid had settled to the bottom of the flask. Which statement *best* describes what happened?

A As the solution cooled, evaporation of water increased the KCl concentration beyond its solubility.

B Water molecules, trapped with the KCl crystals, were released after heating.

C At lower temperatures the solubility of the KCl decreased and recrystallization occurred.

D At increased temperatures the solubility of KCl increased and remained too high after cooling.

CSC00012

- 53** If the solubility of NaCl at 25 °C is 36.2 g/100 g H₂O, what mass of NaCl can be dissolved in 50.0 g of H₂O?

A 18.1 g

B 36.2 g

C 72.4 g

D 86.2 g

CSC00275

- 54** How many moles of HNO₃ are needed to prepare 5.0 liters of a 2.0 M solution of HNO₃?

A 2.5

B 5

C 10

D 20

CSC10375

- 55** The Dead Sea is the saltiest sea in the world. It contains 332 grams of salt per 1000 grams of water. What is the concentration in parts per million (ppm)?

A 0.332 ppm

B 332 ppm

C 33,200 ppm

D 332,000 ppm

CSC20046

- 56** The random molecular motion of a substance is greatest when the substance is

A condensed.

B a liquid.

C frozen.

D a gas.

CSC00258

- 57** Which of these is an example of an exothermic chemical process?

A evaporation of water

B melting ice

C photosynthesis of glucose

D combustion of gasoline

CSC00153

Chemistry

58 The boiling point of liquid nitrogen is 77 kelvin. It is observed that ice forms at the opening of a container of liquid nitrogen. The *best* explanation for this observation is

- A water at zero degrees Celsius is colder than liquid nitrogen and freezes.
- B the nitrogen boils and then cools to form a solid at the opening of the container.
- C water trapped in the liquid nitrogen escapes and freezes.
- D the water vapor in the air over the opening of the liquid nitrogen freezes out.

CSC00171

59 The specific heat of copper is about 0.4 joules/gram °C. How much heat is needed to change the temperature of a 30-gram sample of copper from 20.0 °C to 60.0 °C?

- A 1000 J
- B 720 J
- C 480 J
- D 240 J

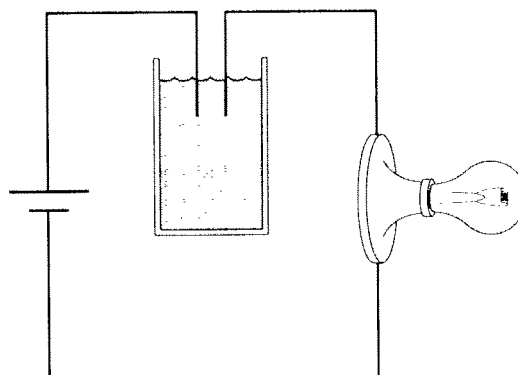
CSC00045

60 Equal volumes of 1 molar hydrochloric acid (HCl) and 1 molar sodium hydroxide base (NaOH) are mixed. After mixing, the solution will be

- A strongly acidic.
- B weakly acidic.
- C nearly neutral.
- D weakly basic.

CSC00188

61



The above picture shows a light bulb connected to a battery with the circuit interrupted by a solution. When dissolved in the water to form a 1.0 molar solution, all of the following substances will complete a circuit allowing the bulb to light *except*

- A hydrochloric acid.
- B sodium nitrate.
- C sucrose.
- D ammonium sulfate.

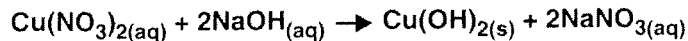
CSC00146

62 Which of the following is an observable property of many acids?

- A They become slippery when reacting with water.
- B They react with metals to release hydrogen gas.
- C They produce salts when mixed with other acids.
- D They become more acidic when mixed with a base.

CSC20338

- 63 Copper (II) nitrate and sodium hydroxide solutions react in a test tube as shown below.



If nitric acid is added to the test tube, the amount of solid precipitate decreases. The *best* explanation for this is that the acid

- A dilutes the solution making the precipitate dissolve.
- B reacts with the copper (II) nitrate, pulling the equilibrium to the left.
- C will dissolve most solids, including sodium nitrate.
- D will react with the copper (II) hydroxide to form water and soluble copper (II) nitrate.

CSC00160

- 64 Potassium hydroxide (KOH) is a strong base because it

- A easily releases hydroxide ions.
- B does not dissolve in water.
- C reacts to form salt crystals in water.
- D does not conduct an electric current.

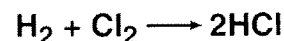
CSC20341

- 65 Of four different laboratory solutions, the solution with the *highest* acidity has a pH of

- A 11.
- B 7.
- C 5.
- D 3.

CSC00173

66

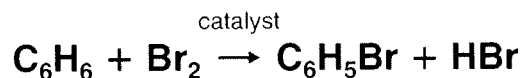


Which of these describes the rate of this chemical reaction?

- A an increase in the concentration of HCl and H_2 with time
- B an increase in the concentration of HCl with time
- C an increase in H_2 and Cl_2 with time
- D a decrease in HCl and Cl_2 with time

CSC10369

67



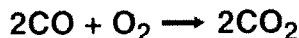
Which of the following changes will cause an increase in the rate of the above reaction?

- A increasing the concentration of Br_2
- B decreasing the concentration of C_6H_6
- C increasing the concentration of HBr
- D decreasing the temperature

CSC00027

Chemistry

68



If the above reaction takes place inside a sealed reaction chamber, then which of these procedures will cause a decrease in the rate of reaction?

- A raising the temperature of the reaction chamber
- B increasing the volume inside the reaction chamber
- C removing the CO_2 as it is formed
- D adding more CO to the reaction chamber

CSC00106

69

A catalyst can speed up the rate of a given chemical reaction by

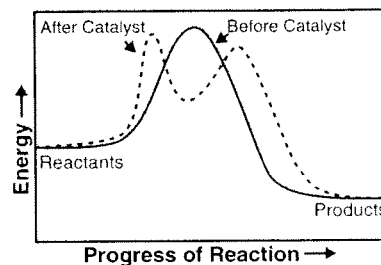
- A increasing the equilibrium constant in favor of products.
- B lowering the activation energy required for the reaction to occur.
- C raising the temperature at which the reaction occurs.
- D increasing the pressure of reactants, thus favoring products.

CSC00184

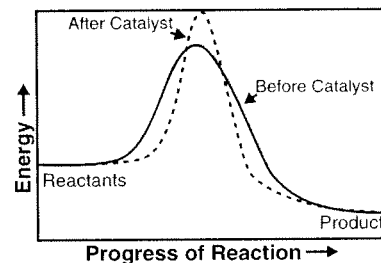
70

Which reaction diagram shows the effect of using the appropriate catalyst in a chemical reaction?

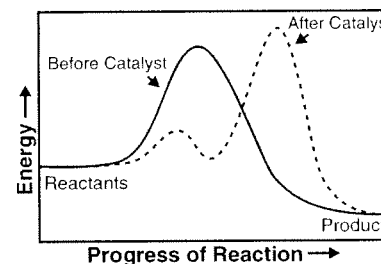
A



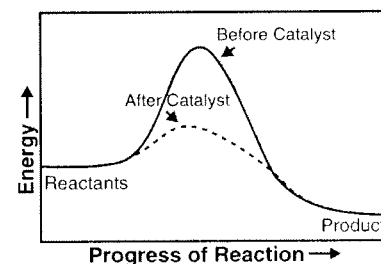
B



C



D



CSC 20412

71 H_2O_2 , hydrogen peroxide, naturally breaks down into H_2O and O_2 over time. MnO_2 , manganese dioxide, can be used to lower the energy of activation needed for this reaction to take place and, thus, increase the rate of reaction. What type of substance is MnO_2 ?

- A a catalyst
- B an enhancer
- C an inhibitor
- D a reactant

CSC10368

72 When a reaction is at equilibrium and more reactant is added, which of the following changes is the immediate result?

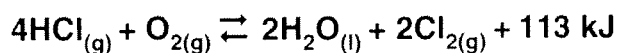
- A The reverse reaction rate remains the same.
- B The forward reaction rate increases.
- C The reverse reaction rate decreases.
- D The forward reaction rate remains the same.

CSC00248

73 In which of the following reactions involving gases would the forward reaction be favored by an increase in pressure?

- A $\text{A} + \text{B} \rightleftharpoons \text{AB}$
- B $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$
- C $2\text{A} + \text{B} \rightleftharpoons \text{C} + 2\text{D}$
- D $\text{AC} \rightleftharpoons \text{A} + \text{C}$

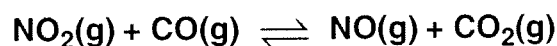
CSC100129

74

Which action will drive the reaction to the right?

- A heating the equilibrium mixture
- B adding water to the system
- C decreasing the oxygen concentration
- D increasing the system's pressure

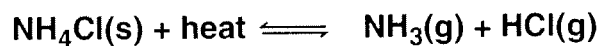
CSC10082

75

The reaction shown above occurs inside a closed flask. What action will shift the reaction to the left?

- A pumping CO gas into the closed flask
- B raising the total pressure inside the flask
- C increasing the NO concentration in the flask
- D venting some CO_2 gas from the flask

CSC20419

76

What kind of change will shift the reaction above to the right to form more products?

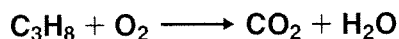
- A a decrease in total pressure
- B an increase in the concentration of HCl
- C an increase in the pressure of NH_3
- D a decrease in temperature

CSC20103

Chemistry

- 77** In a sealed bottle that is half full of water, equilibrium will be attained when water molecules
- A cease to evaporate.
 - B begin to condense.
 - C are equal in number for both the liquid and the gas phase.
 - D evaporate and condense at equal rates.

CSC00152

78

This chemical equation represents the combustion of propane. When correctly balanced, the coefficient for water is

- A 2.
- B 4.
- C 8.
- D 16.

CSC00311

- 79** Which of the following is a balanced equation for the combustion of ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)?

- A $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- B $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \longrightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
- C $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \longrightarrow 2\text{CO}_2 + 3\text{HO}$
- D $\text{CH}_3\text{CH}_2\text{OH} + 2\text{O}_2 \longrightarrow 3\text{CO}_2 + 2\text{H}_2\text{O}$

CSC10401

- 80** Hydrazine, N_2H_4 , and dinitrogen tetroxide, N_2O_4 , react to form gaseous nitrogen and water. Which of these represents a properly balanced equation for this reaction?

- A $\text{N}_2\text{H}_4 + \text{N}_2\text{O}_4 \rightarrow \text{N}_2 + \text{H}_2\text{O}$
- B $2\text{N}_2\text{H}_4 + \text{N}_2\text{O}_4 \rightarrow 2\text{N}_2 + 4\text{H}_2\text{O}$
- C $2\text{N}_2\text{H}_4 + \text{N}_2\text{O}_4 \rightarrow 3\text{N}_2 + 4\text{H}_2\text{O}$
- D $2\text{N}_2\text{H}_4 + 3\text{N}_2\text{O}_4 \rightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$

CSC00092

81

When the reaction above is completely balanced, the coefficient for NH_3 will be

- A 2.
- B 3.
- C 4.
- D 6.

CSC20068

- 82** How many moles of carbon-12 are contained in exactly 6 grams of carbon-12?

- A 0.5 mole
- B 2.0 moles
- C 3.01×10^{23} moles
- D 6.02×10^{23} moles

CSC00068

- 83** How many atoms are contained in 97.6 g of platinum (Pt)?

A 5.16×10^{30}
 B 3.01×10^{23}
 C 1.20×10^{24}
 D 1.10×10^{28}

CSC00255

- 84** When methane (CH_4) gas is burned in the presence of oxygen, the following chemical reaction occurs.



If 1 mole of methane reacts with 2 moles of oxygen, then

- A 6.02×10^{23} molecules of CO_2 and 6.02×10^{23} molecules of H_2O are produced.
 B 1.2×10^{24} molecules of CO_2 and 1.2×10^{24} molecules of H_2O are produced.
 C 6.02×10^{23} molecules of CO_2 and 1.2×10^{24} molecules of H_2O are produced.
 D 1.2×10^{24} molecules of CO_2 and 6.02×10^{23} molecules of H_2O are produced.

CSC20428

- 85** How many moles of CH_4 are contained in 96.0 grams of CH_4 ?

A 3.00 moles
 B 6.00 moles
 C 12.0 moles
 D 16.0 moles

CSC00162

- 86** How many atoms are in a chromium sample with a mass of 13 grams?

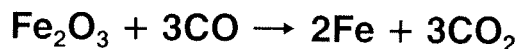
A 1.5×10^{23}
 B 3.3×10^{23}
 C 1.9×10^{26}
 D 2.4×10^{24}

CSC10251

- 87** How many moles of chlorine gas are contained in 9.02×10^{23} molecules?

A 1.5 moles
 B 2.0 moles
 C 6.02 moles
 D 9.03 moles

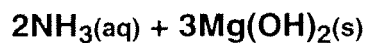
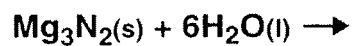
CSC10373

88

In this reaction, how many grams of Fe_2O_3 are required to completely react with 84 grams of CO ?

A 64 g
 B 80 g
 C 160 g
 D 1400 g

CSC00159

Chemistry**89**

If 54.0 grams of water are mixed with excess magnesium nitride, then how many grams of ammonia are produced?

- A 1.00
- B 17.0
- C 51.0
- D 153

CSC20076

90

A mass of 5.4 grams of aluminum (Al) reacts with an excess of copper (II) chloride (CuCl_2) in solution, as shown below.



What mass of solid copper (Cu) is produced?

- A 0.65 g
- B 8.5 g
- C 13 g
- D 19 g

CSC10496