

Part A

Answer all questions in this part.

Directions (1–30): For each statement or question, record on your separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Chemistry.

- Compared to the charge of a proton, the charge of an electron has
 - a greater magnitude and the same sign
 - a greater magnitude and the opposite sign
 - the same magnitude and the same sign
 - the same magnitude and the opposite sign
- Which atom has the largest atomic radius?
 - potassium
 - rubidium
 - francium
 - cesium
- In the wave-mechanical model of the atom, an orbital is defined as
 - a region of the most probable proton location
 - a region of the most probable electron location
 - a circular path traveled by a proton around the nucleus
 - a circular path traveled by an electron around the nucleus
- When an excited electron in an atom moves to the ground state, the electron
 - absorbs energy as it moves to a higher energy state
 - absorbs energy as it moves to a lower energy state
 - emits energy as it moves to a higher energy state
 - emits energy as it moves to a lower energy state
- Which polyatomic ion is found in the compound represented by the formula NaHCO_3 ?
 - acetate
 - hydrogen carbonate
 - hydrogen sulfate
 - oxalate
- The atomic mass of magnesium is the weighted average of the atomic masses of
 - all of the artificially produced isotopes of Mg
 - all of the naturally occurring isotopes of Mg
 - the two most abundant artificially produced isotopes of Mg
 - the two most abundant naturally occurring isotopes of Mg
- Which element has atoms that can form halide ions?
 - iodine
 - silver
 - strontium
 - xenon
- Two forms of solid carbon, diamond and graphite, differ in their physical properties due to the differences in their
 - atomic numbers
 - crystal structures
 - isotopic abundances
 - percent compositions
- Which quantity can be calculated for a solid compound, given only the formula of the compound and the Periodic Table of the Elements?
 - the density of the compound
 - the heat of fusion of the compound
 - the melting point of each element in the compound
 - the percent composition by mass of each element in the compound
- Which terms identify types of chemical reactions?
 - decomposition and sublimation
 - decomposition and synthesis
 - deposition and sublimation
 - deposition and synthesis

- 11 The greatest amount of energy released per gram of reactants occurs during a
- (1) redox reaction
 - (2) fission reaction
 - (3) substitution reaction
 - (4) neutralization reaction
- 12 Which element has atoms with the strongest attraction for electrons in a chemical bond?
- (1) chlorine
 - (2) nitrogen
 - (3) fluorine
 - (4) oxygen
- 13 Compared to the physical and chemical properties of the compound NO_2 , the compound N_2O has
- (1) different physical properties and different chemical properties
 - (2) different physical properties and the same chemical properties
 - (3) the same physical properties and different chemical properties
 - (4) the same physical properties and the same chemical properties
- 14 Which phrase describes a molecule of CH_4 , in terms of molecular polarity and distribution of charge?
- (1) polar with an asymmetrical distribution of charge
 - (2) polar with a symmetrical distribution of charge
 - (3) nonpolar with an asymmetrical distribution of charge
 - (4) nonpolar with a symmetrical distribution of charge
- 15 Which sample of copper has atoms with the *lowest* average kinetic energy?
- (1) 10. g at 45°C
 - (2) 20. g at 35°C
 - (3) 30. g at 25°C
 - (4) 40. g at 15°C
- 16 Which change results in the formation of different substances?
- (1) burning of propane
 - (2) melting of $\text{NaCl}(s)$
 - (3) deposition of $\text{CO}_2(g)$
 - (4) solidification of water
- 17 Which substance can *not* be broken down by a chemical change?
- (1) ammonia
 - (2) ethanol
 - (3) propanal
 - (4) zirconium
- 18 According to Table I, which equation represents a change resulting in the greatest quantity of energy released?
- (1) $2\text{C}(s) + 3\text{H}_2(g) \rightarrow \text{C}_2\text{H}_6(g)$
 - (2) $2\text{C}(s) + 2\text{H}_2(g) \rightarrow \text{C}_2\text{H}_4(g)$
 - (3) $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$
 - (4) $\text{N}_2(g) + \text{O}_2(g) \rightarrow 2\text{NO}(g)$
- 19 Which element is a liquid at STP?
- (1) bromine
 - (2) cesium
 - (3) francium
 - (4) iodine
- 20 Which statement describes a reversible reaction at equilibrium?
- (1) The activation energy of the forward reaction must equal the activation energy of the reverse reaction.
 - (2) The rate of the forward reaction must equal the rate of the reverse reaction.
 - (3) The concentration of the reactants must equal the concentration of the products.
 - (4) The potential energy of the reactants must equal the potential energy of the products.
- 21 Given the balanced equation representing a reaction:
- $$\text{O}_2 \rightarrow \text{O} + \text{O}$$
- What occurs during this reaction?
- (1) Energy is absorbed as bonds are broken.
 - (2) Energy is absorbed as bonds are formed.
 - (3) Energy is released as bonds are broken.
 - (4) Energy is released as bonds are formed.
- 22 In terms of entropy and energy, systems in nature tend to undergo changes toward
- (1) lower entropy and lower energy
 - (2) lower entropy and higher energy
 - (3) higher entropy and lower energy
 - (4) higher entropy and higher energy

23 Which term is defined as the difference between the potential energy of the products and the potential energy of the reactants in a chemical reaction?

- (1) activation energy (3) heat of fusion
(2) thermal energy (4) heat of reaction

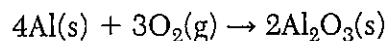
24 What is the atomic number of the element whose atoms bond to each other in chains, rings, and networks?

- (1) 10 (3) 6
(2) 8 (4) 4

25 How many pairs of electrons are shared between two adjacent carbon atoms in a saturated hydrocarbon?

- (1) 1 (3) 3
(2) 2 (4) 4

26 Given the balanced equation representing a reaction:



As the aluminum loses 12 moles of electrons, the oxygen

- (1) gains 4 moles of electrons
(2) gains 12 moles of electrons
(3) loses 4 moles of electrons
(4) loses 12 moles of electrons

27 Which compound is an electrolyte?

- (1) CH_3CHO (3) CH_3COOH
(2) CH_3OCH_3 (4) $\text{CH}_3\text{CH}_2\text{CH}_3$

28 Which statement describes one acid-base theory?

- (1) An acid is an H^+ acceptor, and a base is an H^+ donor.
(2) An acid is an H^+ donor, and a base is an H^+ acceptor.
(3) An acid is an H^- acceptor, and a base is an H^- donor.
(4) An acid is an H^- donor, and a base is an H^- acceptor.

29 Which compounds are classified as Arrhenius acids?

- (1) HCl and NaOH
(2) HNO_3 and NaCl
(3) NH_3 and H_2CO_3
(4) HBr and H_2SO_4

30 Which statement describes the stability of the nuclei of potassium atoms?

- (1) All potassium atoms have stable nuclei that spontaneously decay.
(2) All potassium atoms have unstable nuclei that do not spontaneously decay.
(3) Some potassium atoms have unstable nuclei that spontaneously decay.
(4) Some potassium atoms have unstable nuclei that do not spontaneously decay.

Part B-1

Answer all questions in this part.

Directions (31–50): For each statement or question, record on your separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Chemistry.

31 Which notations represent different isotopes of the element sodium?

- (1) ^{32}S and ^{34}S (3) Na^+ and Na^0
 (2) S^{2-} and S^{6+} (4) ^{22}Na and ^{23}Na

32 Which electron configuration represents the electrons in an atom of Ga in an excited state?

- (1) 2-8-17-3 (3) 2-8-18-3
 (2) 2-8-17-4 (4) 2-8-18-4

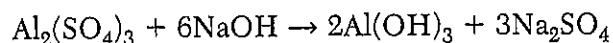
33 Which statement describes the general trends in electronegativity and first ionization energy as the elements in Period 3 are considered in order from Na to Cl?

- (1) Electronegativity increases, and first ionization energy decreases.
 (2) Electronegativity decreases, and first ionization energy increases.
 (3) Electronegativity and first ionization energy both increase.
 (4) Electronegativity and first ionization energy both decrease.

34 What is the gram-formula mass of $\text{Fe}(\text{NO}_3)_3$?

- (1) 146 g/mol (3) 214 g/mol
 (2) 194 g/mol (4) 242 g/mol

35 Given the balanced equation representing a reaction:



The mole ratio of NaOH to $\text{Al}(\text{OH})_3$ is

- (1) 1:1 (3) 3:1
 (2) 1:3 (4) 3:7

36 Which equation represents a single replacement reaction?

- (1) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
 (2) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 (3) $\text{H}_2\text{SO}_4 + \text{Mg} \rightarrow \text{H}_2 + \text{MgSO}_4$
 (4) $\text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{H}_2\text{O}$

37 The accepted value for the percent by mass of water in a hydrate is 36.0%. In a laboratory activity, a student determined the percent by mass of water in the hydrate to be 37.8%. What is the percent error for the student's measured value?

- (1) 5.0% (3) 1.8%
 (2) 4.8% (4) 0.05%

38 The boiling points, at standard pressure, of four compounds are given in the table below.

Boiling Points of Four Compounds

Compound	Boiling Point (°C)
H_2O	100.0
H_2S	-59.6
H_2Se	-41.3
H_2Te	-2.0

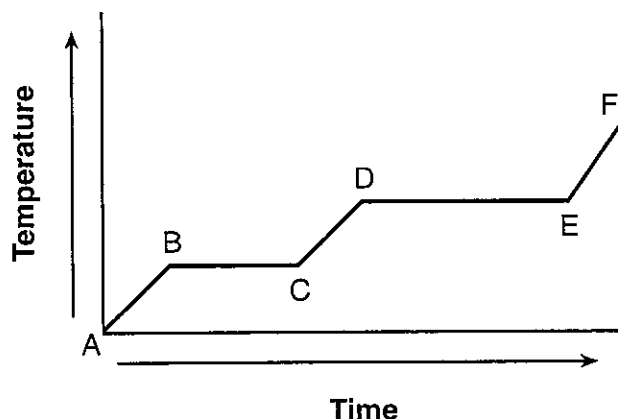
Which type of attraction can be used to explain the unusually high boiling point of H_2O ?

- (1) ionic bonding
 (2) hydrogen bonding
 (3) polar covalent bonding
 (4) nonpolar covalent bonding

39 Which formula represents a molecule with the most polar bond?

- (1) CO (3) HI
 (2) NO (4) HCl

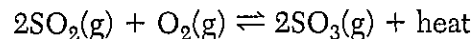
- 40 The graph below represents the uniform heating of a substance from the solid to the gas phase.



Which line segment of the graph represents boiling?

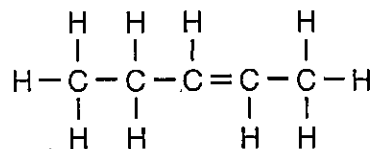
- (1) \overline{AB} (2) \overline{BC} (3) \overline{CD} (4) \overline{DE}
- 41 A 1-gram sample of a compound is added to 100 grams of $\text{H}_2\text{O}(\ell)$ and the resulting mixture is then thoroughly stirred. Some of the compound is then separated from the mixture by filtration. Based on Table F, the compound could be
- (1) AgCl (2) CaCl_2 (3) NaCl (4) NiCl_2
- 42 At standard pressure, the total amount of heat required to completely vaporize a 100.-gram sample of water at its boiling point is
- (1) $2.26 \times 10^1 \text{ J}$ (2) $2.26 \times 10^2 \text{ J}$ (3) $2.26 \times 10^3 \text{ J}$ (4) $2.26 \times 10^5 \text{ J}$
- 43 A sample of helium gas is in a sealed, rigid container. What occurs as the temperature of the sample is increased?
- (1) The mass of the sample decreases.
 (2) The number of moles of gas increases.
 (3) The volume of each atom decreases.
 (4) The frequency of collisions between atoms increases.

- 44 Given the equation representing a reaction at equilibrium:



Which change causes the equilibrium to shift to the right?

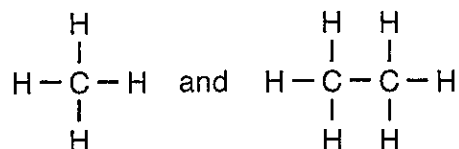
- (1) adding a catalyst
 (2) adding more $\text{O}_2(\text{g})$
 (3) decreasing the pressure
 (4) increasing the temperature
- 45 Given the formula representing a compound:



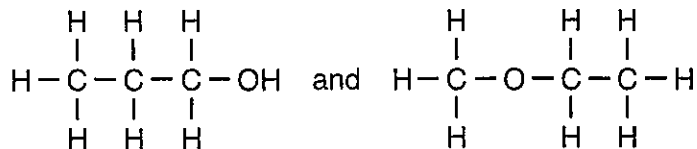
What is a chemical name of this compound?

- (1) 2-pentene (2) 2-pentyne (3) 3-pentene (4) 3-pentyne
- 46 What is the oxidation number of manganese in KMnO_4 ?
- (1) +7 (2) +2 (3) +3 (4) +4
- 47 When the pH of an aqueous solution is changed from 1 to 2, the concentration of hydronium ions in the solution is
- (1) decreased by a factor of 2
 (2) decreased by a factor of 10
 (3) increased by a factor of 2
 (4) increased by a factor of 10
- 48 What is the color of the indicator thymol blue in a solution that has a pH of 11?
- (1) red (2) blue (3) pink (4) yellow

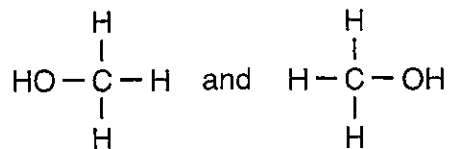
49 Which formulas represent compounds that are isomers of each other?



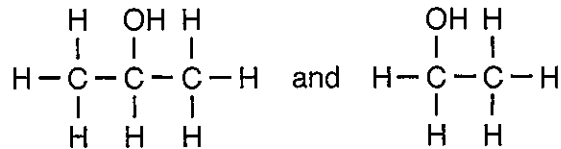
(1)



(3)



(2)



(4)

50 One beneficial use of radioisotopes is

- (1) detection of disease
- (2) neutralization of an acid spill
- (3) decreasing the dissolved $\text{O}_2(\text{g})$ level in seawater
- (4) increasing the concentration of $\text{CO}_2(\text{g})$ in the atmosphere

Part B-2

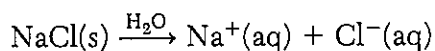
Answer all questions in this part.

Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Chemistry.

- 51 Draw a Lewis electron-dot diagram for a molecule of bromomethane, CH_3Br . [1]
- 52 Explain, in terms of atomic structure, why Group 18 elements on the Periodic Table rarely form compounds. [1]
- 53 Explain, in terms of electrons, why the radius of a potassium atom is larger than the radius of a potassium ion in the ground state. [1]
- 54 Identify the type of bonding in solid potassium. [1]

Base your answers to questions 55 and 56 on the information below and on your knowledge of chemistry.

A 2.50-liter aqueous solution contains 1.25 moles of dissolved sodium chloride. The dissolving of $\text{NaCl}(s)$ in water is represented by the equation below.



- 55 Determine the molarity of this solution. [1]
- 56 Compare the freezing point of this solution to the freezing point of a solution containing 0.75 mole NaCl per 2.50 liters of solution. [1]
-

Base your answers to questions 57 and 58 on the information below and on your knowledge of chemistry.

A 1.00-mole sample of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, completely reacts with oxygen, as represented by the balanced equation below.



- 57 Write the empirical formula for glucose. [1]
- 58 Using the axes in your answer booklet, complete the potential energy curve for the reaction of glucose with oxygen. [1]
-

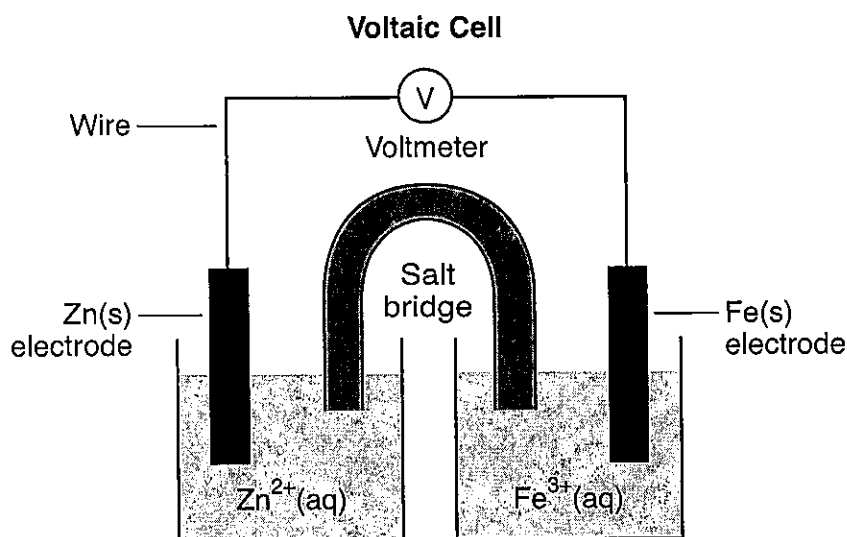
Base your answers to questions 59 through 61 on the information below and on your knowledge of chemistry.

Ethane, C_2H_6 , has a boiling point of $-89^\circ C$ at standard pressure. Ethanol, C_2H_5OH , has a much higher boiling point than ethane at standard pressure. At STP, ethane is a gas and ethanol is a liquid.

- 59 Identify the class of organic compounds to which ethanol belongs. [1]
- 60 A liquid boils when the vapor pressure of the liquid equals the atmospheric pressure on the surface of the liquid. Based on Table H, what is the boiling point of ethanol at standard pressure? [1]
- 61 Compare the intermolecular forces of the two substances at STP. [1]
-

Base your answers to questions 62 through 65 on the information below and on your knowledge of chemistry.

An operating voltaic cell has zinc and iron electrodes. The cell and the unbalanced ionic equation representing the reaction that occurs in the cell are shown below.



- 62 Identify the subatomic particles that flow through the wire as the cell operates. [1]
- 63 Balance the equation *in your answer booklet* for the redox reaction that occurs in this cell, using the smallest whole-number coefficients. [1]
- 64 Identify *one* metal from Table J that is more easily oxidized than Zn. [1]
- 65 Explain, in terms of Zn atoms and Zn ions, why the mass of the Zn electrode *decreases* as the cell operates. [1]
-

Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

Base your answers to questions 66 through 69 on the information below and on your knowledge of chemistry.

A student compares some models of the atom. These models are listed in the table below in order of development from top to bottom.

Models of the Atom

Model	Observation	Conclusion
Dalton model	Matter is conserved during a chemical reaction.	Atoms are hard, indivisible spheres of different sizes.
Thomson model	Cathode rays are deflected by magnetic/electric fields.	Atoms have small, negatively charged particles as part of their internal structure.
Rutherford model	Most alpha particles pass straight through gold foil but a few are deflected.	An atom is mostly empty space with a small, dense, positively charged nucleus.
Bohr model	Unique spectral lines are emitted by excited gaseous elements.	Packets of energy are absorbed or emitted by atoms when an electron changes shells.

- 66 State the model that first included electrons as subatomic particles. [1]
- 67 State *one* conclusion about the internal structure of the atom that resulted from the gold foil experiment. [1]
- 68 Using the conclusion from the Rutherford model, identify the charged subatomic particle that is located in the nucleus. [1]
- 69 State *one* way in which the Bohr model agrees with the Thomson model. [1]
-

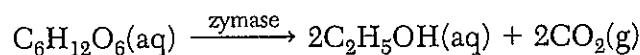
Base your answers to questions 70 through 72 on the information below and on your knowledge of chemistry.

Paintball is a popular recreational activity that uses a metal tank of compressed carbon dioxide or nitrogen to launch small capsules of paint. A typical tank has a volume of 508 cubic centimeters. A 340.-gram sample of carbon dioxide is added to the tank before it is used for paintball. At 20.°C, this tank contains both CO₂(g) and CO₂(ℓ). After a paintball game, the tank contains only CO₂(g).

- 70 Determine the total number of moles of CO₂ added to the tank before it is used for paintball. [1]
- 71 In the box *in your answer booklet*, use the key to draw a particle diagram to represent the two phases of CO₂ in a newly filled tank. Your response must include *at least six* molecules of CO₂ in *each* phase. [1]
- 72 After the paintball game, the tank has a gas pressure of 6.1 atmospheres and is at 293 K. If the tank is heated to 313 K, the pressure in the tank will change. Show a numerical setup for calculating the pressure of the gas in the tank at 313 K. [1]
-

Base your answers to questions 73 through 75 on the information below and on your knowledge of chemistry.

Many breads are made by adding yeast to dough, causing the dough to rise. Yeast is a type of microorganism that produces the catalyst zymase, which converts glucose, C₆H₁₂O₆, to ethanol and carbon dioxide gas. The balanced equation for this reaction is shown below.



- 73 Draw a structural formula for the ethanol formed during this reaction. [1]
- 74 Describe how the catalyst, zymase, speeds up this reaction. [1]
- 75 Determine the total mass of ethanol produced when 270. grams of glucose reacts completely to form ethanol and 132 grams of carbon dioxide. [1]
-

Base your answers to questions 76 through 79 on the information below and on your knowledge of chemistry.

During a laboratory activity, a student places 25.0 mL of $\text{HCl}(\text{aq})$ of unknown concentration into a flask. The student adds four drops of phenolphthalein to the solution in the flask. The solution is titrated with 0.150 M $\text{KOH}(\text{aq})$ until the solution appears faint pink. The volume of $\text{KOH}(\text{aq})$ added is 18.5 mL.

- 76 What number of significant figures is used to express the concentration of the $\text{KOH}(\text{aq})$? [1]
- 77 Complete the equation *in your answer booklet* for the neutralization reaction that occurs during the titration. [1]
- 78 Determine the concentration of the $\text{HCl}(\text{aq})$ solution, using the titration data. [1]
- 79 Describe *one* laboratory safety procedure that should be used if a drop of the $\text{KOH}(\text{aq})$ is spilled on the arm of the student. [1]
-

Base your answers to questions 80 through 82 on the information below and on your knowledge of chemistry.

A few pieces of dry ice, $\text{CO}_2(\text{s})$, at -78°C are placed in a flask that contains air at 21°C . The flask is sealed by placing an uninflated balloon over the mouth of the flask. As the balloon inflates, the dry ice disappears and no liquid is observed in the flask.

- 80 State the direction of heat flow that occurs between the dry ice and the air in the flask. [1]
- 81 Write the name of the process that occurs as the dry ice undergoes a phase change in the flask. [1]
- 82 Compare the entropy of the CO_2 molecules in the dry ice to the entropy of the CO_2 molecules in the inflated balloon. [1]
-

Base your answers to questions 83 through 85 on the information below and on your knowledge of chemistry.

Illuminated EXIT signs are used in public buildings such as schools. If the word EXIT is green, the sign may contain the radioisotope tritium, hydrogen-3. The tritium is a gas sealed in glass tubes. The emissions from the decay of the tritium gas cause a coating on the inside of the tubes to glow.

- 83 State, in terms of neutrons, how an atom of tritium *differs* from an atom of hydrogen-1. [1]
- 84 Determine the fraction of an original sample of tritium that remains unchanged after 24.62 years. [1]
- 85 Complete the nuclear equation *in your answer booklet* for the radioactive decay of tritium, by writing a notation for the missing product. [1]
-

Measurements and Calculations

Mixed Metric and American Conversions: Show ALL work, using dimensional analysis, and answer in scientific notation.

1. 0.014 kilograms to centigrams
2. 4.305 liters to milliliters
3. 61.2 microliters to milliliters
4. 5.48 centimeters to millimeters
5. 3.80 km to meters
6. 40.6 decimeters to decameters
7. 3.88 miles to hectometers
8. 2.994 ounces to milligrams
9. 926 tons to Megagrams
10. How many centimeters are there in 7.88×10^2 feet?
11. Convert 6.775 yards to picometers.
12. Convert 5.47×10^{-2} hectograms to ounces
13. How many centimeters are there in 51.004 miles

Density: Show ALL work, use dimensional analysis when necessary.

14. If an unknown solid weighs 84.0 grams and occupies 30.0 cm³ of space, what is its density?
15. What is the mass of a liquid having a density of 1.50 g/ml and a volume of 3.5 liters?
16. What volume would a 200 gram sample of gold have if its density is known to be 20.5 g/cm³?
K H D M D C M
17. A solid block of substance is 74.0 cm by 55.0 cm by 29.0 cm and it weighs 625 kg. Assuming that it did not chemically react with water nor dissolve in it, would it float in water? Show your work.
18. A gas has a volume of 7.0 liters and a mass of 4.44×10^5 micrograms. What is its density?
19. A certain liquid has a density of 0.855 g/ml. How many LITERS would weigh 1.00 kg?

Dimensional Analysis (Exercising Problem Solving Skills): Show ALL work, using dimensional analysis, Report answers using the correct number of significant figures.

20. The record long jump is 349.5 inches. Convert this to meters. There are 2.54 cm in an inch.
21. A car traveling 55.0 miles per hour. Convert this to meters per second. 1 mile = 1.61 km.
22. How many milligrams are there in a 5.00 grain aspirin tablet? 1 grain = 0.00229 ounces. There are 454 grams/pound and 16.0 ounces/pound.
23. Mercury has a density of 13.54 g/mL. How many milliliters would 100. grams fill?
24. In 1980, the US produces 18.4 billion pounds (1.84×10^{10} lbs) of phosphoric acid to be used in the manufacture of fertilizer. The average cost of the acid is \$318/ton. (1 ton = 2000 lbs) What was the total value of the phosphoric acid produced?
25. On planet Zizzag, city Astric is 35.0 digs from city Betrek. The latest in teenage transportation is a Zeka which can travel a maximum of 115 millidigs/zip. On Zizzag their time system divides each dyne into 25.0 zips. How many dyne will it take Pezzi to get from Astric to Betrek to see his girlfriend?
26. While prospecting in the North Woods, Joe found a gold nugget which had a density of 19.2 g/cm³. Joe dropped the gold into water in a graduated cylinder, the water level increased by 15.0 mL. How many grams of gold did he have?
27. Light travels at a speed of 3.00×10^{10} cm/sec. What is the speed of light in km/hr?
28. A cheetah has been clocked at 112 km/hr over a 100. meter distance. What is this speed in m/sec?

Stoichiometry

Complete the following problems using dimensional analysis. Balance all of the equations that need to be balanced. The answers are given in parenthesis at the end of each problem.

1. In the decomposition of sodium hydroxide, how many moles of sodium hydroxide are needed to produce 30.0 moles of water? (60.0 moles NaOH)
2. In the single replacement reaction of lithium and magnesium nitrate, what mass of lithium combines with 75.0 grams of magnesium nitrate? (7.02 g Li)
3. How many grams of lead (II) nitrate are needed to produce 60.0 grams of potassium nitrate in the double replacement reaction of potassium iodide and lead (II) nitrate. (98.3 g lead (II) nitrate)
4. In the synthesis reaction of zinc(II) and sulfur, what mass of zinc (II) sulfide is produced from 100.0 grams of sulfur? (303.9 g ZnS)
5. A synthesis reaction of calcium and oxygen was completed in a lab and 234.9 grams of calcium oxide were produced from 75.00 grams of oxygen. What is the percent yield? (89.36%)
6. In the single replacement reaction of magnesium and aluminum phosphate, if 7.00 moles of magnesium react, how many moles of aluminum phosphate would be needed? (4.67 mol AlPO_4)
7. When methane and oxygen react (complete combustion reaction) how many grams of water would be produced from 25.0 grams of methane? (56.1g water)
8. A 26.3 gram sample of potassium chlorate decomposed and produced 9.45 grams of oxygen. What is the percent yield for oxygen? (91.7%)
9. If 7.40 grams of calcium hydroxide react with nitric acid to produce 2.01 grams of water, what is the percent yield? (55.8%)
10. Lime, CaO, reacts with hydrochloric acid to form calcium chloride and water. How many moles of HCl would be required to react with 7.5 moles of lime? How many moles of water would be formed? (15 mol HCl; 7.5 mol water)

For each of the following write balanced chemical equations and then solve the problem.

11. What is the maximum number of grams of PH_3 that can be formed when 6.2 g of phosphorus reacts with 6.0 g of hydrogen to form PH_3 ?
12. Copper is formed when aluminum reacts with cupric sulfate in a single-replacement reaction. How many grams of copper can be obtained when 29.0 g of Al reacts with 156 g of cupric sulfate?
13. If you begin with 1250 g of N_2 and 225 g of H_2 in the reaction that forms ammonia gas (NH_3), how much ammonia will be formed? What is the limiting reagent? How much of the reagent is left when the maximum amount of ammonia is formed?

Composition

Complete the following problems showing all work and with answers using the correct significant digits.

1. A 0.941 gram piece of magnesium metal is heated and reacts with oxygen. The resulting oxide weighed 1.560 grams. Determine the percent composition of each element in the compound.
2. Determine the empirical formula given the following data for each compound:
 - a) Fe = 63.53%, S = 36.47%
 - b) Fe = 46.55%, S = 53.45%
3. A compound contains 21.6% sodium, 33.0% chlorine, 45.1% oxygen. Determine the empirical formula of the compound.
4. A 2.500 gram sample of uranium was heated in air. The resulting oxide weighed 2.949 gram. Determine the empirical formula of the oxide. {Hint: Carry out the calculations to four decimal places}.
5. When 1.010 g of zinc vapor is burned in air, 1.257 grams of the oxide is produced.
 - a) What elements are present in the oxide?
 - b) Determine the percent composition of each element in the oxide.
 - c) Determine the empirical formula of the compound.
6. A compound has the empirical formula of CH_3Br and a vapor density of 6.00 g/L, at 375 K and 0.983 atm. Using these data, determine the following:
 - a) The molar mass of the compound.
 - b) The molecular formula of the compound.
7. A compound containing the elements C, H, N, and O is analyzed. When a 1.2359 gram sample is burned in excess oxygen, 2.241 g of $\text{CO}_2(\text{g})$ is formed. The combustion analysis showed that the sample contained 0.0648 g of H.
 - a) Determine the mass, in grams, of C in the 1.2359 g sample of the compound.
 - b) When the compound is analyzed for N content only, the mass percent of N is found to be 28.84%. Determine the mass, in grams, of N in the original 1.2359 g sample of compound.
 - c) Determine the mass, in grams, of O in the original 1.2359 g sample of the compound.
 - d) Determine the empirical formula of the compound.

Naming Chemical Compounds

The following are a good mix of naming and formula writing problems to help you get some practice. I will expect that you know how to name both ionic and covalent compounds in your work.

Name the following chemical compounds:

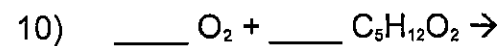
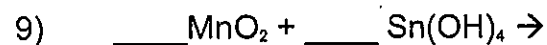
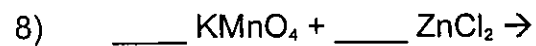
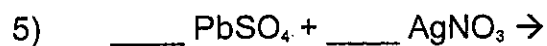
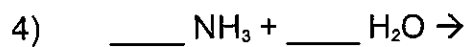
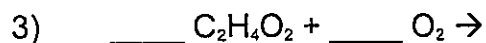
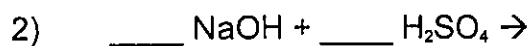
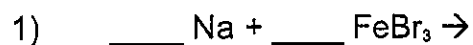
- 1) NaBr _____
- 2) $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$ _____
- 3) P_2O_5 _____
- 4) $\text{Ti}(\text{SO}_4)_2$ _____
- 5) FePO_4 _____
- 6) K_3N _____
- 7) SO_2 _____
- 8) CuOH _____
- 9) $\text{Zn}(\text{NO}_2)_2$ _____
- 10) V_2S_3 _____

Write the formulas for the following chemical compounds:

- 11) silicon dioxide _____
- 12) nickel (III) sulfide _____
- 13) manganese (II) phosphate _____
- 14) silver acetate _____
- 15) diboron tetrabromide _____
- 16) magnesium sulfate heptahydrate _____
- 17) potassium carbonate _____
- 18) ammonium oxide _____
- 19) tin (IV) selenide _____
- 20) carbon tetrachloride _____

Predicting Reaction Products

Balance the equations and predict the products and states of matter (assumer reactions are taking place at STP) for the following reactions. If no reaction occurs write 'NR'.



AP Chem Summer Assignment Worksheet #6

Name the following (give classical and stock names where appropriate).

1. PbCl_2
2. NaOH
3. K_2SO_4
4. NH_4NO_3
5. Cu_3PO_4
6. AgI
7. MgS
8. $\text{Fe}(\text{ClO})_3$
9. $\text{Zn}(\text{CN})_2$
10. $(\text{NH}_4)_2\text{O}$

Write the chemical formula for the following, and draw a lewis dot diagram.

11. sodium chloride
12. magnesium iodide
13. potassium sulfide
14. gallium oxide
15. aluminum phosphide

Write the chemical formula for the following.

16. silver nitrate
17. iron (II) hydroxide
18. magnesium phosphate
19. tin (IV) iodide
20. potassium chlorate
21. sodium hypochlorite
22. zinc nitrate
23. sodium bicarbonate
24. Explain why ionic compounds are able to conduct electricity. Under what conditions will they conduct? Under what conditions will they not conduct?
25. Explain why you would use parentheses in a chemical formula.
26. Why do ionic compounds have high melting points?
27. What physical state are ionic compounds likely to be found in at room temperature? (Hint: see #26)
28. Why are many transition metals capable of forming more than one cation?

AP Chem Summer Assignment Worksheet #7

Name the following (give classical and stock names where appropriate).

1. CaCO_3
2. $\text{Ni}_3(\text{PO}_3)_2$
3. $\text{Cu}(\text{CN})_2$
4. $\text{Zn}(\text{OH})_2$
5. NH_4ClO_3
6. NaClO
7. AgNO_3
8. PbSO_4

Write the chemical formula for the following, and draw a lewis dot diagram.

9. sodium bromide
10. potassium oxide
11. magnesium chloride
12. lithium sulfide
13. calcium nitride

Write the chemical formula for the following.

14. lead (IV) hydride
15. silver bromide
16. copper (II) nitrate
17. manganese (III) chlorite
18. iron (III) sulfate
19. lead (II) hydroxide
20. tin (IV) phosphate
21. ammonium hypochlorite
22. sodium bicarbonate
23. chromium (II) permanganate

AP Chem Summer Assignment Worksheet #8

Round the following to 3 significant figures:

- 1) 0912
- 2) 31
- 3) 092,300.2
- 4) 129
- 5) 31.07
- 6) 100
- 7) 1202
- 8) 3×10^{12}
- 9) 6.09201×10^{-3}
- 10) 7.1×10^9

Round the following to 2 significant figures:

- 11) .7034
- 12) 879900
- 13) 5500.
- 14) 3000
- 15) 7.991×10^{13}
- 16) .0891
- 17) 0901
- 18) 830.
- 19) 800
- 20) 3

Complete the following calculations, and round answer to correct significant figures.

- 21) $34 \text{ m} \times 5.4 \text{ m}$
- 22) $2.0 \text{ kg} \div 4 \text{ kg}$
- 23) $10.34 \text{ s} \div 11 \text{ s}$
- 24) $5.1 \text{ g} + 14.1910 \text{ g}$
- 25) $10 \text{ L} \times 1052 \text{ L}$
- 26) $49.3473 \text{ kg} + 45.2 \text{ kg}$
- 27) $.012 \text{ cm} \times 300. \text{ cm}$
- 28) $(0.32 \times 10^{-4} \text{ cm}) \times (4.803 \times 10^{-2} \text{ cm})$
- 29) $500 \text{ mm} \times 48.1 \text{ mm}$
- 30) $(12.5 \text{ m}) \times (5.3 \text{ m})$
- 31) $(9.2 \text{ mm} \times 6.829 \text{ mm}) + 4.5 \text{ mm}^2$
- 32) $(53.0 \text{ g} / 5.6 \text{ mL}) \times 4 \text{ mL}$
- 33) $(31 \text{ cm} \times 2 \text{ cm}) + .26 \text{ cm}^2$
- 34) $2.0 \text{ km} - 1.2 \text{ km} \times 3.4 \text{ km}$
- 35) $[(1.60 \times 10^8 \text{ cm}) / (4.107 \times 10^1 \text{ cm})] + 110$
- 36) $(8.2 \times 10^{-1} \text{ m}^2) + (5.7 \times 10^{-1} \text{ m}^2)$
- 37) $4 \text{ s} + 9.72 \text{ s} + 250. \text{ s}$
- 38) $(70 \text{ cm}^3 / 2.2 \text{ s}) \times 800$
- 39) $(26.002 \text{ g} + 5.000017 \text{ g}) \times 2.6$
- 40) $(1.67 \times 10^{12} \text{ km})(1.00 \times 10^2 \text{ km}) + 2.3 \text{ km}^2$

