Chem 1A
Test-1 Review

1. (a) A swimming pool is 50.0 m long and 25.0 m wide, and it has an average depth of 7.00 ft. How many liters of water is needed to completely fill the swimming pool? (b) If the swimming pool water contains 115 mg $CaCO_3$/L, how many kilograms (kg) of $CaCO_3$ are present in the swimming pool water? (Given: 1 foot = 12 inches; 1 inch = 2.54 cm (exactly); 1 m = 100 cm; 1 $m^3 = 10^3$ L)

2. (a) What is 98.6^oF in degrees Celsius (^oC) and in Kelvin?

   (b) What is 233 K in degrees Celsius (^oC) and in Fahrenheit (^oF)?

3. Indicate whether each of the following is a physical or chemical process:

   (a) Silver tarnishes;
   (b) Butter turns rancid;
   (c) Salt dissolves in water;
   (d) The toast is burnt;
   (e) The alcohol has evaporated;
   (f) The egg is hard-boiled;
   (g) The lake is frozen;
   (h) The wood is rotting;
   (*i*) Sugar crystallizes.
   (j) The grape juice has fermented.

4. Classify each of the following as a pure substance (element or compound), a homogeneous or heterogeneous mixture:

   (a) a bag of coffee beans;
   (b) a gallon of nonfat milk;
   (c) A teaspoon of table sugar;
   (d) A tank of gasoline;
   (e) Muddy river water;
   (f) A tablespoon of sulfur powder.

5. A cylindrical metal rod is 1.35 m long, and it has a uniform diameter of 0.750 inch. What is the volume of metal rod in cm^3? If the metal has a density of 2.70 g/cm^3, what is the mass of the rod?

6. Suppose that mercury forms a perfect spherical droplet with a diameter of 5.0 mm. (a) What is the volume of the mercury droplet in cubic centimeters (cm^3)? (b) If the density of mercury is 13.6 g/cm^3, calculate the mass of the droplet. (c) How many mercury atoms are present in the droplet? (Volume of sphere = $(4/3)\pi r^3$)

7. Complete the following table for isotopes of elements.

Name of Element	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons	Isotope Symbol
Magnesium				13	10	
	15			16	15	
						$^{63}_{29}Cu$
		108	47		46	
						$^{207}_{82}Pb^{2+}$

8. Name each of the following compounds:

(a) $HClO_4$: _____;

(b) Ag_3PO_4: _____;

(c) SiF_4 :_____;

(d) KH_2PO_4:_____;

(e) $CuSO_4$:_____;

(f) N_2O_4 : _____;

(g) $Ni(OH)_2$:_____;

(h) NH_4NO_3:_____;

(*i*) $HC_2H_3O_2$:_____;

(j) $Ca(OCl)_2$:_____.

9. Write the correct formula of each of the following compounds:

(a) Calcium nitrate: _____;

(b) Sodium phosphate: _____;

(c) Cobalt(II) chloride: _____;

(d) Lead(II) acetate:_____;

(e) Titanium(IV) oxide:_____;

(f) Ammonium sulfate:_____

(g) Diphosphorus pentasulfide:_____

(h) Sulfuric acid: _____

(*i*) Barium hydroxide:_____

(j) Potassium dichromate:_____

10. Write a balanced equation for each reaction described below:

(a) A solid sample of magnesium nitride reacts with water to form solid magnesium hydroxide and aqueous ammonia.

(b) When heated, solid ammonium carbonate decomposes to produce ammonia gas, carbon diuoxidde gas, and water vapor.

(c) Liquid phosphorus pentachloride reacts with water to form phosphoric acid and hydrochloric acid solution.

11. Balance the following chemical equations.

(a) $C_4H_{10}O(l) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$;

(b) $NH_3(g) + O_2(g) \rightarrow NO(g) + H_2O(g)$;

(c) $Ca(NO_3)_2(aq) + Na_3PO_4(aq) \rightarrow Ca_3(PO_4)_2(s) + NaNO_3(aq)$;

(d) $FeCl_3(aq) + Na_2S(aq) \rightarrow Fe_2S_3(s) + NaCl(aq)$;

(e) $Ca_3P_2(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) + PH_3(g)$

12. Tungsten has two naturally occurring isotopes with the following atomic masses and natural abundances: ^{185}W (184.953 *u*; 37.07%) and ^{187}W (186.956 *u*; 62.93%). Calculate the weighted average atomic mass of tungsten.

13. Element-X forms an oxide with the formula X_2O_3. If the mass percent of oxygen in the oxide is 17.3%, calculate the atomic mass of E and identify element-X.

14. A compound is composed of 40.0% carbon, 6.72% hydrogen, and 53.28% oxygen, by mass. (a) Determine the empirical formula of the compound. (b) If the molar mass of the compound is 150 g/mol, determine the molecular formula.

15. (a) Calculate the molar mass of ammonium nitrate, NH_4NO_3. (b) What is the mass percent of nitrogen in ammonium nitrate? (c) How many kilograms of nitrogen are present in a 10.0-lb bag of ammonium nitrate? (d) How many kilograms of ammonium nitrate contain 1.00 lb of nitrogen? (1 lb = 453.6 g)

16. Ammonium phosphate fertilizer is prepared by the following reaction:

$$3\ NH_{3(g)} + H_3PO_{4(aq)} \rightarrow (NH_4)_3PO_{4(s)}$$

(a) How many grams of ammonia and phosphoric acid, respectively, are required to produce 1.00 kg of ammonium phosphate, $(NH_4)_3PO_4$, if the reaction has 100% yield?
(b) How many grams of ammonia and phosphoric acid, respectively, are required to produce 1.00 kg of ammonium phosphate, $(NH_4)_3PO_4$, if the reaction has 85.0% yield?

17. Consider the following reaction: $3I_{2(s)} + 6NaOH_{(aq)} \rightarrow 5NaI_{(aq)} + NaIO_{3(aq)} + 3H_2O_{(l)}$
(a) If the reaction is carried out using 30.0 g of I_2 and 12.0 g of NaOH, which reactant will be completely reacted if the reaction is allowed to go to completion? (b) How many grams of NaI would be produced when the limiting reactant is completely reacted and the reaction has 100% yield?
(c) What is the percent yield if 24.0 grams of NaI are produced?

18. (a) Calculate the molar mass of Cobalt(II) chloride hexahydrate, $CoCl_2 \cdot 6H_2O$. (b) If 15.0 g of this compound is dissolved in 250.0 mL of solution, what is the molarity of $CoCl_2$? (c) How many grams of $CoCl_2 \cdot 6H_2O$ are required to prepare 500.0 mL of 0.150 *M* $CoCl_2$ solution?

19. Sea water contains 3.5% NaCl, by mass. (a) If the density of seawater is 1.02 g/mL, how many grams of NaCl are present in 1.00 L of sea water? (b) What is the molarity of NaCl in seawater?

20. (a) If sea water contains 3.5% NaCl, by mass, how many grams of NaCl can be obtained from 1.00 gallon of sea water? (b) How many gallon of seawater will yield 454 g of NaCl?
(Assume density of seawater = 1.02 g/mL; 1 gallon = 3.7854 L)

Answers:

1. (a) 2.67×10^6 L; (b) 3.07 kg
2. (a) 37.0°C and 310.2 K; (b) 233 K = –40.0°C; –40.0°F;
3. (a) chemical (b) chemical (c) physical (d) chemical (e) physical
   (f) chemical (g) physical (h) chemical (*i*) physical (j) chemical
4. (a) heterogeneous mixture (b) homogeneous mixture (c) compound
   (d) homogeneous mixture (e) heterogeneous mixture (f) element
5. Volume of rod = 385 cm^3; Mass = 1.04×10^3 g or 1.04 kg
6. Volume of mercury = 0.065 cm^3; mass of mercury = 0.89 g; # of atom = 2.7×10^{21}
7.

Name of Element	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons	Isotope Symbol
Magnesium	(12)	(25)	(12)	13	10	$^{25}_{12}Mg^{2+}$
(Phosphorus)	15	(31)	(15)	16	15	$^{31}_{15}P$
(Copper)	(29)	(63)	(29)	(34)	(29)	$^{63}_{29}Cu$
(Silver)	(47)	108	47	(61)	46	$^{108}_{47}Ag^{+}$
(Lead)	(82)	(207)	(82)	(125)	(80)	$^{207}_{82}Pb^{2+}$

8. (a) Perchloric acid (b) Silver phosphate (c) Silicon tetrafluoride
   (d) Potassium dihydrogen phosphate (e) Copper(II) sulfate (f) Dinitrogen tetroxide
   (g) Nickel(II) hydroxide (h) Ammonium nitrate (*i*) Acetic acid
   (j) Calcium hypochloride
9. (a) $Ca(NO_3)_2$ (b) Na_3PO_4 (c) $CoCl_2$ (d) $Pb(C_2H_3O_2)_2$ (e) TiO_2
   (f) $(NH_4)_2SO_4$ (g) P_2S_5 (h) H_3PO_4 (*i*) $Ba(OH)_2$ (j) $K_2Cr_2O_7$)
10. (a) $Mg_3N_2(s) + 6H_2O(l) \rightarrow 3Mg(OH)_2(s) + 2NH_3(aq)$;
    (b) $(NH_4)_2CO_3(s) \rightarrow 2NH_3(g) + CO_2(g) + H_2O(g)$;
    (c) $PCl_5(l) + 4H_2O(l) \rightarrow H_3PO_4(aq) + 5HCl(aq)$
11. (a) $C_4H_{10}O(l) + \mathbf{6}\ O_2(g) \rightarrow \mathbf{4}\ CO_2(g) + \mathbf{5}\ H_2O(g)$;
    (b) $\mathbf{4}NH_3(g) + \mathbf{5}\ O_2(g) \rightarrow \mathbf{4}\ NO(g) + \mathbf{6}\ H_2O(g)$;
    (c) $\mathbf{3}Ca(NO_3)_2(aq) + \mathbf{2}Na_3PO_4(aq) \rightarrow Ca_3(PO_4)_2(s) + \mathbf{6}\ NaNO_3(aq)$;
    (d) $\mathbf{2}FeCl_3(aq) + \mathbf{3}Na_2S(aq) \rightarrow Fe_2S_3(s) + \mathbf{6}NaCl(aq)$;
    (e) $Ca_3P_2(s) + \mathbf{6}H_2O(l) \rightarrow \mathbf{3}Ca(OH)_2(aq) + \mathbf{2}PH_3(g)$
12. Average atomic mass of tungsten = 186.2 *u*
13. Atomic mass of element-X = 114.8 g/mole; X = Indium (In)
14. (a) Empirical formula = CH_2O; (b) molecular formula = $C_5H_{10}O_5$;
16. (a) 343 g NH_3 and 658 g H_3PO_4; (b) 403 g NH_3 and 774 g H_3PO_4
17. (a) I_2 will be completely consumed; (b) 4.92 g of NaI expected; (c) Percent yield = 78.3%
18. (a) molar mass = 237.94 g/mol; (b) 0.252 *M* (c) 17.8 g of $CoCl_2 \cdot 6H_2O$
19. (a) 36 g of NaCl (b) 0.61 *M*
20. (a) 140 g NaCl; (b) 3.4 gallons