

Chemistry 106: General Chemistry

Syracuse University Project Advance

Fall 2014 Exam #1

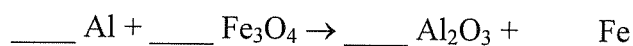
Name _____ Date _____

- (1) Which one of the following is an **extensive** property?
- (a) density
 - (b) mass
 - (c) boiling point
 - (d) freezing point
 - (e) all are extensive properties
- (2) Platinum has a density of 21.4 g/cm^3 . What is the mass of 5.9 cm^3 of this metal? (express correctly the number of significant figures in your answer)
- (a) 0.276 g
 - (b) $1.3 \times 10^2 \text{ g}$
 - (c) 126. g
 - (d) 3.6 g
 - (e) 3.63 g
- (3) The number of significant figures in the mass measured as 0.05010 is
- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5
- (4) A solution is a
- (a) pure mixture
 - (b) heterogeneous mixture
 - (c) pure element
 - (d) homogeneous mixture
 - (e) pure compound

- (5) The melting point and the normal boiling point of water can be used to calibrate thermometers. What are these respective temperatures in Kelvin degrees?
- (a) 32 and 212
 - (b) 0 and 100
 - (c) 100 and 273
 - (d) 0 and 373
 - (e) 273 and 373
- (6) Which of the statements I-V is (are) correct?
- I. Barium Nitrate is $\text{Ba}(\text{NO}_3)_2$
 - II. Calcium carbonate is CaCO_3
 - III. Sodium perchlorate is NaClO_4
 - IV. Lithium carbonate is Li_2CO_3
 - V. KNO_3 is potassium nitrate
- (a) all are correct
 - (b) all except IV
 - (c) II and IV only
 - (d) I, II, and III only
 - (e) none is correct
- (7) The species ^1_1H , ^2_1H and ^3_1H represent three
- (a) allotropes
 - (b) homologs
 - (c) isomers
 - (d) isotopes
 - (e) members of an homologous series
- (8) A sodium ion differs from a sodium atom in that the sodium ion
- (a) is more reactive
 - (b) has fewer electrons
 - (c) is an isotope of sodium
 - (d) exists only in solution
 - (e) has a negative charge on the nucleus

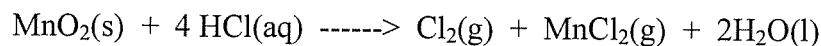
- (9) When alpha particles were shot at a gold target, most of the particles were undeflected. This indicated to Rutherford that
- (a) the gold foil was continuous matter
 - (b) the mass of the gold atoms was spread out thinly and the electron carried the negative charge
 - (c) the atoms of gold were mostly empty space
 - (d) the alpha particles had great penetrating power and the nucleus has a positive charge
 - (e) the alpha particles had charges opposite to those on the gold nuclei
- (10) _____ and _____ reside in the atomic nucleus
- (a) protons, electrons
 - (b) protons, neutrons
 - (c) neutrons, electrons
 - (d) none of these
- (11) Which one of the following formulas is also an empirical formula?
- (a) $C_6H_6O_2$
 - (b) C_2H_6SO
 - (c) H_2O_2
 - (d) $H_2P_4O_6$
 - (e) C_6H_6
- (12) Magnesium reacts with a certain element to form a compound with the general formula MgX . What would be the most likely formula for the compound formed between potassium and element X?
- (a) K_2X
 - (b) KX_2
 - (c) K_2X_3
 - (d) K_2X_2
 - (e) potassium and X cannot form a compound
- (13) The species formed when a neutral atom loses an electron is called
- (a) an anion.
 - (b) a cation.
 - (c) an isotope.
 - (d) a charge mass ratio.
 - (e) an isomer.

- (14) What is the **sum** of the coefficients for the following chemical reaction when it is balanced?



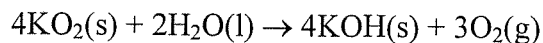
- (a) 9
(b) 16
(c) 17
(d) 24
(e) none of the above
- (15) The composition of oxalic acid is 26.7% carbon, 2.2% hydrogen and 71.1% oxygen, by mass. What is the empirical formula of oxalic acid?
- (a) CHO_2
(b) CHO
(c) C_2HO_4
(d) C_2HO_2
(e) none of the above
- (16) Which combination represents a ${}^{57}_{26}\text{Fe}^{3+}$ ion?
- (a) 57p, 26n, 54e
(b) 26p, 31n, 29e
(c) 26p, 31m, 26e
(d) 57p, 26n, 23e
(e) 26p, 31n, 23e
- (17) A certain element has two naturally occurring isotopes. These isotopes have mass numbers of 63 and 65, and their fractional abundances are, respectively, 0.692 (69.2%) and 0.308 (30.8%). What is the atomic weight (or atomic mass) of this element?
- (a) 58.7
(b) 63.1
(c) 63.6
(d) 64.4
(e) 65.4

- (18) According to the following balanced reaction, how many moles of manganese(II) chloride can be produced when 1.83 g of HCl gas completely reacts with manganese(IV) oxide?



- (a) 0.0125 moles
(b) 1.577 moles
(c) 0.010 moles
(d) 0.00313 moles
(e) none of these
- (19) How many aluminum atoms are there in 25 g of Al_2S_3 ?
- (a) 1.0×10^{23}
(b) 2.0×10^{23}
(c) 4.5×10^{23}
(d) 4.0×10^{21}
(e) 6.0×10^{21}
- (20) What is the percentage of mass of oxygen in vanillin, $\text{C}_8\text{H}_8\text{O}_3$, which is used as a flavoring?
- (a) 27.3%
(b) 31.6%
(c) 45.8%
(d) 63.2%
(e) 68.4%
- (21) A compound has an empirical formula of CH_2 and a molecular weight of 56.06 amu. Calculate the molecular formula of the compound:
- (a) CH_2
(b) C_3H_6
(c) C_2H_4
(d) C_5H_{10}
(e) C_4H_8

Questions (22) and (23). Consider the following reaction:



The reaction vessel initially contains 0.25 mol KO_2 and 0.15 mol H_2O .

(22) Which is the limiting reactant?

- (a) KO_2
- (b) H_2O
- (c) KOH
- (d) O_2
- (e) cannot be determined from the given data

(23) How many moles of O_2 can be produced?

- (a) 0.22 mol
- (b) 0.19 mol
- (c) 0.25 mol
- (d) 0.15 mol
- (e) 0.39 mol

(24) What is the molarity of sodium hydroxide (NaOH , molar mass = 40.01 g) solution made by dissolving 57.2 g of NaOH in 250 mL of water?

- (a) 0.1092 M
- (b) 2.80 M
- (c) 14.3 M
- (d) 6.99 M
- (e) 5.72 M

(25) When a 25.0 mL sample of $\text{HNO}_3(\text{aq})$ was titrated with 0.101 M $\text{NaOH}(\text{aq})$, the stoichiometric point was reached when 41.2 mL of the base had been added. What is the concentration of $\text{HNO}_3(\text{aq})$ in the sample?

- (a) 0.166 M
- (b) 0.00416 M
- (c) 0.104 M
- (d) 0.101 M
- (e) 0.332 M

(26) The balanced net ionic equation for the precipitation of CaCO_3 when aqueous solutions of Li_2CO_3 and CaCl_2 are mixed is

- (a) $2 \text{Li}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{Li}_2\text{CO}_3(\text{aq})$
- (b) $2 \text{Li}^+(\text{aq}) + 2 \text{Cl}^-(\text{aq}) \rightarrow 2 \text{LiCl}(\text{aq})$
- (c) $\text{Li}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{LiCl}(\text{aq})$
- (d) $\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$
- (e) $\text{Li}_2\text{CO}_3(\text{aq}) + \text{CaCl}_2(\text{aq}) \rightarrow 2 \text{LiCl}(\text{aq}) + \text{CaCO}_3(\text{s})$

(27) What are the respective molar concentrations of Na^+ and SO_4^{2-} afforded by dissolving 0.500 moles of Na_2SO_4 in water and diluting it to 1.33 L?

- (a) 0.665 and 0.665
- (b) 0.665 and 1.33
- (c) 1.33 and 0.665
- (d) 3.76 and 7.52
- (e) 0.752 and 0.376

EC) The combustion of 3.42 g of a compound known to contain only nitrogen and hydrogen was burned in oxygen. The result was the formation of 9.82 g of NO_2 and 3.85 g of water. Determine the empirical formula of this compound. SHOW ALL WORK


- (a) NH
- (b) NH_2
- (c) N_2H
- (d) NH_3
- (e) N_2H_4

TABLE 4.1 Solubility Guidelines for Common Ionic Compounds in Water

Soluble Ionic Compounds		Important Exceptions
Compounds containing	NO_3^-	None
	$\text{C}_2\text{H}_3\text{O}_2^-$	None
	Cl^-	Compounds of Ag^+ , Hg_2^{2+} , and Pb^{2+}
	Br^-	Compounds of Ag^+ , Hg_2^{2+} , and Pb^{2+}
	I^-	Compounds of Ag^+ , Hg_2^{2+} , and Pb^{2+}
	SO_4^{2-}	Compounds of Sr^{2+} , Ba^{2+} , Hg_2^{2+} , and Pb^{2+}
Insoluble Ionic Compounds		Important Exceptions
Compounds containing	S^{2-}	Compounds of NH_4^+ , the alkali metal cations, and Ca^{2+} , Sr^{2+} , and Ba^{2+}
	CO_3^{2-}	Compounds of NH_4^+ and the alkali metal cations
	PO_4^{3-}	Compounds of NH_4^+ and the alkali metal cations
	OH^-	Compounds of the alkali metal cations, and Ca^{2+} , Sr^{2+} , and Ba^{2+}

TABLE 4.5 Activity Series of Metals in Aqueous Solution

Metal	Oxidation Reaction
Lithium	$\text{Li}(s) \longrightarrow \text{Li}^+(aq) + e^-$
Potassium	$\text{K}(s) \longrightarrow \text{K}^+(aq) + e^-$
Barium	$\text{Ba}(s) \longrightarrow \text{Ba}^{2+}(aq) + 2e^-$
Calcium	$\text{Ca}(s) \longrightarrow \text{Ca}^{2+}(aq) + 2e^-$
Sodium	$\text{Na}(s) \longrightarrow \text{Na}^+(aq) + e^-$
Magnesium	$\text{Mg}(s) \longrightarrow \text{Mg}^{2+}(aq) + 2e^-$
Aluminum	$\text{Al}(s) \longrightarrow \text{Al}^{3+}(aq) + 3e^-$
Manganese	$\text{Mn}(s) \longrightarrow \text{Mn}^{2+}(aq) + 2e^-$
Zinc	$\text{Zn}(s) \longrightarrow \text{Zn}^{2+}(aq) + 2e^-$
Chromium	$\text{Cr}(s) \longrightarrow \text{Cr}^{3+}(aq) + 3e^-$
Iron	$\text{Fe}(s) \longrightarrow \text{Fe}^{2+}(aq) + 2e^-$
Cobalt	$\text{Co}(s) \longrightarrow \text{Co}^{2+}(aq) + 2e^-$
Nickel	$\text{Ni}(s) \longrightarrow \text{Ni}^{2+}(aq) + 2e^-$
Tin	$\text{Sn}(s) \longrightarrow \text{Sn}^{2+}(aq) + 2e^-$
Lead	$\text{Pb}(s) \longrightarrow \text{Pb}^{2+}(aq) + 2e^-$
Hydrogen	$\text{H}_2(g) \longrightarrow 2\text{H}^+(aq) + 2e^-$
Copper	$\text{Cu}(s) \longrightarrow \text{Cu}^{2+}(aq) + 2e^-$
Silver	$\text{Ag}(s) \longrightarrow \text{Ag}^+(aq) + e^-$
Mercury	$\text{Hg}(l) \longrightarrow \text{Hg}^{2+}(aq) + 2e^-$
Platinum	$\text{Pt}(s) \longrightarrow \text{Pt}^{2+}(aq) + 2e^-$
Gold	$\text{Au}(s) \longrightarrow \text{Au}^{3+}(aq) + 3e^-$



Periodic Table of the Elements

1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.012															9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.31															17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.955	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	89 Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (263)	[107] Bh (262)	[108] Hs (265)	[109] Mt (268)									

Lanthanide Series		58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.96
Actinide Series		90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)