Chemistry 11 Review for Chem 12

- Do all of the following questions to prepare yourself to continue in Chem 12.

(1) Solve the following using the method of unit conversions.

a) If there are 6.02×10^{23} atoms in 1 mol of atoms, how many atoms are there in 5.5 mol of atoms?

b) If one mole of a gas has a volume of 22.4 L, how many moles are there in 25.0 L of gas?

c) If one mole of nitrogen has a mass of 28 g, how many moles of nitrogen gas are in 7.0 g of nitrogen gas?

d) How many seconds must an electrical current of 35 coulombs/s flow in order to deliver 200.0 coulombs?

(2) Convert the following

(a) 3 s into milliseconds
(b) 50.0 mL into litres
(c) 2 L into microlitres
(d) 25 kg into grams
(e) 3 Mm into metres
(f) 2 L into decilitres
(g) 7 μs into milliseconds
(h) 51 kg into milligrams
(i) 3125 μL into kilolitres
(j) 1.7 μg into centigrams

(3) A 3.50 mL chunk of boron has a mass of 8.19 g. What is the density of the boron?

(4) An iron bar has a mass of 125 g. If iron's density is 7.86×10^3 g/L, what volume does the bar occupy ?

(5) A block of beeswax has a volume of 200.0 mL and a density of 961 g/L. What is the mass of the block?

(6) Alcohol has a density of 789 g/L. What volume of alcohol is required in order to have 46 g of alcohol?

(7) A gas called neon is contained in a glass bulb having a volume of 22.4 L. If the density of the neon is 0.900 g/L, what is the mass of the neon in the bulb?

(8) Perform the indicated operations and give the answer to the correct number of significant figures.

(a) 12.5×0.50
(b) 0.15×0.0016
(c) $40.0 / 30.0000$
d) $2.5 \times 7.500 / 0.150$
(e) $(6.40 \times 10^8) \times (5 \times 10^5)$
(f) $4.37 \times 10^3 / 0.008\,560\,0$
(g) 51.3×3.940
(h) $0.51 \times 10^{-4} / 6 \times 10^{-7}$
(i) 4.75×5
(j) $0.000\,01 / 0.1000$
(k) $7.4 / 3$
(l) $0.000\,43 \times 0.005\,001$

(9) A sample of liquid butanol at room temperature is put into a pressure–measuring device and the vapour pressure created by the evaporation of vapour from the butanol is found to be 0.9 kPa. When a few millilitres of butanol are placed in an open evaporating dish on an electronic balance, the balance shows that the mass of butanol remains almost unchanged for several minutes. A thermometer placed in boiling butanol registers a temperature of 117°C. When the series of measurements is repeated with liquid acetone, the vapour pressure is found to be 31 kPa and the boiling temperature is found to be 56°C. When acetone is placed in an open evaporating dish on an electronic balance, the mass of acetone is found to decrease quickly and steadily.

(a) Which substance, butanol or acetone, has the higher vapour pressure?
(b) What relationship exists between a liquid's boiling temperature and its vapour pressure?
(c) What relationship exists between a liquid's vapour pressure and its evaporation rate?
(d) What would you expect to be true about the vapour pressure of iron metal?
(e) Diethyl ether ("hospital ether") boils at 35°C. Compare the expected evaporation rate and vapour pressure of diethyl ether to acetone.

(10) Small steel pellets are simultaneously dropped down three glass tubes, each of which is one metre long and each of which contains a different liquid: hexane, carbon tetrachloride and glycerol. A pellet drops very quickly to the bottom of the tube containing hexane. A pellet drops quickly to the bottom of the tube containing carbon tetrachloride, but less quickly than in the tube of hexane. A pellet passing through the tube containing glycerol seems to "take forever" to reach the bottom. When 25 mL samples of each of carbon tetrachloride, glycerol and hexane are poured into the same tube, three distinct layers are seen. The carbon tetrachloride is found on the bottom, the glycerol lies in the middle and the hexane floats on top.

(a) Rank the liquids – hexane, glycerol and carbon tetrachloride – from lowest to highest viscosity.
(b) Rank the liquids – hexane, glycerol and carbon tetrachloride – from lowest to highest density.
(c) What relationship appears to exist between the viscosity and density of a liquid?

(11) Write the formula for the following compounds. You should use your table of ***Names, Formulae, and Charges of Some Common Ions*** to help identify the ions present.

(a) tin(IV) sulphate
(b) ammonium oxalate
(c) lithium oxide
(d) copper(I) nitride
(e) mercury(I) nitrite
(f) iron(III) hydroxide
(g) silver sulphate
(h) lead(II) perchlorate
(i) chromium(III) oxide
(j) manganese(II) fluoride
(k) potassium dihydrogen phosphate
(l) uranium(IV) sulphate
(m) ammonium dichromate
(n) copper(I) phosphate
(o) calcium hypochlorite
(p) sodium hydrogen sulphite
(q) magnesium permanganate
(r) tungsten(V) bromide
(s) ammonium phosphate
(t) mercury(II) acetate

(12) Write the name of the following compounds.

(a) Ag_3PO_4
(b) $Al_2(SO_4)_3$
(c) Fe_2S_3
(d) $CuCl$
(e) $(NH_4)_2CO_3$
(f) VCl_3
(g) Hg_2CO_3
(h) $CuSO_4$
(i) $(NH_4)_2S$
(j) NH_4HCO_3
(k) FeC_2O_4
(l) $Mg(HSO_3)_2$
(m) $LiClO_2$
(n) Na_2HPO_4
(o) $Al(OH)_3$
(p) CrI_3
(q) SnO_2
(r) $ZnCr_2O_7$
(s) V_2O_5
(t) Sr_3N_2

(13) Calculate the mass of the following.

(a) 1.00 mol of NH_4Cl
(b) 4.50 mol of NH_4Cl
(c) 3.25 mol of PCl_3
(d) 0.00355 mol of Na_2HPO_4
(e) 0.0125 mol of XeF_4
(f) 2.60 mol of CH_3CH_3
(g) 3.25×10^2 mol of NH_3

(14) Calculate the number of moles in the following.

(a) 17.0 g of H_2SO_4
(b) 91.5 g of H_2O
(c) 53.0 g of C
(d) 0.125 mg of CuS
(e) 4.50 kg of CH_4
(f) 225 g of $(NH_4)_2SO_4$

(15) Calculate the molar mass of each of the substances mentioned in the following.

(a) A 0.250 mol sample of methane has a mass of 4.00 g.
(b) A 0.00248 mol sample of cholesterol has a mass of 0.947 g.
(c) The mass of 6.47×10^{-4} mol of diamond is 7.76 mg.
(d) A 3.44×10^{-5} mol sample of a particular protein has a mass of 74.8 g.

(16) Calculate the number of moles contained in the following.

(a) 10.6 L of $SO_2(g)$ at STP
(b) 7.50×10^{21} molecules of HNO_3
(c) 425 mg of $Ca(OH)_2$
(d) 4.25×10^{12} molecules of Fe_2O_3
(e) 0.950 kg of NaOH
(f) 25.0 mL of $N_2(g)$ at STP
(g) 5.50×10^{25} molecules of CCl_4
(h) 0.120 L of $NO_2(g)$ at STP

(17) A gas has the empirical formula CH_2. If 0.850 L of the gas at STP has a mass of 1.59 g, what is the molecular formula?

(18) A gas has the percentage composition: 30.4% N and 69.6% O. If the density of the gas is 4.11 g/L at STP, what is the molecular formula of the gas?

(19) A compound has an empirical formula C_5H_{11}. If 0.0275 mol of the compound has a mass of 3.91 g, what is the molecular formula of the compound?

(20) A gas has an empirical formula CH. If 450 mL of the gas at STP has a mass of 0.522 g, what is the molecular formula?

(21) Calculate the molar concentration of the following solutions.
(a) 0.26 mol of HCl in 1.0 L of solution
(b) 2.8 mol of HNO_3 in 4.0 L of solution
(c) 0.0700 mol of NH_4Cl in 50.0 mL of solution

(22) How many moles of $AlCl_3$ are contained in 350.0 mL of 0.250 M $AlCl_3$?

(23) What volume of 2.40 M HCl can be made from 100.0 g of HCl?

(24) The density of acetic acid, $CH_3COOH(l)$, is 1049 g/L. What is the molarity of pure acetic acid?

(25) The molar concentration of pure $HClO_4(l)$ is 17.6 M. What is the density of pure $HClO_4$?

(26) What is the concentration of the solution produced when
(a) 125 mL of 3.55 M LiOH is mixed with 475 mL of 2.42 M LiOH?
(b) 150.0 mL of water is added to 200.0 mL of 0.250 M NaCl?
(c) 100.0 mL of 12.0 M KBr is mixed with 950.0 mL of 0.200 M KBr?
(d) 75 mL of water is mixed with 5.0 mL of 2.50 M KBr?
(e) 50.0 mL of water is mixed with 850.0 mL of 0.1105 M HCl?
(f) 50.0 mL of 0.125 M HCl is mixed with 75.0 mL of 0.350 M HCl?

(27) Consider the reaction $4\,NH_3(g) + 5\,O_2(g) \longrightarrow 6\,H_2O(g) + 4\,NO(g)$.
a) What mass of NO(g) is produced when 2.00 mol of $NH_3(g)$ are reacted with excess $O_2(g)$?
b) What mass of $H_2O(g)$ is produced when 4.00 mol of $O_2(g)$ are reacted with excess $NH_3(g)$?
c) What volume of $NH_3(g)$ at STP is required to react with 3.00 mol of $O_2(g)$?
d) What volume of $NH_3(g)$ at STP is required to produce 0.750 mol of $H_2O(g)$?

(28) Pentane, C_5H_{12}, burns according to the reaction $C_5H_{12}(l) + 8\,O_2(g) \longrightarrow 5\,CO_2(g) + 6\,H_2O(l)$.
a) What mass of $CO_2(g)$ is produced when 100.0 g of $C_5H_{12}(l)$ is burned?
b) What mass of $O_2(g)$ is required to produce 60.0 g of $H_2O(l)$?
c) What mass of $C_5H_{12}(l)$ is required to produce 90.0 L of $CO_2(g)$ at STP?
d) What volume of $O_2(g)$ at STP is required to produce 70.0 g of $CO_2(g)$?
e) What volume of $O_2(g)$ at STP is required to produce 48.0 L of $CO_2(g)$ at STP?
f) What mass of $H_2O(l)$ is made when the burning of C_5H_{12} gives 106 L of $CO_2(g)$ at STP?

(29) Complete the table. Show the atomic number and atomic mass in the "Symbol" column.

	Symbol	Atomic Mass	Atomic Number	Number of protons	Number of neutrons	Number of electrons
(a)		84	36			36
(b)				35	45	35
(c)		127	53			54
(d)			27		32	27
(e)	Zn				36	
(f)	Cd^{2+}	112				
(g)				38	50	36
(h)	X^{2-} =				75	54
(i)	X^{3+} =	103				42
(j)	X^{3-} =		33		42	

(30) Predict the electron configuration of the following.

(a) P (b) Ti (c) Co (d) Br (e) Sr (f) Ar (g) K (h) Cd (i) Ca (j) Xe (k) Cs (l) Pb (m) Ga (n) Mn (o) Zr

(31) Predict the electron configuration of the following ions, using core notation.

(a) H^- (b) Sr^{2+} (c) Br^- (d) N^{3+} (e) Ti^{2+} (f) N^{2-} (g) Mn^{2+} (h) Ge^{4+} (i) Fe^{3+} (j) Ge^{2+} (k) Ru^{3+} (l) Sb^{3+}

(32) What is the concentration of SO_4^{2-} present in 0.135 M $Al_2(SO_4)_3$?

(33) What is the $[Cl^-]$ formed when 10.0 g of $BaCl_2(s)$ is dissolved and diluted to 0.600 L?

(34) What is the concentration of Cl^- produced when 55.0 mL of 0.300 M HCl is mixed with 80.0 mL of 0.550 M $CaCl_2$?

(35) When 350.0 mL of 0.250 M $MgCl_2$ is boiled down to a final volume of 275.0 mL, what is the $[Cl^-]$ in the resulting solution?

(36) Calculate the number of moles of all aqueous ions in the following solutions, assuming that each dissolved substance dissociates completely in solution.

(a) 0.60 L of 0.20 M K_2SO_4
(b) 0.450 L of 0.300 M Na_3PO_4
(c) 75.0 mL of 0.160 M $MnCl_2$
(d) 0.0950 L of 0.235 M $Fe_2(SO_4)_3$