CHEM 110 Hand-in-Sheet 1, 2013

Chapters 1 – 4, The Atom, The Language of Chemistry, Chemical Reactions and Stoichiometry, Atomic Energy Levels

Please e-submit via the CHEM110 Moodle website or post to T&LC by**:** ***Wednesday 20th March***.

Name: **Student No:**		**Mark:** **(Out of 40)**	

1 A compound of phosphorous and chlorine used in the manufacture of a flame retardant treatment for fabrics contains 1.20 g of P for every 4.12 g of Cl. Suppose a sample of this compound contains 6.22 g of Cl. What mass of P does it contain? [2 marks]

2 Naturally occurring Mg is composed of 78.99% of ^{24}Mg (atomic mass 23.9850 u), 10.00% of ^{25}Mg (atomic mass 24.9858 u) and 11.01% of ^{26}Mg (atomic mass 25.9826 u). Calculate the average atomic mass of Mg. [2 marks]

3 (a) Write the chemical formula for calcium hydride. Rationalize the Ca to H ratio in your answer.
(b) Provide the IUPAC-approved name for $CH_3CH(CH_3)CH_2CH_2CH(CH_3)CH_3$. [2 marks]

(a)	(b)

4 Write the equation that expresses in acceptable chemical shorthand the following statement: 'Iron can be made to react with molecular oxygen, O_2, to give iron oxide with the formula Fe_2O_3.' [1 mark]

5 (a) Which contains more molecules: 2.5 moles of H_2O or 2.5 moles of H_2? (b) How many moles of (i) hydrogen atoms, (ii) sulphur atom and (iii) oxygen atoms are in 1 mole of H_2SO_4? [2 marks]

(a)	(b) (i)	(ii)	(iii)

6 When 0.684 g of an organic compound containing only carbon, hydrogen and oxygen was burned in oxygen, 1.312 g of CO_2 and 0.805 g of H_2O were obtained. What is the empirical formula of the compound? [3 marks]

7 The following unbalanced equation shows the reaction of powdered aluminium and iron(III) oxide:

$$Al(s) + Fe_2O_3(s) \rightarrow Al_2O_3(s) + Fe(l)$$

Suppose that, in one batch of reactants, 114 g of Al was mixed with 280 g of Fe_2O_3.
(a) Balance the above reaction. (b) Which reactant, if either, was the limiting reactant? Show your working to justify your answer. (c) Calculate the mass of Fe that can be formed from this mixture of reactants. [6 marks]

(a)
(b)

(c)

8 What volume of 0.150 M $FeCl_3$(aq) solution is needed to react completely with 20.0 mL of 0.0450 M $AgNO_3$(aq)? What mass of AgCl will be formed? The net ionic reaction is: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ [6 marks]

9 When light of wavelength 231 nm shines on the surface of caesium metal, electrons are ejected with a maximum kinetic energy of 5.2×10^{-19} J. Calculate: (a) the frequency (in s^{-1}) of the light, (b) the binding energy of electrons to the caesium metal, (c) the longest wavelength of light that will eject electrons. [5 marks]

10 Arrange the following in order of decreasing size (radius): Cl^-, K^+, Cl, Br^-. Explain your rankings in terms of quantum numbers and electrical (i.e., positive-negative) interactions. [3 marks]

11 The first four ionization energies of aluminium are as follows: E_{i1}=577 kJ mol^{-1}, E_{i2}=1817 kJ mol^{-1}, E_{i3}=2745 kJ mol^{-1}, and E_{i4}=11578 kJ mol^{-1}. (i) Explain the trend in ionization energies. (ii) Which ion of aluminium has the largest electron affinity? [2 marks]

12 (a) Write the electron configuration for the Mn and Mn^{2+} ground state, and give a set of quantum numbers for all electrons in the *least stable* occupied orbital. (b) Is Mn^{2+} paramagnetic? Draw an orbital diagram to support your answer. (c) What orbital is represented by the quantum numbers $n = 4$, $l = 1$? How many electrons can this orbital contain? [6 marks]

(a)	(b) Paramagnetic? Y/ N (circle one)
(c)	