

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:		Mark:	
Student No:		(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 ²⁴Mg (atomic mass 23.9850 u), 10.00% of ²⁵Mg (atomic mass 24.9858 u) and 11.01% of ²⁶Mg (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 CH₃CH(CH₃)CH₂CH₂CH(CH₃)CH₃. [2 marks]

(a)	(b)
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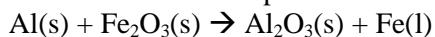
- 4 Write the equation that expresses in acceptable chemical shorthand the following statement: 'Iron can be made to react with molecular oxygen, O₂, to give iron oxide with the formula Fe₂O₃.' [1 mark]

- 5 (a) Which contains more molecules: 2.5 moles of H₂O or 2.5 moles of H₂? (b) How many moles of (i) hydrogen atoms, (ii) sulphur atom and (iii) oxygen atoms are in 1 mole of H₂SO₄? [2 marks]

(a)	(b) (i)	(ii)	(iii)
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- 6 When 0.684 g of an organic compound containing only carbon, hydrogen and oxygen was burned in oxygen, 1.312 g of CO₂ and 0.805 g of H₂O 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:



Suppose that, in one batch of reactants, 114 g of Al was mixed with 280 g of Fe₂O₃.

- (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 $\text{FeCl}_3(\text{aq})$ solution is needed to react completely with 20.0 mL of 0.0450 M $\text{AgNO}_3(\text{aq})$? What mass of AgCl will be formed? The net ionic reaction is: $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$ [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: $E_{i1}=577 \text{ kJ mol}^{-1}$, $E_{i2}=1817 \text{ kJ mol}^{-1}$, $E_{i3}=2745 \text{ kJ mol}^{-1}$, and $E_{i4}=11578 \text{ kJ mol}^{-1}$. (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)