



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. Second year Semester I Examination – April / May 2016
CHE 2105 – Inorganic Chemistry II

Electronic rest mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Proton rest mass	$m_p = 1.672 \times 10^{-27} \text{ kg}$
Neutron rest mass	$m_n = 1.675 \times 10^{-27} \text{ kg}$
Magnitude of the electron charge	$e = 1.60 \times 10^{-19} \text{ C}$
Universal gas constant	$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Planck constant	$h = 6.626 \times 10^{-34} \text{ J s}$
Avogadro number	$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
Speed of light	$c = 3.0 \times 10^8 \text{ ms}^{-1}$
1 atomic mass unit (amu)	$1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$
1 eV	$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$

Answer both questions.

Time: 1 hour

The use of non-programmable calculator is permitted.

- 1). (a) Write a balanced chemical equation to show hydrogen acts as strong reducing agent. Give four uses of hydrogen.
- (b) How do you account for the strong reducing power of Li in aqueous solution?
- (c) Mention the oxides formed by Li, and K when heated in air and write down the balance chemical equation in each step.
- (d) What is the structure of BeCl_2 molecule in gaseous and solid state?

- (e) Arrange the increasing order of the solubility in water of following compounds. BeSO_4 , MgSO_4 , CaSO_4 and BaSO_4 .
- (f) Give reasons for the following observations:
- (i) boron form covalent compounds
 - (ii) LiF shows the lowest solubility in water amongst fluorides of alkali metals.
- (g) Give three differences between the nuclear reactions and chemical reactions.
- (h) Write down the balanced nuclear reactions for the following decay processes and identify the new elements:
- (i) decay of 7 alphas and 4 betas from ${}^{235}_{92}\text{U}$
 - (ii) decay of 8 alphas and 6 betas from ${}^{238}_{92}\text{U}$.
- (i) Define the term half life ($t_{1/2}$) period and show that the $t_{1/2}$ is independent of the initial concentration.
- (j) The half life of ${}^{123}_{52}\text{I}$ is 13 hours. How much of a 64 mg sample of ${}^{123}_{52}\text{I}$ is left after 52 hours?

(10 x 12 marks = 120 marks)

2). Answer either part (A) or part (B)

Part (A)

Answer all parts.

- (a) Give balanced chemical equations for the following reactions:
- (i) thermal decomposition of barium carbonate
 - (ii) reaction between sodium peroxide and water
 - (iii) reaction between calcium oxide and dilute hydrochloric acid
 - (iv) preparation of XeO_3 and XeOF_4 .

(35 marks)

- (b) Suggest reason for the following observations:
- (i) barium sulphate (VI) is insoluble in water, while potassium sulphate(VI) is soluble in water .
(The ionic radii of potassium ion and barium ion are 0.133 nm and 0.135 nm respectively.)
 - (ii) the melting point and boiling point of alkaline earth metals are higher than the alkali metals
 - (iii) Be and Mg do not impart colour to the flame.

(24 marks)

- (c) Arrange, giving reason for the following in the order of property indicated for each set:

- (i) increasing bond dissociation enthalpy of F_2, Cl_2, Br_2 , and I_2
- (ii) increasing acid strength of HF, HCl, HBr, and HI
- (iii) increasing base strength of NH_3, PH_3, AsH_3, SbH_3 , and BiH_3 .

(21 marks)

Part (B)

Answer all parts.

- (a) Calculate the nuclear binding energy (i) per nucleon (MeV/nucleon) (ii) per mole of atoms (kJ/mol) for $^{63}_{29}Cu$.
(The actual mass of $^{63}_{29}Cu$ is 62.9137 amu).
- (25 marks)
- (b) (i) Derive an equation for a radioactive decay process, and give one assumption you have made in deriving the equation.
- (ii) Discuss the use of radiocarbon dating in radiochemistry.
- (iii) A scrap of paper taken from the Dead Sea Scrolls was found to have a $^{14}C/^{12}C$ ratio of 0.795 times that found in plants living today. Estimate the age of the scroll.
(The half-life of ^{14}C is 5720 years).
- (35 marks)
- (c) Explain briefly the uses of radioisotopes in medicine and agriculture.

(20 marks)

Periodic table of the elements

1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0															9 F 19.0	10 Ne 20.1
11 Na 23.0	12 Mg 24.3															17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 44.9	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.9	27 Co 58.9	28 Ni 58.7	29 Cu 63.6	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.1	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 Uub	114 Uuq	116 Uuh				118 Uuo

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.3	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.1	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 (262)
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