



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES
B.Sc. Second year Semester I Examination – June / July 2018
CHE 2105 – Inorganic Chemistry - I

Answer both questions.

Time: 1 hour

Mass of electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Mass of proton	$m_p = 1.672 \times 10^{-27} \text{ kg}$
Mass of neutron	$m_n = 1.675 \times 10^{-27} \text{ kg}$
Avogadro number	$N_A = 6.022 \times 10^{23} \text{ per mole}$
Universal gas constant	$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$
Speed of light	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
1 atomic mass unit (amu)	$1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$
	$1 \text{ MeV} = 9.648 \times 10^7 \text{ kJ mol}^{-1}$

The use of a non-programmable calculator is permitted.

- 1). (a) Write down the primary and secondary reforming reactions with conditions in the production of hydrogen.
- (b) What conditions of temperature and pressure would favour the formation of products in both the primary and the secondary stage in the production of hydrogen?
- (c) Explain the following observations;
- (i) BeCl_2 is linear molecule whereas H_2O is bent.
 - (ii) Bond angle in NH_3 is less than that in CH_4 .
- (d) Write down the balanced chemical equations of Boron with conc. H_2SO_4 and N_2 at high temperature.
- (e) Draw the structures of F_2O and Cl_2O and give a reason why the bond angle in F_2O is different than in Cl_2O .
- (f) List three industrial processes which used transition metals or their compounds as catalyst. Name the catalyst in each case.

- (g) The mass defect for an isotope was found to be 0.1587 amu/atom. Calculate the binding energy in kJ/mol.
- (h) Complete the following nuclear reactions and identify X in each case;
- (i) ${}^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow {}^{94}_{36}\text{Kr} + {}^{139}_{56} + 3\text{X}$
- (ii) ${}^{59}_{27}\text{Co} + {}^1_0\text{n} \rightarrow {}^{56}_{25}\text{Mn} + \text{X}$

(10 x 12 marks = 120 marks)

2). Answer either Part A or Part B

Part A

- (a) Write down the reaction with conditions involving in the shift reaction to converts CO to CO₂ in the steam reforming process in the production of hydrogen. Above what temperature will the shift reaction begin to favour the reactants?
(the ΔH° and ΔS° values of the shift reactions are - 41.2 kJ mol⁻¹ and - 42.0 J K⁻¹ mol⁻¹ respectively.)
- (b) Calculate the spin only magnetic moment, μ_s of the following species;
- (i) $[\text{Zn}(\text{NH}_3)_4]^{2+}$
- (ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (iii) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- (c) Explain the following observations;
- (i) The conductivity measurements in aqueous solution of alkali metal ions are $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$
- (ii) The solubility of the sulphates of alkaline earth elements in water decreases and the thermal decomposition of their carbonates increases down the group.

(26 marks)

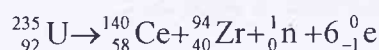
(24 marks)

(30 marks)

Part B

- (a) Explain the following terms;
- (i) Nuclear binding energy.
- (ii) Half life.
- (b) Describe the term nuclear fission and state which isotopes can undergo nuclear fission. The following reaction in one of the processes which occurs during fission:

(20 marks)



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Calculate how much energy is released for one mole $^{235}_{92}\text{U}$. If one ton of TNT releases about 4×10^9 J of energy, estimate how many grams of $^{235}_{92}\text{U}$ required to produce the energy which is equal to 20,000 tons of TNT produces. (one ton = 1000 kg)
(the masses are: U = 235.0439 amu, Ce = 139.9054 amu and Zr = 93.9063 amu).

(35 marks)

- (c) $^{24}_{11}\text{Na}$ is an unstable isotope of sodium with a half-life of 15 hours. Calculate the radioactive decay constant. State any assumption/s you have made in this calculation.

(25 marks)

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