BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources and Coastal Engineering
Student Group: 0 < Earned Credit Hour <= 36, Spring Final Examination: June 2019

Subject: CHEM-101, Chemistry

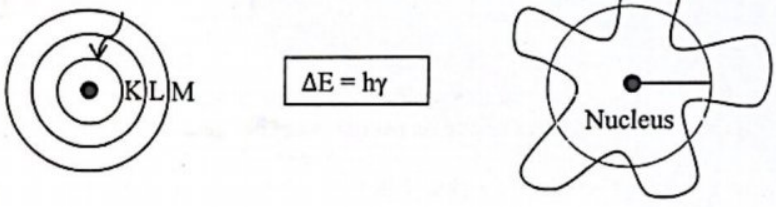
Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1 in section-A** and **Question-5** in **section-B** are compulsory.
c. Answer any **OTHER TWO** questions from **EACH** section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1



I II III

a. How does stem – I describe the atomic structure? What is the value of angular momentum of an electron moving in M-shell? [$h = 6.626 \times 10^{-34}$ Js] **7+3 =10**

b. What property of an electron is presented in stem - III? Discuss how does stem - III points out the defect of stem – I proposition. Calculate the energy emitted through a radiation of wavelength at 620 nm for a transfer of an electron from one state to another. **3+3+4 =10**

c. How many orbitals are in L-shell of stem – I. Draw their shapes. 1.0 F electric charge is carried in the relation below. How much charge an electron carries? **3+3+4 =10**

$$A^+ + e^- = A$$

Question – 2

I: Element 'A' $\Rightarrow n = 4, l = 0, m = 0, S = +^1/_2$

II:



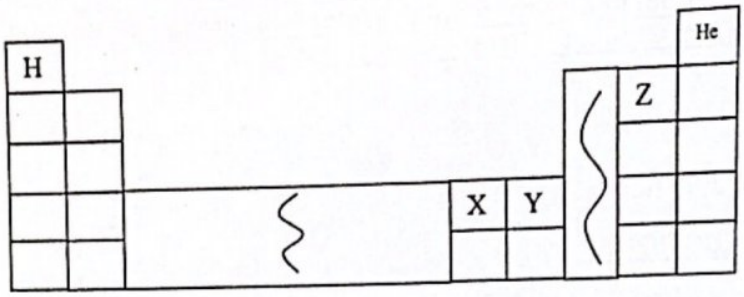
a. What is 'Aufbau principle'? Why are 3d-orbitals in stem – II vacant? Justify your answer. **2+8=10**

b. Write electronic configuration for the element 'A' in stem – I. Identify the element using this configuration. Give justification for both. Is A^{2+} possible here? Why? **3+3+4 =10**

c. What is ionization potential? Explain the trend of change of ionization potential values in a periodic group. **2+8=10**

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Question – 3



a. Identify the elements X, Y and Z of the stem with justification. What are their positions in the periodic table? **5+5=10**

b. Which block do the elements 'X' & 'Y' belong to? Provide reasons with electronic configuration though in the same block, elements 'X' & 'Y' differ significantly in their chemical properties. **5+5=10**

c. What is electronegativity? 'Z' has the highest value of electronegativity in the periodic table – analyze. **2+8=10**

Question – 4

Na	C	O
0.9	2.5	3.5

The figures below the stem boxes indicate the electronegativity values of the respective stem elements.

a. What is a chemical bond? What types of bonds are formed between carbon-oxygen in CO_2 and sodium-oxygen in Na_2O? Explain using electronegativity values. **2+8=10**

b. What types of hybridization take place in each of CH_3-CH_3 and $H_2C{=}CH_2$? Show with reasons. Draw their orbital diagram and mention the corresponding bond angles and bond length. **5+5=10**

c. Shapes of NH_3 and H_2O are different though the type of hybridization of N and O is same in the respective compounds – explain. **5+5=10**

SECTION-B

Question – 5

a. Define the terms 'acid' and 'base' according to Usanovich concept. Classify the following substances as acids and bases giving reasons:
SO_3, Cl_2, Na, KCN, NH_4^+, NH_3 **08**

b. What is the basis of the strength of acids in halogen acids? Arrange the following acids in terms of increasing strength of the following acids: H_2SO_4, H_2SO_3, HClO, H_3AsO_3, HNO_3, $HClO_4$ **07**

c. Explain what is meant by molarity and mole fraction of a solute in a solution. What is the molarity of a solution prepared by dissolving 75.5 g of pure KOH in 540 mL of solution? [molar mass of KOH is 56.2 g/mol] **08**

d. State and explain the 'Distribution Law'. How does the solubility of a gas in a liquid depend on temperature? **07**

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Question – 6

a. What are the colligative properties and why are they so called? Deduce an Expression relating the molecular mass of a solute with the lowering of vapour pressure of a solvent on the addition of a solute from Raoult's law. **10**

b. 10.0 g of urea are dissolved in 100 g of water of the vapour pressure of water at the working temperature is 27.32 mm Hg. What will be the vapour pressure of the solution? [molecular mass of urea is 60.06 g/mol] **07**

c. State Hess's law of constant heat summation. Calculate ΔH for the reaction: **08**

$$C\ (graphite) + 2H_2\ (g) \rightarrow CH_4\ (g)$$

from the following data:

$$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O;\ \Delta H = -890.35\ KJmol^{-1}$$

$$H_2\ (g) + \frac{1}{2}O_2\ (g) \rightarrow H_2O\ (l);\quad \Delta H = -286.2\ KJmol^{-1}$$

$$C\ (graphite) + O_2\ (g) \rightarrow CO_2,\ (g)\ \Delta H = -890.35\ KJmol^{-1}$$

d. Heat of neutralization of strong acids by strong bases is approximately constant and is equal to about -57 KJ mol^{-1}. Explain the statement. **05**

Question – 7

a. State the Le Chatelier Principle. With the help of this principle, explain the effect of pressure on the reaction: **07**

$$N_2\ (g) + 3H_2\ (g) \rightleftharpoons 2NH_3\ (g)$$

b. State faradays law of electrolysis and explain these clearly. If 3.0 ampere current is passed through a Ag coulometer for 1 hour 25 minutes. Calculate the mass of Ag deposited in the coulometer. [Relative atomic mass of Ag is 107.88 g/mol] **08**

c. What are the advantages of conductometric titration over ordinary titration? Explain titration of weak acid and strong base. **08**

d. What is salt bridge? Why is it used? What determines the suitability of a substance for preparing a salt bridge? **07**

Question – 8

a. What is a colloid? Explain the Tyndall effect shown by sol particles. **08**

b. The smoke coming from industrial plants pollutes the atmosphere. Explain, how can you remove the pollutants using Cottrell smoke precipitator. **07**

c. Classify the impurities that are usually found in natural water. **07**

d. What is Portland cement? Explain the manufacturing of Portland cement with a flow sheet. **08**

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