BANGLADESH UNIVERSITY OF PRO
Military Institute of Science and Technology
B.Sc. in Environment, Water, and Costal Engineering
Level-1, Term-I Final Examination: May- June 2017

Subject: Chem-101, Chemistry

Full Marks: 210

Time: 3.00 hours

INSTRUCTIONS:

a. Use SEPARATE answer scripts for each section.
b. Answer any THREE questions from each section.
c. Figures in the margin indicate full marks.
d. Assume reasonable data if necessary.
e. Symbols used have their usual meanings.

SECTION-A

Question – 1

a. Describe three permanent fundamental particles. Write down the main assumptions of Bohr's Atom Model. 6+6=12

b. Write short notes on: 3x5=15
   i. Pauli Exclusion Principle.
   ii. Hund's Rule.
   iii. Photo-electric Effect.

c. Define sigma (σ) and pie (π) bond. Differentiate between Node and Nodal Plane. 4+4=8

Question – 2

a. Give the electronic configurations of the following : 8

   i. Cu^{2+} ii. Fe^{3+} iii. La iv. Pr

b. What are the possible values for the quantum number of n, l, m and s for 4f orbital. 7

c. Define electron affinity. How does it change in same group and period? 3+4=7

d. Describe various types of hydrogen bonding? Compare and justify basicity between trimethyl ammonium hydroxide and tetramethyl ammonium hydroxide. 6+7=13

Question – 3

a. Define transmutation and transuranium elements. Balance the following reactions: 4+6=10

   i. $^{49}_{25}Mn \longrightarrow {}^{0}_{1}e + ?$

   ii. $^{247}_{100}Fm \longrightarrow {}^{4}_{2}He + ?$

   iii. $^{234}_{90}Th \longrightarrow {}^{234}_{91}Pa + ?$

b. What is heliox? Identify the following elements: 2+8=10

   i. $^{209}_{83}X$ ii. $^{247}_{97}X$ iii. $^{223}_{87}X$ iv. $^{248}_{98}X$

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c. Define Lewis acid and Lewis base? Classify each of the following as a Lewis acid or a Lewis base. 6+9=15
i. CN^- ii. H^+ iii. H_2O iv. OH^-
v. CO_2 vi. $P(CH_3)_3$ vii. $B(CH_3)_3$

Question – 4

a. Draw molecular orbital energy level diagrams for O_2^+ and CN. Work out the bond order and magnetic properties of these molecules. 10+4+2 =16

b. Explain the hybridization of PCl_5. Which of the following compound do you expect to have less bond angle: (i) NF_3 (ii) NH_3 5+3=8

c. Predict the shape of each of the following molecules:
i. H_2O ii. SF_4 iii. SF_6 6

d. Write short note on Acid Rain. 5

SECTION-B

Question 5

a. Define solution and classify it with example on the basis of physical state of solute and solvent. 8

b. What do you understand by solubility and solubility curve? State Le-Chatelier's principle and explain the effect of temperature on the solubility of a solid in water. 12

c. Discuss the effect of nature of solute and solvent on the solubility of a solid in water. 7

d. The solubility of NaOH (M=40) in water at 25°C is 16.0. Calculate the molality and mole fraction of NaOH in solution. 8

Question 6

a. What are colligative properties? Why are they so called? 5

b. Define boiling point of a liquid with respect to vapor pressure. Derive a mathematical relationship between the change of boiling point and the molality of a solution. 10

c. Show that the relative lowering of vapor pressure of a solution of a non-volatile non-electrolyte solute is equal to the mole fraction of the solute in solution. 10

d. What will be the boiling point of a solution containing 9.0 g of urea in 100 g water? [Molecular weight of urea = 60; K_b= 0.51] 10

Question 7

a. Why is heat evolved or absorbed in a chemical reaction? State and explain the law of Lavoisier and Laplace. 8

b. Describe the following terms with suitable examples:
(i) Heat of neutralization, (ii) heat of solution and (iii) heat of combustion. 9

c. Derive expressions for equilibrium constant K_p and K_c of a chemical reaction. 10

d. What is phase rule? Describe each term's in the rule. 8

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Question 8

a. What is collision theory of rate of a reaction? Based on collision theory, explain the effect of surface area and concentration on the rate of a reaction. 12

b. Define electro-chemical cell. With the help of a diagram, describe the construction of a Daniel Cell. The standard reduction potential of zinc and copper electrodes are -0.76 V and + 0.34 V, respectively. Show that the standard potential of Daniel cell is + 1.10 V. 13

c. What is half cell? Describe in brief the different kinds of half cells with examples. 10

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