BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Environmental, Water Resources and Coastal Engineering
Level – 1, Term – I Final Examination: June - July 2018

Subject: CHEM - 101, Chemistry

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

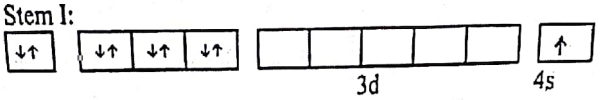
a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions out of **FOUR** from each section.
c. Figures in the margin indicate full marks.
d. Assume reasonable data if necessary.
e. Symbols used have their usual meanings.

SECTION-A

Na
$3s^1$

Question – 1

Stem I:



Stem II: Element 'P' has n=3, l=0, m=0, s= +1/2

a. What is Aufbau principle? Explain why 3d- orbitals in stem I are vacant? 2+8=10

b. Write the electronic configuration of element 'P'. Identify the element 'P' from electronic configuration. Is P^{2+} possible? Why? 2+3+5=10

c. First ionization potential of element 'P' is low – why? Explain the trend of change of ionization potential value in the group, where 'P' is placed. 5+10=15

Question – 2

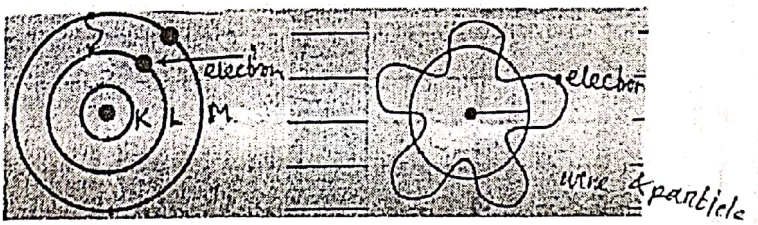
The figures in the bracket indicate the electronegativity value of each of the respective element. [$_{11}$Na(0.9), $_{6}$C(2.5), $_{8}$O(3.5)]

a. Define a chemical bond. What types of bonds are formed between carbon-oxygen and sodium-oxygen? Explain. 2+8=10

b. Mention the type of hybridization of carbon taking place in ethane and ethene, show with reasoning. Draw the orbital pictures of the compounds with mention of bond angles and carbon-carbon bond lengths in them. 15

c. Arrange the halogens in order of their reactivity. Justify this order. 10

Question – 3



I II

a. Max Planc has provided the basis for the atomic structure concept presented in stem-I –explain. 3+7=10
How did Bohr has picked up the idea to detail out the structure of an atom?

energy
emission
angular momentum

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b. What is the concept lacking in stem I, but presented in stem II? How does Heisenberg correlate the concept? 5+5=10

c. i) Mass of an electron is 1/115 of the mass of an atom of element 'X'. If the mass of an electron is 9.11×10^{-28}g, then calculate the atomic mass of the element 'X'. 8+7=15
ii) Energies in 'L' and 'M' shells in stem I are -3.65×10^{-19}J and -5.42×10^{-19}J, respectively. Calculate the wavelength of the radiation emitted when an electron is transferred from M-shell to L-shell.

Question – 4

$X \rightarrow ns^2 np^2$, $Y \rightarrow ns^2 np^3$, $Z \rightarrow ns^2 np^4$
Here 'n' is the outermost shell of each element and n=2.

a. Identify the elements 'X', 'Y' and 'Z'. Which groups in periodic table they belong to? Justify your answer. 5+5=10

b. Explain the type of hybridization each of the elements show. Hydrides of 'X', 'Y' and 'Z' have different molecular shape – analyze. 15

c. i. Why Gr-1 element are known as alkali metals and Gr-17 elements are halogens? Gr-1 members are most reactive metals while Gr-17 ones are most reactive nonmetals in the periodic table – explain with proper reason. 10

SECTION-B

Question – 5

a. Discuss the factors, which influence the solubility of a solid solute in an aqueous solution. What are the steps of the process of dissolution of a solid solute in water? Comment on the exothermic and endothermic process in this regard. 15

b. How much sucrose ($C_{12}H_2O_{11}$) will be required to prepare 0.02 molar aqueous solution? 10

c. What are colligative properties? Why is the boiling point of a solution is higher than that of a pure solvent? Discuss it with the help of a vapour pressure-temperature diagram. 10

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Question – 6

a. Deduce Kirchoff's equation showing the influence of temperature on the heat of reaction. 12

b. Deduce the equilibrium constant expression, K_p for the reaction: $N_2O_4\,(g) \rightleftharpoons 2NO_2\,(g)$. Suppose N_2O_4 is a partially dissociated gas. Calculate the value of degree of dissociation, α when P_{NO2} = 0.31 atm and the total pressure is 1atm. 13

c. For the following reaction:
$\frac{1}{2}\,H_2(g) + \frac{1}{2}\,Cl_2(g) = HCl(g)$
$\Delta H_{25}{}^{\circ}C = -22{,}060$ cal and the heat capacities are:
$C_p(H_2) = 6.82$ cal mol^{-1} deg^{-1}
$C_p(Cl_2) = 7.71$ cal mol^{-1} deg^{-1}
$C_p(HCl) = 6.81$ cal mol^{-1} deg^{-1}
Calculate ΔH at 348 °C by using above data. 10

Question – 7

a. What are true solution, colloidal solution and suspension? Discuss them with suitable examples. 12

b. Give examples of micromolecular, macromolecular and associated colloids. Discuss the cleansing action of soap in connection with micelles formation. 11

c. Discuss the conductometric titration behavior in case of (i) strong acid with strong alkali (ii) strong acid with weak alkali (iii) weak acid with weak alkali and (iv) mixture of strong and weak acids with strong alkali. 12

Question – 8

a. What is a Voltaic cell? Describe with a suitable example for the function of a voltaic cell. 08

b. Discuss the effect of dilution on conductance, specific conductance and molar conductance. 10

c. What is Portland cement? Describe very briefly the wet and dry process for the manufacture of Portland cement. Describe the setting and hardening process of Portland cement. 17

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