BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2015-2016

Sub : **CHEM 119** (Chemistry I)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) What do you understand by 'Quantization of energy'?   **(6)**

   (b) Briefly describe Bohr's theory of hydrogen atom. How does Bohr theory explain the different lines of hydrogen atom in visible region?   **(6+8=14)**

   (c) How does Schrödinger equation introduce the concept of atomic orbital?   **(8)**

   (d) Explain that the Pauli's exclusion principle can be verified by the concept of magnetism.   **(7)**

2. (a) 'Ionic bond is an extreme case of polar covalent bond' – justify the statement.   **(10)**

   (b) According to VSEPR theory predict the geometry and bond angle of the followings: **(9)**

   (i) O_3 (ii) NO_3^- (iii) XeO_2F_2

   (c) VBT and MOT are two approximation theory of quantum mechanics for the qualitative and quantitative explanation of covalent bond. What are the main differences you can notice between them?   **(8)**

   (d) Rank each set of ions in order of decreasing size, explain your ranking.   **(8)**

   (i) Ca^{2+}, Sr^{2+}, Mg^{2+} (b) K^+, S^{2-}, Cl^-

3. (a) The three states of matter (solid, liquid and gas) can combine together and form different binary solutions. Write down the names of different combinations with mentioning the solute and solvent. Give at least one example for each of the binary solutions.   **(9)**

   (b) How does thermal pollution lead to ecological imbalance?   **(8)**

   (c) Give the molecular interpretation of positive and negative deviation of Raoult's law.   **(12)**

   (d) Glucose, $C_6H_{12}O_6$ is a sugar that occurs in fruits. It is also known as 'blood sugar' because it is found in blood and the body's main source of energy. What is the molality of a solution containing 5.67 g of glucose dissolved in 25.2 g of counter?   **(6)**

4. (a) Define 'freezing point of solution'. Show that freezing point depressions of a solution due to addition of non-volatile and non-electrolyte is independent on the nature but dependent on the concentration.

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Contd ... Q. No. 4

(b) You add 1.00 kg ethylene glycol ($C_2H_6O_2$) antifreeze to 4450 g of water in your car's radiator. What are the boiling and freezing point of the solution? **(8)**

($K_b = 0.512°C/m$ and $K_t = 1.86°C/m$)

(c) What is the hybridized state of P in PCl_5? Show the hybridization process with diagram. **(8)**
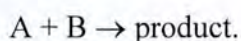
(d) With the help molecular orbital theory show that H_2 is stable but H_2^+ is transient. **(7)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.
Assume reasonable value for any missing data.

5. Consider the following reaction:

$$A + B \rightarrow product.$$

The rate law for the reaction is, rate = K[A][B].

(a) Discuss the reaction in terms of molecularity, order and rate constant. **(9)**

(b) How can you determine the order of the reaction by isolation method? **(7)**

(c) If [A] = [B], derive an expression for the rate constant of the reaction. **(11)**

(d) Under the condition given in(c), if 25% of the reaction is complete in 600 sec. how long will it take for the reaction to go to 75% completion? **(8)**

6. (a) State and explain the low of mass action. **(7)**

(b) Consider the following equilibrium $PCl_5 \rightleftharpoons PCl_3 + Cl_2$. Explain the effect of pressure, addition of Cl_2, and an inert gas on the equilibrium of the above reaction. **(10)**

(c) Derive an expression for the standard free energy change relating equilibrium constant of a reaction. **(12)**

(d) Calculate the equilibrium constant for the reaction taking place at 25°C in the cell

$$Zn| Zn^{++}||Fe^{+++}, Fe^{++}|p+$$
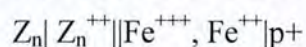
Given: $E°_{zn|zn++} = 0.762$ V and $E°_{P+|Fe++,Fe+++} = - 0.771$ V **(6)**

7. (a) Define buffer solution. How does buffer solution resists the change in its pH due to the addition of small quantities of strong acids or bases? **(10)**

(b) What is buffer capacity? Establish the conditions at which a buffer solution show maximum buffer capacity. **(17)**

(c) Calculate the pH of the 1.0 M CH_3COOH/ 1.0 M CH_3COONa buffer system. What is the pH after the addition of 0.10 mol of HCl to one liter of this buffer? **(8)**

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8. (a) Define the following terms: (i) heat of solution (ii) heat of formation and (iii) heat of neutralization. **(9)**

(b) Deduce the relation between ΔH and ΔF for a constant pressure process. Show the form of the relation for a constant volume process. **(16)**

(c) The heat of formation of methane at 27°C is $-$ 19.3 KCal at constant pressure. What will be the heat of formation at constant volume? **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2015-2016

Sub : **MATH 191** (Differential and Integral Calculus)

Full Marks : 280   Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Consider the function $f(x) = \begin{cases} x^2 + 1; & 0 \le x < \frac{1}{2} \\ 0; & x = \frac{1}{2} \\ x + 3; & \frac{1}{2} < x \le 1 \end{cases}$

Check the continuity and differentiability at $x = \frac{1}{2}$. Also sketch the graph of f.   **(15)**

(b) If $x = sin\left(\frac{ln\, y}{m}\right)$ then shown that

$(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - (n^2 + m^2)y_n = 0$. Also find $(y_n)_0$ **(16⅔)**

(c) Discuss the application of Rolle's theorem for $f(x) = ln\dfrac{x^2 + ab}{(a + b)x}$ in the interval

(a, b).   **(15)**

2. (a) Evaluate (i) $lim_{x \to 0}(cot^2\, x)^{sin\, x}$.   **(20)**

(ii) $lim_{x \to 0}\dfrac{xe^x - ln(1 + x)}{x^2}$.

(b) Prove that $ln(sec\, x) = \dfrac{1}{2}x^2 + \dfrac{1}{12}x^4 + \dfrac{1}{45}x^6 + \cdots$ **(10⅔)**

(c) Find the area of the triangle formed by the axes and the tangent to the curve

$x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$.   **(16)**

3. (a) Find all the asymptotes of $4x^3 - x^2y - 4xy^2 + y^3 + 3x^2 + 2xy - y^2 - 7 = 0$.   **(20)**

(b) An open box is to made from a 16-inch by 30-inch piece of cardboard by cutting out squares of equal size from the four corners and bending up the sides. What size should the squares be to obtain a box with the largest volume?   **(15)**

(c) If $f(x, y) = \begin{cases} \dfrac{xy(x^2 - y^2)}{x^2 + y^2}; & (x, y) \ne (0, 0) \\ 0 ; & (x, y) = (0, 0) \end{cases}$

then prove that $f(0, y) = -y, f_y(x, 0) = x$ and $f_{xy}(0, 0) \ne f_{yx}(0, 0)$.   **(16⅔)**

4. (a) Sketch a graph of the equation $y = x^3 - 3x^2 + 1$ and identify the exact location of relative extrema, inflection points and also find the interval of increasing and decreasing.   **(20)**

(b) Find the envelope of the family of ellipses $x^2 + \alpha^2 y^2 = 4\alpha, \alpha$ being parameter. Also interpret the result.   **(10)**

(c) Find the radius of curvature at any point t on the curve $x = a\, cos^3\, t, y = a\, sin^3\, t$.   **(16⅔)**

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SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. Evaluate the following :

   (a) $\int \dfrac{\sin 2x}{\sin^4 x + \cos^4 x}\,dx$ **(15)**

   (b) $\int \dfrac{x^2 + x + 1}{\sqrt{x^2 + 2x + 3}}\,dx$ **(15)**

   (c) $\int \dfrac{dx}{\sqrt{1 - 2\cos x + 3\sin x}}$ **(16⅔)**

6. (a) Evaluate the following:

   (i) $\displaystyle\int_{0}^{\pi/2} \dfrac{\sin^2 x}{1 + \sin x \cos x}\,dx$ **(15)**

   (ii) $\displaystyle\int_{0}^{\infty} \dfrac{x^{2m}}{1 + x^{2n}}\,dx$ **(15)**

   (b) Prove that $\displaystyle\int_{0}^{\pi/2} \sin^p x \cos^q x\,dx = \dfrac{\Gamma\dfrac{p+1}{2}\,\Gamma\dfrac{q+1}{2}}{2\Gamma\dfrac{p+q+2}{2}}$ **(16⅔)**

7. (a) Derive reduction formula for $I_n = \int x^n \cos mx\,dx$ and using it evaluate $\int x^3 \cos 3x\,dx$.   **(23⅔)**

   (b) Find the intrinsic equation of the cardiode $r = a(1 - \cos\theta)$ when the arc length is measured from one cusp where $\theta = 0$.   **(23)**

8. (a) Find the area interior to $y^2 = 2ax - x^2$ and exterior to $y^2 = ax$ lying in the first quadrant. Hence find the corresponding total area.   **(20)**

   (b) Find the volume of the solids generated by revolving the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ about its (i) major axis (ii) minor axis.   **(26⅔)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2015-2016

Sub : **PHY 117** (Structure of Matter, Electricity and Magnetism and Modern Physics)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) Write down the postutates of special theory of realativity and derive the Lorentz transformation equations for a pair of inertial frames of references, where one is moving with a constant velocity 'v' with respect to other along +Z axis.   (20)

   (b) What is LIGO and what are the basic differences between LIGO's interferometer and Michelson-Morley's interferometer?   (8)

   (c) Find the speed and momentum of a proton in GeV/c, whose energy is 3.5 GeV.   (7)

2. (a) Define photoelectric effect and explain it's results using the quantum theory radiation.   (19)

   (b) Explain the tem "Wave particle duality".   (8)

   (c) 1.5 mW of 400 nm light is directed at a photoelectric cell. If 0.10 percent of the incident photons produce photoelectrons, find the current in the cell.   (8)

3. (a) Define binding energy and explain the binding energy curve.   (12)

   (b) Define radioactivity and obtain an expression for the mean life of a radioactive specimen.   (15)

   (c) Calculate the activity of ^{20}K in a man of 100 kg assuming that 0.35% of the body weight is potassium. The abundance of ^{40}K is 0.012% and it's half-life is 1.31×10^9 years.   (8)

4. (a) Deduce Bragg's law in X-ray diffraction.   (14)

   (b) Write down the names of various X-ray diffraction techniques. Discuss briefly an X-ray diffraction technique that is suitable for crystals of any form. What are the advantages these techniques for crystallographic measurements.   (15)

   (c) Some X-rays are incident on a body centered cubic crystal with lattice parameter 2.24 Å. If the Bragg angle for the reflection from the (110) plane is 18.6°, what is the wavelength of the X-rays?   (6)

PHY 117

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Explain the terms translation vector and co-ordination number of a crystal. **(8)**

    (b) Describe CsCl structure with necessary diagram. Calculate the ionic packing factor of CsCl structure considering the ionic radii of Cs^+ and Cl^- ions to be 0.174 nm and 0.181 nm, respectively. **(12)**

    (c) Write short notes on – (i) Metallic bond, (ii) Van der Waals bond, (iii) Hydrogen bond. **(15)**

6. (a) Define the terms:- valence band, conduction band, forbidden energy gap and Fermi level. **(12)**

    (b) Explain the effect of changing temperature on the conductivity of a metal and a semiconductor on the basis of band theory of solid. **(8)**

    (c) What does the term crystal defect stand for? Write down the name of some physical properties of solid that can be influenced by defects. Discuss line defects in crystal. **(15)**

7. (a) Distinguish between electric potential and electric potential energy. **(6)**

    (b) A solid conductivity sphere of radius R has a total charge Q. Find the electric potential both inside and outside the sphere. Draw schematically $V(r)$ as a function of r. **(16)**

    (c) A capacitor C_1 is charged to a potential difference V_0. The charging battery is then removed and the capacitor is connected to an uncharged capacitor C_2. (i) What is the final potential difference across the combination? (ii) What is the stored energy before and after the switch is closed? **(13)**

8. (a) Explain the terms self-inductance and mutual inductance. **(7)**

    (b) What is toroid? Derive an expression for self-inductance of a toroid having rectangular cross-section. **(16)**

    (c) A long coaxial cable consists of two concentric cylinders with radii a and b. Its central conductor carries a steady current i, the outer conductor providing the return path. (i) Calculate the energy stored in the magnetic field for length l of such a cable. (ii) What is the inductance of a length l of coaxial cable? **(12)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2015-2016

Sub : **HUM 211** (Sociology)

Full Marks : 140   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) 'Ethnocentrism is a habit judge other's ways of life by the standards of our own group' – explain. **(10)**

    (b) What is cultural lag? Do you think cultural lag resists social change? Show arguments in favour of your answer. **(13 ⅓)**

2. (a) What is meant by family? Discuss the global practices of family system. **(13 ⅓)**

    (b) How does a functionalist evaluate the changing roles of family in modern society? **(10)**

3. (a) What is social stratification? How do various systems of social stratification perpetuate social inequality? **(10)**

    (b) Discuss Karl Marx's theory of social stratification. **(13 ⅓)**

4. Write short notes on any three of the following: **(23 ⅓)**

    (a) Social mobility. (b) Sociological imagination. (c) Functionalism (d) Social norms and social values.

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) In what ways might globalization render the nation-state relatively weak? **(13 ⅓)**

    (b) Describe the social factors associated with the rapid population growth rate in Bangladesh. **(10)**

6. (a) Distinguish the key differences between 'human ecology' and new 'urban sociology'. **(13 ⅓)**

    (b) Enumerate the push-pull factors of rural-urban migration in Bangladesh. **(10)**

7. (a) How are the physical and human environment connected in your neighborhood or community? **(13 ⅓)**

    (b) Illustrate the social impacts during industrial revolution in Great Britain. **(10)**

8. Write short notes on any THREE of the following: **(23 ⅓)**

    (a) Infant Mortality (b) Noise pollution (c) Migration during 1971 (d) Guild.