

L-1/T-1/IPE

Date : 05/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 211** (Sociology)

Full Marks: 140

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Define sociology. Explain the significant roles of sociological imagination for understanding human society. (10)
 (b) Make a comparison between functionalism and conflict perspective of sociology. (13 1/3)
2. (a) 'Language manifests cultural traits of a society'. Discuss. (10)
 (b) Define social values. Do you think that social values can defer the progress of technology? Substantiate your answer with arguments. (13 1/3)
3. (a) What do you understand by social stratification? Discuss the caste system of social stratification. (10)
 (b) 'The history of all hitherto existing societies is the history of class struggle' — explain this statement on the basis of Karl Marx's theory of social stratification. (13 1/3)
4. Write short notes on any three of the following: (23 1/3)
 - (a) Sociobiology
 - (b) Anomie theory
 - (c) White collar crime
 - (d) Theory of socialization.

SECTION – B

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

5. (a) What do you know about industrial revolution? (3 1/3)
 (b) Write down the important characteristics of capitalism. (10)
 (c) Describe the social consequences of industrial revolution. (10)
6. (a) What do you mean by environment and pollution? (4)
 (b) Describe the stage of demographic transition theory. (10)
 (c) Critically discuss the evolution of cities. (9 1/3)
7. (a) What do you understand by social change? Discuss the characteristics of social change. (13 1/3)
 (b) Briefly describe the sources of social change. (10)
8. Write short notes on any three of the following: (23 1/3)
 - (a) Potential consequences of global warming
 - (b) The factors responsible for population growth
 - (c) The major effects of rural to urban migration
 - (d) Globalization and modern life.

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L-1/T-1/IPE

Date : 29/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **IPE 105** (Principles of Cost and Management Accounting)

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**.

1. (a) Job order costing and Process costing are two different ways to calculate product cost.

How can you distinguish these two?

(8)

(b) Lindex Company manufactures baseball-style hats. Material is introduced at the beginning of the process in the Cutting Department. Conversion costs are incurred (and allocated) uniformly throughout the process. As the cutting of material is completed, the pieces are immediately transferred to the Sewing Department. Data for the Cutting Department for the month of February 2012 follow:

(27)

Work in process, January 31 - 50,000 units
 100% complete for direct materials, 40% completed for conversion costs
 actual costs of direct materials, \$70,500; actual costs of conversion, \$34,050

Units started during February 225,000
 Units completed during February, 200,000

Work in process, February 28 - 75,000 units
 100% complete for direct materials, 20% completed for conversion costs

Direct materials added during February [actual costs] \$342,000
 Conversion costs added during February [actual costs] \$352,950

Required:

i. Prepare a quantity schedule and a computation of equivalent units for February for the cutting department, assuming that the company uses the FIFO method of accounting for units.

ii. Prepare cost reconciliation.

2. (a) What do you understand by "operating leverage"?

(5)

(b) Silicon optics has supplied the following data for using in its activity based costing system:

(30)

Overhead Costs	
Wages and Salaries	\$350,000
Other overhead costs	\$200,000
Total overhead costs	\$550,000

	<u>NOI'm</u>	<u>Order Processing</u>	<u>Customer Support</u>	<u>Other</u>	<u>Total</u>
Wages and salaries :	30%	35%	25%	10%	100%
Other overhead cost :	25%	15%	20%	40%	100%

IPE 105

Contd ... Q. No. 4(a)

Activity cost pool	Activity measure	Total activity
Volume	Number of direct labor-hours	10,000 DLHS
Order processing	Number of orders	500 orders
Customer support	Number of customers	100 customers
Other	The cost are not allocated to products or customers	N/A

During this year, Silicon optics completed an order for a special optical switch for a new customer, Indus Telecom. This customer did not order any other products during the year.

Data for that order follow:

Data concerning the Indus Telecom order

Selling price	\$295 per unit
Units ordered	100 units
Direct materials	\$264 per unit
Direct labor hours	0.5 DLH per unit
Direct labor rate	\$25 per DLH

- i. Prepare a report showing the first stage allocation of overhead costs to the activity cost pools.
 - ii. Compute the activity rates for the activity cost pools.
 - iii. Prepare a report showing the overhead costs for the order from Indus Telecom. Do not include customer support costs at this point in the analysis.
 - iv. Prepare a report showing the product margin for the order and the customer margin for Indus Telecom.
3. (a) Briefly explain the concept "cost behavior". (6)
- (b) How can you classify cost based on function? (6)
- (c) The art factory has provided the following financial information for year 2011. (23)

Raw materials inventory, January 1	\$40,000
Work in process inventory, January 1	20,000
Finished goods inventory, January 1	70,000
Direct labor incurred	110,000
Accumulated depreciation	40,000
Indirect materials purchases	15,000
Direct materials purchases	80,000
Indirect materials used	10,000
Sales commissions expense	100,000
Finished goods inventory, December 31	30,000
Raw materials inventory, December 31	10,000
Rent expense, sales offices	35,000
Rent expense, factory	50,000
Indirect labor expense	20,000
Rent expense, corporate office	50,000
Depreciation expense, factory	10,000
Utilities expense, factory	10,000
Utilities expense, corporate office	10,000
Utilities expense, sales offices	10,000
Prepaid insurance	38,000
Work in process inventory, December 31	60,000

Contd P/3

IPE 105

Contd ... Q. No. 4(a)

Prepare a schedule of cost of goods sold and cost of goods manufactured sections of the company's income statement for the year.

4. (a) How can you explain changing business environment in today's competitive market? (5)

(b) High desert pottery works makes a variety of pottery products that it sells to retailers. The company uses a job order costing system in which predetermined overhead rates are used to apply manufacturing overhead costs to jobs. The pre-determined overhead rate in the Molding department is based on machine hours, and the rate in the painting department is based on direct labor cost. At the beginning of the year the company's management made the following estimates:

(30)

	Department	
	Molding	Painting
Direct labour-hours	12,000	60,000
Machine-hours	70,000	8,000
Direct materials cost	\$510,000	\$650,000
Direct labour cost	\$130,000	\$420,000
Manufacturing overhead cost	\$602,000	\$735,000

Job 205 was started on August 1 and completed on August 10. The company's cost records shows the following information concerning the job:

	Department	
	Molding	Painting
Direct labour-hours	30	85
Machine-hours	110	20
Materials placed into production	\$470	\$332
Direct labour cost	\$290	\$680

Required:

- (i) Compute the predetermined overhead rate used during the year in the Molding department. Compute the rate used in the painting department.
- (ii) Compute the total overhead cost applied to job 205.
- (iii) What would be the total cost recorded for job 205? If the job contained 50 units, what would be the unit product cost?
- (iv) At the end of the year, the records of the company revealed the following actual cost and operating data for all jobs worked on during the year:

	Department	
	Molding	Painting
Direct labour-hours	10,000	62,000
Machine-hours	65,000	9,000
Direct materials cost	\$430,000	\$680,000
Direct labour cost	\$108,000	\$436,000
Manufacturing overhead cost	\$570,000	\$750,000

What was the amount of under or over-applied overhead in each department at the end of the year?

IPE 105

SECTION - B

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

5. (a) If a company has manufacturing cycle efficiency (MCE) of greater than 1, what does it mean? How would you interpret an MCE of 1.5? (8)

(b) Shirt makers Inc., manufactures short and long sleeved men's shirts for large stores. Shirt makers produces a single quality shirt in lots to each customer's order and attaches the store's label to each shirt. The standard direct costs for a dozen long sleeved shirts include: (27)

Direct materials: 24 yards at 140BDT per yard3360BDT

Direct labor: 3 hours at 120 BDT per hour360BDT

During April, Shirt makers worked on three different orders for long sleeved shirts. Job cost records for the month disclose the following:

Lot	Units in Lot (dozens)	Material Used (Yards)	Hours Worked
30	1,000	24,100	2,980
31	1,700	40,440	5,130
32	1,200	28,825	2,890

The following additional information is available:

- (i) Shirt makers purchased 95,000 yards of material during April at a cost of 13,965,000 BDT.
- (ii) Direct labor cost incurred amounted to 1,353,000 BDT. During April.
- (iii) There was no work in progress at April 1. During April, lots 30 and 31 were fully completed. At April 30, lot 32 was 100% complete with respect to materials but only 80% complete with respect to labor.

Now,

1. Compute the materials price variance for April and show whether the variance was favorable or unfavorable.
2. Determine the materials quantity variance for April in both yards and dollars:
 - (a) For the company in total
 - (b) For each lot worked on during the month.
3. Compute the labor rate variance for April, and show whether the variance was favorable or unfavorable.
4. Determine the labor efficiency variance for April in both hours and dollars:
 - (a) For the company in total
 - (b) For each lot worked on during the month.
5. In what situations might it be better to express variances in units (hours, yards and so on) rather than in dollars? In dollars rather than in units?

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6. (a) Write short notes on semi variable cost.

(5)

(b) Modern Building Supply sells various building materials to retail outlets. The company has just approached Linden State Bank requesting a \$300,000 loan to strengthen the cash account and to pay certain pressing short term obligations. The company's financial statement for the most recent two years follow:

(30)

Modern Building Supply
Comparative Balance Sheet

Assets	This Year	Last Year
Current assets:		
Cash.....	90,000	200,000
Marketable securities.....	0	50,000
Accounts receivable, net.....	650,000	400,000
Inventory.....	1,300,000	800,000
Prepaid expenses.....	20,000	20,000
Total current assets.....	2,060,000	1,470,000
Plant and equipment, net.....	1,940,000	1,830,000
Total Assets.....	\$4,000,000	\$3,300,000
Liabilities & Stockholders' Equity		
Liabilities		
Current liabilities.....	1,100,000	600,000
Bonds payable, 12%.....	750,000	750,000
Total liabilities.....	1,850,000	1,350,000
Stockholders' equity		
Preferred stock, \$50 par, 8%.....	200,000	200,000
Common stock, \$10 par.....	500,000	500,000
Retained earnings.....	1,450,000	1,250,000
Total stockholders' equity.....	2,150,000	1,950,000
Total liabilities and stockholders' equity.....	\$4,000,000	\$3,300,000

Modern Building Supply
Comparative Income Statement

	This Year	Last Year
Sales	\$7,000,000	\$6,000,000
Less cost of goods sold	5,400,000	4,800,000
Gross margin	1,600,000	1,200,000
Less operating expenses	970,000	710,000
Net operating income	630,000	490,000
Less interest expense	90,000	90,000
Net income before taxes	540,000	400,000
Less income taxes (40%)	216,000	160,000
Net income	324,000	240,000

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Contd ... Q. No. 6(b)

Now, find out the following ratios for both this year and last year

- (i) The amount of working capital
- (ii) The current ratio
- (iii) The acid-test ratio
- (iv) The average age of receivables (The account receivable at the beginning of last year totaled \$350,000)
- (v) The inventory turnover in days. (The inventory at the beginning of last year totaled \$720,000)
- (vi) The debt-to-equity ratio
- (vii) The number of times interest was earned
- (viii) Gross margin percentage
- (ix) Book value per share
- (x) Return on total asset (Total assets at the beginning of last year totaled \$3,100,000)

7. (a) Matador Company manufactures and sells a single product. The following costs were incurred during the company's first year of operations:

(20)

Variable costs per unit (BDT)

Production:

Direct materials	18
Direct labor	7
Variable manufacturing overhead	2
Variable selling and administrative	5

Fixed costs per year

Fixed manufacturing overhead	160,000
Fixed selling and administrative expenses	110,000

During the year, the company produced 20,000 units and sold 16,000 units. The selling price of the company's product is 50 BDT per unit.

Now,

- i. Assume that the company uses absorption costing method
 - (a) Compute the unit product cost
 - (b) Prepare an income statement for the year
- ii. Assume that the company uses variable costing method
 - (a) Compute the unit product cost
 - (b) Prepare an income statement for the year

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Contd ... Q. No. 7

(b) You have just been appointed as a director of recreation programs for Young Boys Club, a rapidly growing sports club. In the past, the club has sponsored a number of football leagues in the water season. From the club's cost records, you have found the following total costs associated with football leagues over last five years:

(15)

Number of leagues	Total cost
5	130,000
2	70,000
4	105,000
6	140,000
3	100,000

Now, you would like to scrutinize the amount of variable cost per league and total fixed cost per year associated with the football program because this information will help you to plan accordingly.

i. Using the least square regression method, estimate the variable cost per league and the total fixed cost per year for the football program. Also express the data into $Y = a + bX$ form.

ii. Suppose higher authority wants to expand the program up to 8 leagues in the coming year. Compute the expected total cost of the football program for 8 leagues.

8. (a) Describe the limitations of activity based costing method.

(5)

(b) A 10% decrease in the selling price of a product will have same impact on net income as a 10% increase in the variable expenses. Do you agree? Why or why not?

(8)

(c) State the significance of break-even point.

(7)

(d) Teri Hall has recently opened Sheer Elegance, Inc., a store in fashionable stockings. She has prepared the following analysis:

(15)

Sales price per pair of stockings	\$2.00
Variable expense per pair of stockings	0.80
Contribution margin per pair of stockings	1.20
Fixed expenses per year	
Building rental	\$12,000
Equipment depreciation	3,000
Selling	30,000
Administrative	15,000
Total fixed expenses	\$60,000

i. How many pairs of stockings must be sold to break even? What does this represents in total dollar sells?

ii. How many pairs of stockings must be sold to earn a \$9,000 target profit for the first year?

iii. Ms. Hall has one full time and one part time sales person. It will cost her additional \$8000 per year to convert the part time position to full time position. She believes that the change would bring an additional \$20,000 in sales each year. Should she convert the position?

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Briefly explain classification of solids from crystallographic point of view. (7)
- (b) Draw a schematic diagram of an X-ray diffractometer. Deduce Bragg's law. (10)
- (c) What are the Miller indices? Show that the Miller indices and interplanar distance are related for a cubic crystal system by $\frac{1}{d^2} = \frac{1}{a^2}(h^2 + k^2 + l^2)$ (14)
- where the symbols have their usual meanings
- (d) The KCl crystal is face centered cubic having a density of 1.98 g/cm³. If its molecular weight is 74.6 g/mole. Calculate the distance from one atom to the next atom of same kind. (4)

2. (a) What is lattice energy of an ionic crystal? (11)
- (b) Show that lattice energy of NaCl crystal is $-\frac{\alpha e^L}{4\pi\epsilon_0 r_0} \left(1 - \frac{1}{n}\right)$, (7)
- where the symbols have their usual meanings
- (c) Distinguish between intrinsic and extrinsic semiconductors. Write expressions for conductivities for intrinsic semiconductor and various extrinsic semiconductors. (9)
- (d) The covalent bonding energy of C – C is 370 kJ/mole. What wavelength of light will break C – C bond. What is its colour? (5)

3. (a) Define density of packing for a crystal system. Calculate packing factor for NaCl crystal if radii of Cl and Na ions are 0.187 and 0.097 nm, respectively. Is there any deviation of the values of density of packing for NaCl and an ideal FCC crystal? If so why? (11)
- (b) Calculate number of atoms per unit cell in various space lattices of cubic crystal system. Provide necessary diagrams. (7)
- (c) What are the lattice parameters for hexagonal crystal system? Draw a typical unit cell of hexagonal crystal. Give some examples of hexagonal crystal. Show that C/a ratio for the ideal hexagonal crystal structure is 1.633. (12)
- (d) Sketch (110) plane of α – Fe crystal which is body centered cubic. Atomic radius of α – Fe is 0.1243 nm. What is the area of this plane? Calculate number of atoms/mm² of (110) plane of this crystal. (5)

4. (a) Define electric flux and state Gauss's law in electrostatics. (7)
- (b) Using Gauss's law obtain expressions for electric field E at any particular point at a distance r from the centre of a charged non-conducting sphere of radius R. In case of

$$b = \epsilon + 9$$

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PHY 117(IPE)

Contd ... Q. No. 4(b)

- (i) Outside ($r > R$) (ii) Inside ($r < R$), and (iii) Surface ($r = R$). Also draw schematically $E(r)$ as a function of distance. (19)
- (c) What is surface charge density? A small sphere whose mass is 1.0×10^{-3} g carries a charge q of 2×10^{-8} C. It hangs from a silk thread which makes an angle 30° with a large charged conducting sheet. Calculate surface charge density for the sheet. (9)

SECTION - B

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

5. (a) State and explain Faraday's law of electromagnetic induction and lenz's law for the direction of the induced emf. Does Kirchoff's loop rule lose its validity in case of electromagnetic induction? In what condition it becomes valid? (10)
- (b) Show that when a closed conducting loop is moved across a magnetic field, and induced current is produced in the loop which produces an internal energy at the same rate as the mechanical work is done on the loop. (10)
- (c) Write down the four Maxwell's equations of electromagnetism. Explain the physical significance of 2nd equation (Gauss's law of magnetism) (8)
- (d) Give some examples of ferromagnetic materials. Draw a typical hysteresis loop for a ferromagnetic material. (7)
6. (a) What is a dielectric material? Show that when the space between the plates of a parallel plate capacitor is filled with a material of dielectric constant k , Gauss's law of electrostatics becomes $\epsilon_0 \oint kE \cdot ds = q$. (15)
- (b) State Ampere's law. A solenoid is 1.0 m long and 3.0 cm in mean diameter. It has 5 layers of windings of 850 turns each and carries current of 5.0 amp. What is B at the centre of the solenoid. (8)
- (c) A circuit contains a self inductor of inductance L and a resistor of resistance R placed in series with a cell of emf ϵ . (15)
- (i) Obtain expression for the growth of current in the circuit
- (ii) Draw schematically current vs time in this case.
- (iii) What is time constant of this circuit? (6)
7. (a) What is photoelectric effect? (6)
- (b) Discuss the important results of photoelectric effect and hence establish the Einstein's photoelectric equation. (21)
- (c) What potential difference must be applied to stop the fastest photoelectrons emitted by a nickel surface under the action of ultraviolet light of wavelength 2000 \AA ? The work function of nickel is 5.00 eV. (8)
8. (a) Derive Lorentz transformation equations. Show that the Galilean transformation is a special case of the Lorentz transformation. (19)
- (b) What is length contraction and time dilation in case of relativity? (8)
- (c) How fast must be a spacecraft travel relative to the earth for each day on the spacecraft to correspond to 2 days on the earth? (8)

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L-1/T-1/IPE

Date : 17/11/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 280

Time : 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

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

1. (a) A function $f(x)$ is defined as follows:

(20 $\frac{2}{3}$)

$$f(x) = \begin{cases} x, & 0 \leq x < 1 \\ 2 - x, & 1 \leq x \leq 2 \\ x - \frac{1}{2}x^2, & x > 2 \end{cases}$$

Discuss the continuity and differentiability of $f(x)$ at $x = 2$. Also sketch the graph of $f(x)$.

(b) Evaluate : $\lim_{x \rightarrow \frac{\pi}{2}} (\sin x)^{\tan x}$.

(13)

(c) Show that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (a^2 - n^2)y_n = 0$ when $x = \sin\left(\frac{1}{a} \sin^{-1} y\right)$.

(13)

2. (a) State and prove Rolle's theorem. Verify Rolle's theorem for $f(x) = e^{-x} \sin x$ in the interval $(0, \pi)$.

(20 $\frac{2}{3}$)

(b) Expand $\cos^2 x$ in power of $\left(x - \frac{\pi}{2}\right)$ with Lagrange's form of remainder after n -terms.

(13)

(c) A fuel charge for running a train are proportional to the square of the speed generated in miles per hour and cost TK. 48 per hour at 16 miles per hour. What is the most economical speed, if the fixed charges, i.e. salaries etc. amount to TK. 300 per hour.

(13)

3. (a) If $u = x^3 y f\left(\frac{y}{x}\right) + x^2 y^2 g\left(\frac{y}{x}\right) + x^4 h\left(\frac{y}{x}\right)$, then show that

(15)

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 12u.$$

(b) Find the height of the tent so that a conical tent with given volume can be made by using minimum amount of canvas.

(15)

(c) Show that the condition that the curves $x^{\frac{2}{3}} + y^{\frac{2}{3}} = c^{\frac{2}{3}}$ and $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ may touch

is $a + b = c$.

(16 $\frac{2}{3}$)

Contd P/2

MATH 191

4. (a) For the curve $x^2y^2 = a^2(x^2 - a^2)$ find the radius of curvature at $(a, 0)$. (15)
 (b) Find the asymptotes of the curve (16 $\frac{2}{3}$)

$$y^3 - 5xy^2 + 8x^2y - 4x^3 - 4y^2 + 12xy - 8x^2 + 3y - 3x + 2 = 0.$$

 (c) Find the envelope of the straight lines $\frac{x}{a} + \frac{y}{b} = 1$, where a, b are variable parameters, connected by the relation $a + b = c$, c being a non-zero constant. (15)

SECTION - B

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

5. (a) Workout the following:
- (a) $\int \frac{x^2 + x + 1}{\sqrt{x^2 + 2x + 3}} dx$ (15)
 (b) $\int \frac{\sqrt{\sin x}}{\cos^2 x} dx$ (15)
 (c) $\int \sqrt{1 + \sec x} dx$ (16 $\frac{2}{3}$)
6. (a) Evaluate the following:
- (i) $\int_0^{\pi/2} \frac{\sin^2 x}{\sin x + \cos x} dx$ (13 $\frac{2}{3}$)
 (ii) $\int_0^1 x^6 \sqrt{1 - x^2} dx$ (13)
- (b) If $I_n = \int_0^{\pi/2} x^n \sin x dx$ ($n > 0$) then prove that $I_n + n(n-1)I_{n-2} = n\left(\frac{\pi}{2}\right)^{n-1}$. (20)
7. (a) Show that $\Gamma\left(\frac{1}{9}\right)\Gamma\left(\frac{2}{9}\right)\Gamma\left(\frac{3}{9}\right) \dots \Gamma\left(\frac{8}{9}\right) = \frac{3\pi^4}{16}$. (20)
 (b) Find the perimeter of the cardioid $r = a(1 - \cos\theta)$ and show that the arc length of the upper half of the curve is bisected by $\theta = \frac{2}{3}\pi$. (26 $\frac{2}{3}$)
8. (a) Find the area bounded by $y^2 = 8x$ and $x^2 = 8y$. (23)
 (b) Find the volume of the solid produced by revolution of the curve $y^2(a-x) = a^2x$ about its asymptote. (23 $\frac{2}{3}$)
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L-1/T-1/IPE

Date : 23/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210

Time : 3 Hours

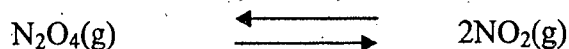
The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

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

1. (a) How does heat evolve or absorb during dissolution of solute in a solvent? (10)
(b) What are the factors affecting the solubility of gas in liquids? State Henry's law giving mathematical relation. (8)
(c) What types of liquid pairs are steam distilled? How steam distillation is useful in evaluating the molar masses of compounds? (7)
(d) An aqueous solution containing 10.00 g of KOH and 90.0 g of water has a density of 1.12 kg/dm^3 . Find (i) w/v% of KOH, (ii) Molality, (iii) Molarity and (iv) Mole fraction of KOH. (10)
2. (a) What do you mean by colligative properties? With the help of a diagram, prove that the elevation of boiling point of a solvent, produced by dissolving a non-volatile and non-electrolytic substance is proportional to the corresponding lowering of vapour pressure and molality of solute in the solvent. (15)
(b) Derive a mathematical relation between osmotic pressure and vapour-pressure of a dilute solution of a solid in a liquid. (10)
(c) A 3.75 g sample of a non volatile and non-electrolytic substance was dissolved in 95 g of acetone. The boiling point of the solution was 56.50°C . The boiling point of pure acetone is 55.95°C at 1 atm, and the boiling point constant for acetone is 1.71°C/m . Calculate the molar mass of the solute. (10)
3. (a) What do you mean by the term internal energy of a system? How is it related to the enthalpy of the system? (4+4)
(b) Derive Kirchoff's equations of heat of reaction at variable temperature. (10)
(c) Discuss the working principle of H_2 - O_2 fuel cell. (12)
(d) What is cathodic protection of corrosion? (5)
4. (a) Derive the expression for thermodynamic equilibrium constant. (12)
(b) What type of information you can get from equilibrium constant? (6)
(c) In the following gaseous reaction (8)



Contd P/2

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some helium gas (He) is added in the reaction mixture. What type of equilibrium shift do you expect?

(d) A mixture of 0.750 mol of H_2 and 0.750 mol of I_2 was placed in a 1.00 L stainless-steel flask at $430^\circ C$. The equilibrium constant K_c for the reaction



is 54.3 at this temperature. Calculate the concentrations of H_2 , I_2 and HI at equilibrium.

(9)

SECTION - B

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

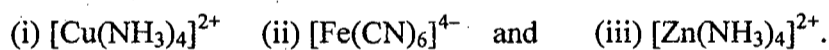
5. (a) An electron is in a 3d orbital. Mention the possible quantum numbers for the electron? (5)

(b) Derive Schrodinger wave equation and solve the equation for a particle in an one-dimensional box. (10+12=22)

(c) A particle is known to be in the ground state of infinite square well of length L . Calculate the probability that this particle will be found in the middle half of the well, that is between $x = L/4$ and $3L/4$. (8)

6. (a) What are transition metals? Why do they show variable oxidation states? (5)

(b) What are the important features of the valence bond theory? Apply the valence bond theory for the formation of the following complexes: (12)



(c) Mention the assumptions of the crystal field theory. What are the advantages of the crystal field theory over the valence bond theory? (12)

(d) Rationalize the following:

(i) Aqueous Ti^{3+} is colored but Ti^{4+} is not. (ii) MnO_4^- is colored even though Mn(vii) does not have d-electrons. (6)

7. (a) Explain why: (16)

(i) PCl_5 exists but NCl_5 does not.

(ii) *p*-Nitrophenol boils at higher temperature than *o*-Nitrophenol.

(iii) SF_6 attains octahedral structure with all F-S-F bond angles of 90°

(iv) O_2 is paramagnetic but O_2^{2-} is diamagnetic.

(b) Draw a glass electrode and explain its use for the determination of pH of a test solution. (13)

(c) What is the origin of electrode potential? (6)

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8. (a) What is the order of a reaction? How can you determine the order of a reaction by graphical method? (12)
- (b) What is a parallel reaction? Derive the expressions for the rate constants of a parallel reactions. (12)
- (c) The conversion of cyclopropane to propene in gas phase is a first-order reaction with a rate constant of $6.7 \times 10^{-4} \text{ s}^{-1}$ at 500°C . (11)
- (i) If the initial concentration of cyclopropane is 0.25 M, what is the concentration after 8.8 min?
- (ii) How long will it take for the concentration of cyclopropane to decrease from 0.25 M to 0.15 M?
- (iii) How long will it take to convert 75% of the starting material?
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