L-1/T-1/ME

Date : 29/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **EEE 159** (Fundamentals of Electrical Engineering)

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) Find the equivalent resistance Req as seen from the terminals (a, b) in the following electrical circuit (Fig for Q. 1(a)). **(15)**

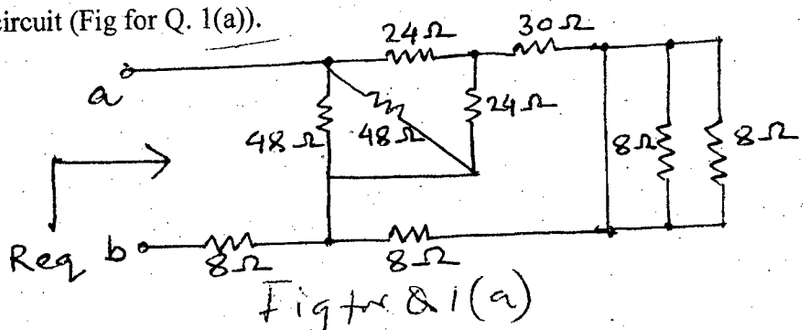


Fig for Q 1(a)

(b) For the following circuit which is powered by a 20 A current source, find the voltage V as shown in the figure (Fig. for Q. 1(b)). **(20)**

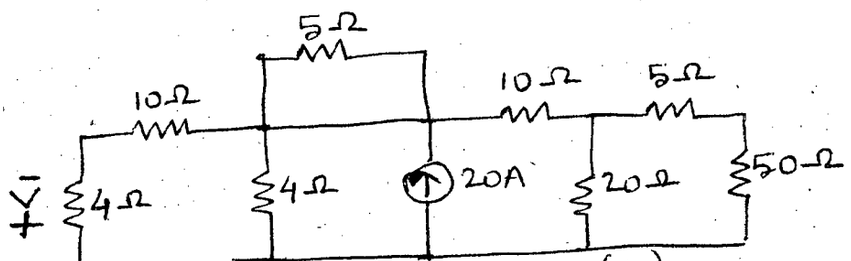


Fig for Q 1(b)

2. (a) Using mesh analysis technique, determine the current I flowing through the 100 Ω resistor in the following figure (Fig. for Q. 2(a)). Also determine whether the voltage source V_2 is absorbing or delivering power in this circuit. **(15)**

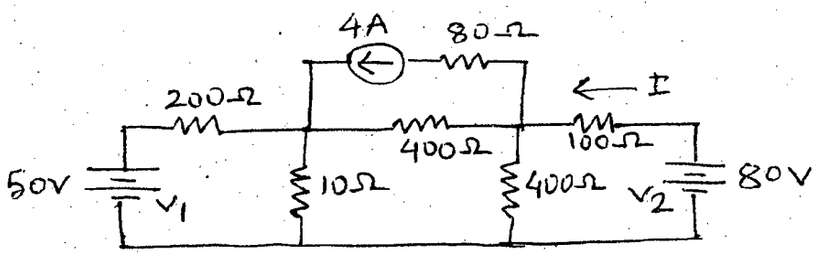


Fig for Q 2(a)

(b) Use an appropriate technique to find the magnitude of the current I_0 in the following circuit (Fig. for Q. 2(b)) which contains three independent sources. **(20)**

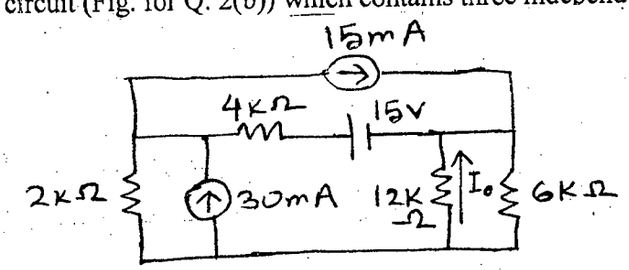


Fig for Q 2(b)

Contd P/2

EEE 159(ME)

3. (a) Find the voltage of node 3 in the following d.c. circuit (Fig. for Q. 3(a)) using node analysis technique. **(20)**

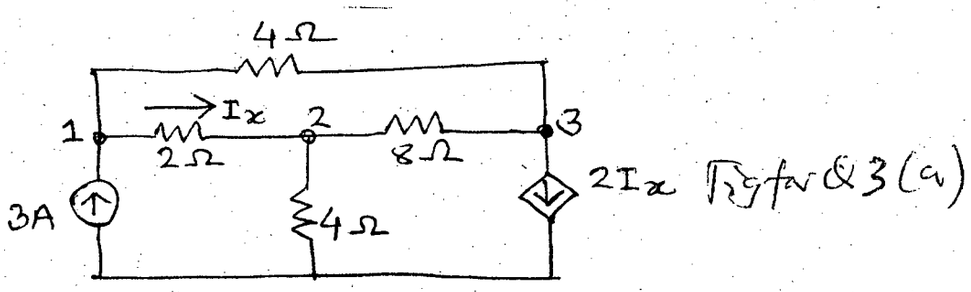


Fig for Q3(a)

(b) Using an appropriate technique find the node voltages V_1 and V_2 as shown in the following figure (Fig. for Q. 3(b)). **(15)**

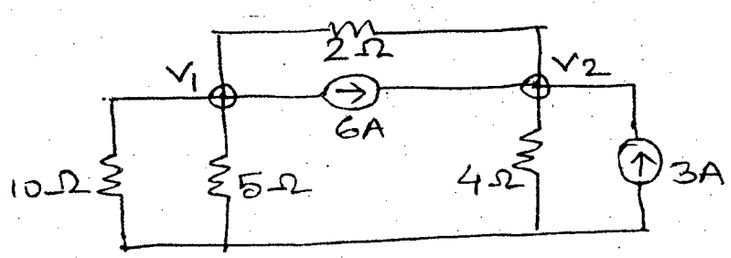


Fig for Q3(b)

4. (a) With the application of the principle of source transformation, obtain the voltage V_x for the following circuit (Fig. for Q. 4(a)). **(15)**

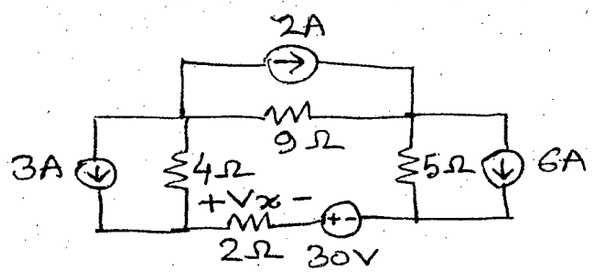


Fig for Q4(a)

(b) By employing Thevnin's theorem, find the equivalent circuit of the block to the left of the terminals (a, b) and use this circuit to determine the current I, as shown in the following diagram (Fig. for Q. 4(b)). **(20)**

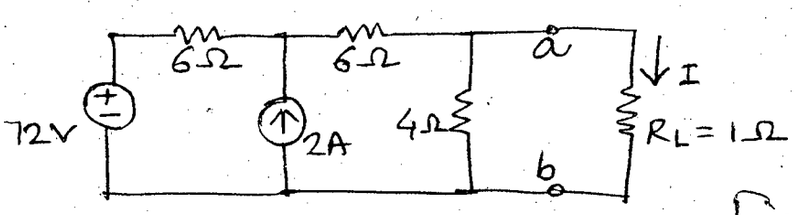


Fig for Q4(b)

Contd P/3

EEE 159(ME)

SECTION – B

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

5. (a) Calculate (i) average value, (ii) effective value, (iii) form factor, and (iv) crest factor of the voltage having the waveshape as in Fig. for Q. No. 5(a). **(20)**

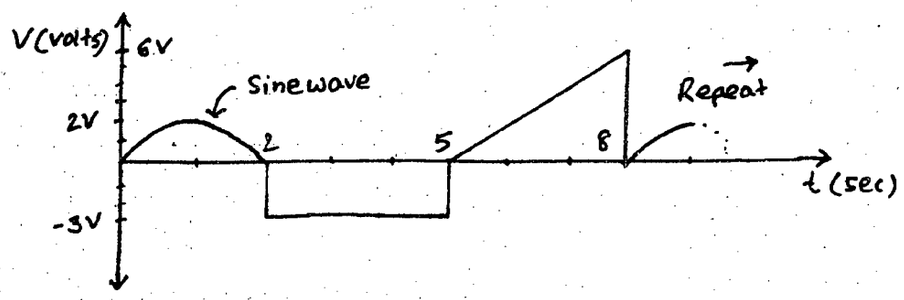
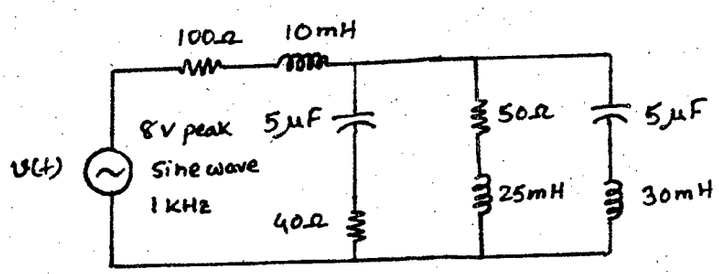


Fig. for Q. No. 5(a)

(b) Consider a series R-C circuit. The current through the capacitor is $i(t) = I_m \sin(wt)$. Find (i) the expression of the applied voltage, and (ii) average power supplied by the source. **(10)**

(c) Show that for both Y and Δ connected system, the total real power supplied by 3 phase source is $\sqrt{3}\, V_L I_L \cos\theta$ where, V_L = Line voltage, I_L = Line current and θ is the phase difference between phase current and corresponding phase voltage. **(5)**

6. (a) Find the equivalent impedance of circuits (i) and (ii) shown in Fig. for Q. No. 6(a). **(20)**



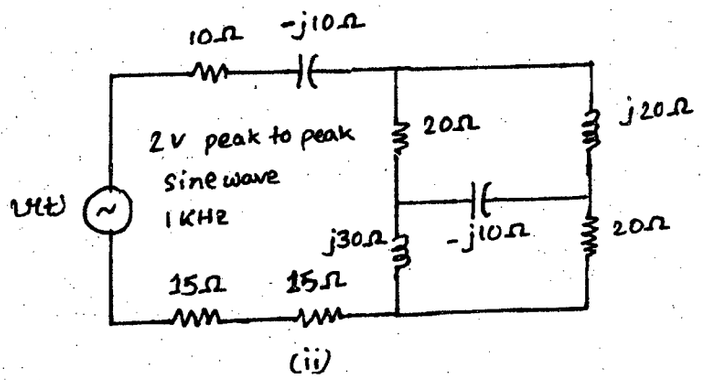


Fig. for Q. No. 6(a)

Contd P/4

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Contd ... Q. No. 6

(b) For the circuit shown in Fig. for Q. No. 6(b), v(t) = 141.4 Sin (2000 πt + 30°) V. Find (i) total real power, (ii) total reactive power, (iii) total vA, (iv) power factor, (v) real power dissipated in XY branch. Also draw the phasor diagram of $\bar{V}, \bar{I}$, and $\bar{I}_2$ with taking $\bar{I}_1$ as reference. **(15)**

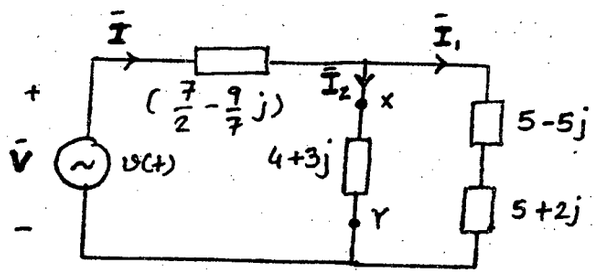

Fig. for Q. No. 6 (b)

7. (a) Find the mesh currents for the circuit shown in Fig. for Q. No. 7(a). Also find (i) power consumed by 30 Ω resistance, (ii) real power supplied by $\bar{V}$ source, and (iii) current through 20 Ω resistance. **(20)**

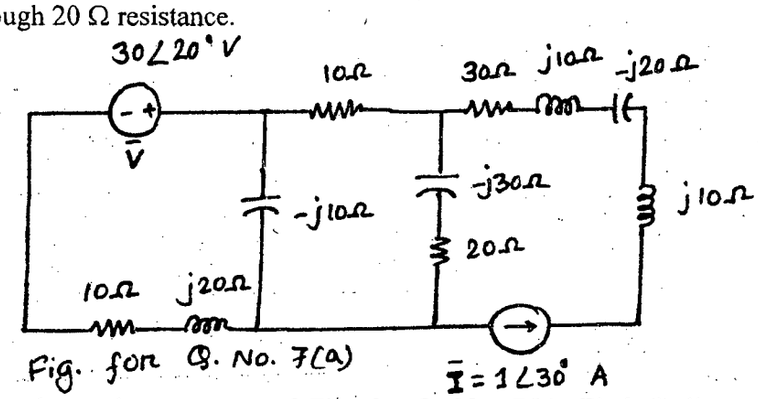

Fig. for Q. No. 7(a)

(b) Consider the three phase system of Fig. for Q. No. 7(b). Find (i) line currents, (ii) phase currents, (iii) real power per phase, and (iv) total reactive power. Given, $V_{ab} = 415\angle 0°$, $V_{bc} = 415\angle -120°$ and $V_{ca} = 120°$. All these voltages are in r.m.s. **(15)**

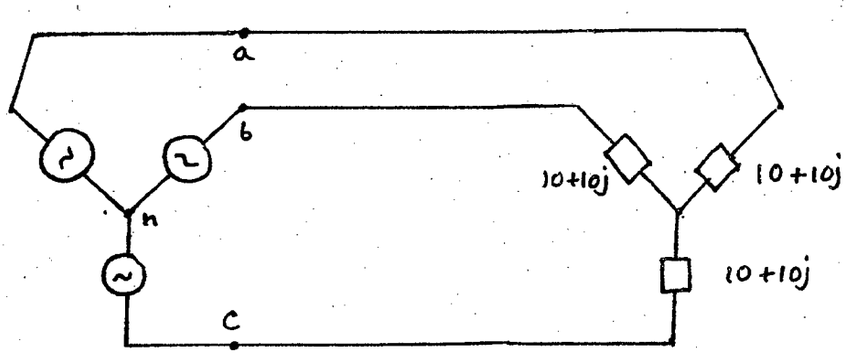

Fig. for Q. No. 7(b)

EEE 159(ME)

8. (a) For the circuit shown in Fig. for Q. No. 8(a), the voltage $v_s(t) = 20 \sin (100\,t + 60°)$ V. Find (i) current i(t), (ii) total real power supplied by the voltage source, and (iii) voltage across capacitor, $v_c(t)$. **(10)**

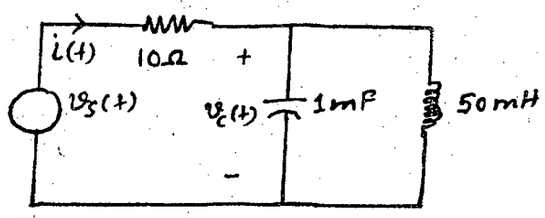

Fig. for Q. No. 8(a)

(b) Show that energy stored per unit volume in the magnetic field of a coil is $W = \frac{1}{2}\mu_o H^2$. Here, notations have their usual meaning. **(5)**

(c) Determine the current I_2 if the resultant flux $\phi = 2.5 \times 10^{-4}$ ωb (clockwise) for the magnetic circuit shown in Fig. for Q. No. 8(c). The cross sectional area thoroughout the cast steel core is 5 cm^2. Given, $l_{abcdef} = 0.24$ m and $l_{af} = 0.01$ m. Neglect fringing effect. **(20)**

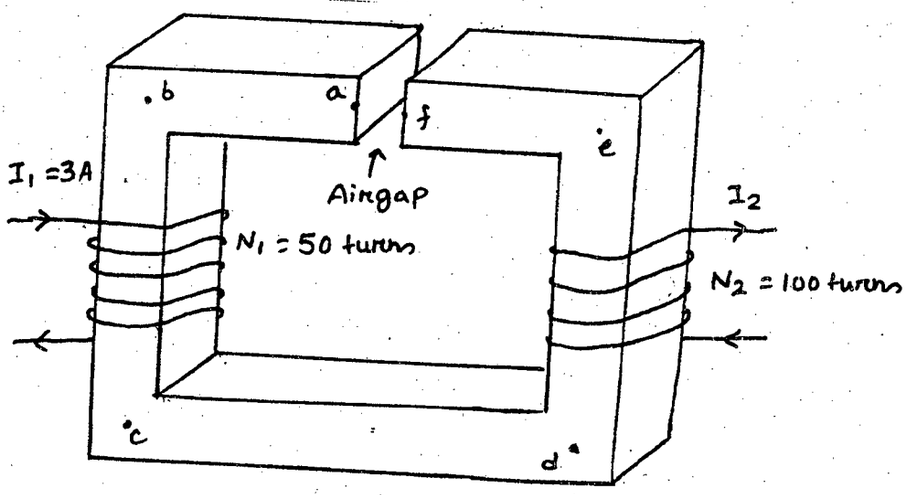

Fig. for Q. No. 8(c)

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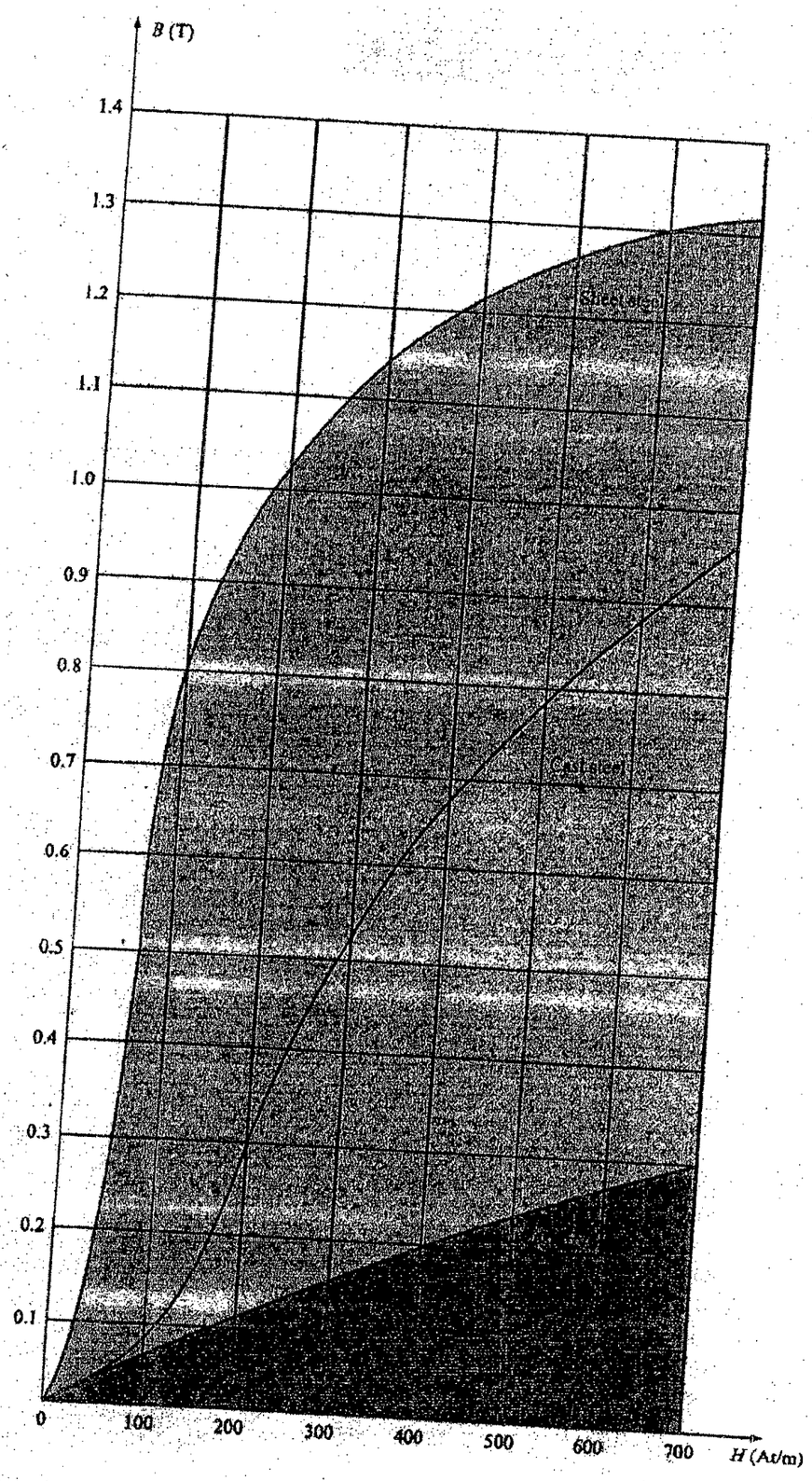

B-H curve for Q. No. 8(c)

L-1/T-1/ME **Date : 15/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **PHY 105** (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**.

1. (a) State the basic postulates of special theory of relativity and hence obtain the Lorentg space-time transformation formulae. **(17)**

   (b) Deduce the mathematical expression for the lane of addition of relativistic velocities. **(10)**

   (c) A space craft is moving relative to the earth. An observer on the earth finds that, between 1 p.m and 2 p.m according to her clock, 3601 sec elapse on the spacecraft's clock. What is the spacecraft's speed relation to the earth? **(8)**

2. (a) What is photo-electric effect? Describe an experiment for studying the phenomenon of photo-electric emission. **(12)**

   (b) Discuss the important results of photoelectric effect and hence establish the Einstein's photoelectric equation. **(15)**

   (c) A photo-electric surface has a work function of 4eV. What is the maximum velocity of the photoelectrons emitted by light of frequency 10^{15} Hz incident on the surface given, $h = 6.6 \times 10^{-34}$ J-s, $e = 1.6 \times 10^{-19}$; $m = 9 \times 10^{-31}$ kg. **(8)**

3. (a) What happens to the atomic number and mass number of a nucleus when it (i) emits an alpha particle, (ii) emits an electron (iii) emits a positron (iv) captures an electron. **(8)**

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   (c) The radious of $^{165}H_O$ is 7.731 fermi. Deduce the radius of ^{4}He. **(8)**

4. (a) Define Miller indices. Find the relation between Miller indices and interplaner spacing for an orthorhombic crystal system. **(15)**

   (b) Derive Bragg's law in x-ray diffraction. **(10)**

   (c) Find the Miller indices of a plane that makes an intercept of 3 Å, 8 Å and 10 Å on the coordinate axes of an orthorhombic crystal with a : b : c = 1 : 2 : 5. **(10)**

Contd P/2

PHY 105(ME)

SECTION – B

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5. (a) Define and classify unit cell with diagram. **(10)**

   (b) Describe the hexagonal close packet structure. Calculate the packing fraction for a hexagonal close packet system. **(15)**

   (c) Lithium has a body centered cubic structure. Its density and atomic weight are 542 kg/m^3 and 6.94 respectively. Calculate the unit cell dimension and atomic diameter in Å unit. **(10)**

6. (a) Define imperfections in a crystal system and classify them. Mention some of the properties of solids arise due to defects. **(10)**

   (b) Explain the following **(15)**

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   (c) Find the interplanar specing for the lattice plane of Miller indices (213) and (120) for a cubic lattice with lattice constant 4.21 Å. **(10)**

7. (a) Discuss charge and matter in electrostatics. With the help of a suitable example show that charge is conserved. An electron is an electric monopole but it's a magnetic dipole. Briefly explain this property of an electron. **(12)**

   (b) What is an electric dipole? Draw an electric dipole and show the dipolar axis, and the direction of dipole moment P. Show that the electric field E due to a dipole, a distance r along the perpendicular bisector of the line joining the two charges is given by

$$E = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$$

   where the symbols have their usual meaning. Show graphically how E varies with r for a dipole and a point charge. **(15)**

   (c) A charge of 100 coulomb is located at point (3,4,0) (meter). Find the electric field intensity at the origin (0, 0, 0). **(8)**

8. (a) Distinguish current, current density, Resistivity, Potential and Electric field. Write down all the integral and differential forms of relation between all these electrical parameters. **(12)**

Contd P/3

PHY 105(ME)

Contd ... Q. No. 8

(b) In the figure below the free electrons drift in the direction opposite to the electric field E in a metallic conductor. Show that the electron drift velocity v_d is given by $v_d = \frac{\vec{f}}{ne}$, where the symbols have their usual meaning. **(15)**

(c) A resistor is connected across a battery in a circuit show that the power per unit volume, p, for transformed into Joule heat in the resistor is, **(8)**

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L-1/T-1/ME **Date : 15/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **PHY 105** (Structure of Matter, Electricity and Magnetism and Modern Physics)

Full Marks : 210 Time : 3 Hours

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Contd P/2

PHY 105(ME)

SECTION – B

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Contd P/3

PHY 105(ME)

Contd ... Q. No. 8

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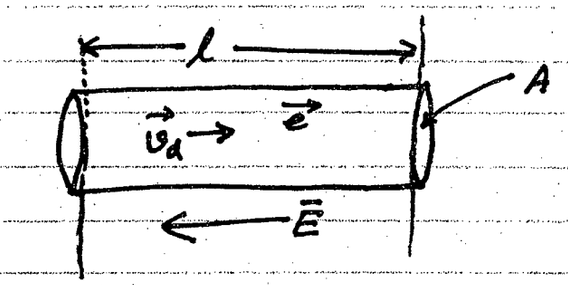

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L-1/T-1/ME Date : 15/12/2012

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PHY 105(ME)

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Contd P/3

PHY 105(ME)

Contd ... Q. No. 8

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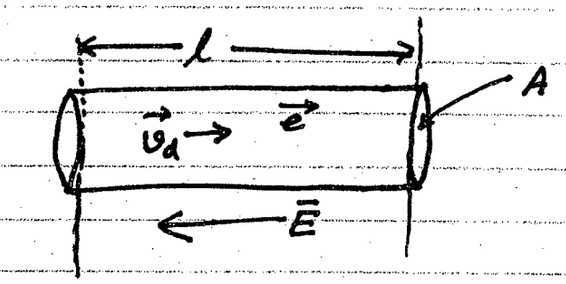

Fig. 3(b)

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L-1/T-1/ME **Date : 23/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **MATH 161** (Differential Calculus, Three Dimensional Geometry and Vectors)

Full Marks : 280 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) Show that $f(x)$ defined below is continuous at x = 0 but not differentiable there.

$$f(x)=\begin{cases} x\cos\left(\frac{1}{x}\right), & x\neq 0 \\ 0, & x=0 \end{cases}$$

Also sketch $f(x)$ near x = 0. **(26⅔)**

(b) Evaluate the following limits:

(i) $\lim\limits_{x\to 0}\left[\frac{4}{x^2}-\frac{2}{1-\cos x}\right]$ **(10)**

(ii) $\lim\limits_{x\to\infty}\left[x\left(1+\frac{1}{x}\right)^x-kx^2\log\left(1+\frac{1}{x}\right)\right]$ **(10)**

2. (a) State Leibnitz's theorem and utilize this theorem to find the value of

$x^2y_{n+2}+(2n+1)xy_{n+1}+2n^2y_n$ if, $\cos^{-1}\left(\frac{y}{b}\right)=\log\left(\frac{x}{n}\right)^n$. **(15)**

(b) Find the infinite series of y = log(1 + cos3x) and also state the condition under which the expansion is valid. **(21⅔)**

(c) Expand $\sec^2 x$ utilizing the expansion of tan x. **(10)**

3. (a) A wire of length L is available for making a circle and a square. How should the wire be divided between the two shapes to make the sum of the areas enclosed a maximum? **(16⅔)**

(b) Find the condition that the conics $ax^2 + by^2 = 1$ and $cx^2 + dy^2 = 1$ shall cut orthogonally. **(15)**

(c) Find the envelope for the family of curves $ax^2 + a^2y = 1$ where a is a parameter. **(15)**

4. (a) State Euler's theorem for homogeneous functions and hence verify the theorem for

$f(x,y)=\sin\frac{x^2+y^2}{xy}$. **(15)**

(b) If α and β are the coordinates of the centre of curvature of the curve $\sqrt{x}+\sqrt{y}=\sqrt{a}$ at (x, y), then show that $\alpha+\beta=3(x+y)$. **(15)**

(c) Find the area of the triangle formed by the asymptotes of $(x^2 - y^2)y - 2ay^2 + 5x - 7 = 0$. **(16⅔)**

Contd P/2

MATH 161(ME)

SECTION – B

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

5. (a) Prove that the two lines whose direction cosines are connected by the relations $al + bm + cn = 0$ and $ul^2 + vm^2 + wn^2 = 0$ are perpendicular if $a^2(v + w) + b^2(w + u) + c^2(u + v) = 0$ and are parallel if $\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w} = 0$. **(24)**

(b) A point P moves on the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ which is fixed. The plane through P perpendicular to OP meets the axes in A, B, C. The plane through A, B, C parallel to yz, zx and xy planes intersect in Q. Prove that the locus of Q is $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{1}{ax} + \frac{1}{by} + \frac{1}{cz}$. **(22⅔)**

6. (a) Find the length and equation of the line of shortest distance between

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \text{ and } \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}.$$ **(16⅔)**

(b) Find the angle between the lines whose direction cosines are given by the equations

$$l + m + n = 0 \text{ and } l^2 + m^2 - n^2 = 0.$$ **(15)**

(c) Through the point $P(-1, 1, 2)$ a line is drawn parallel to the line of intersection of the planes $x - 2y + z = 3$ and $x + 6y - 5z = 0$. This line cuts the plane $x - 3y + 2z = 2$ in Q. Find the coordinates of P, Q and the equation of the line PQ. **(15)**

7. (a) Define linearly dependent and independent set of vectors. Examine whether the vectors $5\underline{a} + 6\underline{b} + 7\underline{c}$, $7\underline{a} - 8\underline{b} + 9\underline{c}$, and $3\underline{a} + 2\underline{b} + 5\underline{c}$ ($\underline{a}$, $\underline{b}$, $\underline{c}$ being non-coplanar vectors) are linearly dependent or not. **(16⅔)**

(b) A rigid body is rotating with an angular velocity 8 radians per second about an axis parallel to $3\underline{i} - 4\underline{j}$ passing through the point (1, 3, – 1). Find the linear velocity of the point with position vector $4\underline{i} - 2\underline{j} + \underline{k}$. **(15)**

(c) A force $\underline{F} = 3\underline{i} + 2\underline{j} - 4\underline{k}$ is applied at the point (1, – 1, 2). Find the moment of the force about the point (2, – 1, 3). **(15)**

8. (a) Show that any four vectors are linearly dependent. **(24)**

(b) Show that $\underline{a} \times (\underline{b} \times \underline{c}) = (\underline{a} \cdot \underline{c})\underline{b} - (\underline{a} \cdot \underline{b})\underline{c}$. **(12)**

(c) A vector $\underline{x}$ satisfies the equations $\underline{x} \times \underline{b} = \underline{c} \times \underline{b}$ and $\underline{x} \cdot \underline{a} = 0$. Prove that

$$\underline{x} = \underline{c} - \frac{(\underline{a} \cdot \underline{c})\underline{b}}{\underline{a} \cdot \underline{b}}.$$ **(10⅔)**

Sushanta 12/1/13

L-1/T-1/ME

Date: 17/11/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **ME 161** (Introduction to Mechanical Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meanings.

Assume reasonable values for missing data, if any.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Identify different forms and sources of Energy. **(10)**

   (b) Describe in brief a 'Parabolic Concentrating Solar Heat Collector'. **(7)**

   (c) What is the thermodynamic cycle that is used to generate electricity from the sun using several banks of highly-polished mirrors called 'heliostats'? Draw the schematic diagram showing different modules of the system and show the processes of the cycle on a T-s plot. **(10)**

   (d) With a block diagram show the different components/modules used in a grid-connected solar home system. **(8)**

2. (a) Derive the maximum value of the power coefficient for a wind turbine as dictated by Betz's limit. **(12)**

   (b) With a schematic diagram show how an Oscillating Water Column (OWC) device can be used to extract wave energy. **(7)**

   (c) Write short notes on **(16)**

   (i) Solar Thermo-Siphon System

   (ii) Hydrogen Fuel Cell

3. (a) Classify different types of turbines. **(4)**

   (b) Differentiate between the working principles of impulse and reaction type turbines. **(10)**

   (c) A steam turbine power plant operates between a boiler saturation temperature of 230 °C and a condenser saturation temperature of 40 °C. Dry saturated steam enters the turbine. Draw the T-s diagram, calculate Rankine Cycle efficiency and specific steam consumption (SSC) in kg/kW-hr. Neglect pump work input. **(21)**

Contd P/2

ME 161

4. (a) What are pump, fan, blower and compressor used for? Differentiate their usage. **(4)**

(b) With a neat sketch explain how pressure is added to the fluid by a centrifugal pump. **(12)**

(c) What will happen if the delivery valve is closed in case of (i) a rotodynamic pump and (ii) a positive displacement type pump, while it is running? **(6)**

(d) A pump is to be used to lift water to the rooftop of a six-storeyed building at a height of 21 m from the pump house while the underground water is at 4 m below the pump house. The water tank at the rooftop has a capacity of 7500 liters and the tank is to be filled in 30 minutes. Calculate the required power rating of the pump-motor unit assuming a motor efficiency of 90%. (Line losses can be neglected). **(13)**

SECTION – B

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

5. (a) State the items to be included in the "Engine Specification" of a reciprocating internal combustion engine. **(7**

(b) Define Displacement Volume and Compression Ratio for a reciprocating IC engine. Calculate the total displacement volume of a 6 cylinder diesel engine with bore × stroke dimensions of 78 × 70 mm, typically how would it be expressed? **(8**

(c) Compare the performance and characteristics of typical "Spark Ignition" and "Compression Ignition" reciprocating IC engines. **(**

(d) What is a "transmission system" for an automobile? How can you identify whether an automobile has a manual or an automatic transmission system? **(**

(e) Briefly explain – FWD, RWD and 4WD vehicles. **(**

6. (a) What do you understand by a valve timing diagram of a reciprocating IC engine? **(**

(b) Briefly explain the functions of piston rings used in engines. **(**

(c) What do you understand by "firing order" of a SI engine? State the typical firing order used for a 4-cylinder petrol engine.

(d) Define – Air Conditioning. Classify air conditioning systems based on the type of configuration used.

(e) Briefly explain the differences between "Window-type" and "Split Type" air conditioners.

Contd P/3

ME 161

7. (a) Define – COP and Ton of Refrigeration. A refrigeration system has a cooling capacity of 2 Tons and a COP of 4. Calculate the power requirement in kW. **(7)**

(b) Draw a schematic diagram of a NH_3-Water vapor absorption refrigeration system identifying the components. **(7)**

(c) Compare the environmental impact of CFC, HCFC and HFC refrigerants. **(6)**

(d) Discuss applications of Gas turbines. What are the advantages of using gas turbines compared to other IC engines? **(7)**

(e) What is "Propulsive Power"? Briefly explain the working principle of a basic jet engine. **(8)**

8. (a) Mention some application of boilers. Differentiate between fire-tube and water-tube boilers. **(9)**

(b) What are boiler mountings and accessories? Mention at least four boiler mounting and four accessories. Briefly explain the function of a superheater. **(9)**

(c) How are boilers classified according to the number of passes? What is the benefit of using multi-pass boilers? **(7)**

(d) With a schematic diagram identify the components of a water cooling system of an automotive IC engine. Briefly explain the function of the thermostatic valve. **(10)**

STEAM TABLE

SATURATED STEAM - TEMPERATURE TABLE

		Spec. vol. m^3=kg		Int. Ener. kJ/kg		Enthalpy kJ/kg		Entropy kJ=(kg°K)	
T °C	P bar	Sat. liq. v_f X1000	Sat. vap. v_g	Sat. liq. u_f	Sat. vap. u_g	Sat. liq. h_f	Sat. vap. h_g	Sat. liq. s_f	Sat. vap. s_g
0.01	0.0061	1.0002	206.1	0.01	2376	0.01	2501	0	9.156
4	0.0081	1.0001	157.2	16.79	2381	16.79	2509	0.061	9.051
5	0.0087	1.0001	147.1	21.00	2383	21	2511	0.0762	9.026
6	0.0093	1.0001	137.7	25.21	2384	25.21	2512	0.0912	9.000
8	0.0107	1.0001	120.9	33.61	2387	33.61	2516	0.1212	8.950
10	0.0123	1.0001	106.4	42.01	2389	42.01	2520	0.151	8.901
11	0.0131	1.0007	99.86	46.19	2391	46.19	2522	0.1658	8.876
12	0.0140	1.0007	93.79	50.40	2392	50.4	2523	0.1806	8.852
13	0.0150	1.0007	88.13	54.59	2393	54.59	2525	0.1953	8.828
14	0.0160	1.0007	82.85	58.80	2394	58.8	2527	0.2099	8.805
15	0.0170	1.0007	77.93	62.99	2396	62.99	2529	0.2245	8.781
16	0.0182	1.0013	73.34	67.17	2397	67.17	2531	0.239	8.758
17	0.0194	1.0013	69.05	71.36	2399	71.36	2533	0.2535	8.735
18	0.0206	1.0013	65.04	75.57	2400	75.57	2534	0.2679	8.712
19	0.0220	1.0013	61.30	79.76	2401	79.76	2536	0.2823	8.690
20	0.0234	1.002	57.79	83.94	2403	83.94	2538	0.2966	8.667
21	0.0249	1.002	54.52	88.13	2404	88.13	2540	0.3108	8.645
22	0.0264	1.002	51.45	92.32	2406	92.32	2542	0.3251	8.623
23	0.0281	1.0026	48.58	96.50	2407	96.5	2544	0.3392	8.601
24	0.0298	1.0026	45.89	100.7	2409	100.7	2545	0.3533	8.579
25	0.0317	1.0032	43.36	104.9	2410	104.9	2547	0.3673	8.558
26	0.0336	1.0032	41.00	109.0	2411	109.0	2549	0.3814	8.537
27	0.0357	1.0032	38.78	113.2	2412	113.2	2551	0.3953	8.515
28	0.0378	1.0038	36.69	117.4	2414	117.4	2553	0.4093	8.495
29	0.0401	1.0038	34.73	121.6	2415	121.6	2554	0.4231	8.474
30	0.0425	1.0045	32.90	125.8	2416	125.8	2556	0.4369	8.453
31	0.0450	1.0045	31.17	130.0	2418	130.0	2558	0.4507	8.433
32	0.0476	1.0051	29.54	134.1	2419	134.1	2560	0.4644	8.413
33	0.0503	1.0051	28.01	138.3	2421	138.3	2562	0.478	8.393
34	0.0532	1.0057	26.57	142.5	2422	142.5	2563	0.4917	8.373
35	0.0563	1.0057	25.22	146.7	2423	146.7	2565	0.5053	8.353
36	0.0595	1.0063	23.94	150.8	2425	150.8	2567	0.5188	8.333
38	0.0663	1.007	21.60	159.2	2427	159.2	2571	0.5457	8.295
40	0.0738	1.0076	19.52	167.5	2430	167.5	2574	0.5725	8.257
45	0.0959	1.010	15.26	188.4	2437	188.4	2583	0.6386	8.165
50	0.1235	1.012	12.03	209.3	2443	209.3	2592	0.7037	8.076
55	0.1576	1.015	9.569	230.2	2450	230.2	2601	0.7679	7.991
60	0.1994	1.017	7.671	251.1	2457	251.1	2610	0.8311	7.910
65	0.2503	1.020	6.197	272.0	2463	272.0	2618	0.8934	7.831
70	0.3119	1.023	5.042	293.0	2470	293.0	2627	0.9549	7.755
75	0.3858	1.026	4.131	313.9	2476	313.9	2635	1.016	7.682
80	0.4739	1.029	3.407	334.8	2482	334.9	2644	1.075	7.612
90	0.7013	1.036	2.361	376.8	2494	376.9	2660	1.193	7.479
95	0.8455	1.039	1.982	397.9	2501	398.0	2668	1.250	7.416
100	1.013	1.044	1.673	418.9	2507	419.0	2676	1.307	7.355
110	1.433	1.052	1.21	461.1	2518	461.3	2691	1.418	7.239
120	1.985	1.060	0.892	503.5	2529	503.7	2706	1.528	7.130
130	2.701	1.069	0.669	546.0	2540	546.3	2720	1.634	7.027
140	3.613	1.080	0.509	588.7	2550	589.1	2734	1.739	6.930
150	4.758	1.091	0.393	631.7	2559	632.2	2746	1.842	6.838
160	6.178	1.102	0.307	674.9	2568	675.5	2758	1.943	6.750
170	7.916	1.114	0.243	718.3	2576	719.2	2769	2.042	6.666
180	10.02	1.127	0.194	762.1	2584	763.2	2778	2.140	6.586
190	12.54	1.141	0.157	806.2	2589	807.6	2786	2.236	6.508
200	15.54	1.156	0.127	850.6	2596	852.4	2793	2.331	6.432
210	19.06	1.172	0.104	895.5	2600	897.8	2798	2.425	6.358
220	23.18	1.190	0.086	940.8	2603	943.6	2802	2.518	6.286
230	27.95	1.209	0.072	986.7	2603	990.1	2804	2.610	6.215
240	33.44	1.229	0.06	1033	2603	1037.3	2804	2.702	6.144
250	39.73	1.251	0.05	1080	2603	1085.3	2802	2.793	6.073
260	46.88	1.275	0.042	1128	2600	1134.4	2797	2.884	6.002
270	54.98	1.302	0.036	1177	2592	1184.5	2790	2.975	5.930
280	64.11	1.332	0.03	1227	2587	1236.0	2780	3.067	5.857
290	74.36	1.365	0.026	1279	2573	1289.0	2766	3.159	5.782
300	85.81	1.403	0.022	1332	2560	1344.0	2749	3.253	5.704
320	112.7	1.499	0.015	1445	2531	1461.5	2700	3.448	5.536
340	145.9	1.638	0.011	1570	2462	1594.1	2622	3.659	5.336
360	186.5	1.893	0.007	1725	2351	1760.5	2481	3.915	5.053
374.14	220.9	3.155	0.003155	2030	2030	2099.3	2099	4.430	4.430

Roumak

L-1/T-1/ME

Date : 05/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **CHEM 109** (Chemistry-I)

Full Marks: 210 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) Why the boiling point of a liquid rises when a non-volatile solute is dissolved in it? Show the depression of freezing point is directly proportional to the molality of the solution. **(5+8=13)**

   (b) Explain the following statements: **(8+5=13)**

   (i) Osmotic pressure is analogous to the gas pressure.

   (ii) Isotonic solutions have equimolar concentration at the same temperature.

   (c) A solution containing 0.512 g of naphthalene (M = 128.17) in 50 g of CCl_4 yields a boiling point elevation of 0.402°C, while a solution of 0.6216 g of an unknown solute in the same weight of the solvent gives boiling point elevation of 0.647°C. Find molecular weight of the unknown solute. **(09)**

2. (a) How would you classify the solutions? The solubility is greatly influenced by the nature of the solute and solvent. Explain the statement. **(5+7=12)**

   (b) Justify the following statements: **(5+5=10)**

   (i) The concentration of the solution remain constant at the saturated point.

   (ii) The mole fraction of the gas dissolved in a solvent is directly proportional to the pressure of the gas.

   (c) The solubility of pure oxygen in water at 20°C and 1 atm pressure is 1.38×10^{-3} moles/litre. Calculate the concentration of oxygen at 20°C at partial pressure 0.21 atm. **(05)**

   (d) Discuss the mutual solubility of phenol-water system with respect to temperature. **(08)**

3. (a) Discuss the salient features of the phase diagram of sulphur as a mono component system. **(11)**

   (b) Calculate the number of phases, components and degrees of freedom for the following systems. **(06)**

   (i) $Na_2SO_4\cdot10H_2O(s) \Leftrightarrow Na_2SO_4(s)+10H_2O(g)$

   (ii) $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

   (iii) $CaCO_3(s) \Leftrightarrow CaO(s)+CO_2(g)$

Contd P/2

CHEM 109

Contd. Q. No. 3

(c) What are the postulates/assumptions of Bohr atomic model? Derive an equation for the calculation of the difference in energies between two levels. Using the equation, explain the Paschen series of spectrum of hydrogen atom. **(6+8+4=18)**

4. (a) Discuss how the nucleus of an atom is so stable having all the positively charged protons in it. **(08)**

(b) Two pairs of electrons make two bonds in oxygen molecule formation. Explain, why do we need to use modern concept of covalent bond formation (valence bond theory and molecular orbital theory) to discuss the properties of oxygen. **(17)**

(c) What information do you obtain from the photoelectric effect? How does it help in explaining the spectrum of hydrogen atom? **(10)**

SECTION – B

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

5. (a) Define the following terms: **(08)**

(i) Rate of reaction

(ii) Rate constant

(iii) Order and molecularity.

(b) Derive the integrated rate equation for the second order reaction **(10+4=14)**

$$2A \rightarrow P$$

How does it differ from first order behaviour?

(c) A first order reaction is never completed— Prove this statement. **(05)**

(d) The rate of a chemical reaction is plotted as $\frac{1}{[A]_t}$ vs time and the plot is a straight line. If the intercept is 2×10^{3} mole.lit^{-1} and slope 2×10^{-2} mole.lit^{-1}.sec^{-1}. Calculate the half-life. **(08)**

6. (a) Define heat of reaction. How is heat of reaction related with temperature at constant pressure and volume? Derive the mathematical model. **(2+8=10)**

(b) The relationship of equilibrium constant (K) with temperature is not linear but exponential— prove this statement through mathematical equation. **(10)**

(c) The heat of reaction for $N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$ at 27°C is –21.976 Kcal. What will be heat of reaction at 50°C? [The molar heat capacities at constant pressure and at 27°C for N_2, H_2 and NH_3 are 6.8, 6.77, 8.86 cal.mole^{-1}.deg^{-1} respectively.] **(6)**

(d) What is buffer solution? How can they be classified? Discuss how buffer operates. **(9)**

Contd P/3

CHEM 109

7. Write note on: **(3×6=18)**

   (i) Kinetic of a consecutive reaction

   (ii) Le Chatelier principle

   (iii) Relationship between "Kp" and "Kc".

   (b) Mention the important steps of LASER production. Discuss LASER production using noble gases. **(9)**

   (c) With suitable examples, define acids and bases according to Lewis. Why has this definition more advantages over others? **(8)**

8. (a) Show a few important reactions involving noble gases and their compounds. What noble gas compound of sodium is used as the basis for gravimetric determination of sodium in a solution? **(6)**

   (b) What is a coordination complex compound? How naming of a complex compound is done according to IUPAC? Mention the importance of the formation of complexes from the application point of view. **(9)**

   (c) What is de Broglie's equation? Deduce and discuss its applicability in case of both smaller and bigger particles. Mention how the Davisson and Germer's experiment supports de Broglie's equation. **(13)**

   (d) In ammonia molecule three hydrogens make three bonds with nitrogen. What should be the apparent structure of the molecule on the basis of bond formation? Is there any difference in structures between the apparent and the actual ones? Justify your answer. **(7)**
