L-1/T-1/CHE **Date : 04/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **ME 141** (Engineering Mechanics)

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) Determine by direct integration the moment of inertia of the area shown in Fig. for Q. No. 1(a) with respect to the x and y axis. **(17)**

(b) Determine the polar moment of inertia of the area shown in Fig. for Q. No. 1(b) with respect to (a) Point O, (b) the centroid of the area. **(18)**

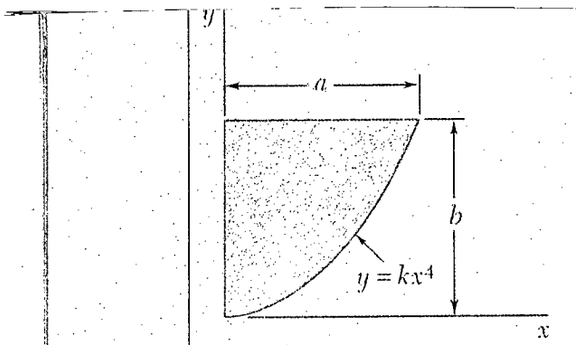

Fig. for Q. No. 1(a)

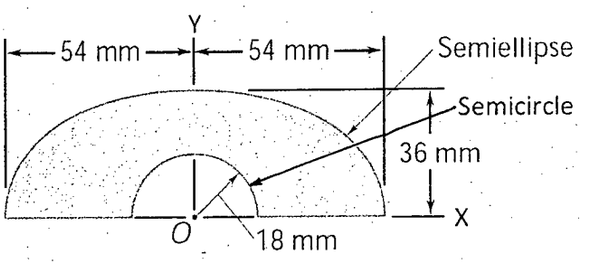

Fig. for Q. No. 1(b)

2. (a) Block B in Fig. for Q. No. 2(a) starts from rest, block A moves with a constant acceleration , and slider block C moves to the right with a constant acceleration of 75 mm/s^2. Knowing that at t = 2 sec the velocities of B and C are 480 mm/s downward and 280 mm/s to the right, respectively, determine (a) the accelerations of A and B, (b) the initial velocities of A and C, (c) the change in position of slider block C after 3 sec. **(20)**

(b) The oscillation of rod OA as shown in Fig. for Q. No. 2(b) about O is defined by the relation $\theta = (3/\pi)\ (\sin \pi t)$, where θ and t are expressed in radians and second, respectively. Collar B slides along the rod so that its distance from O is $r = 6\ (1 - e^{-2t})$ where r and t are expressed in meters and seconds, respectively. When t = 1 s, determine (a) the velocity of the collar, (b) the acceleration of the collar, (c) the acceleration of the collar relative to the rod. **(15)**

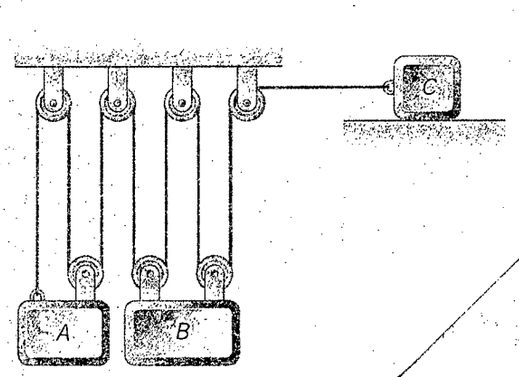

Fig. for Q. No. 2(a)

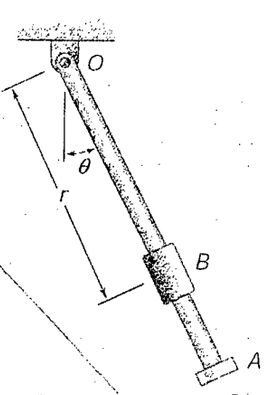

Fig. for Q. No. 2(b)

Contd P/2

ME 141/CHE

3. (a) The coefficients of friction between blocks *A* and *C* and the horizontal surfaces as shown in the Fig. for Q. No. 3(a) are $\mu_s = 0.24$ and $\mu_k = 0.2$, respectively. Knowing that $m_A = 5$ kg, $m_B = 10$ kg, $m_C = 10$ kg, determine (a) the tension in the cord, (b) the acceleration of each block. **(15)**

(b) A 3-kg block rests on top of a 2-kg block which is supported by, but not attached to a spring as shown in Fig. for Q. No. 3(b). The spring constant is 40 N/m. The upper block is suddenly removed. Determine **(20)**

(i) the maximum speed reached by the 2-kg block,

(ii)the maximum height reached by the 2-kg block.

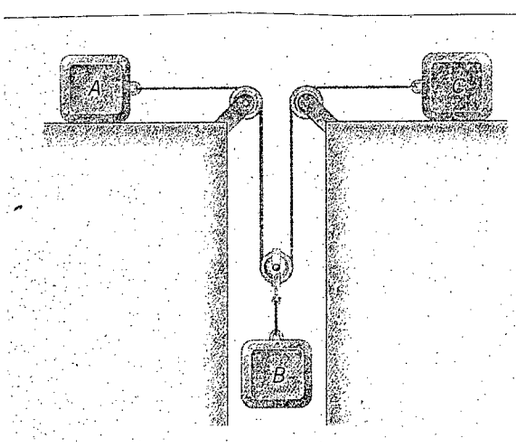

Fig. for Q. No. 3(a)

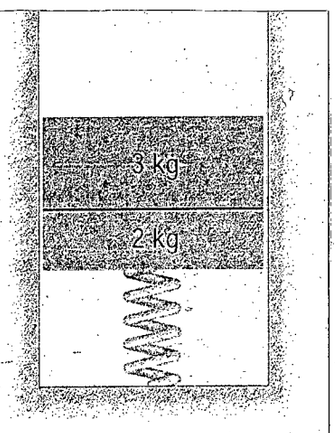

Fig. for Q. No. 3(b)

4. (a) The bent rod *ABCDE* rotates about a line joining Points *A* and *E* as shown in Fig. for Q. No. 4(a) with an angular velocity of 9 rad/s which increases at the rate of 45 rad/s^2. Knowing that the rotation is clockwise as viewed from *E*, determine the velocity and acceleration of corner *B*. **(15)**

(b) Rod *AB* moves over a small wheel at *C* while end *A* moves to the right with a constant velocity of 25 cm/s. At the instant shown in Fig. for Q. No. 4(b), determine **(20)**

(i) the angular velocity of the rod,

(ii) the velocity of end *B* of the rod.

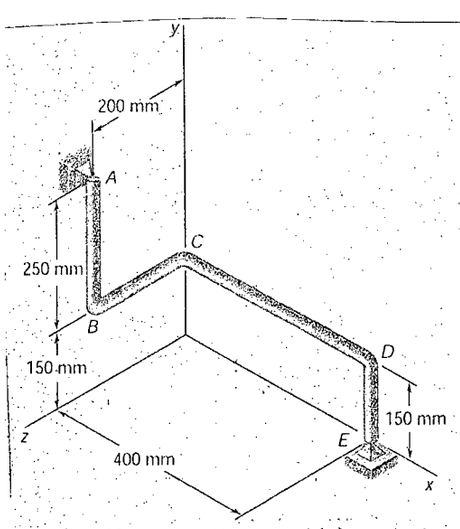

Fig. for Q. No. 4(a)

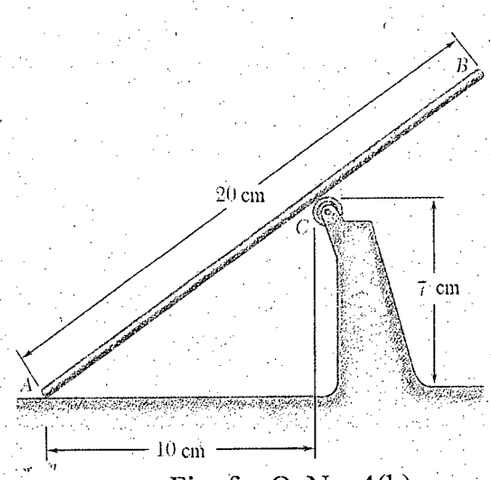

Fig. for Q. No. 4(b)

Contd P/3

SECTION-B

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

5. (a) Determine the force developed in cables AB, AC and AD to support the 40-lb crate, as shown in the Figure 5(a). **(18)**

   (b) The beam AE, as shown in the Figure 5(b), is subjected to a system of coplanar forces. Determine the magnitude, direction and location on the beam of a resultant force which is equivalent to the given system of forces measured from E. **(17)**

6. (a) A light rod AD is supported by frictionless pegs at B and C and rests against a frictionless wall at A, as shown in the Figure 6(a). The 120-lb force is applied at D in a direction perpendicular to the rod ($\alpha = 30°$). Determine the reactions at A, B and C. **(17)**

   (b) The 100 kg block C rests on the 150 kg block D, as shown in the Figure 6(b). The coefficients of friction are $\mu_s = 0.3$ and $\mu_k = 0.25$ between all surfaces of contact. Knowing that P = 800 N, determine (i) the resultant of friction forces exerted on block D if block C is restrained as shown in the figure, (ii) the friction force exerted by the ground on block D if cable AB is removed. **(18)**

7. (a) Determine the force in members GE, GC and BC of the loaded truss, as shown in the Figure 7(a). **(17)**

   (b) Determine the components of the forces acting on each member of the frame as shown in the Figure 7(b). The connections at point A, B and C are pin-ended. **(18)**

8. (a) Locate the centroid of the composite area, as shown in the Figure 8(a). **(17)**

   (b) By direct integration, locate the centroid of the shaded area, as shown in the Figure 8(b). **(18)**

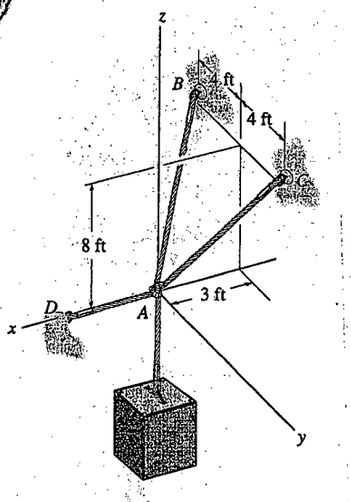

Figure 5(a)

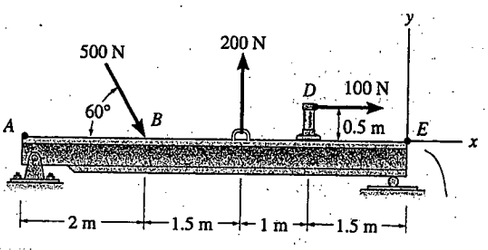

Figure 5(b)

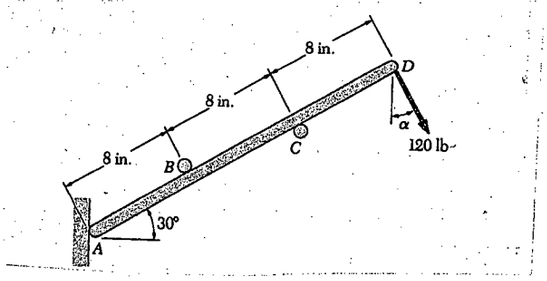

Figure 6(a)

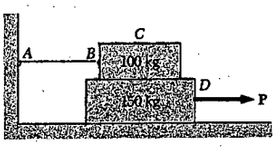

Figure 6(b)

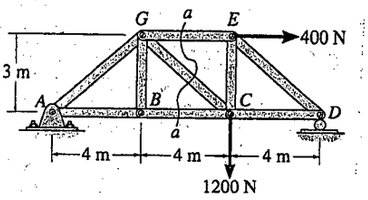

Figure 7(a)

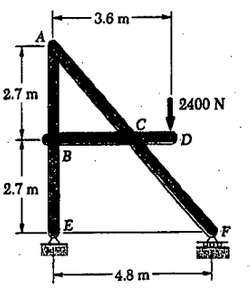

Figure 7(b)

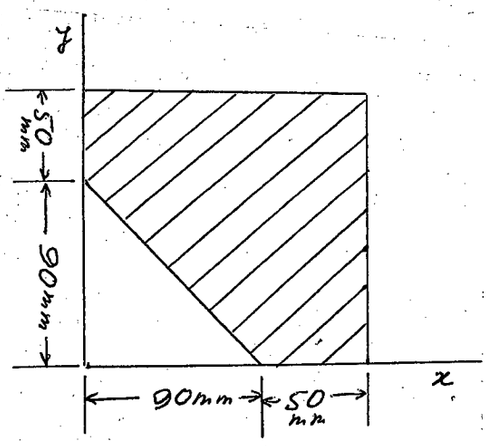

Figure 8(a)

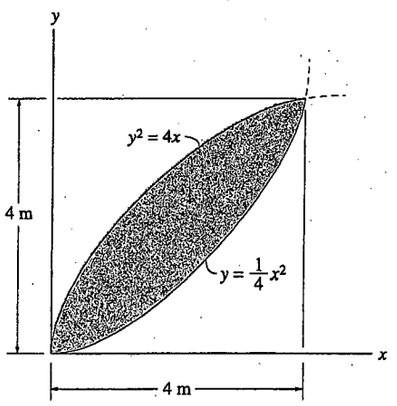

Figure 8(b)

L-1/T-1/CHE **Date : 15/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **MATH 121** (Differential Calculus and Co-ordinate Geometry)

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) Discuss the continuity and differentiability at $x=\frac{1}{2}$ of the function **(20)**

$$f(x)=\begin{cases}\frac{1}{2}-x & \text{for } 0<x<\frac{1}{2}\\ \frac{1}{2} & \text{for } x=\frac{1}{2}\\ \frac{3}{2}-x & \text{for } \frac{1}{2}<x<1\end{cases}$$

Also sketch the graph of $f(x)$.

(b) Evaluate : **(8)**

(i) $\lim_{x\to 0}(cosx)^{cot^2x}$

(ii) $\lim_{x\to 0}\frac{x-sinx}{x^3}$ **(7)**

2. (a) If $y=\frac{x^2+x-1}{x^3+x^2-6x}$, find y_n. **(12)**

(b) Find the value of y_n for $x=0$, when $y=\sin^{-1}x$. **(12)**

(c) Find the Lagrange's remainder after n terms in the expansion of $e^{ax}cosbx$ in power of x. **(11)**

3. (a) A conical tent of given capacity has to be constructed. Find the ratio of the height to the radius of the base for the minimum amount of the canvas required for the tent. **(12)**

(b) If $u=\tan^{-1}\frac{x^3+y^3}{x-y}$, show that **(12)**

$$x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=sin2u.$$

(c) Expand $(\sin^{-1}x)^2$ in a series of ascending powers of x. **(11)**

4. (a) If V is a function of r alone, where $r^2=x^2+y^2+z^2$, show that **(12)**

$$\frac{\partial^2V}{\partial x^2}+\frac{\partial^2V}{\partial y^2}+\frac{\partial^2V}{\partial z^2}=\frac{d^2V}{dr^2}+\frac{2}{r}\frac{dV}{dr}.$$

(b) Show that the portion of the tangent at any point on the curve $x^{\frac{2}{3}}+y^{\frac{2}{3}}=a^{\frac{2}{3}}$ intercepted between the axes is of constant length. **(12)**

(c) Find the pedal equation of the curve $r^m=a^m sinm\theta$. **(11)**

Contd P/2

MATH 121/CHE

SECTION-B

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

5. (a) Transform the equation $3x^2+2xy+3y^2-18x-22y+50=0$ in rectangular coordinates using suitable translation and rotation of axes so as to remove the terms in x, y and xy. Then identify the conic. **(17)**

(b) Prove that the straight lines represented by the equation **(18)**

$$ax^2+2hxy+by^2+2gx+2fy+c=0$$

will be equidistant from the origin if $f^4-g^4=c\left(bf^2-ag^2\right)$.

6. (a) Show that the straight lines joining the origin to the intersections of the curves whose equations are $ax^2+2hxy+by^2+2gx=0$ and $a_1x^2+2h_1xy+b_1y^2+2g_1x=0$ are at right angles if $\frac{a+b}{g}=\frac{a_1+b_1}{g_1}$. **(17)**

(b) If one of the straight lines given by $ax^2+2hxy+by^2=0$ coincide with one of the lines given by $a_1x^2+2h_1xy+b_1y^2=0$ and the other lines represented by them are perpendicular, then prove that $\frac{ha_1b_1}{b_1-a_1}=\frac{h_1ab}{b-a}=\frac{1}{2}\sqrt{-aa_1bb_1}$. **(18)**

7. (a) Find the equation of circle through the intersection of the circles $x^2+y^2=4$, $x^2+y^2+2x+4y+1=0$ which touches the straight line $x+2y+5=0$. **(17)**

(b) Find the coordinates of the limiting points of the system of circles co-axial with the circles $x^2+y^2-2x+8y+11=0$ and $x^2+y^2+4x+2y+5=0$. **(18)**

8. (a) A tangent to the parabola $y^2=4a(x+a)$ is at right angle to a tangent to the parabola $y^2=4a'(x+a')$. Prove that these tangents meet on the line $x+a+a'=0$, which is the common chord of the parabola. **(18)**

(b) Tangents are drawn to the hyperbola $4x^2-y^2=4a^2$. Prove that the poles of these tangents with respect to the parabola $y^2=4bx$ lie on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. **(17)**

L-1/T-1/CHE **Date : 19/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **EEE 155** (Electrical Engineering Fundamentals)

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) Determine the current I in the circuit of Fig. for Q 1(a) and also draw the phasor diagram considering V_c as reference. **(20)**

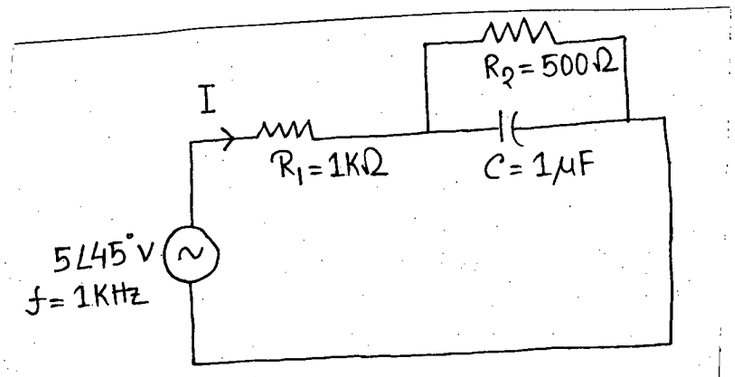

Figure for Q. 1(a)

(b) If the current i(t) (shown in Figure for Q 1(b)) flows through a 9Ω resistor, calculate the average power absorbed by the resistor. **(15)**

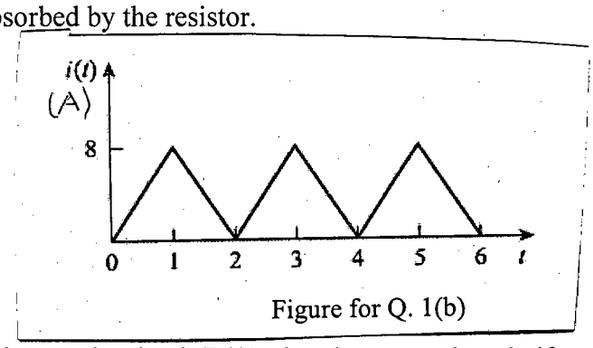

Figure for Q. 1(b)

2. (a) Show that a purely reactive load (L/C) absorbs power in a half cycle and returns power in the next half cycle. **(10)**

(b) State the principle of conservation of ac power and prove it. **(10)**

(c) Assume that a load is being fed by a voltage source through a transmission line. The load impedance is (15-10j) Ω and the transmission line impedance is (4 + 2j) Ω. The rms value of the voltage source is 220 V. Find the power absorbed by the load. For maximum power at load, what should be the value of line impedance? **(15)**

3. (a) Determine the current I in the circuit of Fig. 3(a). **(10)**

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EEE 155/CHE

Contd... Q. No. 3(a)

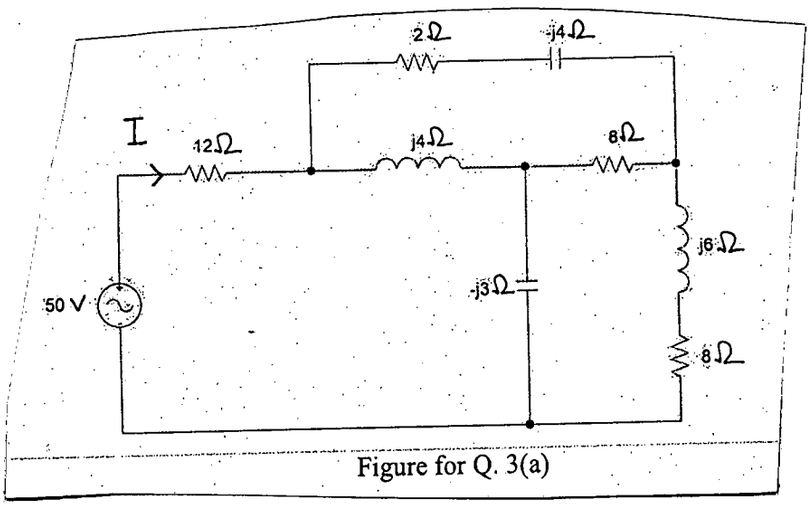


Figure for Q. 3(a)

(b) When connected to a 120 V (rms), 60 Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Find the value of capacitance necessary to be connected in parallel to raise the overall pf to 0.95. (lagging). **(10)**

(c) A series connected load draws a current $i(t) = 4\cos(100\pi t + 10°)$ A when the applied voltage is $v(t) = 120\sin(100\pi t + 20°)$ V. Find the apparent power and the power factor of the load. Determine the element values that form the series-connected load. **(15)**

4. (a) Write short notes on the following terms: **(15)**

(i) Magnetic Field Intensity, H

(ii) Ohm's law for magnetic circuit

(iii) Ampere's circuital law

(b) The core of Fig. for Q. 4(b) is cast steel. Determine the current to establish an air-gap flux $\Phi_g = 6 \times 10^{-3}$ Wb. Neglect fringing. (Magnetization curve supplied) **(20)**

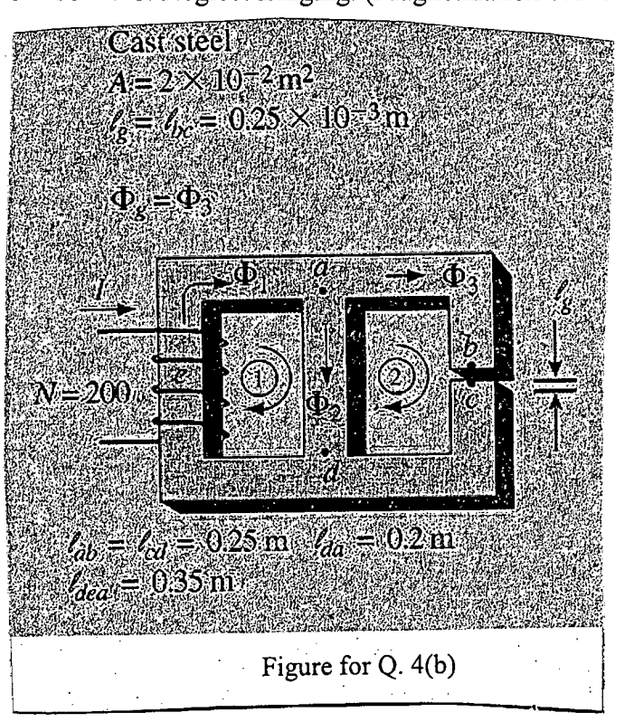


Figure for Q. 4(b)

Contd P/3

EEE 155/CHE

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.
Symbols have their usual meanings.

5. (a) For the circuit of Fig. for Q 5(a), determine the voltage v_x by using appropriate resistor combinations and iteratively employing voltage division. **(15)**

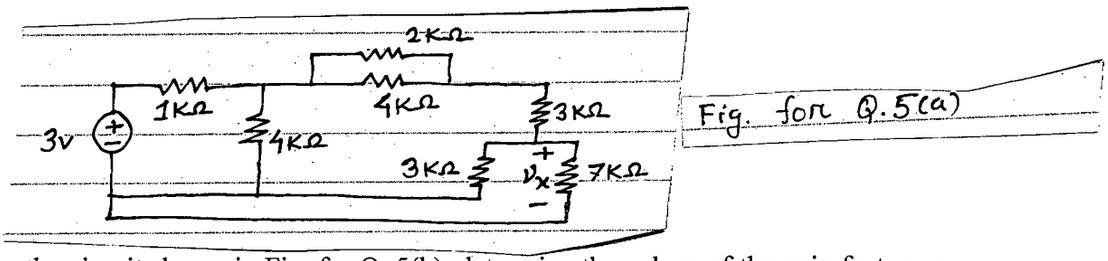


Fig. for Q.5(a)

(b) For the circuit shown in Fig. for Q. 5(b), determine the values of the gain factors, π and g, of the two dependent sources. **(20)**

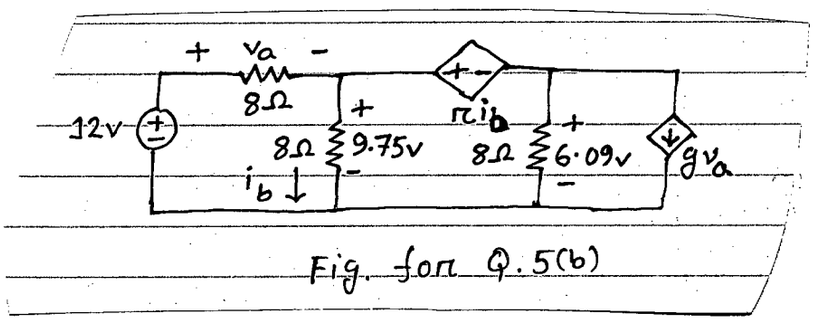


Fig. for Q.5(b)

6. (a) using mesh analysis find the power developed in the dependent source of the circuit shown in Fig for Q. 6(a). **(15)**

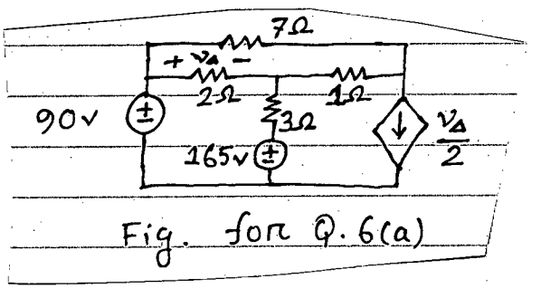


Fig. for Q.6(a)

(b) For the circuit of Fig. for Q. 6(b), the values of the voltages and currents are given as $i_1 = 0.625A$, $v_2 = -25V$, $i_3 = -1.25A$, and $v_4 = -18.75V$. **(20)**
Determine the values of R_1, R_2, R_3, and R_4, by using nodal analysis.

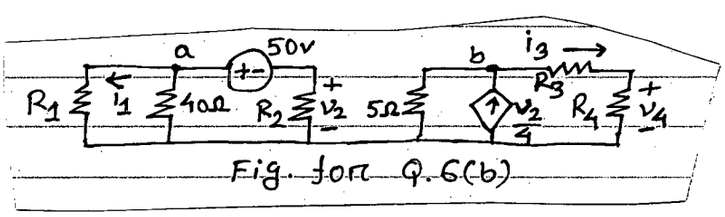


Fig. for Q.6(b)

7. (a) Using source transformation, find the value of the voltage source v_1 given in the circuit of Fig. for Q. 7(a), when the power supplied by that source is 70W. **(15)**

Contd P/4

EEE 155

Contd... Q. No. 7(a)

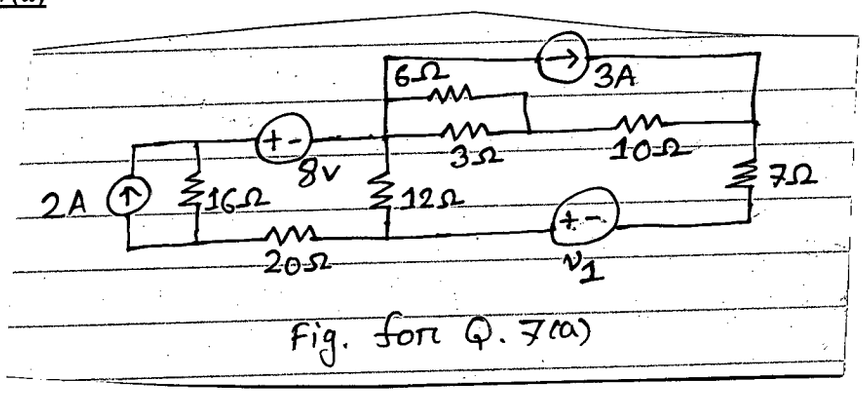


Fig. for Q. 7(a)

(b) For the circuit shown in Fig. for Q. 7(b), find i_0 and v_0 by using superposition principle. **(20)**

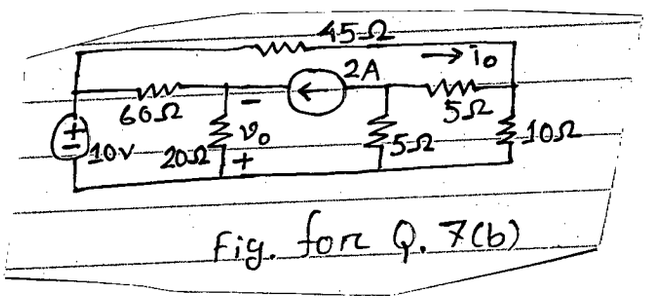


Fig. for Q. 7(b)

8. (a) Determine what value of resistance R_L would absorb maximum power from the circuit of Fig. for Q. 8(a). **(15)**

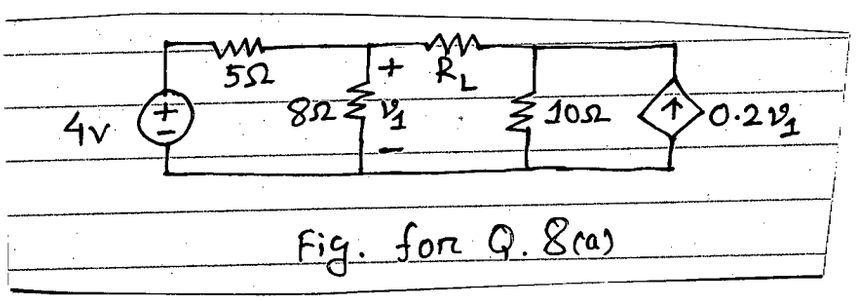


Fig. for Q. 8(a)

(b) Find the Thevenin equivalent circuit with respect to the output terminals a, b for the circuit of Fig. for Q. 8(b). **(20)**

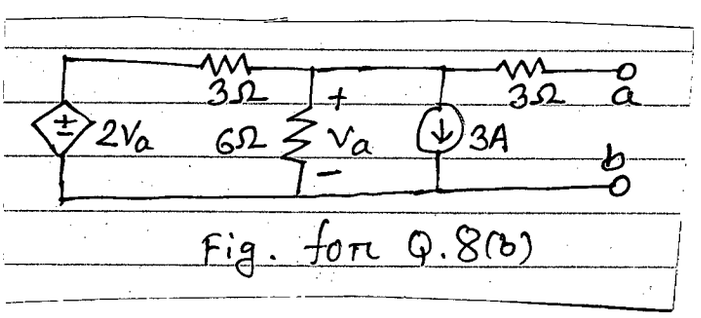
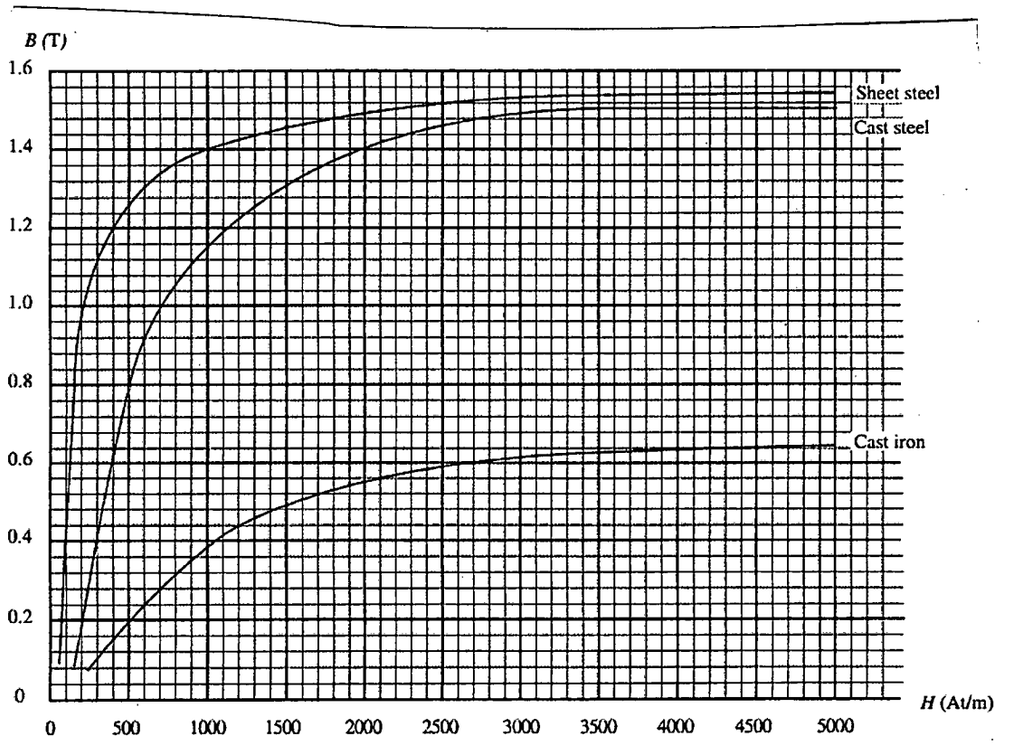


Fig. for Q. 8(b)



Magnetization Curve

L-1/T-1/CHE **Date : 25/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **CHEM 111** (Inorganic Chemistry)

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) What is Ligand? Discuss the classification of ligands. Cite three examples from each class. **(12)**

(b) What are stepwise and overall stability constants of complex compounds? Deduce a relationship between the overall stability constant β_4 and the corresponding stepwise stability constants. **(12)**

(c) Discuss three applications of stability constants in different fields. **(6)**

(d) What is the difference between binary and Ternary complex compounds? **(5)**

2. (a) There are five pairs of complex compounds given bellow: **(10+10)**

(i) [Cu (en) (OX)], [Cu (en) (mal)]

(ii) [Ni (OX) (en)], [Ni (en) (mal)]

(iii)[Zn(Folicacid) (ATP)], [Zn (IMDA) (ATP)]

(iv) [Cu (ATP) (en)], [Cu (ATP) (OX)]

(v) [Ni (pn) (en), [Ni (pn) (OX)].

where, en = ethylenediamine

OX = Oxalic acid

mal = malonix acid

ATP = Adenosintriphosphate

IMDA = Iminodiacetic acid

pn = Propelene diamine.

Compare between the stabilities of the complex compounds in each pair with proper reason. Also draw their probable structures.

(b) What are the limitations of valence bond theory (VBT) of complex compounds? **(7)**

(c) What is pairing energy? Discuss the relationship between pairing energy and 10 Dq with the help of one electron wave function. **(8)**

3. (a) Define hard and soft acids and bases. Explain hard soft acids base principle with example. **(5)**

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(b) Discuss the application of hard soft acids base principle in the following fields: **(20)**

(i) Oxidation Reduction reaction.

(ii) Predicting favorable equilibrium

(iii) Medicinal Chemistry

(iv) Quantitative analysis scheme for metal ions.

(c) You are supplied with H_2SO_4 of specific gravity (sp.gr.) 2.15. How can you alter the sp.gr. of this acid into 1.8? Show all calculations. **(10)**

4. (a) State Werner theory of coordination compounds with its limitations. How did Alfred Werner develop the theory? **(12)**

(b) How does splitting of 'd' orbitals occur when octahedral ligand field interacts with transition metal? Show how a square planar Geometry forms by the distortion of an octahedral geometry and also show the 'd' orbitals splitting in case of a square planar ligand field. **(13)**

(c) The complexes $[Fe\ (NH_3)_6]^{2+}$ and $[Fe\ (CN)_6]^{4-}$ in solution give maximum absorption bands of the frequency of 12250 cm^{-1} and 32900 cm^{-1} respectively. The pairing energy (Ep) value for Fe^{++} is 50 $K.cal.mol^{-1}$. Calculate the crystal field splitting energy (CFSE) of the complexes in $K.cal.mol^{-1}$ for high and low spin systems. Draw the d.orbital splitting diagram for each. **(10)**

SECTION – B

There are four questions in this section. Answer any three questions.

5. (a) Write down the general form of the Schrodinger equation and define each of the terms in it. How does the Bohr theory of the hydrogen atom differ from that of Schrodinger? **(10)**

(b) What is radial probability distribution curve? Discuss distribution curves for 1s, 2s and 2p orbitals in a hydrogen atom. **(12)**

(c) Write a short note on "Heisenberg's uncertainty principle." **(7)**

(d) Calculate the frequency, energy and wave length of the radiation corresponding to the spectral line of the lowest frequency in Lyman series in the spectrum of H-atom. Given that $R_H = 1.09678 \times 107m^{-1}$, $c = 3 \times 10^8\ ms^{-1}$ and $h = 6.625 \times 10^{-34}Js$. **(6)**

Contd P/3

6. (a) Draw MO energy level diagrams for N_2 and F_2. Use the molecular orbital theory to explain why the band strength in a N_2 molecule is greater than that in a F_2 molecule. **(15)**

(b) Draw the resonance structures for the ions SCN^- and OCN^-, and assign formal charges. Select the resonance structures likely to provide the best description of the ions. **(10)**

(c) Select from each set the molecule given below having the smallest bond angle and explain your choice. **(10)**

(i) NH_3, PH_3, AsH_3

(ii) H_2O, OF_2

7. (a) What is screening constant? How does it affect the value of ionization potential of an element? **(8)**

(b) Describe the colour and nature of the solutions of Group 1 metals in liquid ammonia. Give an equation to show how these solutions decompose. **(10)**

(c) Account for the fact that LiF and CsI have low solubility in water whereas LiI and CsF are very soluble. **(7)**

(d) Lithium is the smallest ion in Group 1. It would therefore be expected to have the highest ionic mobility, and hence solutions of its salts would be expected to have a higher conductivity than solutions of caesium salts. Explain why this is not so. **(10)**

8. (a) What is hybridization? On the basis of hybridization of orbitals deduce the shapes of PCl_5, SF_6 and NH_3 molecules and predict the bond angle in each case. **(11)**

(b) Explain the following, giving appropriate reasons:

(i) Magnesium hydroxide is a much more effective antacid than calcium or barium hydroxide. **(8)**

(ii) The alkaline earth metals are harder than alkali metals. **(8)**

(iii) Compounds of beryllium are covalent whereas those of the other Group (II) elements are predominantly ionic. **(8)**
