L-1/T-1/CHE **Date : 19/07/2011**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2010-2011

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

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**.

Symbols have their usual meaning.

1. (a) Discuss the continuity and differentiability of the function $f(x)$ at $x = 0$ and $x = 1$ when **(12)**

$$f(x)=\begin{cases} x^2 & , \quad x \le 0 \\ x & , \quad 0 < x < 1 \\ 1/x & , \quad x \ge 1 \end{cases}$$

(b) If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$ then show that $(x^2-1)y_{n+2} + (2n+1)xy_{n+1} + (n^2-m^2)y_n = 0$. **(12)**

(c) Find the n-th derivative of $y = e^{ax}\sin(bx+c)$. **(11)**

2. (a) If $f(x+h) = f(x) + hf'(x) + \frac{h^2}{\lfloor 2} f''(x+\theta h), (0<\theta<1)$ where, $f(x) = (x-a)^{5/2}$ then show that $\theta = \frac{64}{225}$ for $x = a$. **(12)**

(b) At what point, the tangent to the curve $y = x^3$ will be parallel to the chord joining the points (1, 1) to (2, 8)? **(11)**

(c) Evaluate: (i) $\lim_{x\to 0}(a^x + x)^{\frac{1}{x}}$ (ii) $\lim_{x\to 0}\frac{\log\log(1-x^2)}{\log\log\cos x}$ **(12)**

3. (a) If $u = \log(x^3 + y^3 + z^3 - 3xyz)$ then show that $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = -\frac{9}{(x+y+z)^2}$. **(11)**

(b) If $u = \cos ec^{-1}\left\{\frac{\sqrt{x}+\sqrt{y}}{\sqrt[3]{x}+\sqrt[3]{y}}\right\}^{1/2}$ then show that

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{1}{12}\tan u\left[\frac{13}{12} + \frac{1}{12}\tan^2 u\right].$$ **(12)**

(c) Show that $f(x) = x^5 - 5x^4 + 5x^3 - 10$ has a maximum value when x = 1, a minimum value when x = 3, and neither maximum nor minimum value when x = 0. **(12)**

4. (a) Find the equation of the tangent and the normal to the curve $f(x)$ at $x = 1$ when $f(x) = 3x^2 + 5x - 9$. **(10)**

(b) Show that the curves $r^2\sin 2\theta = a^2$ and $r^2\cos 2\theta = b^2$ intersect orthogonally. **(10)**

(c) Determine the asymptotes of $4x^3 - x^2y - 4xy^2 + y^3 + 3x^2 + 2xy - y^2 - 7 = 0$. **(15)**

Contd P/2

MATH 121

SECTION – B

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

5. (a) Remove the first degree terms and the product term from the equation **(20)**

$$11x^2 + 24xy + 4y^2 - 20x - 40y - 5 = 0$$

by suitable transformation of the co-ordinate system.

(b) Find the condition that two of the straight lines represented by the equation **(15)**

$$ax^3 + bx^2y + cxy^2 + dy^3 = 0$$

will be at right angles.

6. (a) If $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a pair of straight lines, show that the area of the triangle formed by their bisectors and the axis of x is **(20)**

$$\frac{\sqrt{(a-b)^2 + 4h^2}}{2h} \cdot \frac{ac - g^2}{ab - h^2}.$$

(b) Find the locus of the points of intersection of the normals to the parabola $y^2 = 4ax$ such that two of the three normals from them coincide. **(15)**

7. (a) Find the coordinates of the limiting points of the co-axial system of circles determined by the circles **(15)**

$$x^2 + y^2 - 2x + 8y + 11 = 0$$

$$x^2 + y^2 + 4x + 2y + 5 = 0.$$

(b) Prove that the locus of the point of intersection of the tangents to the parabola $y^2 = 4ax$ which intercept of fixed length 'l' on the directrix is **(20)**

$$(y^2 - 4ax)(x + a)^2 = l^2x^2$$

8. (a) Show that the locus of the point of intersection of the normals at the extremities of any two conjugate diameters of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is the curve **(18)**

$$2(a^2x^2 + b^2y^2)^3 = (a^2 - b^2)^2 (a^2x^2 - b^2y^2)^2.$$

(b) Prove that the locus of the middle points of all normal chords of the rectangular hyperbola $x^2 - y^2 = a^2$ is given by **(17)**

$$(y^2 - x^2)^3 = 4a^2x^2y^2.$$

L-1/T-1/ChE **Date : 12/07/2011**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2009-2010

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

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) The collar A, as shown in Figure 1(a) starts from rest and moves to the left with a constant acceleration. Knowing that after 6 sec. the relative velocity of collar B with respect to collar A is 0.45 m/s, determine the accelerations of A and B. **(17)**

   (b) Knowing that at the instant shown in Figure 1(b) assembly A has a velocity of 0.3 m/s and on acceleration of 0.5 m/s^2 both directed downward, determine the velocity of block B. **(20)**

2. (a) A 15 kg block B is suspended from a 2.5 m cord attached to a 20 kg cart A. Neglecting friction, determine (i) the acceleration of the cart, and (ii) the tension in the cord, immediately after the system is released from rest in the position shown in Figure 2(a). **(17)**

   (b) The double pulley as shown in Figure 2(b) has a total mass of 6 kg and a centroidal radius of gyration of 0.135 m. Five collars, each of mass 1.2 kg, are attached to cords A and B as shown. When the system is at rest and in equilibrium, one collar is removed from cord B. Neglecting friction, determine (i) the angular acceleration of the pulley and (ii) the velocity of coir A at t = 2.5 s.

3. (a) A 1.2 kg collar C may slide without friction along a horizontal rod as shown in Figure 3(a). It is attached to three springs, each of constant k = 400 N/m and 0.15 m undeformed length. Knowing that the collar is released from rest in the position shown, determine the maximum velocity it will reach in the ensuing motion. **(17)**

   (b) A bag is gently pushed off the top of a wall at A and swings in a vertical plane at the end of a rope of length l as shown in Figure 3(b). Determine the angle θ for which the rope will break, knowing that it can withstand a maximum tension equal to twice the weight of the bag. **(18)**

4. In the mechanism in Figure 4 the rod BE has a constant angular velocity of 4 rad/s counterclockwise. For the instant shown determine: **(35)**

   (a) the angular velocity of rod AD

   (b) the velocity of collar D,

Contd P/2

ME 141(ChE)

SECTION – B

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

5. (a) A container is supported by three cables AD, AC, and AB as shown in Fig. for Q. No. 5(a). Determine the weight of the container knowing that the tension in cable AB is 500 N. **(15)**

   (b) The rectangular platform ABDC is hinged at A and B and supported by a cable which passes over a frictionless hook at E as shown in Fig for Q. No. 5(b). Knowing that the tension in the cable is 1349 N, determine the moment about the x-axis of the force exerted by the cable at C. **(20)**

6. (a) In Fig. for Q. No. 6(a), one end of rod AB rests in the corner A and the other is attached to cord BD. If the rod supports a 200 N load at its midpoint C, find the reaction at A and the tension in the cord. **(15)**

   (b) Two 8° wedges of negligible weight are used to move and position the 800 kg block as shown in Fig. for Q. No. 6(b). Knowing that the coefficient of static friction is 0.3 at all surfaces of contact, determine the smallest force **P** which should be applied as shown to one of the wedges. **(20)**

7. (a) A truss supports two vertical loads as shown in Fig. for Q. No. 7(a) . Determine the force in members AB, BD and DE and specify if the members are in tension or compression. **(15)**

   (b) A frame is designed to support a 400 N load as shown in Fig. for Q. No. 7(b). Determine the force in member BD and the components of the reaction at C. **(20)**

8. (a) Determine the surface area and volume of the torus obtained by rotating the circular area about the axis AA′ as shown in Fig. for Q. No. 8(a). Solve the problem by using the theorem of Pappus-Guldinus. **(15)**

   (b) Determine the moment of inertia of the area shown in Fig. for Q. No. 8(b) with respect to a vertical axis passing through the centroid of the area. **(20)**

ME 141 (ChE)

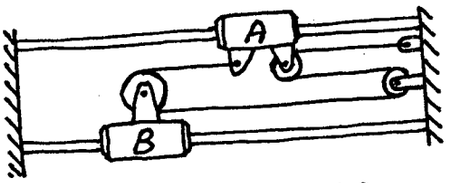


Figure 1(a)

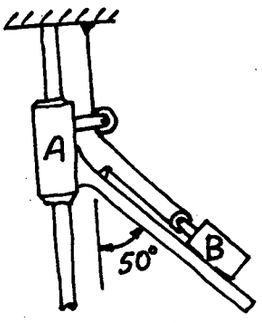


Figure 1(b)

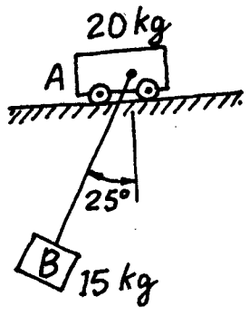


Figure 2(a)

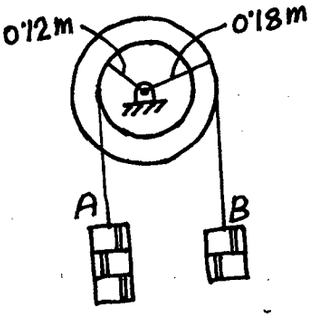


Figure 2(b)

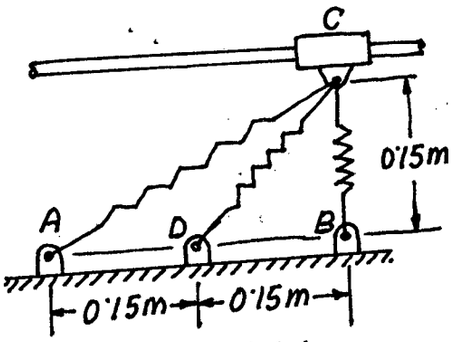


Figure 3(a)

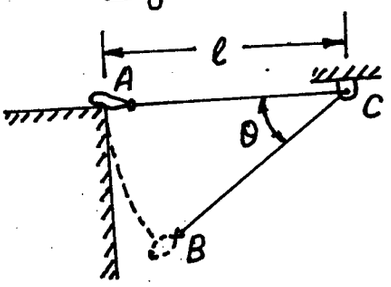


Figure 3(b)

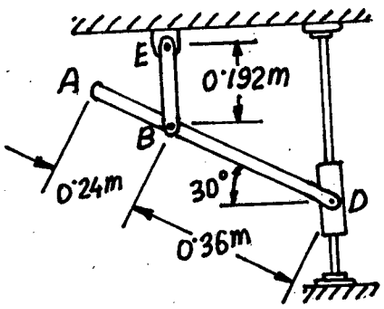


Figure 4

ME 141 (ChE)

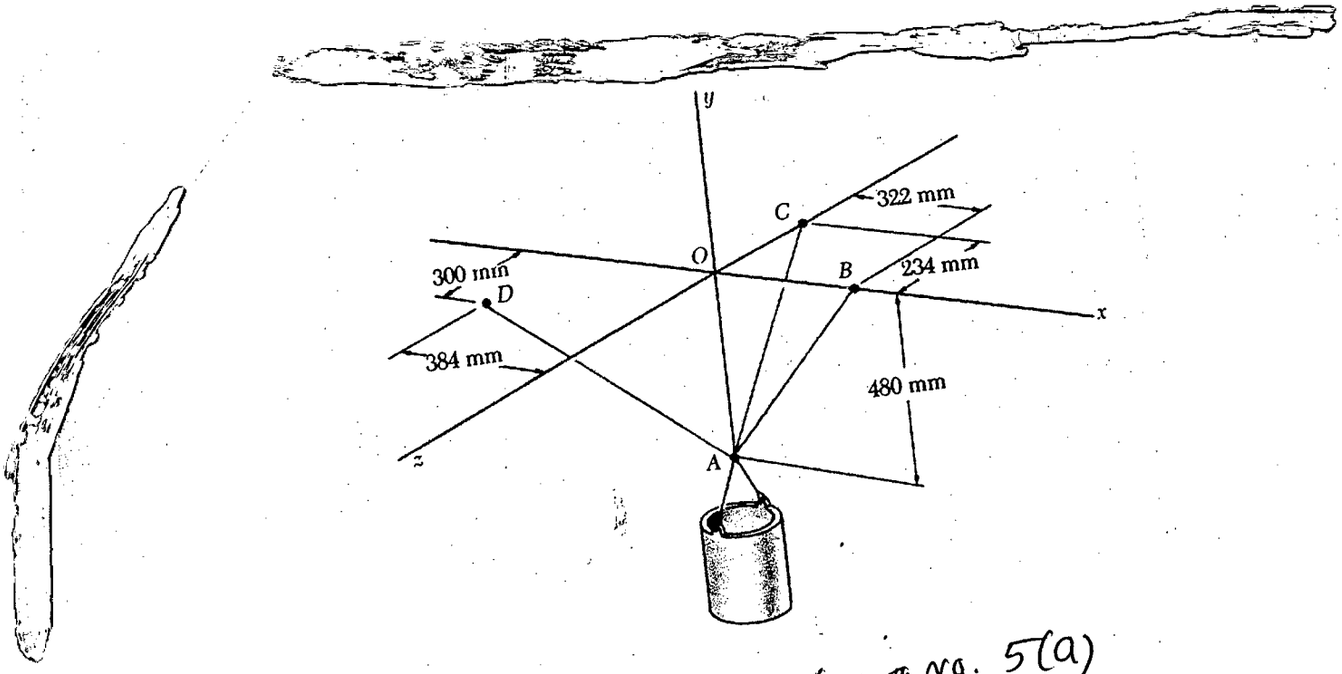


Fig. for Q. No. 5(a)

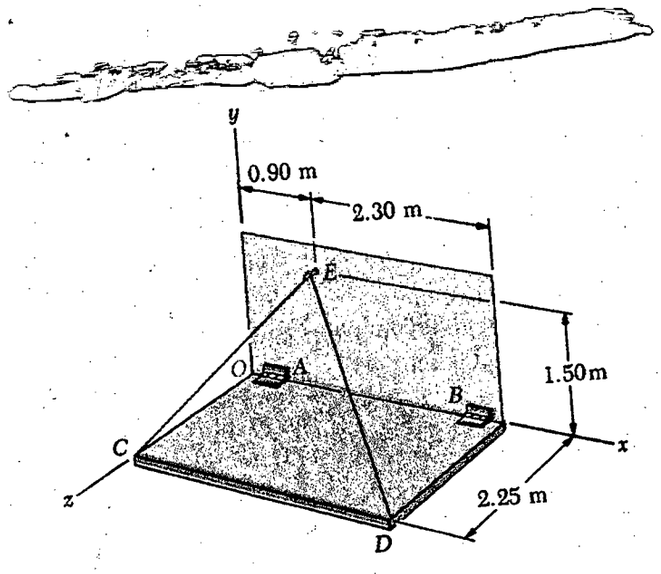


Fig. for Q. No. 5(b)

ME 141 (ChE)

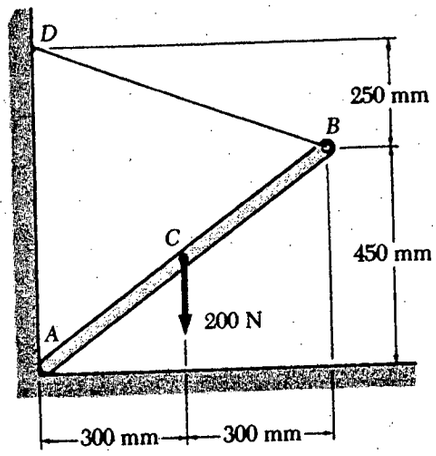


Fig. for Q. No. 6(a)

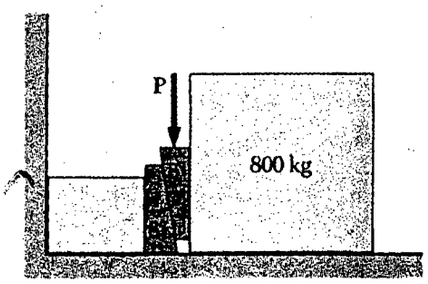


Fig. for Q. No. 6(b)

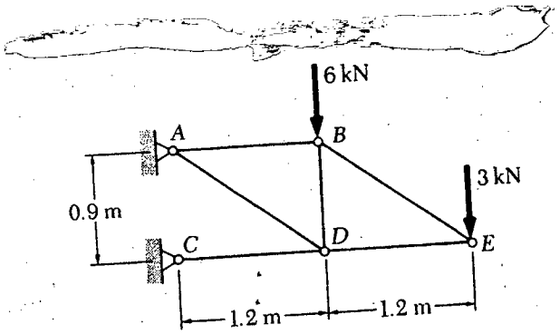


Fig. for Q. No. 7(a)

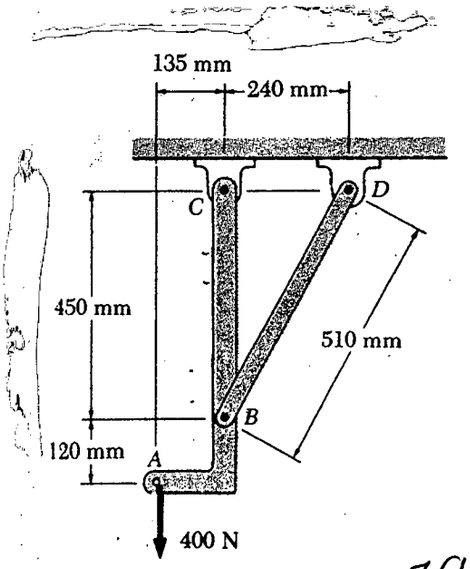


Fig. for Q. No. 7(b)

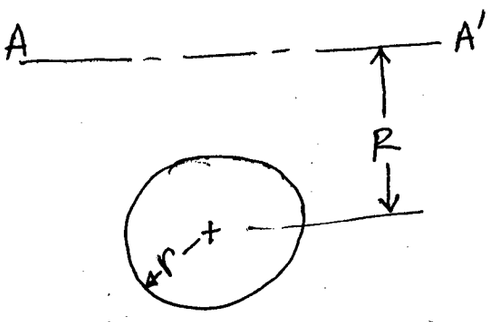


Fig. for Q. No. 8(a)

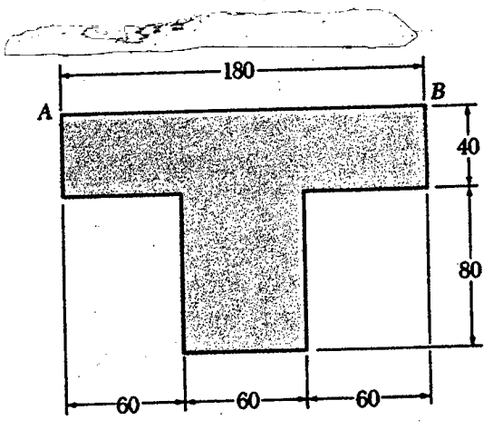


Fig. for Q. No. 8(b)

L-1/T-1/CHE **Date : 01/08/2011**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2010-2011

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

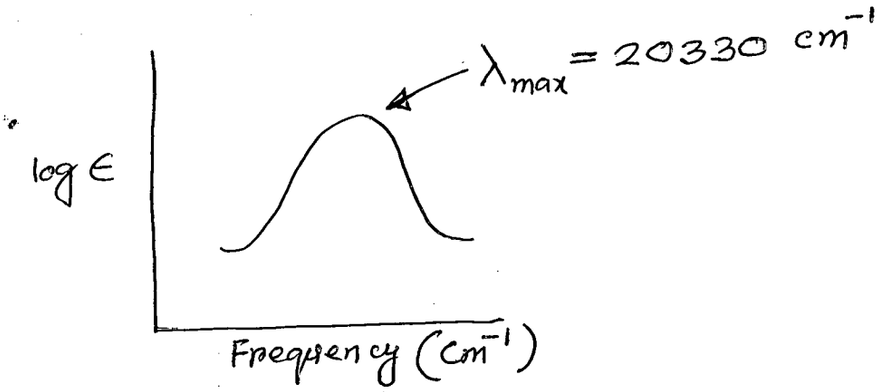
SECTION – A

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

1. (a) What is gyromagnetic ratio? A complex, $[CoF_6]^{3-}$ has a magnetic moment 4.898 BM. Show its formation according to valence bond theory. What should be the structure of the complex? **(10)**

   (b) Discuss the factors which affect the Crystal Field Splitting of d-orbitals. **(7)**

   (c) From the following spectrum of a complex, $[T_i(H_2O)_6]^{3+}$, calculate the crystal field stabilization energy. What type of transition does occur there? **(8)**



   (d) Discuss the weakness of Crystal Field Theory of complex compounds. **(10)**

2. (a) Discuss the molecular orbital theory for the formation of bonds in complex compounds. Cite an example. **(13)**

   (b) Calculate the Crystal Field Stabilization Energy (CFSE) for d^{1-10} electrons in case of octahedral ligand field. Consider both high spin and low spin situations. **(12)**

   (c) What role can stability constant play in removing toxic metal species from the industrial waste? **(5)**

   (d) Haemoglobin acts as an oxygen carrier. What happens when carbonmonoxide comes in contact with the haemoglobin? **(5)**

Contd P/2

CHEM 111

3. (a) How will you justify the stability of a complex according to valence bond theory when a metal ion gains large number of electrons on it? **(8)**

(b) Comment on the decreasing order of the stability constants of the following cobalt ethylene diamine complexes. Calculate the overall stability constant of $[Co(en)_3]^{3+}$ complex ion. **(7)**

$[Co(en)]^{2+}$; $k_1 = 1.8 \times 10^5$

$[Co(en)_2]^{2+}$; $k_2 = 1.2 \times 10^4$

$[Co(en)_3]^{2+}$; $k_3 = 3.7 \times 10^2$

(c) $[NiCl_4]^{2-}$ complex ion can have both square planar and tetrahedral geometrical structures – justify. **(10)**

(d) What is Effective Atomic Number rule? Justify the formation of carbonyl complexes of metals having odd atomic numbers. Cite examples. **(10)**

4. (a) Derive Schrödinger wave equation. **(12)**

(b) Discuss the radial probability distribution curves to explain the probability of finding an electron in a given volume. **(8)**

(c) Applying deBroglie's equation, calculate the wavelength associated with the motion of the earth, a stone and an electron. The masses and velocities of these objects are given below: **(7)**

Mass	Velocity
Earth : 6×10^{24} kg	3×10^4 ms^{-1}
Stone : 0.1 kg	1.0 ms^{-1}
electron : 10^{-30} kg	6×10^5 ms^{-1}

Planck's constant = 6.6×10^{-34} Js. Which of these objects will have the measurable wavelength?

(d) Write a short note on Heisenberg's Uncertainty principle. **(8)**

SECTION – B

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

5. (a) State the postulates of Bohr atomic model. Deduce an equation for the calculation of the radius of Bohr atomic orbit. **(4+7=11)**

(b) Discuss the limitations of Bohr atomic model. Explain how those limitations can be overcome. **(6+6=12)**

(c) What are the various quantum numbers? Write down their physical significances. **(7)**

(d) Write down the orbital electronic configuration of Sc, Fe^{++}, K^+, Mn and La. **(5)**

Contd P/3

CHEM 111

6. (a) Explain the formation of electrovalent, covalent and coordinate covalent compounds with examples. **(3×3=9)**

   (b) Compare the properties of electrovalent and covalent compounds. **(7)**

   (c) Write down the important features of the molecular orbital theory. **(7)**

   (d) Explain the formation of N_2 and NO molecules according to molecular orbital theory. Calculate their bond order and comment on their magnetic properties. **(8+4=12)**

7. (a) State periodic law. Discuss the important features of the modern periodic table. **(2+8=10)**

   What are the limitations of the periodic table? **(5)**

   (b) Mention some important uses of the following inert gases : (i) He, (ii) Ne, (iii) Ar. **(4)**

   (c) Write down the electronic configuration of Cu, Ag and Au. How do you explain the inertness of the elements of group IB in the metallic state considering the values of redox potential? **(6+3=9)**

   (d) Does the reactivity of the elements increases or decreases when we pass down the group from Zn to Cd to Hg? Explain with suitable examples to support your answer. **(7)**

8. (a) Write a short note on allotropic modification of carbon. **(8)**

   (b) Compare the chemistry of carbon with that of silicon. **(15)**

   (c) Discuss the important oxidation states shown by Fe, Co and Ni in their compounds. **(6)**

   (d) What are the conjugate acids and bases? What are the conjugate bases of the following acids? **(6)**

   H_2CO_3, H_2O, $HClO_4$, HCN

L-1/T-1/CHE **Date : 13/08/2011**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2009-2010

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

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) Two cables are tied together at C and loaded as shown in Fig 1(a). Determine the tension in cables AC and BC. **(15)**

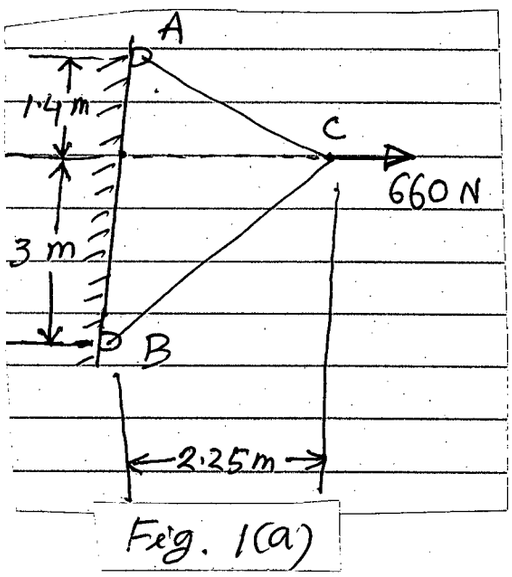


Fig. 1(a)

(b) Determine the smallest force P as shown in Fig. 1(b) required to start the block D moving if block C is restrained by cable AB. The coefficients of friction $\mu_s = 0.30$ and $\mu_k = 0.25$ between all surfaces of contact. **(20)**

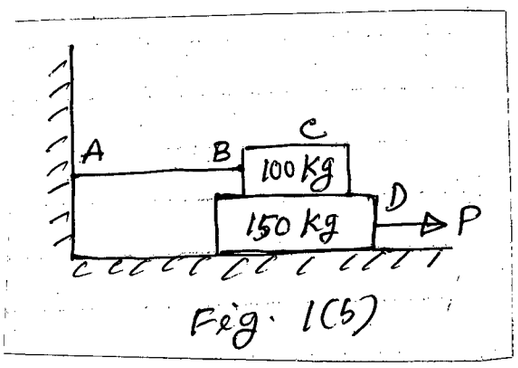


Fig. 1(b)

2. (a) Rod AB is supported by a Pin and bracket at A and rests against a frictionless peg at C as shown in Fig. 2(a). Determine the reactions at A and C when a 170-N vertical force is applied at B. **(15)**

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ME 141

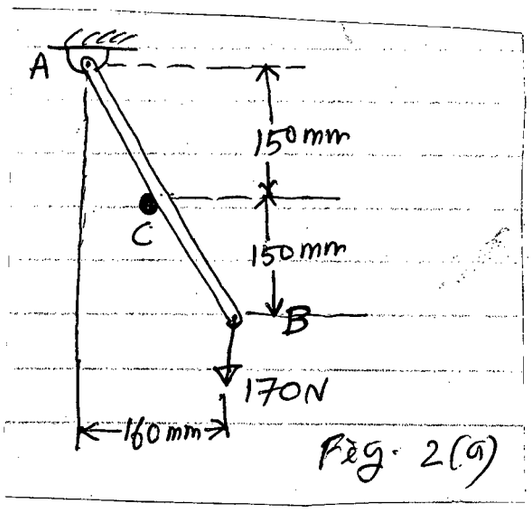

Fig. 2(a)

(b) Determine by direct integration the X-coordinate of the centroid of the area shown in Fig. 2(b). **(20)**

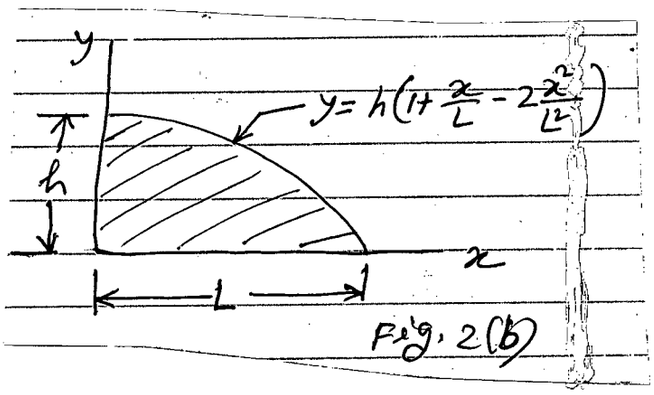

Fig. 2(b)

3. (a) A simple truss is shown in Fig. 3(a). Determine the force in members BC, BF, and EF. State whether the members are in Tension or compression. **(15)**

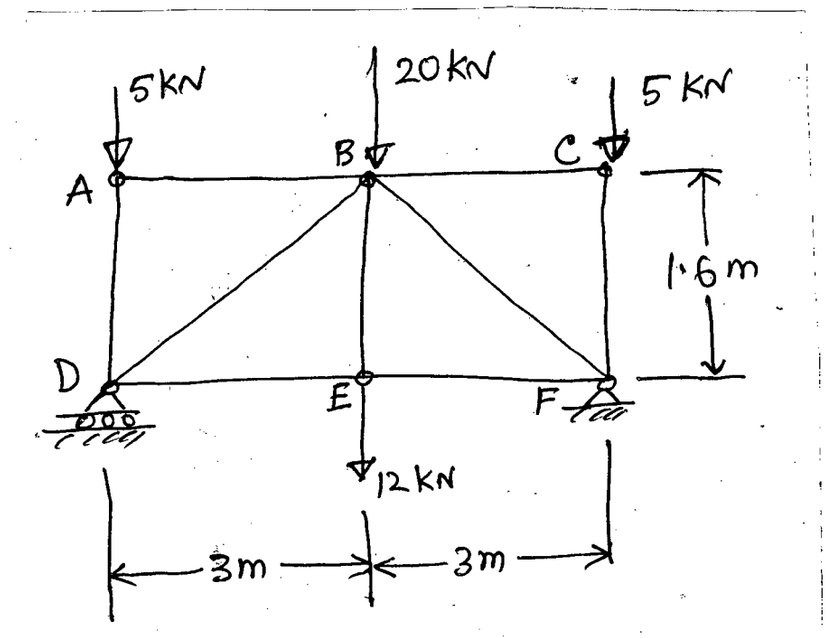

Fig. 3(a)

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ME 141

(b) The frame shown in Fig. 3(b) consists of members AD and EH, which are connected by two links BF and DG. Determine the force in each link for the given loading. **(20)**

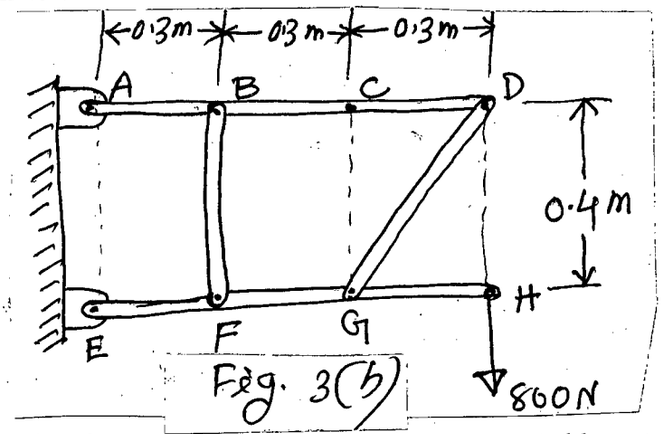

Fig. 3(b)

4. (a) Determine the surface area and the volume generated by rotating the rectangular area ABDC about the anis X - X' as shown in Fig. 4(a). Use pappus Guldinus theorem. **(15)**

(b) Determine the moment of inertia of the hatched area shown in Fig. 4(b), with respect to the anix X-X' and y - y'. **(20)**

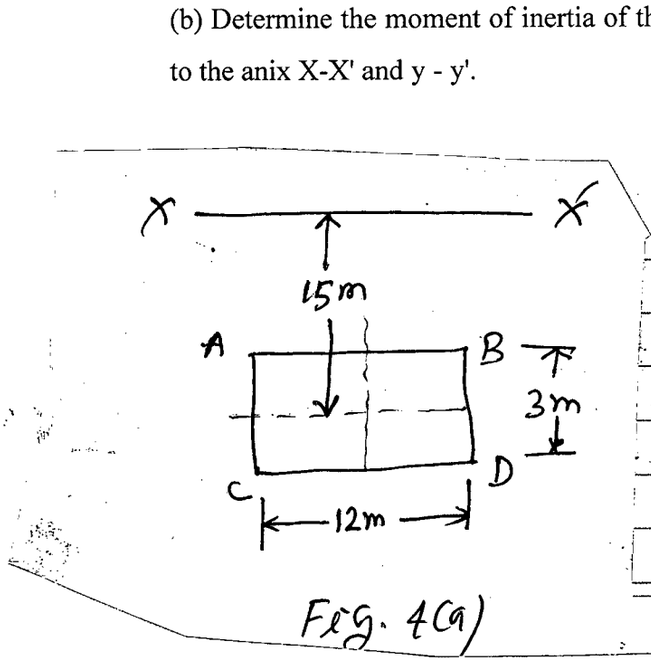

Fig. 4(a)

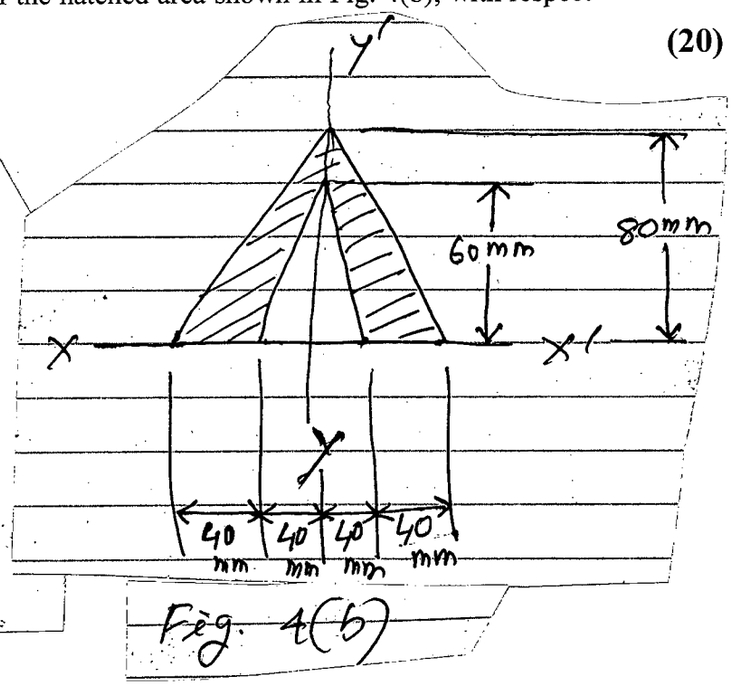

Fig. 4(b)

SECTION – B

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

Assume reasonable value for any missing data

5. (a) A player throws a ball with an initial velocity V_0 of 16m/s from a point A located 1.5m above the floor as shown in Fig. for Q.5(a) Rnowing that h = 3.5m, determine the angle α for which the ball will strike the wall at point B. **(17)**

(b) The two blocks as shown in Fig. for Q.5(b) are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between the blocks and the inclines, determine (i) the acceleration of each block, (ii) the tension in the cable. **(18)**

ME 141

6. (a) Two wires AC and BC are tied at C to a sphere which revolves at a constant speed in the horizontal circle as shown in Fig. for Q.6(a). Determine the range of values of velocity for which both wires remain taut. **(18)**

   (b) A 800 gm collar may slide along the horizontal rod as shown in Fig. for Q.6(b). It is attached to an elastic cord with an undeformed length of 300 mm, and a spring constant of 140N/m. Knowing that the collar is released from rest at A and neglecting friction, determine the speed of the collar (i) at B, and (ii) at E. **(17)**

7. (a) A 600 gm pellet is released from rest at A and slides without friction along the surface as shown in Fig. for Q.7(a). Determine the force exerted by the surface on the pellet as it passes through (i) point B, (ii) point C. **(17)**

   (b) The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are shown in Fig. for Q.7(b) Assuming e = 0.90, determine the magnitude and direction of the velocity of each ball after the impact. **(18)**

8. (a) Collar A moves with a constant velocity of 900 mm/s to the right as shown inFig. for Q.8(a). At the instant when $\theta = 30°$, determine (i) the angular velocity of rod AB, and (ii) the velocity of collar B. **(17)**

   (b) A pulley weighing 5 kg and having a radius of gyration of 200 mm is connected to two cylinders as shown in Fig. For Q. 8(b). Assuming no axle friction, determine the angular acceleration of the pulley and the acceleration of each cylinder. **(18)**

ME-141

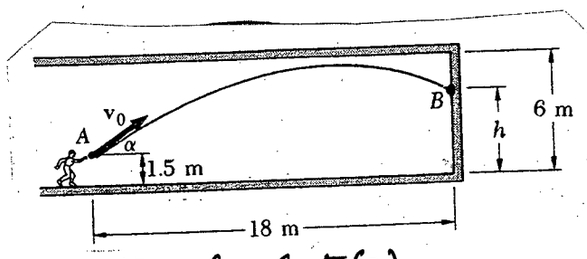

Fig. for Q. 5(a)

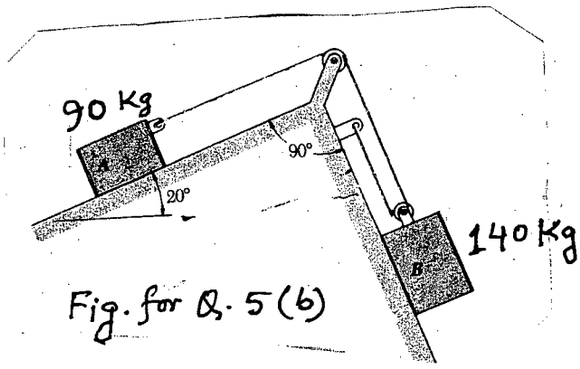

Fig. for Q. 5(b)

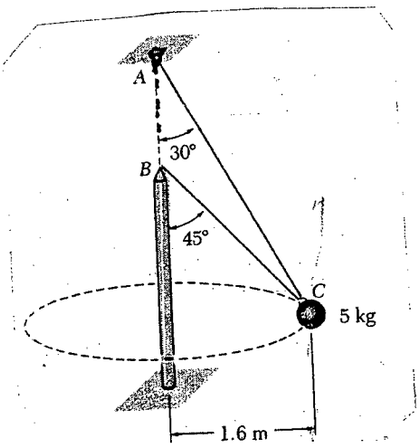

Fig. for Q. 6(a)

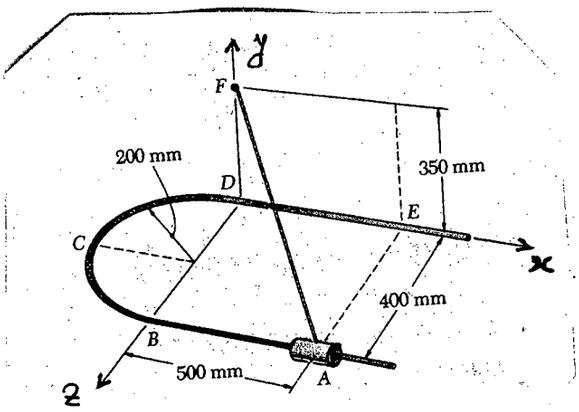

Fig. for Q. 6(b)

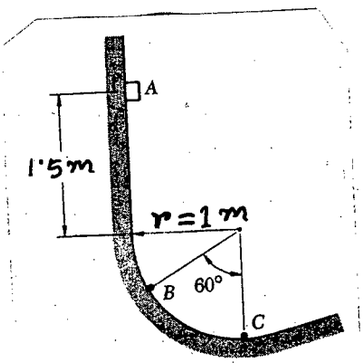

Fig. for Q. 7(a)

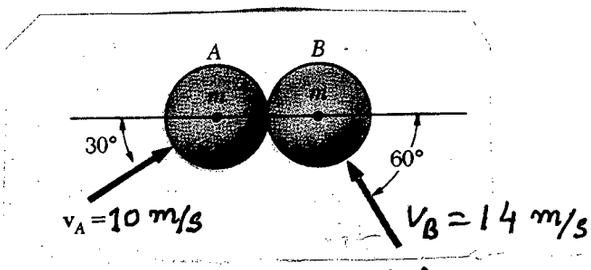

Fig. for Q. 7(b)

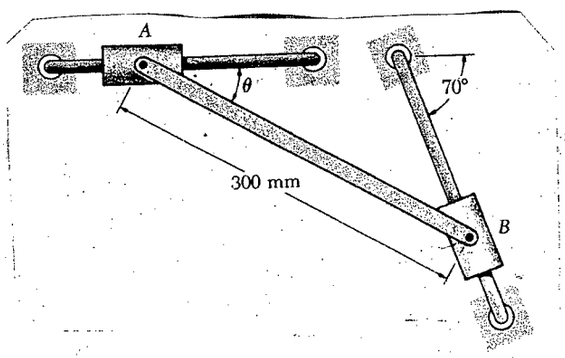

Fig. for Q. 8(a)

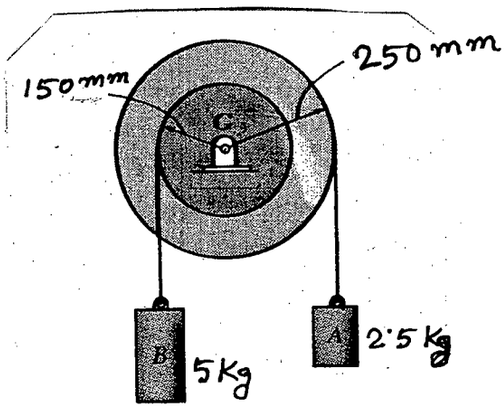

Fig. for Q. 8(b)

L-1/T-1/CHE **Date : 27/06/2011**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2010-2011

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

The questions are of equal value.

1. (a) Calculate the phase difference between

$$v_1(t) = 5\sin(-3t + 15^\circ)$$

and $v_2(t) = -5\cos(3t + 60^\circ)$

Also sketch the waveforms of $v_1(t)$ and $v_2(t)$.

(b) A sinusoidal current $i(t) = I_m \sin \omega t$ flows through the resistor and the inductor of the circuit shown in Fig. 1(b). Find the expression of voltage $v(t)$ and instantaneous power $p(t)$. Also sketch the waveforms of $v(t)$ and $p(t)$.

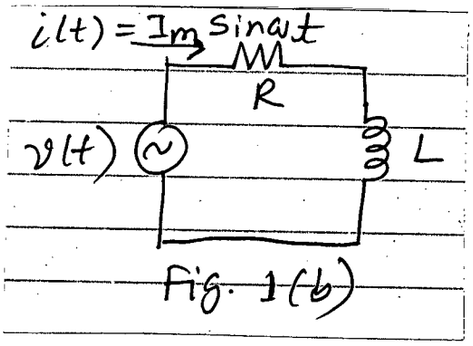

Fig. 1(b)

2. (a) Calculate the average and rms value of the waveform v(t) shown in Fig. 2(a).

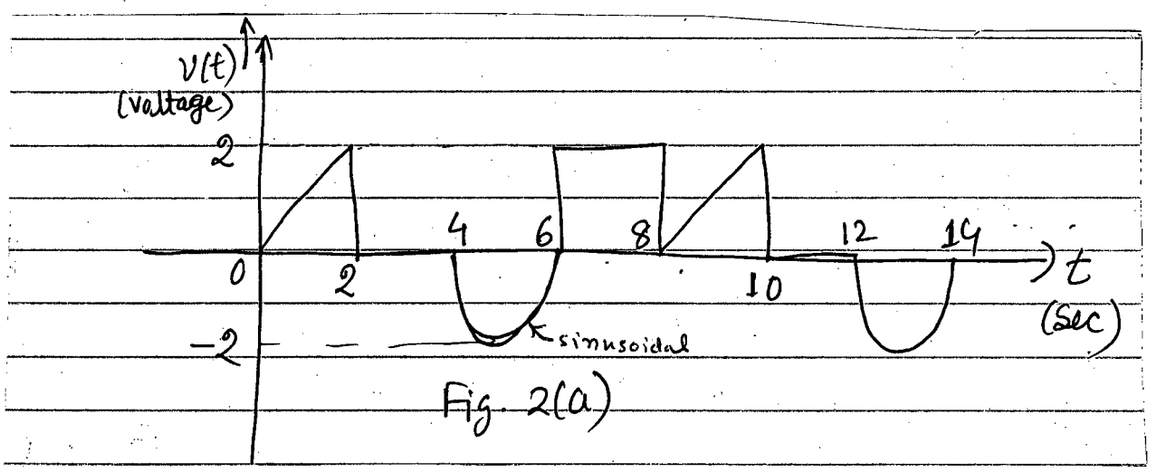

Fig. 2(a)

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EEE 155

Contd ... Q. No. 2

(b) Find the expression of i(t) from the following circuit shown in Fig. 2(b).

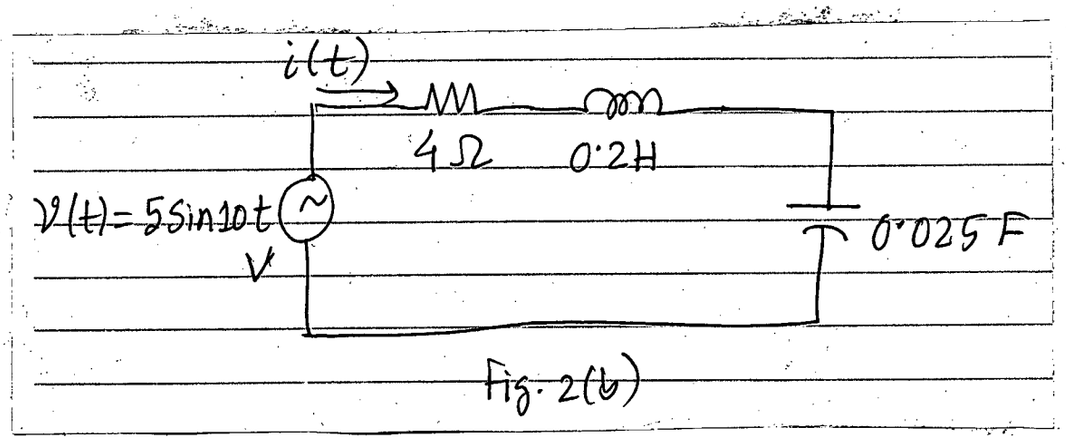

Fig. 2(b)

3. (a) Draw the complete phasor diagram to find the current I shown in Fig. 3(a).

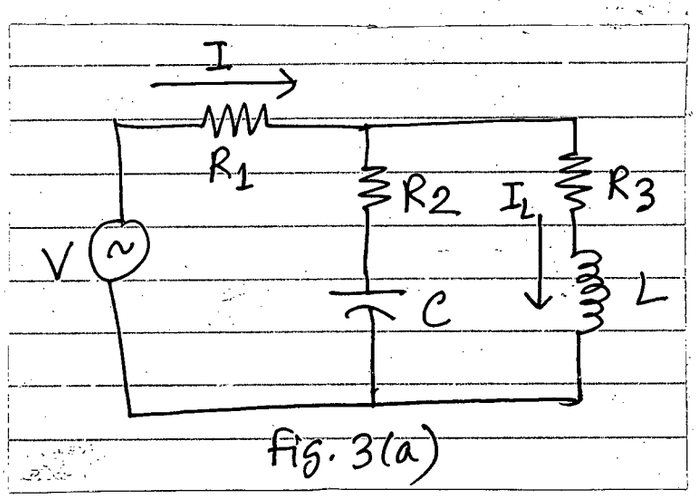

fig. 3(a)

Take I_L as reference.

(b) In the circuit shown in Fig. 3(b), calculate the average power absorbed by the resistor, capacitor and inductor. Also find the average power supplied by the voltage source.

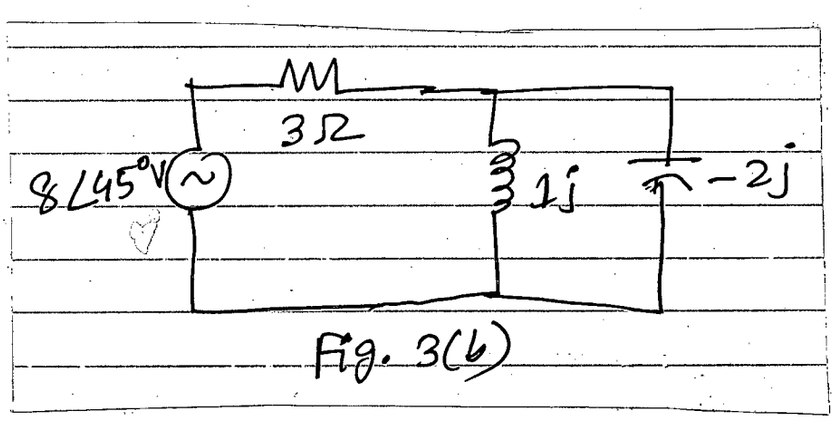

Fig. 3(b)

EEE 155

4. (a) Determine the secondary current I_2 for the transformer shown in Fig. 4(a) if the resultant clockwise flux in the core is 1.5×10^{-5} wb.

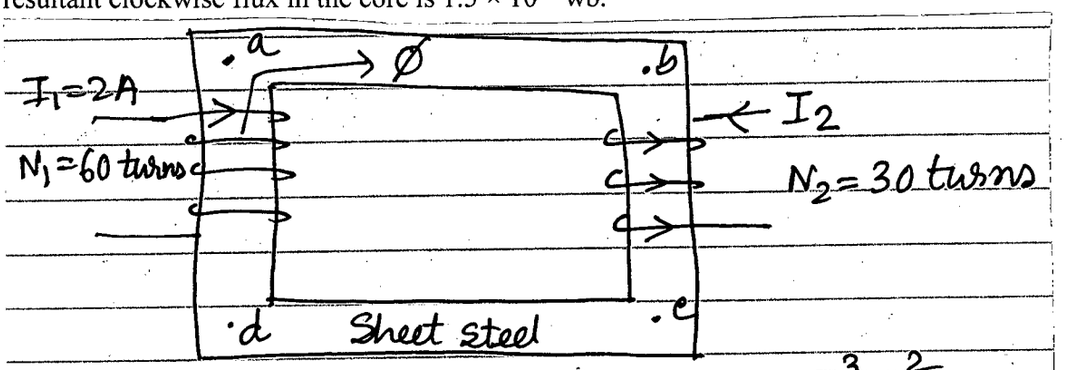

Fig. 4(a) (B-H Curve is attached at the end)

(b) Find the value of I required to establish a magnetic flux of $\phi = 0.75 \times 10^{-4}\, wb$ in the magnetic circuit shown in Fig. 4(b).

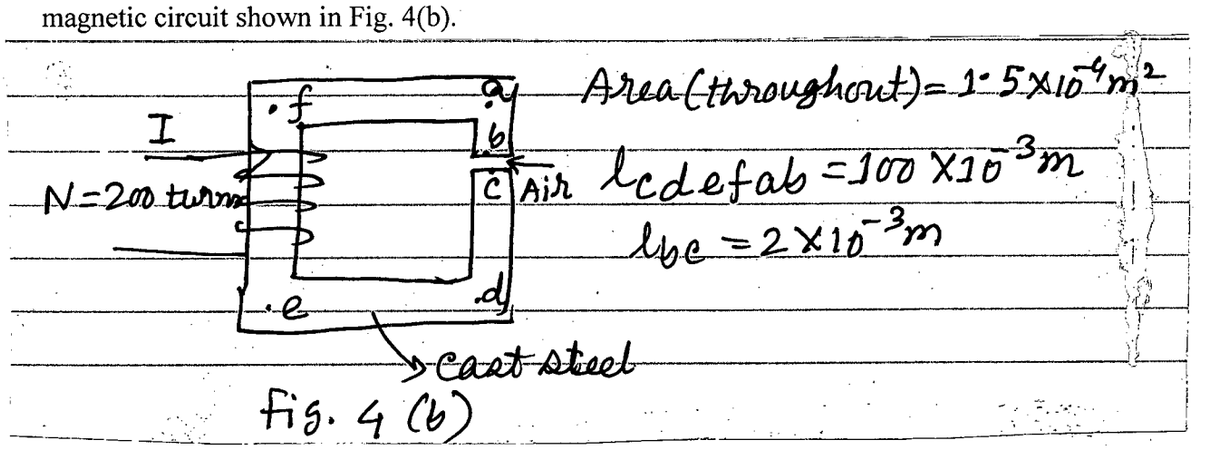

Fig. 4 (b)

SECTION – B

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

The figures in the margin indicate full marks.

5. (a) In the circuit shown in Fig. 5(a), obtain V_1, V_2 and V_3. **(9)**

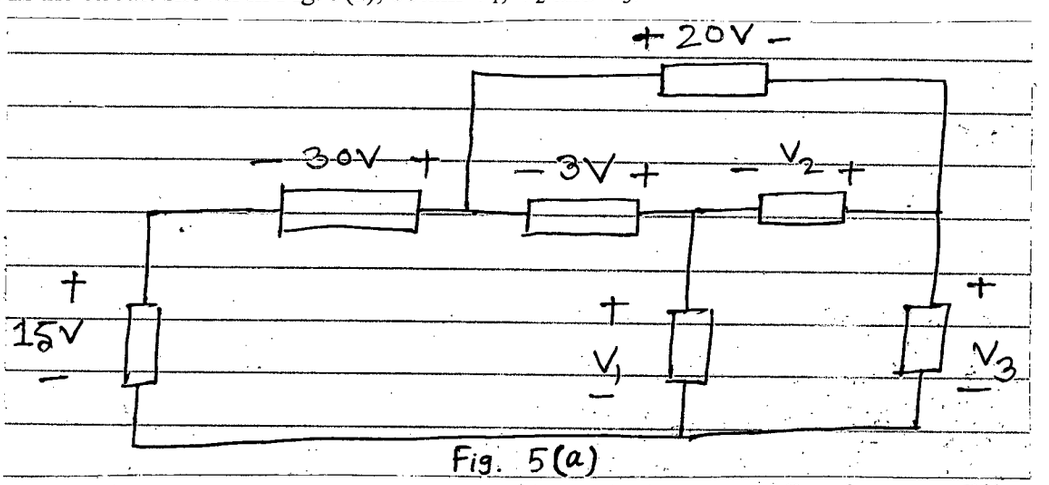

Fig. 5(a)

EEE 155

Contd ... Q. No. 5

(b) Use KCL to obtain the currents I_1, I_2 and I_3 in the circuit shown in Fig. 5(b). **(9)**

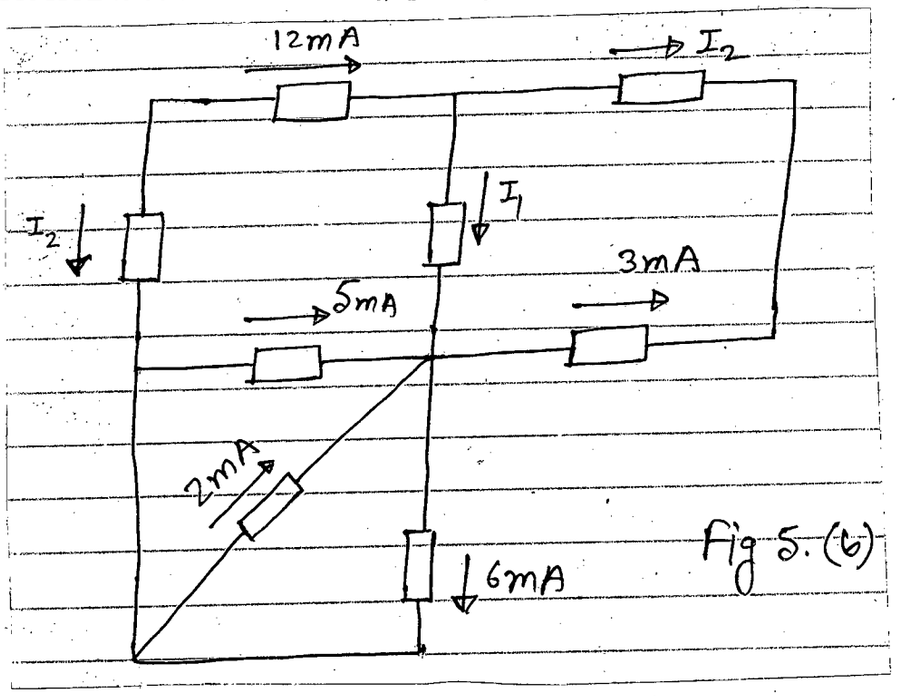

Fig 5. (b)

(c) Find the equivalent resistance at terminals a–b for the circuit shown in Fig. 5(c). **(17)**

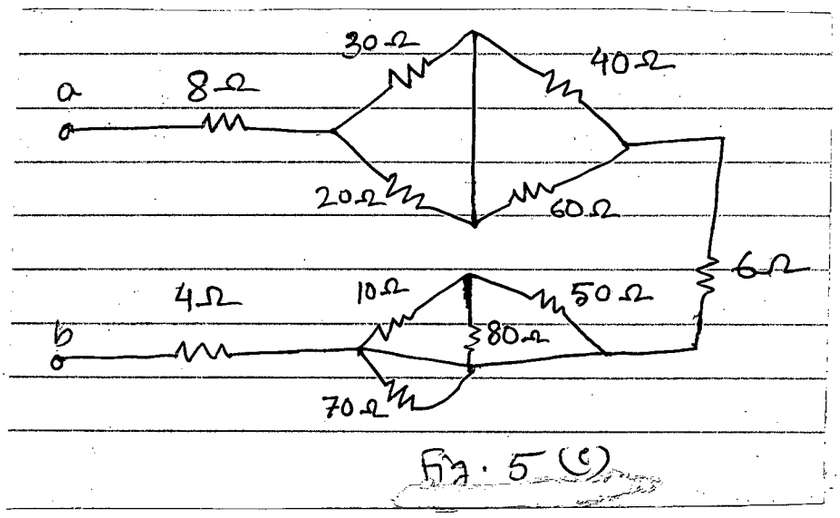

Fig. 5 (c)

6. (a) Use superposition theorem to find V_x in the circuit shown in Fig. 6(a). **(17)**

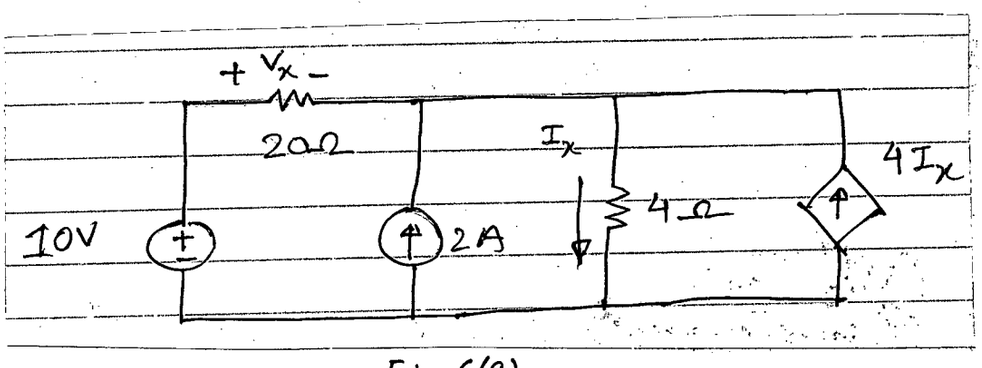

Fig. 6(a)

EEE 155

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(b) Using nodal analysis, calculate the value of I_y and V_x from the circuit shown in Fig. 6(b). **(18)**

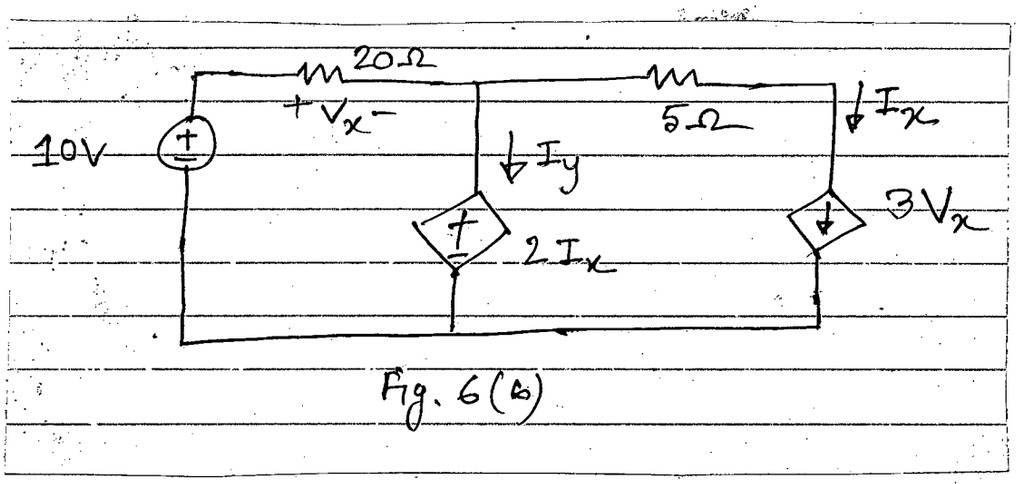

Fig. 6(b)

7. (a) Obtain node voltages V_1, V_2, V_3 in the circuit shown in Fig. 7(a) using nodal analysis. **(17)**

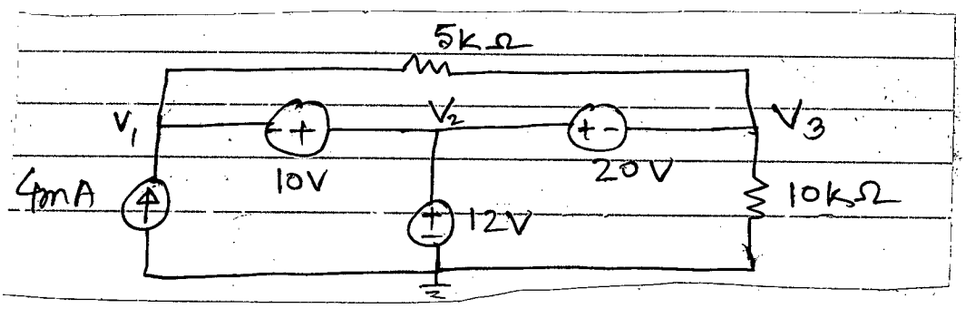

Fig. 7(a)

(b) Using mesh analysis, calculate the power delivered/absorbed by the sources $(V_1 = 24V, I_1 = 5A)$ shown in Fig. 7(b). Are all the sources delivering power? **(18)**

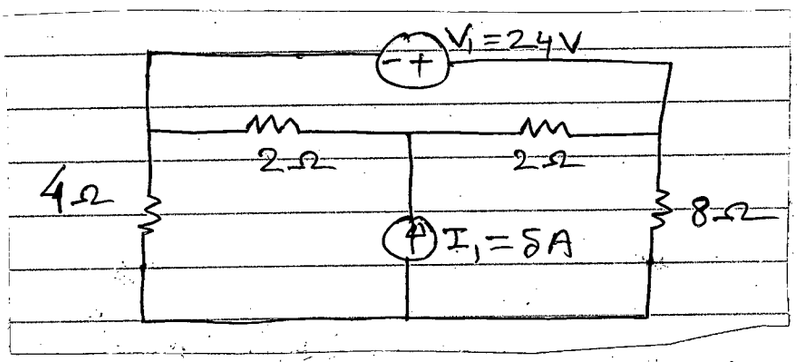

Fig. 7(b)

EEE 155

8. (a) Find the Thevenin equivalent circuit in Fig. 8(a) from the terminal a–b. **(17)**

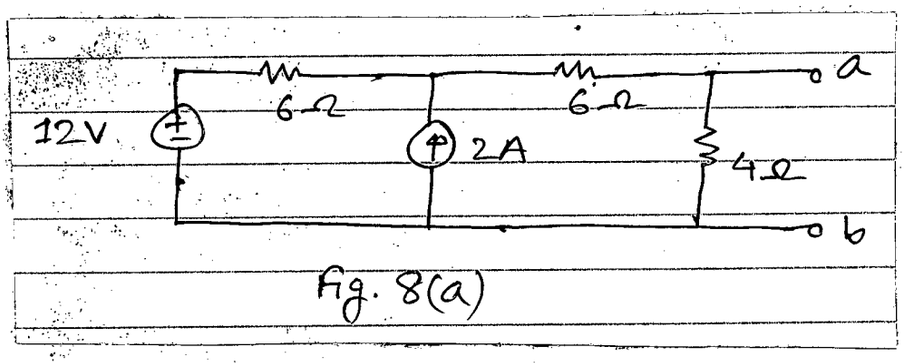

Fig. 8(a)

(b) Find the value of R_L for maximum power transfer in the circuit of Fig. 8(b). Also calculate the maximum power delivered to R_L. **(18)**

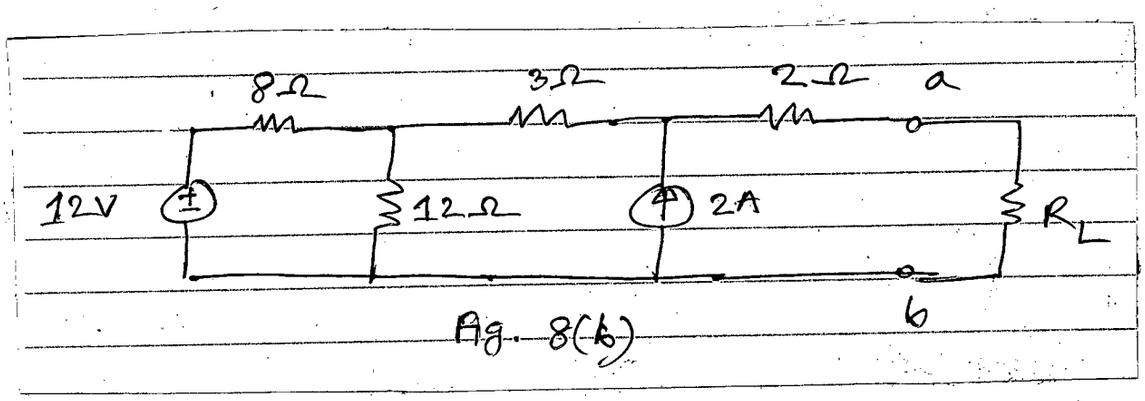

Fig. 8(b)

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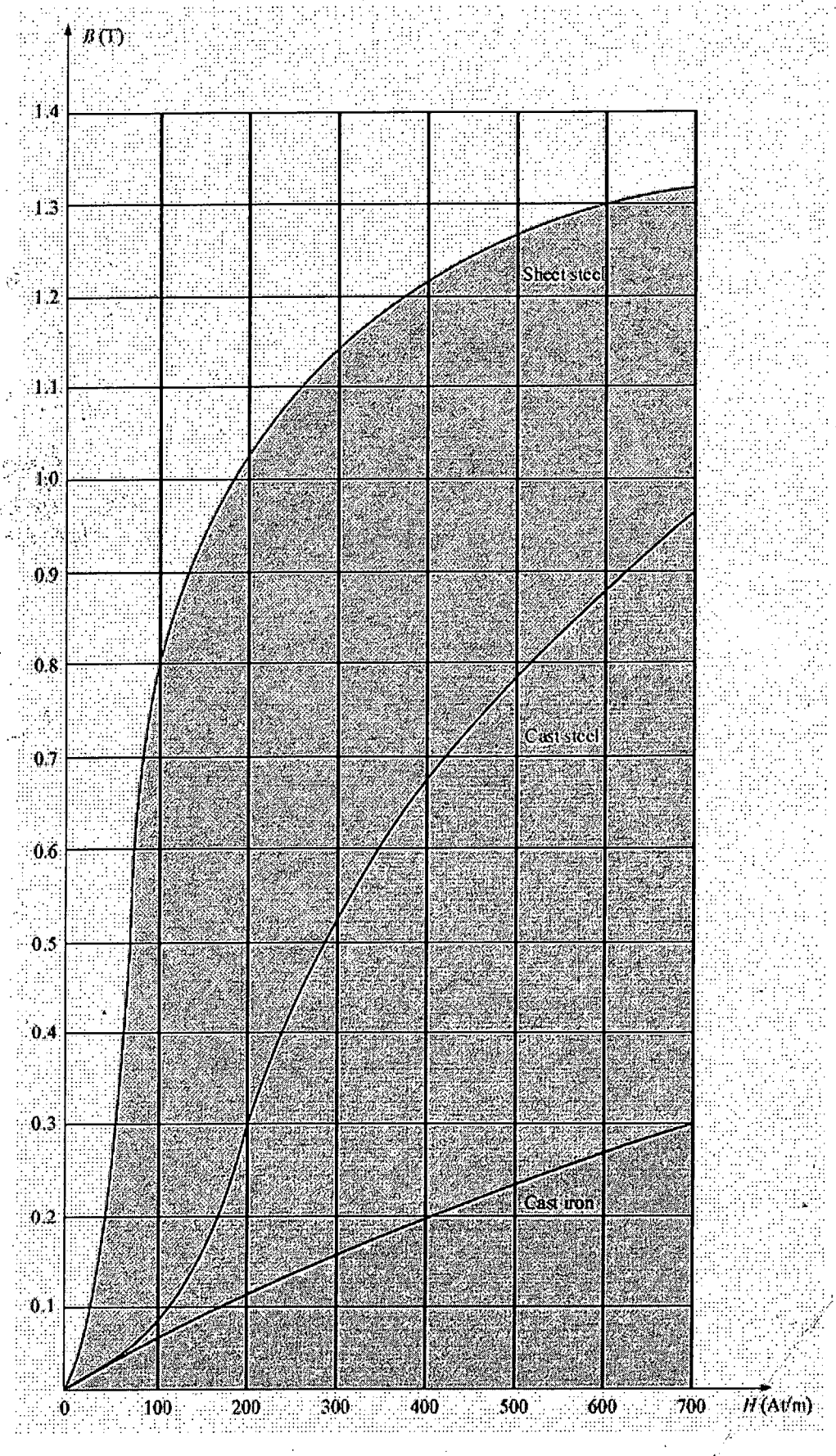

Fig. for Q. 4(a) and 4(b)