

(REVISED COURSE)

(3 Hours)

[Total Marks : 80

N.B. : (1) Question No. 1 is compulsory.  
 (2) Solve any three from the remaining.

1. (a) If  $\alpha + i\beta = \tanh \left( \chi + i\frac{\pi}{4} \right)$ , prove that  $\alpha^2 + \beta^2 = 1$ . 3

(b) If  $u = x^2y + e^{xy^2}$  show that  $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$ . 3

(c) If  $u = 1 - x$ ,  $v = x(1 - y)$ ,  $w = xy(1 - z)$  show that  $\frac{\partial(u, v, w)}{\partial(x, y, z)} = x^2y$ . 3

(d) Prove that  $\log(1 - x + x^2) = -x + \frac{x^2}{2} + \frac{2x^3}{3} - \dots$  3

(e) Express the relation in  $\alpha, \beta, \gamma, \delta$  for which  $A = \begin{bmatrix} \alpha + i\gamma & -\beta + i\delta \\ \beta + i\delta & \alpha - i\gamma \end{bmatrix}$  is unitary. 4

(f) Find  $n^{\text{th}}$  derivative of  $2^x \cos^2 x \sin x$ . 4

2. (a)  $z^3 = (z + 1)^3$ , then show that  $z = \frac{-1}{2} + \frac{i}{2} \cot \frac{\theta}{2}$  where  $\theta = 20 \frac{\pi}{3}$ . 6

(b) Find the non-singular matrices P and Q such that PAQ is in Normal Form. Also find rank of A. 6

$$A = \begin{bmatrix} 4 & 3 & 1 & 6 \\ 2 & 4 & 2 & 2 \\ 12 & 14 & 5 & 16 \end{bmatrix}$$

(c) State and Prove Euler's theorem for homogeneous functions in two variables 8

and hence find the value of  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} + x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$  for

$u = e^{x+y} + \log(x^3 + y^3 - x^2y - xy^2)$

3. (a) For what values of  $\lambda$  the system of equations have ~~X~~ non-trivial solution? Obtain the solution for real values of  $\lambda$  where  $3x + y - \lambda x = 0$ ,  $4x - 2y - 3z = 0$ ,  $2\lambda x + 4y - \lambda z = 0$ . 6

(b) Find the stationary values of  $\sin x \sin y \sin(x + y)$ . 6

(c) If  $\cos(x + iy) \cos(u + iv) = 1$ , where  $x, y, u, v$  are real, then show that  $\tanh^2 y \cosh^2 v = \sin^2 u$ . 8

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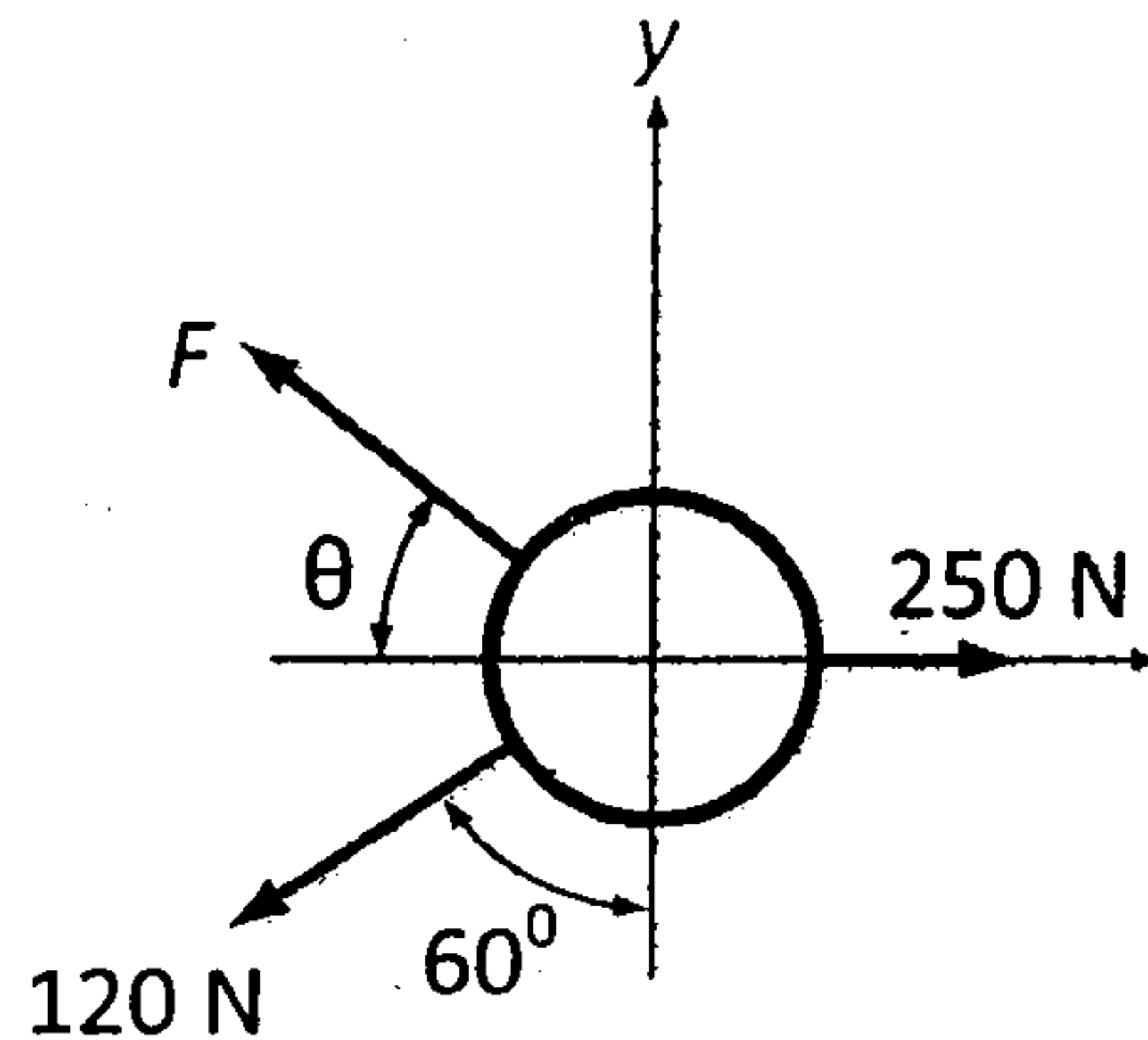
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4. (a) If  $ux + vy = a$ ,  $\frac{u}{x} + \frac{v}{y} = 1$ , Show that  $\frac{u}{x} \left( \frac{\partial x}{\partial u} \right)_v + \frac{v}{y} \left( \frac{\partial y}{\partial v} \right)_u = 0$ . 6
- (b) If  $(1 + i \tan \alpha)^{(1 + i \tan \beta)}$  is real then one of the principal values is  $(\sec \alpha)^{\sec^2 \beta}$ . 6
- (c) Solve by Crout's Method the system of equations  $2x + 3y + z = -1$ ,  $5x + y + z = 9$ ,  $3x + 2y + 4z = 11$  8
5. (a) If  $\sin^4 \theta \cos^3 \theta = a \cos \theta + b \cos^3 \theta + c \cos 5\theta + d \cos 7\theta$  then find a, b, c, d. 6
- (b) Use Taylor theorem and arrange the equation in powers of x. 6
- $7 + (x + 2) + 3(x + 2)^3 + (x + 2)^4 - (x + 2)^5$
- (c) If  $y = \cos(m \sin^{-1} x)$  prove that  $(1 - x^2) y_{n+2} - (2n + 1) x y_{n+1} + (m^2 - n^2) y_n = 0$ . 8
6. (a) Solve correctly upto three iterations the following equations by Gauss-Seidel method. 6
- $10x - 5y - 2z = 3$ ,  $4x - 10y + 3z = -3$ ,  $x + 6y + 10z = -3$ .
- (b) If  $u = \sin(x^2 + y^2)$  and  $a^2 x^2 + b^2 y^2 = c^2$  find  $\frac{du}{dx}$ . 6
- (c) Fit a curve  $y = ax + bx^2$  for the data : 8

<b>x</b>	1	2	3	4	5	6
<b>y</b>	2.51	5.82	9.93	14.84	20.55	27.06

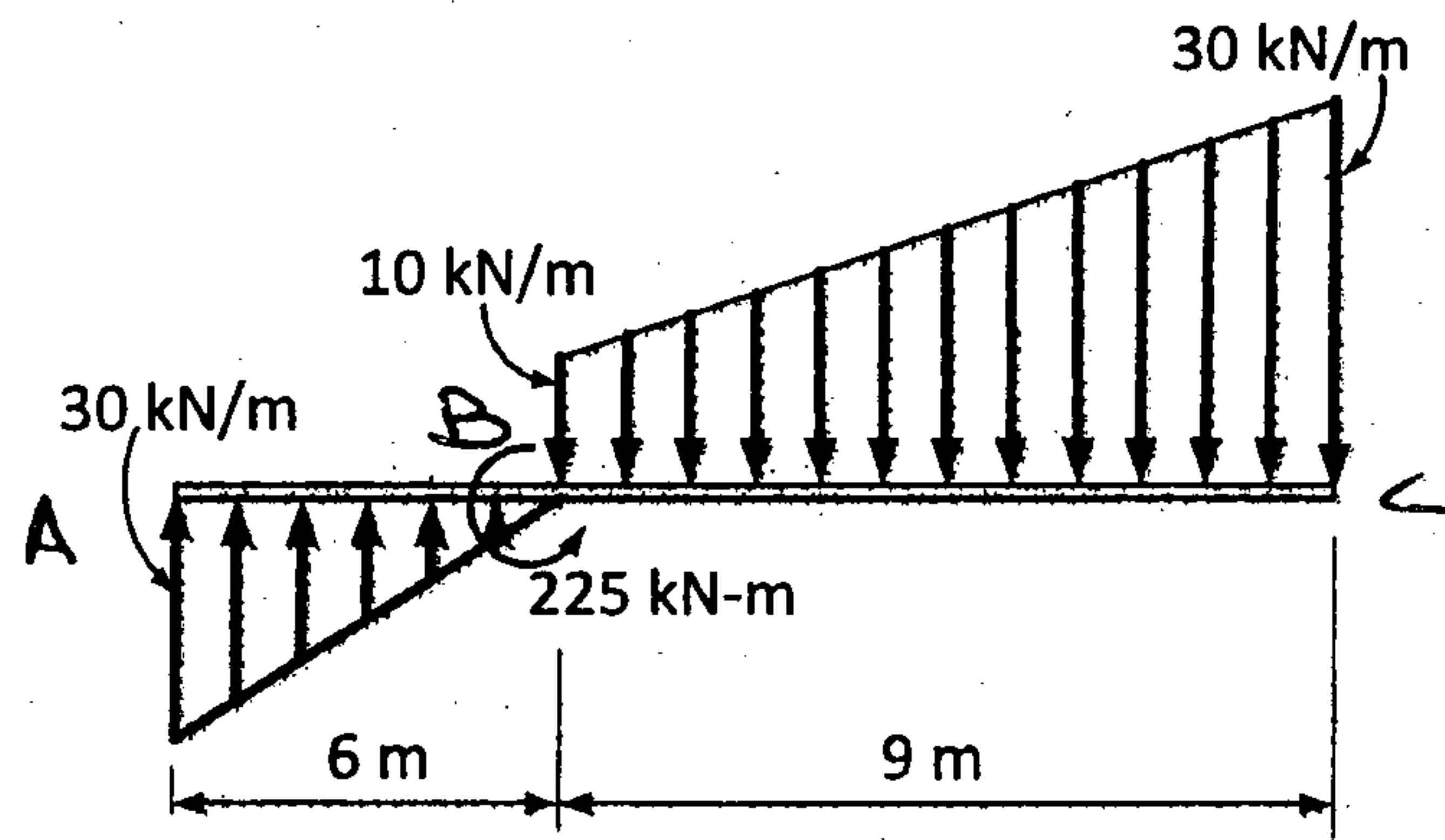
- N.B.** (1) Question No. 1 is **compulsory**.  
 (2) Answer any **three** questions out of **remaining** questions.  
 (3) Use acceleration due to gravity  $g = 9.81 \text{ m/s}^2$ .  
 (4) Use of electronic calculator is **permitted**.

- Q.1. (a)** A ring is pulled by three forces as shown in figure. Find the force  $F$  and the angle  $\theta$  if resultant of these three forces is 100 N acting in vertical direction. [04]

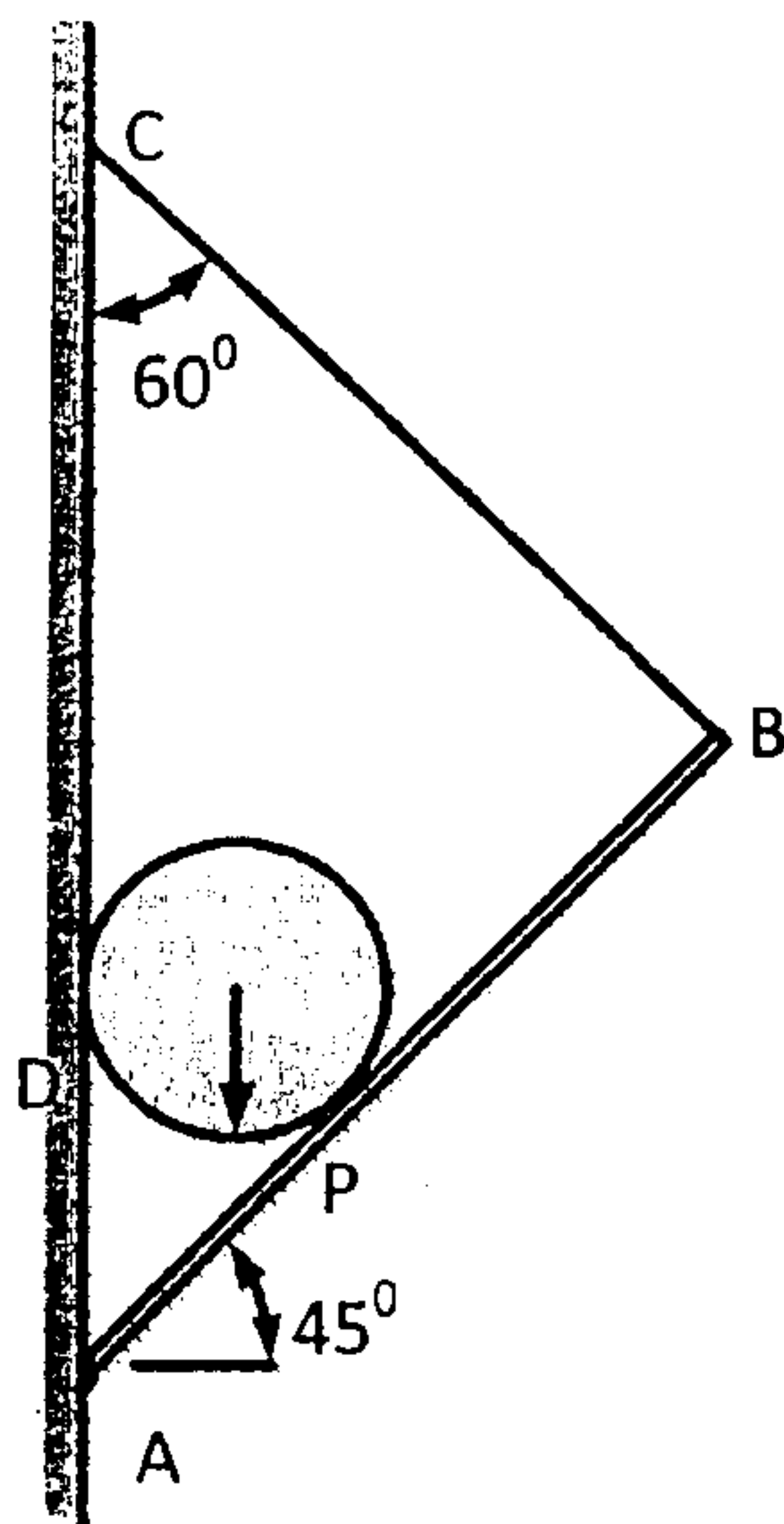


- (b) State and prove Lami's Theorem. [04]  
 (c) Laws of friction. [04]  
 (d) A motorist is travelling at 90 kmph, when he observes a traffic signal 250 m ahead of him turns red. The traffic signal is timed to stay red for 12 sec. If the motorist wishes to pass the signal without stopping just as it turns green. Determine (i) The required uniform deceleration of the motor. (ii) The speed of motor as it passes the signal. [04]  
 (e) A 50 kg block kept on a  $15^\circ$  inclined plane is pushed down the plane with an initial velocity of 20 m/s. If  $\mu_k = 0.4$ , determine the distance traveled by the block and the time it will take as it comes to rest. [04]

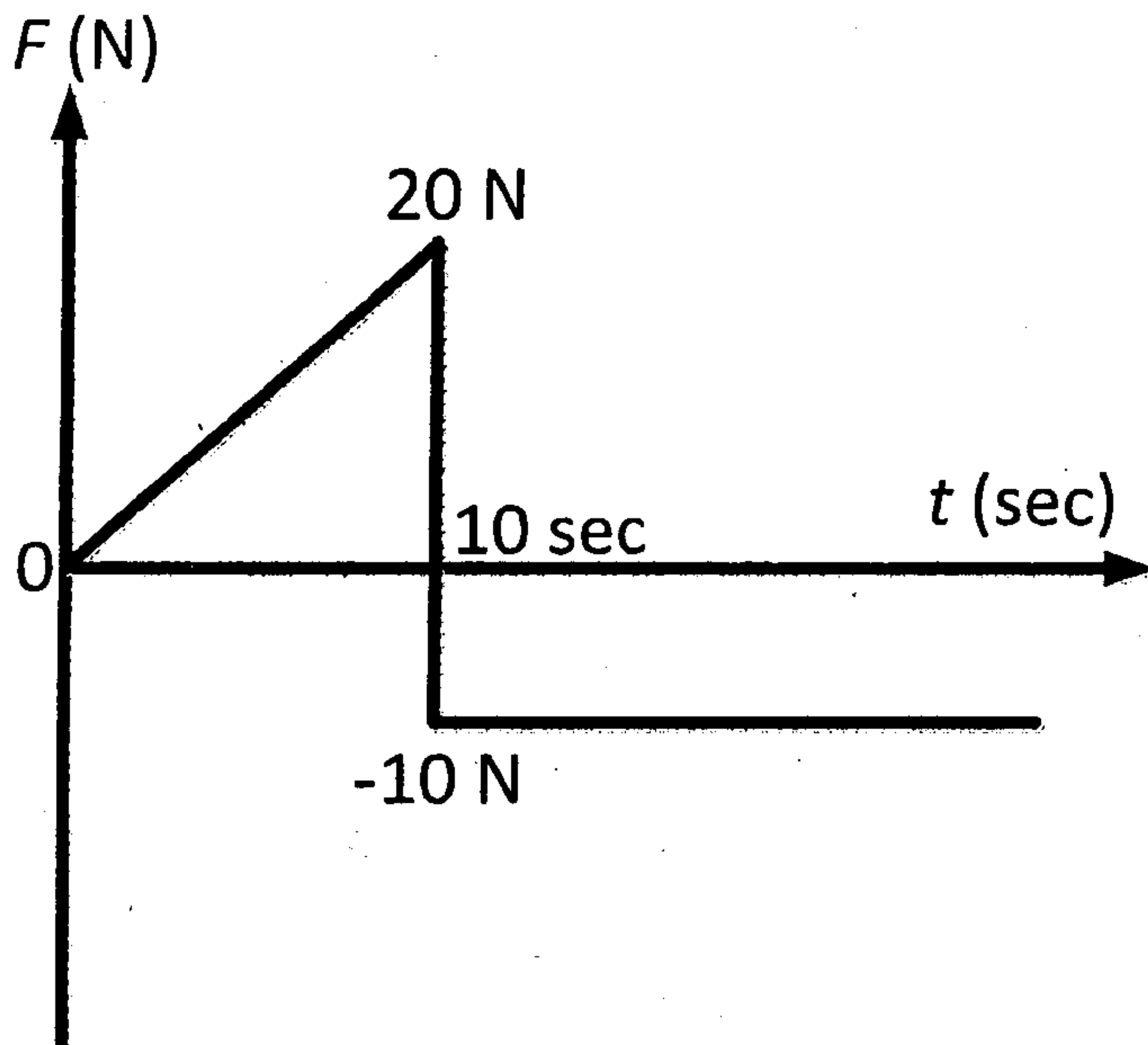
- Q.2. (a)** A member ABC is loaded by distributed load and pure moment as shown in the Figure. Find the (i) magnitude and (ii) position along AC of the resultant. [06]



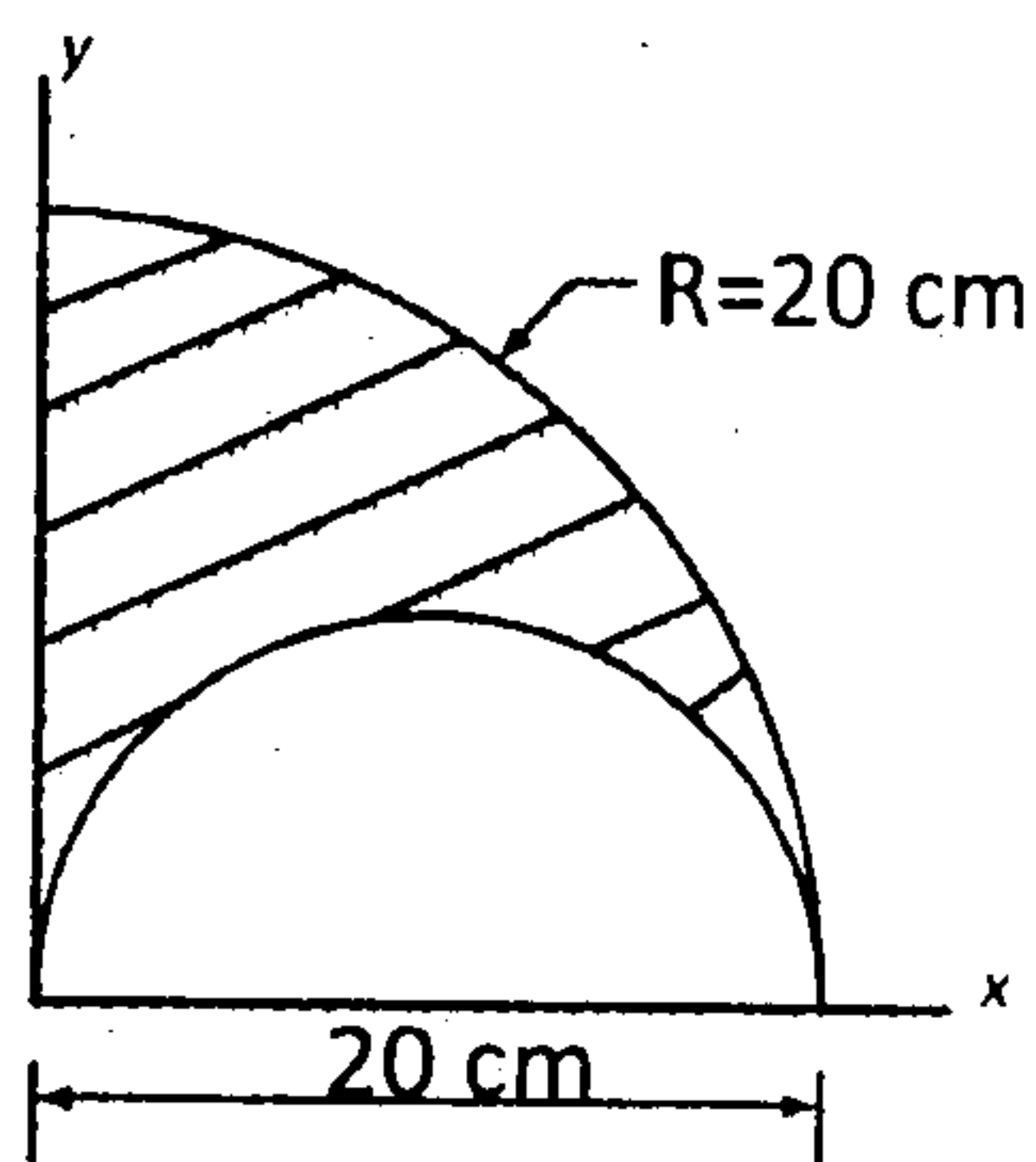
- (b) A cylinder weighing 1000 N and 1.5 m diameter is supported by a beam AB of length 6 m and weight 400 N as shown in figure. Neglecting friction at the surfaces of contacts, determine (i) Wall reaction at D. (ii) Tension in the cable BC and (iii) Hinged reaction at support A. [08]



- (c) A particle of mass 1 kg is acted upon by a force  $F$  which varies as shown in figure. If initial velocity of the particle is 10 m/s determine (i) what is the maximum velocity attained by the particle. (ii) Time when particle will be at the point of reversal. [06]

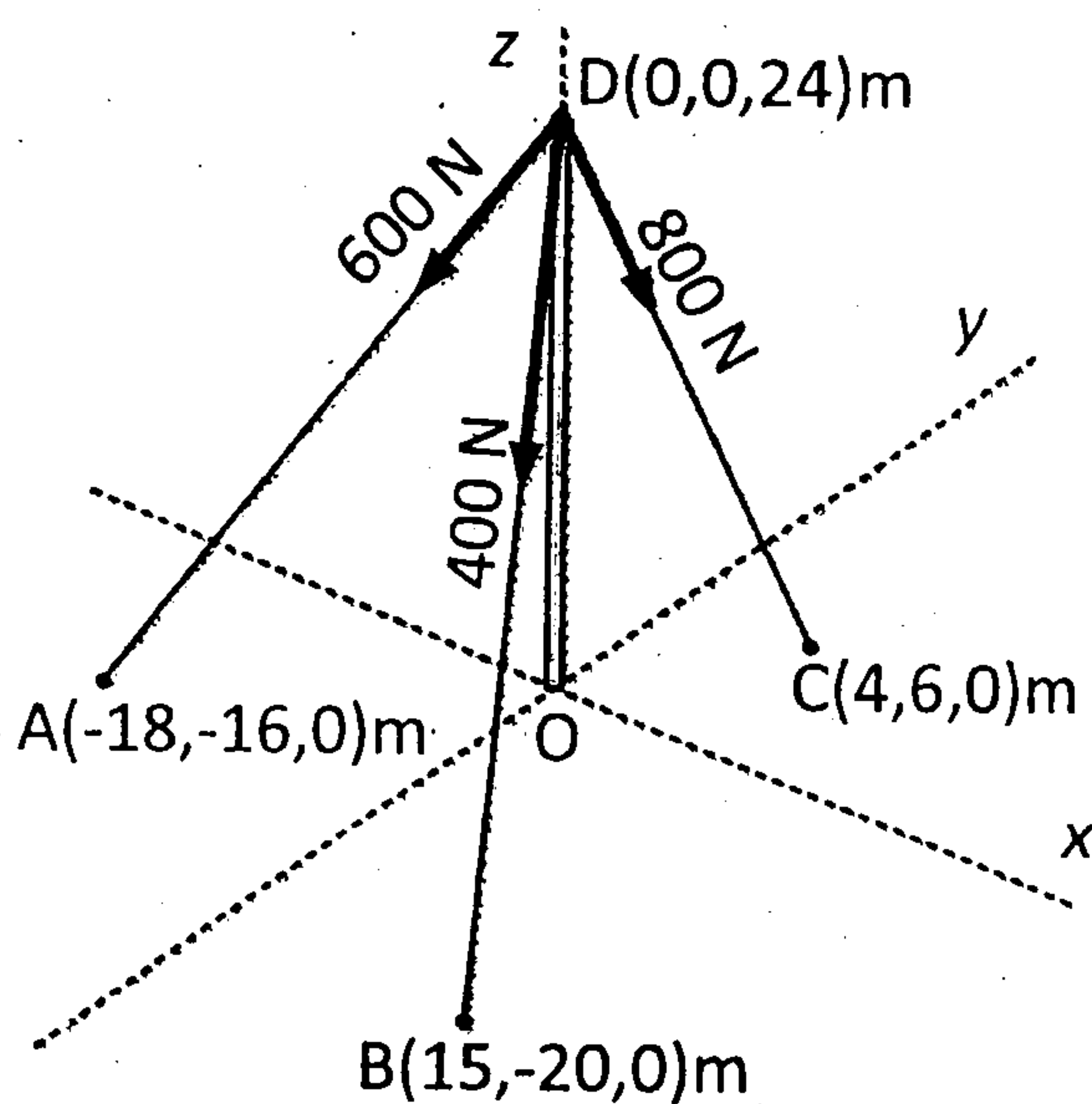


Q.3. (a) Locate the centroid of the shaded area.



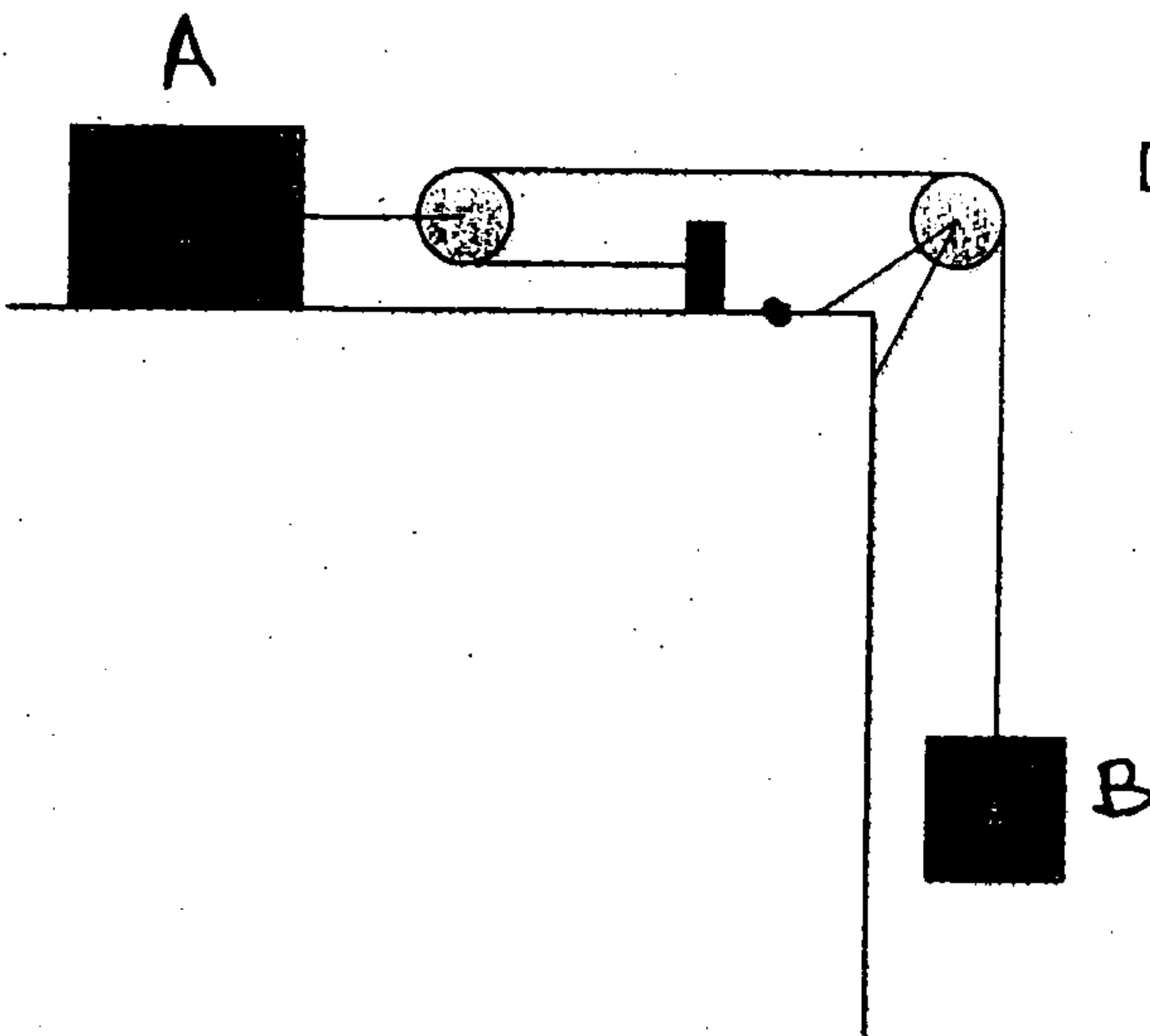
[08]

(b) A pole is held in place by three cables. If the force of each cable acting on the pole is as shown in figure determine the resultant.



[06]

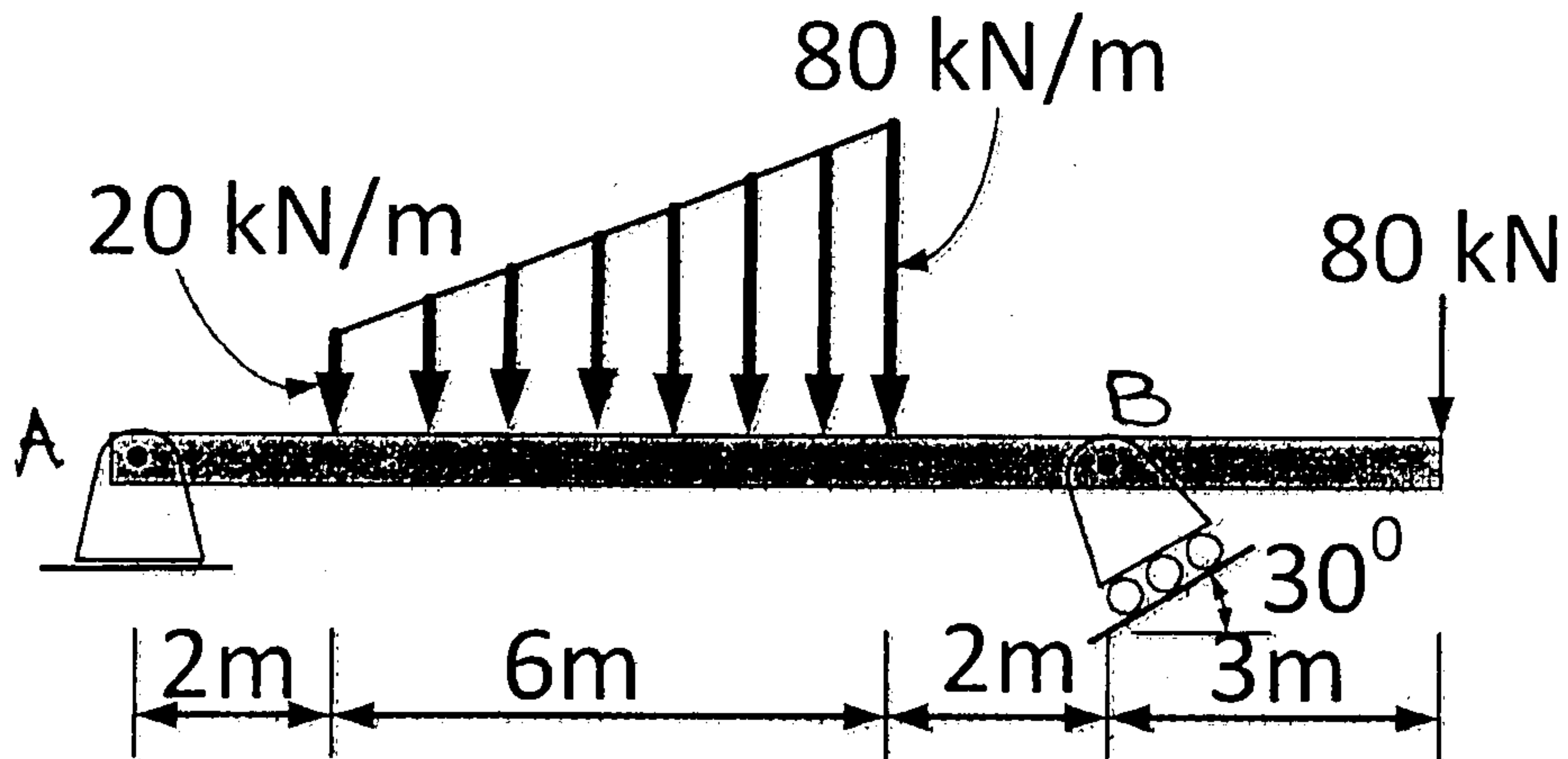
(c) Two blocks  $m_A=10$  kg and  $m_B=5$  kg are connected with cord and pulley system as shown in figure. Determine the velocity of each block when system is started from rest and block B gets displacement by 2 m. Take  $\mu_K=0.2$  between block A and Horizontal surface.



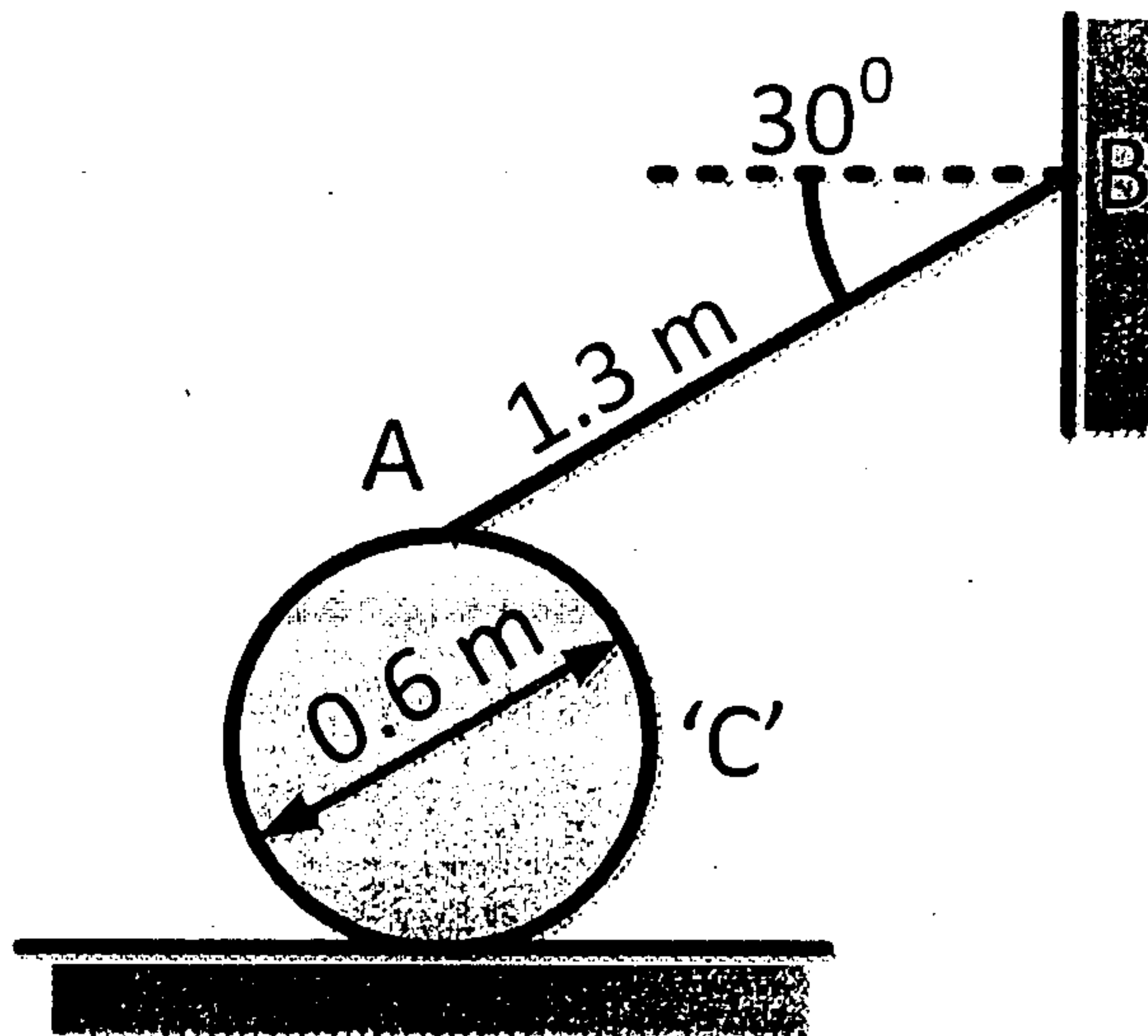
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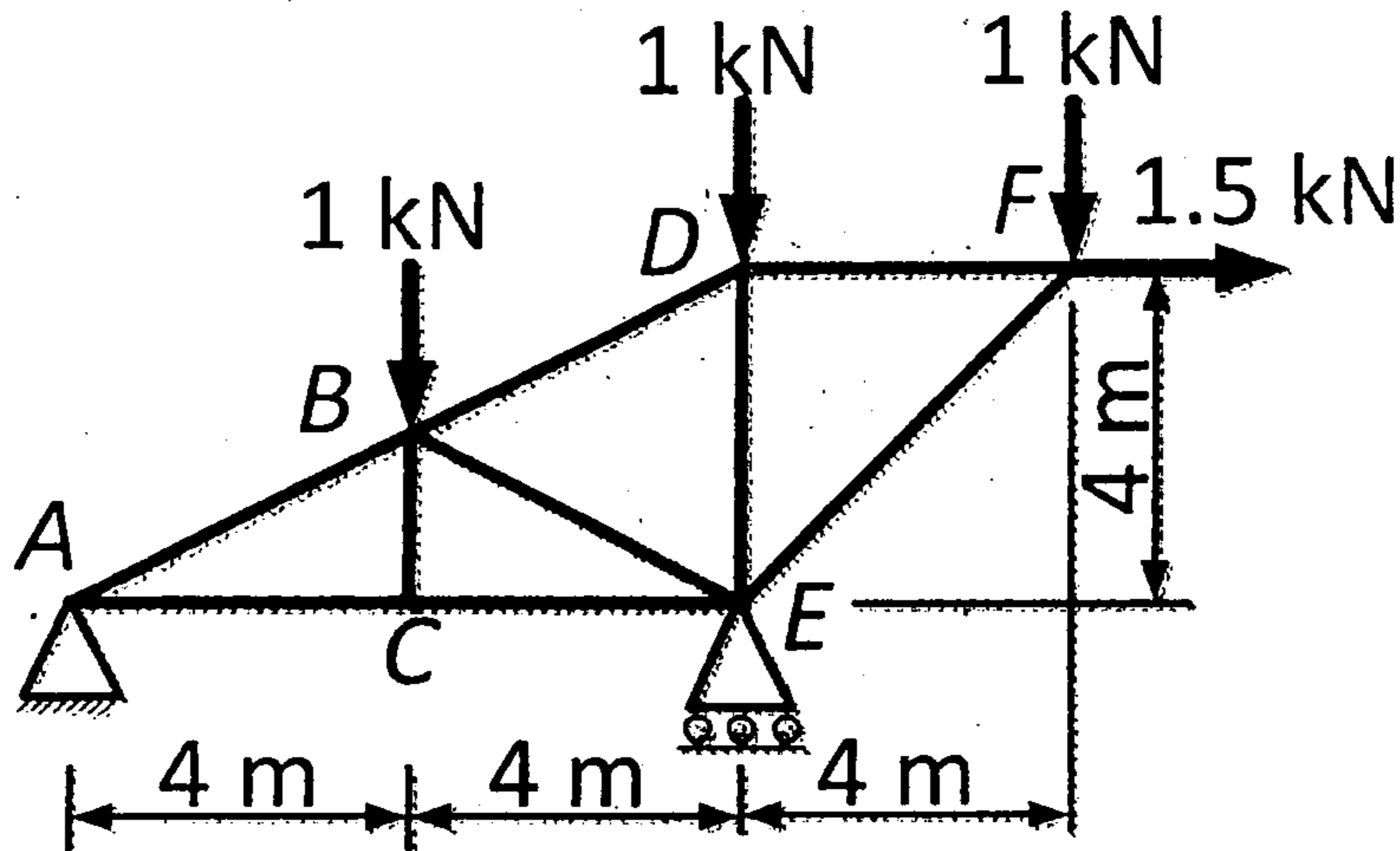
Q.4. (a) Find the support reactions at A and B for the beam shown in figure. [08]



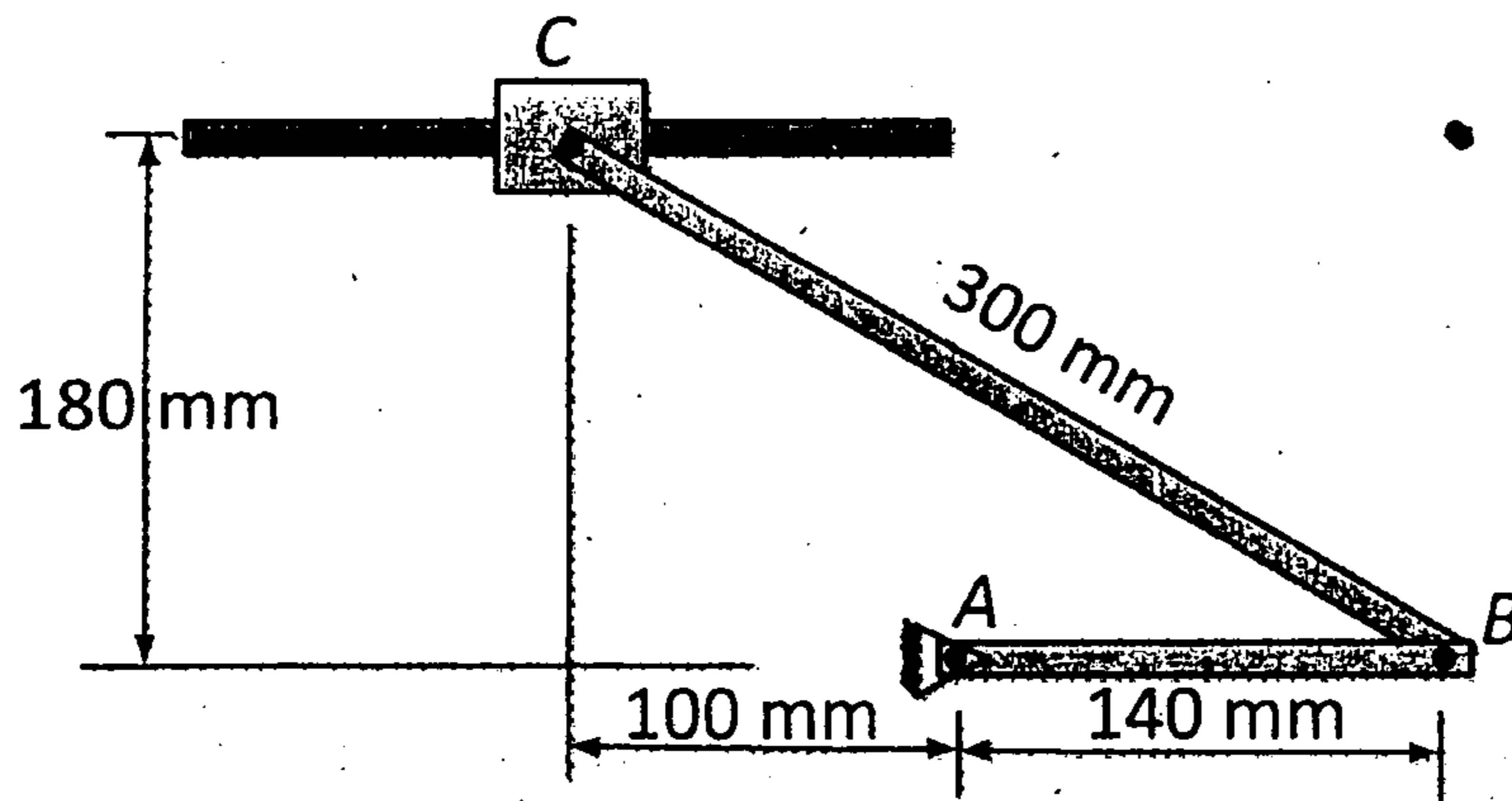
- (b) A ball is thrown from horizontal level, such that it clears a wall 6 m high, situated at a horizontal distance of 35 m. If the angle of projection is  $60^\circ$  with respect to the horizontal, what should be the minimum velocity of projection? [06]
- (c) 'C' is a uniform cylinder to which a rod 'AB' is pinned at 'A' and the other end of the rod 'B' is moving along a vertical wall as shown in figure. If the end 'B' of the rod is moving upward along the wall at a speed of 3.3 m/s find the angular velocity of the cylinder assuming that it is rolling without slipping. [06]



- Q.5. (a) Find the forces in members BD, BE and CE by method of section [08] only for the truss shown in the figure. Also find The forces in other members by method of joints.

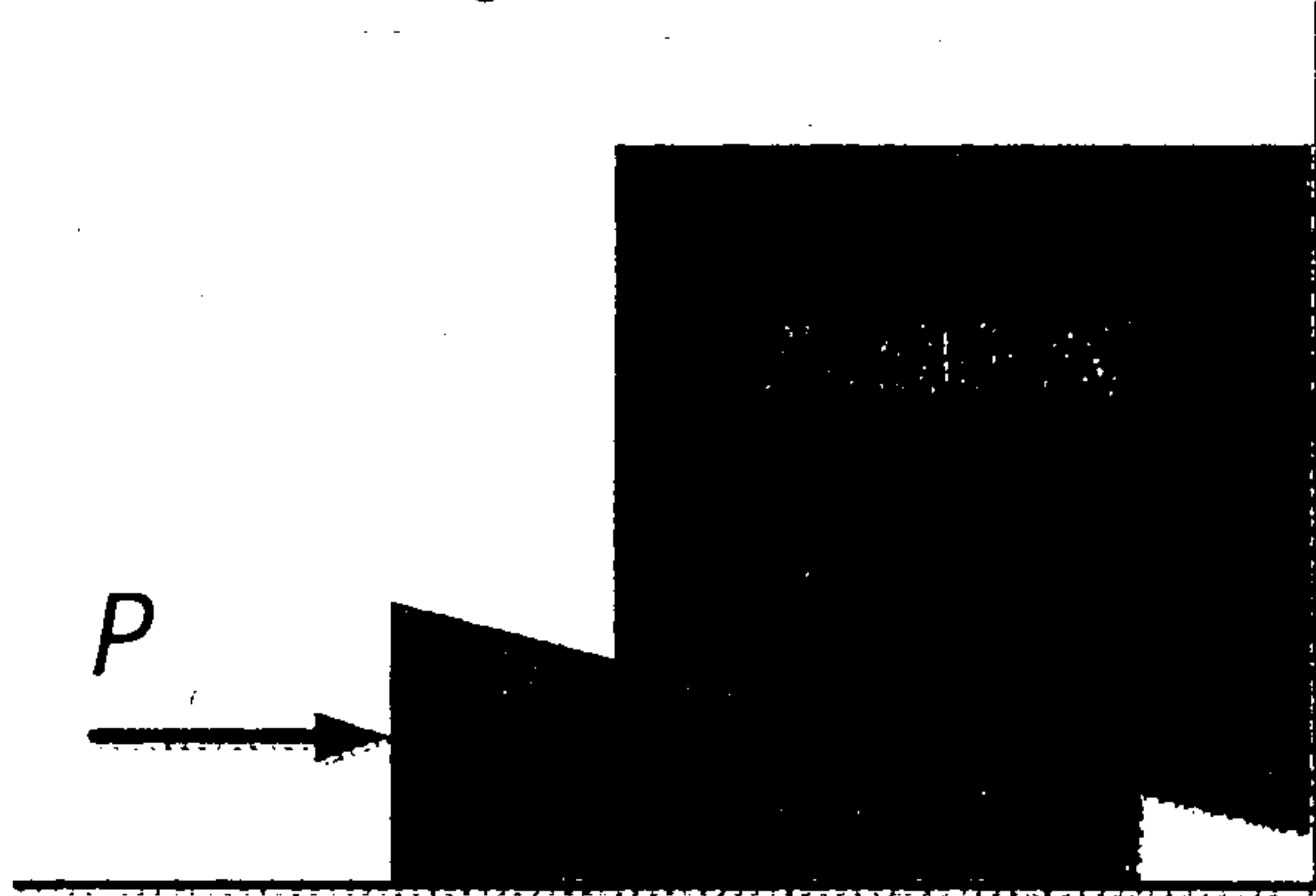


- (b) In Asian games, for 100 m event an athlete accelerates uniformly [06] from the start to his maximum velocity in a distance of 4 m and runs the remaining distance with that velocity. If the athlete finishes the race in 10.4 sec, determine (i) his initial acceleration, (ii) his maximum velocity.
- (c) In figure collar C slides on a horizontal rod. In the position shown rod [06] AB is horizontal and has angular velocity of 0.6 rad/sec clockwise. Determine angular velocity of BC and velocity of collar C.

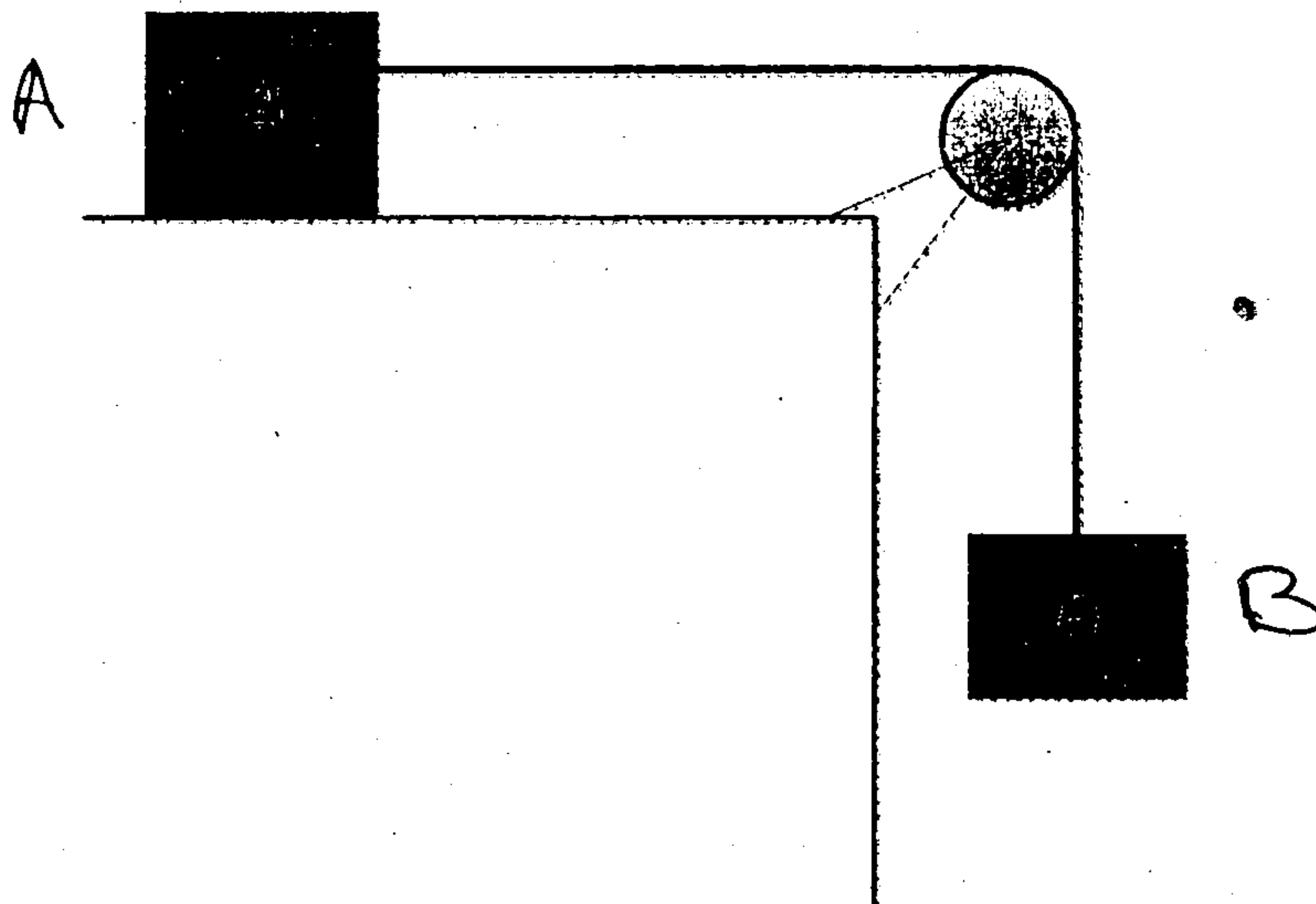


- Q.6. (a) A force of 10 kN acts at a point P(2,3,5) m and has its line of action [04] passing through Q(10,-3,4) m. Calculate moment of this force about a point S(1,-10,3) m.

- (b) Find the necessary force to raise a heavy stone block of 2000 N. Take [08]  
coefficient of friction as 0.25 for all surfaces. Neglect the weight of  
wedge. Take angle of wedge as  $15^\circ$ .



- (c) A ship A travels in the north making an angle of  $45^\circ$  to the West with [04]  
a velocity of 18 km/hr and ship B travels in the East with a velocity of  
9 km/hr. Find the relative velocity of B w.r.t. ship A.
- (d) A body of mass 25 kg resting on a horizontal table is connected by [04]  
string passing over a smooth pulley at the edge of the table to another  
body of mass 3.75 kg and hanging vertically as shown. Initially, the  
friction between the mass A and the table is just sufficient to prevent  
the motion. If an additional 1.25 kg is added to the 3.75 kg mass, find  
the acceleration of the masses.





**(Revised Course)**

(2 Hours)

**[ Total Marks : 60**

- N.B. :** (1) Question No.1 is **compulsary**.  
 (2) **Attempt** any **three** questions from Question No. 2 to 6.  
 (2) Use **suited** data wherever **required**.  
 (3) **Figures** to the right indicate **full** marks.

1. Solve any **five** from the following :- **15**
- (a) Define the term space lattice, unit cell and lattice parameter.
  - (b) Find the interplaner spacing between the family of planes (111) in a crystal of lattice constant  $3A^\circ$ .
  - (c) Represent the following in the cubic unit cell :-  
 $(1\bar{1}2)$ ,  $(002)$ ,  $[121]$
  - (d) Define drift current, diffusion current and mobility of charge carriers.
  - (e) Explain the use of P-N junction as a solar cell.
  - (f) State with neat diagram direct and inverse Piezoelectric effect.
  - (g) What is magnetic circuit ? Explain Ohm's Law in case of magnetic circuit.
2. (a) Explain the Hall effect in metal ? Derive the formulae to determine the density and mobility of the electrons. **8**
- (b) Define ligancy and critical radius ratio in case of ionic solid. Write the conditions for stability of ionic crystal in 3-D ? Determine critical radius ratio for ligancy 6. **7**
3. (a) Explain with neat diagram construction of Bragg's X-ray spectrometer ? Write the procedure to determine crystal structure. Calculate the maximum order of diffraction if X-rays of wavelength  $0.819 A^\circ$  is incident on a crystal of lattice spacing  $0.282 \text{ nm}$ . **8**
- (b) Calculate the number of turns required to produce a magnetic flux of  $4 \times 10^5 \text{ wb}$ , if an iron rod of length  $50 \text{ cm}$  and cross sectional area  $4 \text{ cm}^2$  carrying an electric current  $1 \text{ A}$  is in the form of ring. (*Permeability of iron is  $65 \times 10^{-4} \text{ H/m}$* ). **7**
4. (a) What is mesomorphic state of matter ? Explain with neat diagram cholesteric phase. **5**
- (b) What is dielectric polarization and dielectric susceptibility ? Find the relation between them ? **5**

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- (c) The resistivity of intrinsic InSb at room temperature is  $2 \times 10^{-4} \Omega \text{ cm}$ . If the mobility of electron is  $6 \text{ m}^2/\text{V-sec}$  and mobility of hole is  $0.2 \text{ m}^2/\text{V-sec}$ . Calculate its intrinsic carrier density. **5**
5. (a) Identify the crystal structure if its density is  $9.6 \times 10^2 \text{ kg/m}^3$ , lattice constant is  $4.3 \text{ \AA}$  and atomic weight is 23. **5**
- (b) Explain the formation of depletion region in P-N junction. **5**
- (c) Define reverberation time ? State Sabine's formula and explain the terms involved in it ? **5**
6. (a) What are soft and Hard magnetic material ? State their properties and applications. **5**
- (b) What is Fermi level in semiconductor ? Show that in intrinsic semiconductor Fermi level always at the middle between the forbidden energy gap ? **5**
- (c) An Ultrasonic sound wave is used to detect the position of defect in a steel bar of thickness 50 cm. If the echo times are 40 and 90  $\mu\text{-sec}$ . Locate the position of defect. **5**
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28-10-2013-DTP-P-7-MU-16

Con. 5769-13.

GX - 10040

(2 Hours)

[ Total Marks : 60

- N. B. :**
- (1) Question No. 1 is **compulsory**.
  - (2) Answer any **three** questions from the remaining **five**.
  - (3) **All** questions carry **equal** marks.
  - (4) **Atomic weight** :- Mg = 24, Ca = 40, Si = 28, N = 14, O = 16, C = 12

1. Solve any **five**:-

15

- (a) What happens when temporary hard water is boiled? Give equations to explain.
- (b) Give the preparation and uses of Silica refractory.
- (c) Define Gibbs Phase Rule. State the number of Phases, Components and Degrees of freedom for the following equation-  
$$\text{CaCO}_{3(s)} \rightleftharpoons \text{CaO}_{(s)} + \text{CO}_{2(g)}$$
- (d) What is the function of plasticiser in the compounding of plastic? Give two examples.
- (e) Two samples of water A and B were analysed for their salt content:
  - (i) Sample A was found to contain 168 mg  $\text{MgCO}_3$  per litre.
  - (ii) Sample B was found to contain 820 mg  $\text{Ca}(\text{NO}_3)_2$  per litre and 2 mg  $\text{SiO}_2$  per litre. Calculate the total hardness of each sample and state which sample is more hard.
- (f) Discuss the conditions under which semisolid lubricants are used.
- (g) Distinguish between thermoplastic and thermosetting resins.

2. (a) 50 ml of standard hard water containing 1 mg of pure  $\text{CaCO}_3$  per ml consumed 20 ml of EDTA. 50 ml of the water sample consumed 30 ml of same EDTA solution using Erichrome Black T indicator. After boiling and filtering, 50 ml of the water sample required 10 ml of the same EDTA for titration. Calculate the total and permanent hardness of water sample. 6
- (b) Draw a neat phase diagram of the one component water system and explain with reference to (i) curves (ii) Triple point. 5
- (c) What are carbon nano tubes? What are their types? Discuss their Electrical and Mechanical properties. 4

3. (a) Discuss the mechanism of thick-film lubrication.

6

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**Con. 5769-GX - 10040-13.**

- (b) Define moulding and discuss the Injection moulding method of fabrication of plastic. 5
- (c) Discuss the limitations of phase rule. 4
4. (a) Give the preparation, properties and uses of: (i) PMMA (ii) Buna-S. 6
- (b) Give well balanced equations of the reactions that take place in the Lime soda process. 5
- (c) Find the saponification value of an oil sample weighing 1.5 g, refluxed with 25 ml of 0.5 N KOH, required 15 ml of 0.5 N HCl for the residual titration. The blank titration reading was 25 ml of 0.5 N HCl. 4
5. (a) Discuss the setting and hardening of portland cement as well as the function of gypsum with balanced equations. 6
- (b) What is glass transition temperature? What are the factors that affect it and what is the significance of it. 5
- (c) An exhausted zeolite softener was regenerated by passing 150 litres of NaCl solution having a strength of 150 g/L of NaCl. If the hardness of the water is 600 ppm. Calculate the total volume of water that is softened by the softener. 4
6. (a) Write short notes on any two:- 6
- (i) Reverse osmosis
- (ii) Electrodialysis
- (iii) Ultrafiltration
- (b) Define conducting polymers. Explain Intrinsic and Doped conducting polymer with appropriate examples. 5
- (c) Define and discuss the significance of the following properties of lubricant (any two):- 4
- (i) Acid value of oil
- (ii) Cloud and Pour point
- (i) Flash and Fire point
-

Con. 9026-13.

(REVISED COURSE)

GX-10053

(2 Hours)

[ Total Marks : 60

- N.B. :** (1) Questions No. 1 is **compulsory**.  
 (2) Answer any **three** from Question Nos. 2 to 6.  
 (3) **Figures to right** indicate **full** marks.  
 (4) Draw neat diagrams wherever **necessary**.

1. Attempt any **five** from the following :- 15
- (a) With the help of suitable example explain the concept of food-web.
- (b) Why there is need for sustainable development ?
- (c) Explain briefly causes and effects of Ozone layer depletion.
- (d) Explain briefly the role played by Ministry of Environment and Forest in the conservation of environment.
- (e) Why more emphasis is given on the development of renewable energy resources ?
- (f) Explain the concept of 'Carbon Credit'.
- (g) What are the sources and effects of noise pollution?
2. (a) In what way appropriate technology can lead to better sustainable development. 5
- (b) Draw suitable diagram and explain working of Bag House Filter. 5
- (c) What is hydel energy? Explain briefly the process of hydropower generation. 5
3. (a) How Solid waste management can be carried out by landfilling ? 5
- (b) Explain briefly the important features of environmental clearance and authorization mechanism. 5
- (c) What role is played by the technology for better human health and environment ? 5
4. (a) Explain what are the reasons and impact of depleting nature of natural forest resources. 5
- (b) What are the important functions and powers of Central Pollution Control Board ? 5
- (c) Draw rough sketch and explain how electricity can be generated from wind energy. 5

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**Con. 9026-GX-10053-13.**

**2**

5. (a) In what way environmental education and awareness can help in sustainable development ? **5**
- (b) Draw rough sketch and explain how flat-plate collector can be useful in tapping solar energy. **5**
- (c) How E- pollution is caused? What are its adverse effects ? **5**
6. (a) How disaster management techniques can be implemented in the event of Tsunami ? **5**
- (b) Explain the global environmental crisis caused on account of growing population. **5**
- (c) What are the reasons and effects of global Warming ? **5**

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Con. 5918-13

GX-10011

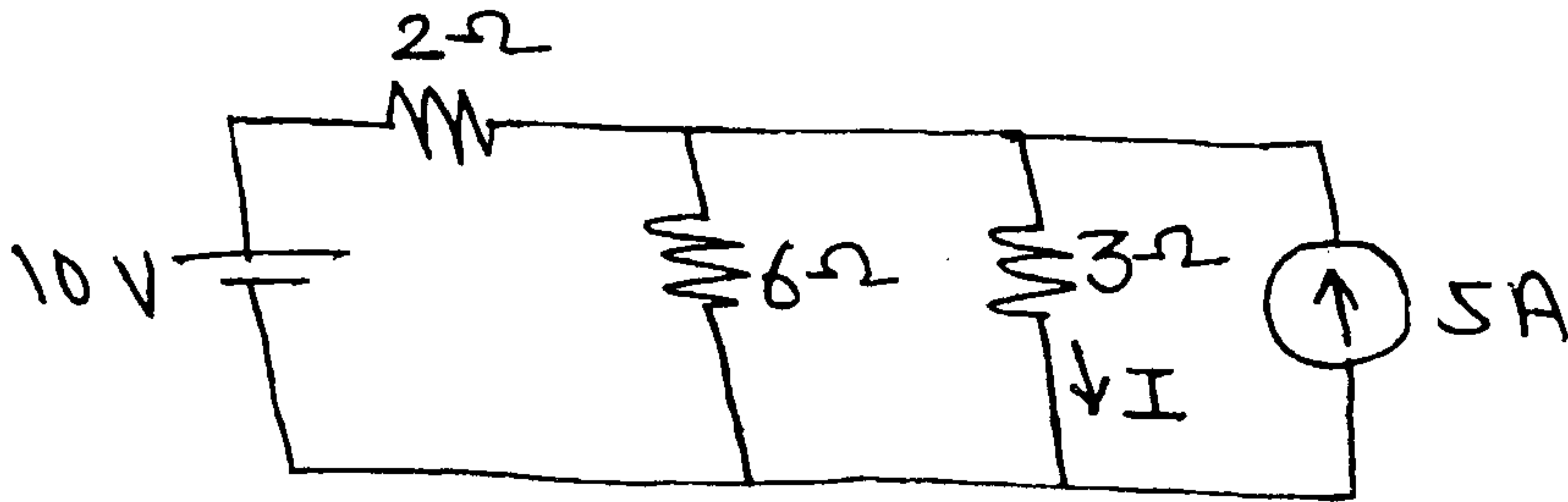
(Revised Course)

( 3 Hours )

[Total Marks : 80

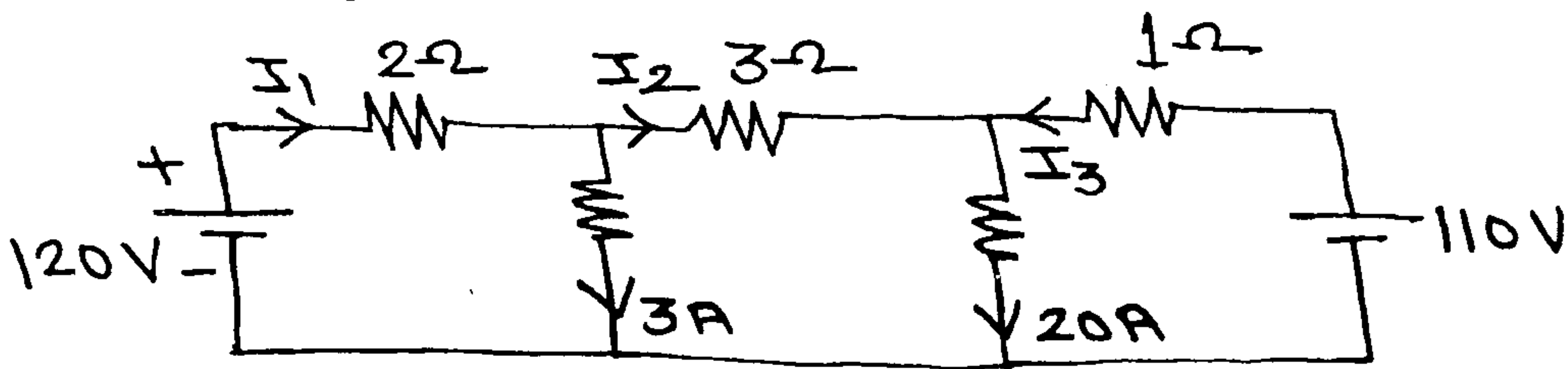
- N.B. :** (1) Question No. 1 are compulsory.  
 (2) Solve any **three** questions out of the remaining **five** questions.  
 (3) Assume data if required , clearly stating the assumptions.

1. (a) Using source transformation find I. 3

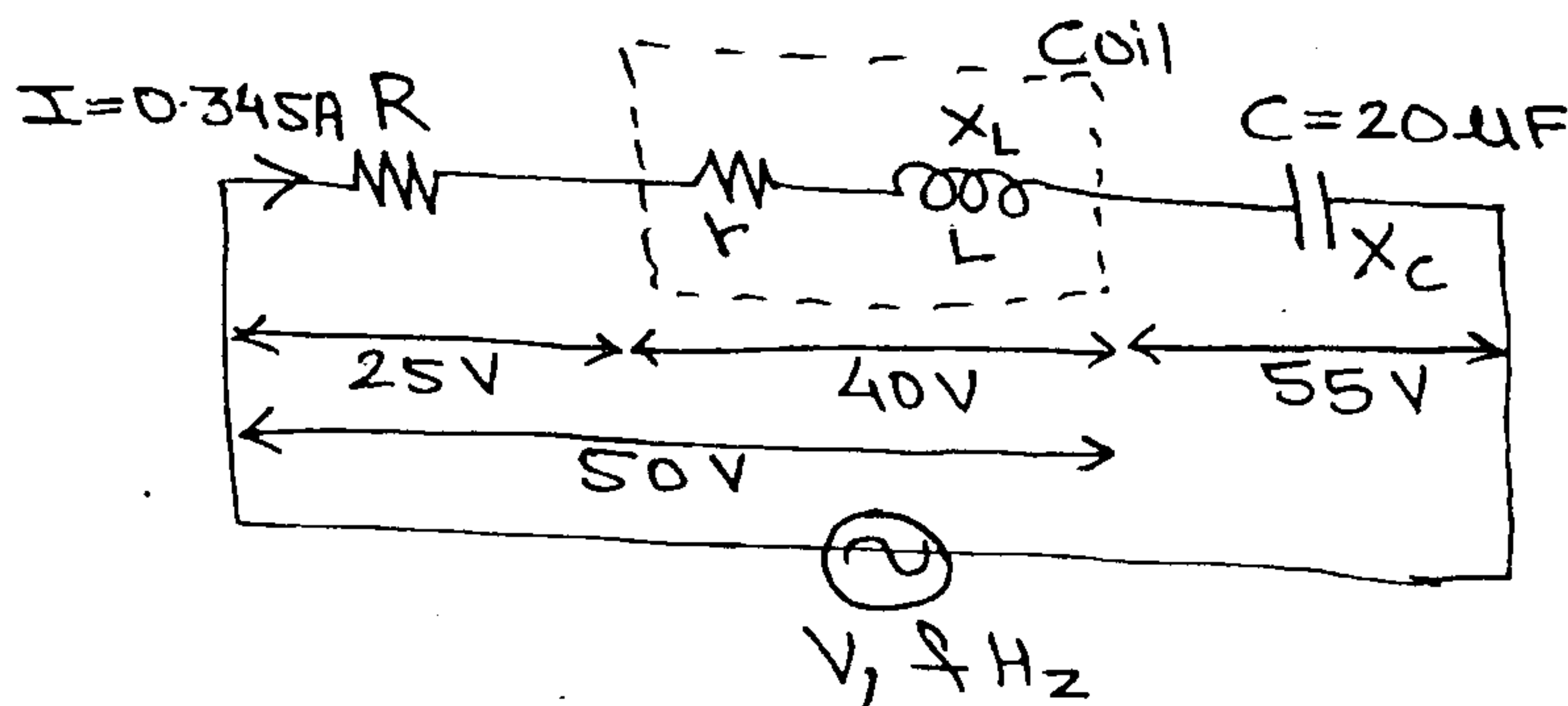


- (b) State and Explain Norton's theorem. 3  
 (c) Derive an expression for the average value of a sinusoidally varying current in terms of Peak Value. 3  
 (d) Derive the condition for resonance in a series circuit. 3  
 (e) Give relation between line current and phase current, line voltage and phase voltage in balanced star and delta connected load. 2  
 (f) What are assumptions for an ideal transformer ? 4  
 (g) Draw and explain circuit diagram for half wave rectifier. 2

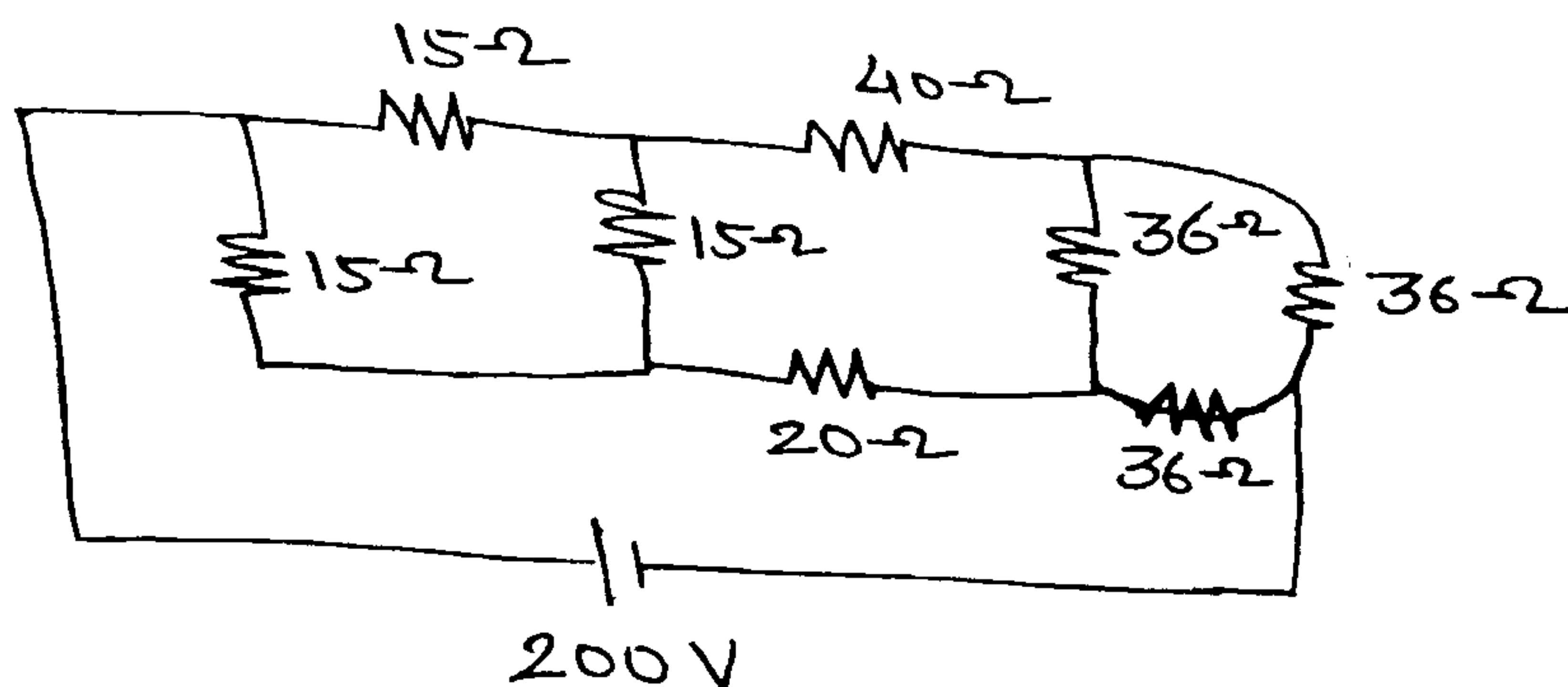
2. (a) Find the currents  $I_1, I_2, I_3$  in the given circuit by node voltage method. 6



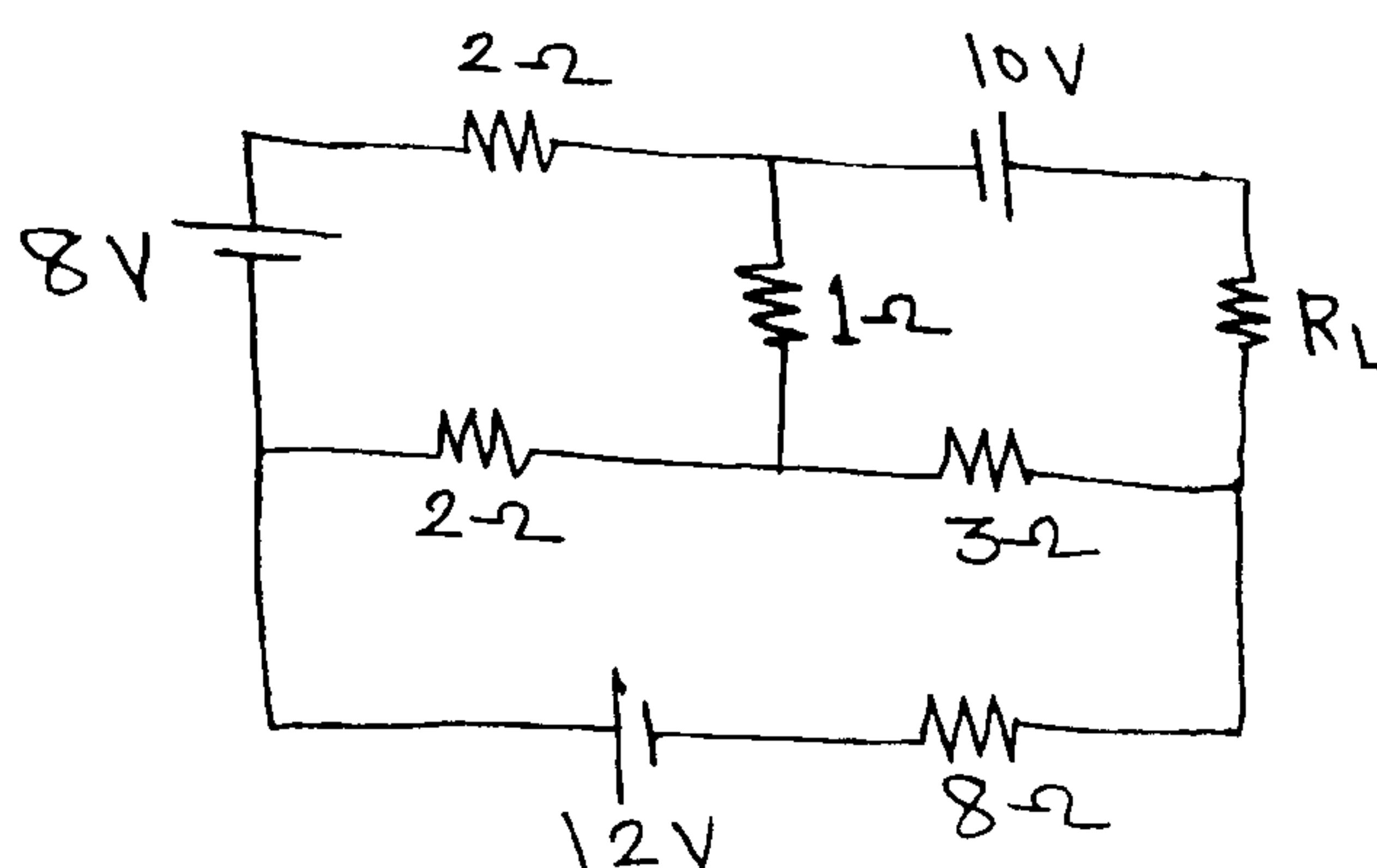
- (b) For the circuit shown determine the 8  
 (i) Supply frequency (f).  
 (ii) Coil resistance (r)  
 (iii) Supply voltage (v)



- (c) Draw and explain Phasor diagram of 1-Phase practical transformer when  
 (i) on no load  
 (ii) Leading power factor load. 6
3. (a) Find the values of circuit elements and reactive voltampere drawn for a balanced 3 phase load connected in delta and draws a power of 12kW at 440V. The power factor is 0.7 leading. 8
- (b) The following results were obtained on a 40 KVA, 2400/120 V transformer.  
 O. C. test : 120V, 9.65A and 396 W (on L.V. side)  
 S. C. test : 92V, 20.8A and 810 W (on H.V. side)  
 Calculate the parameters of approximate equivalent circuit referred to H. V. side. 6
- (c) Explain series inductor filter. 2
- (d) Explain circuit diagram and working of CE configuration of BJT. 4
4. (a) Determine current through  $20\Omega$  resistor in the following circuit. 7



- (b) Two currents are represented by  $I_1 = 15\sin\left(\omega t + \frac{\pi}{3}\right)$  and  $I_2 = 25\sin\left(\omega t + \frac{\pi}{4}\right)$ . These currents are fed into common conductor. Find the total current. If the conductor has resistance  $50\Omega$ , what will be energy loss in 10 hours. 5
- (c) In a three phase power measurement by two wattmeter method, both the wattmeters read the same value. What is the power factor of the load? Justify your answer. 4
- (d) Explain the circuit diagram and waveforms of Bridge rectifier. 4
5. (a) For the given circuit find the value of ' $R_L$ ' so the maximum power dissipated in it. Also find  $P_{max}$ . 8

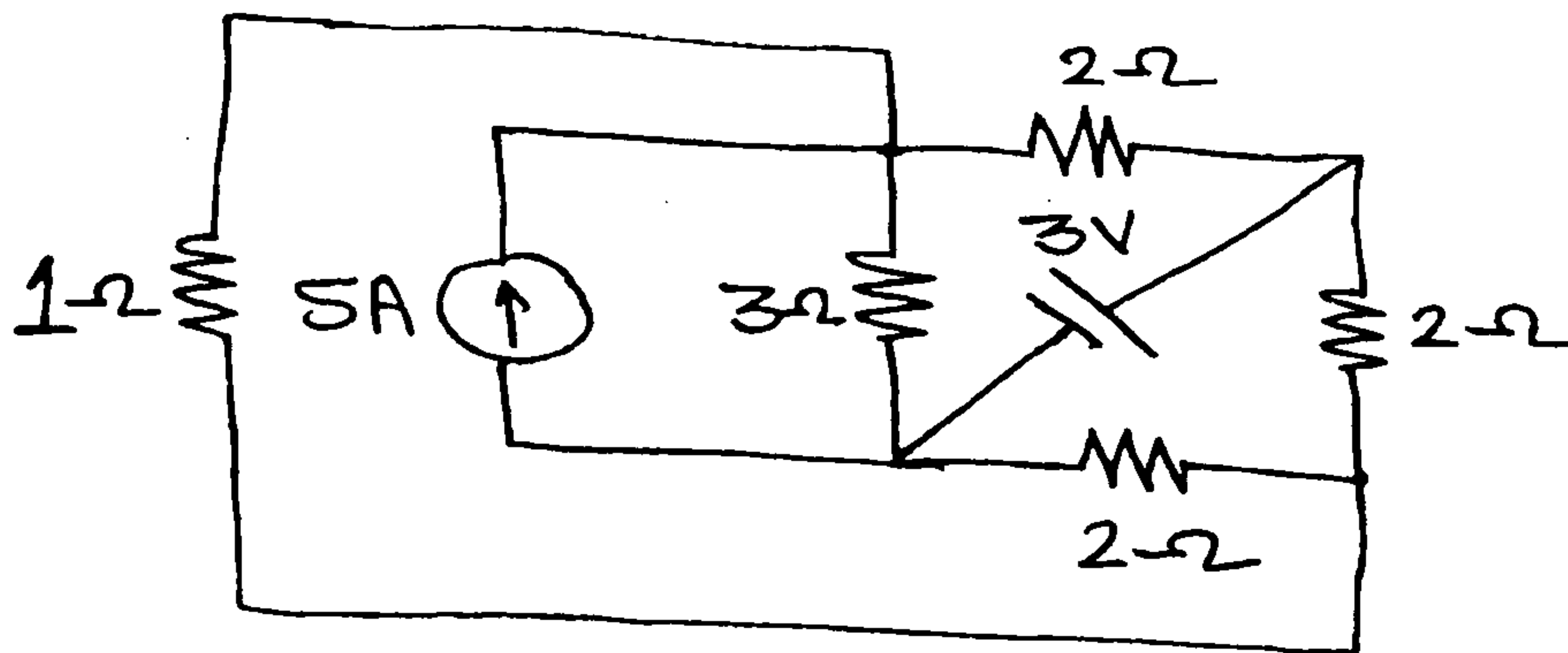




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- (b) With proper phase diagrams, explain behaviour of a pure capacitor in an AC circuit. 4
- (c) Derive condition for maximum efficiency of a transformer. Also derive equation for load at maximum efficiency. 8
6. (a) Determine current in  $1\Omega$  resistor using superposition theorem. 7



- (b) An inductive coil of resistance  $10\Omega$  and inductance  $0.1\text{H}$  is connected in parallel with  $150\ \mu\text{F}$  capacitor to a variable frequency,  $200\text{V}$  supply. Find the resonance frequency at which the total current taken from supply is in Phase with supply voltage. Also find value of this current. Draw the phasor diagram. 7
- (c) Two wattmeters are connected to measure power in a three phase circuit. The reading of one of the wattmeter is  $7\ \text{kW}$  when load power factor is unity. If the power factor of the load is changed to  $0.707$  lagging without changing the total input power, calculate the readings of the two wattmeters. 6