

FE (Sem I) (2014-15) All India  
Dec 2014

**(REVISED COURSE)**

QP Code: 11950

(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:— C=12, O=16, N=14, S=32, Cl=35.5 H=1, Ca=40, Mg=24, Na=23, Al=27, K=39.

1. Solve any **five** :—

15

- Define cloud point and pour point. Discuss its significance.
- Explain the principle of EDTA method.
- Distinguish between thermoplastic and thermosetting resins.
- Write a brief note on CNT's.
- Explain the reduced Phase rule.
- Explain the role of plasticizers and lubricants in the compounding of plastics.
- 25 ml of sewage water is refluxed with 0.1 N  $K_2Cr_2O_7$  solution in presence of  $H_2SO_4$  and  $Ag_2SO_4$ . The unreacted dichromate required 5.5 ml of 0.1N FAS solution. Back titration consumed 15ml of 0.1N FAS solution. Calculate COD of the effluent in mg/l.

6

- (a) Calculate the amount of lime (85% pure) and soda (95% pure) required to soften one million liters of water which contains:  
 $MgCO_3=8.4$  ppm,  $CaCl_2=22.2$  ppm,  $MgCl_2=9.5$  ppm,  $CO_2=33$  ppm,  $HCl=7.3$  ppm,  $KCl=16.8$  ppm.  
(b) Explain the two-component, Pb-Ag system with an appropriate phase diagram.  
(c) Write the preparation and uses of (any **one**)  
(i) Dolomite Bricks (ii) Silicon Carbide bricks

5

4

6

- (a) What are the conditions for the use of solid lubricants? Explain the structure and uses of graphite.  
(b) What is vulcanization? Explain with proper reaction. Mention the advantages of vulcanized rubber.  
(c) Explain the following terms giving **two** suitable examples.  
(i) Phase (ii) Component

5

4

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- (a) Give the preparation, properties and uses of (any **two**)  
(i) PMMA  
(ii) Kevlar  
(iii) Buna-S rubber  
(b) Explain the zeolite method for softening of water including the following points:  
: Diagram, process with reaction, regeneration with reactions.

5

- (c) 2.5g of vegetable oil was mixed with excess of KOH solution and heated with reflux condenser. The mixture required 16.5ml of 0.5N HCl. The blank titration reading was 40.1 ml of same HCl. Find saponification value of oil. 4
5. (a) Write short notes on (any **one**) 6
- (i) Decay of concrete and its prevention.
  - (ii) Setting and hardening of cement.
- (b) What is fabrication of plastics? Explain the injection moulding method with the help of neat diagram. 5
- (c) The hardness of 10,000 Litres of hard water sample was completely removed by passing it through a zeolite softener. The zeolite softener required 5000 litres of NaCl solution containing 1170 mg of NaCl/litre. Determine the hardness of water sample. 4
6. (a) Discuss the following treatment methods for municipal water (any **two**) 6
- (i) Bleaching powder
  - (ii) Ozone
  - (iii) Chlorine.
- (b) Discuss any **two** the following :— 5
- (i) Glass transition temperature
  - (ii) Polymers in medicine and surgery
  - (iii) Conducting polymers
- (c) Write a note on blended oils. (any **four** additives) 4
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*f-e (over)*  
 NOV-DEC-2014      P.E.E      (C.B.S.)

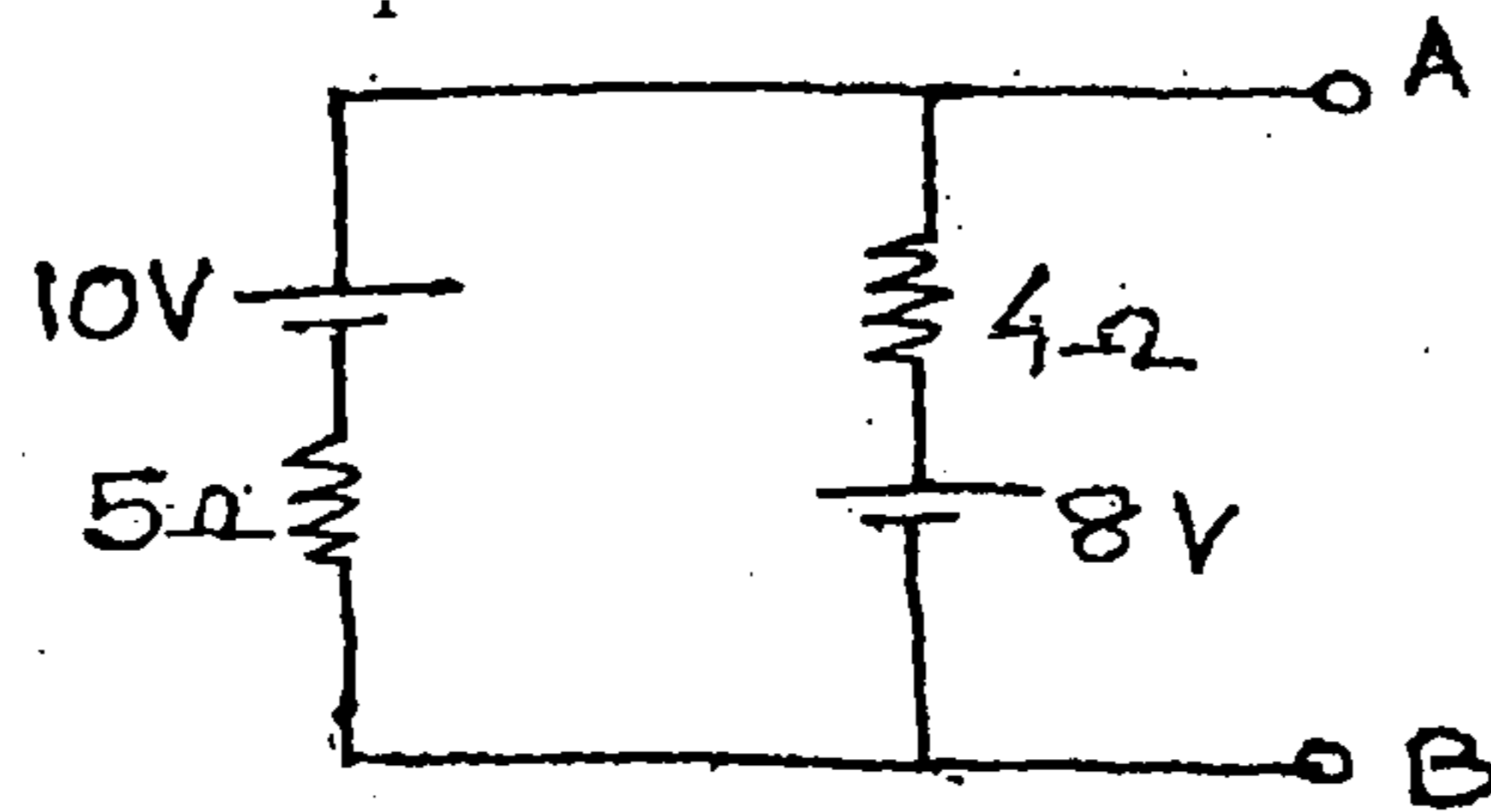
**(REVISED COURSE) QP Code : 11943**

(3 Hours)

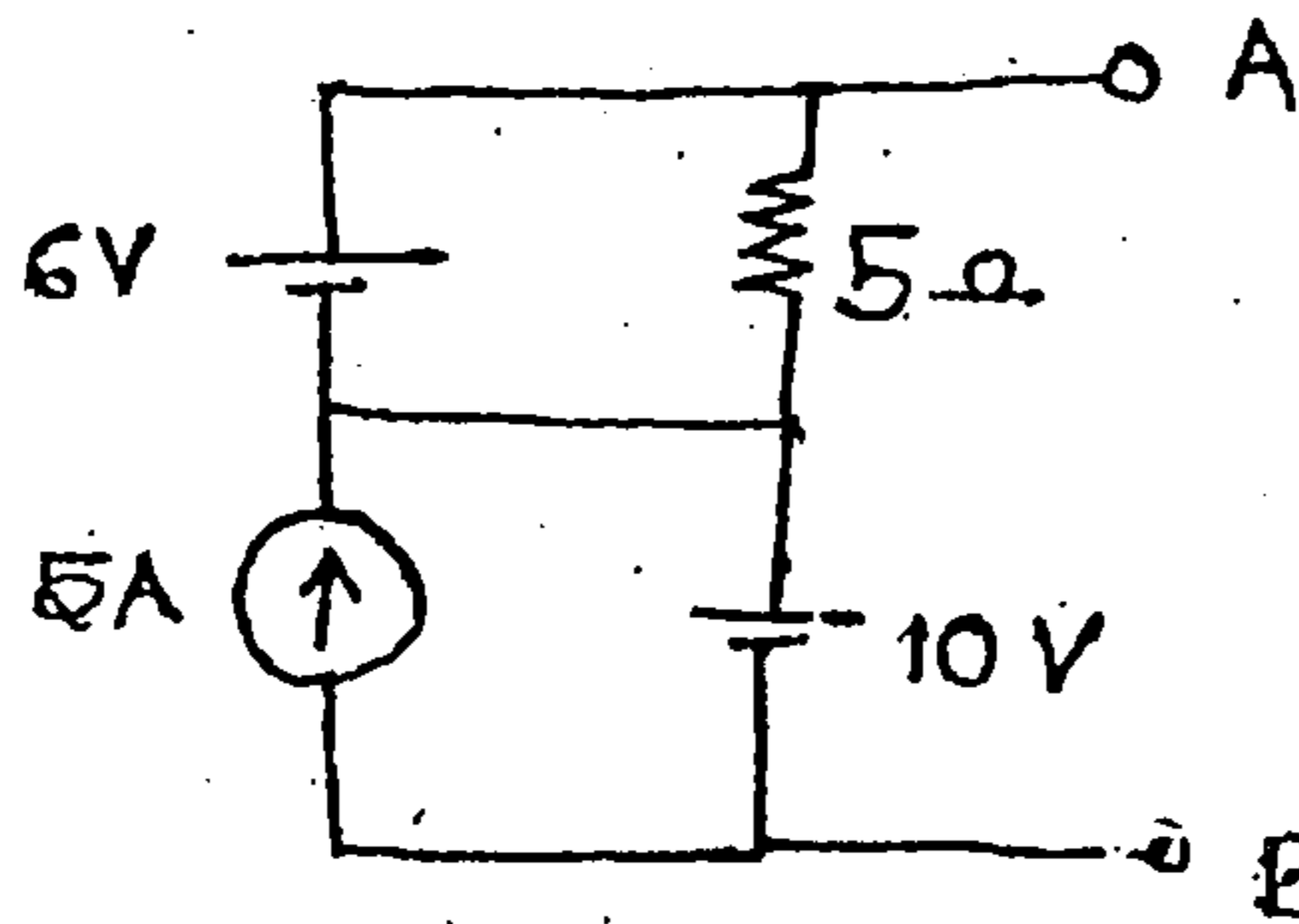
[ Total Marks : 80

- N.B.** (1) Question No. 1 is compulsory.  
 (2) Solve any **three** questions from remaining questions.  
 (3) **Figures** to the right indicate full marks.  
 (4) Assume suitable **data** if necessary.

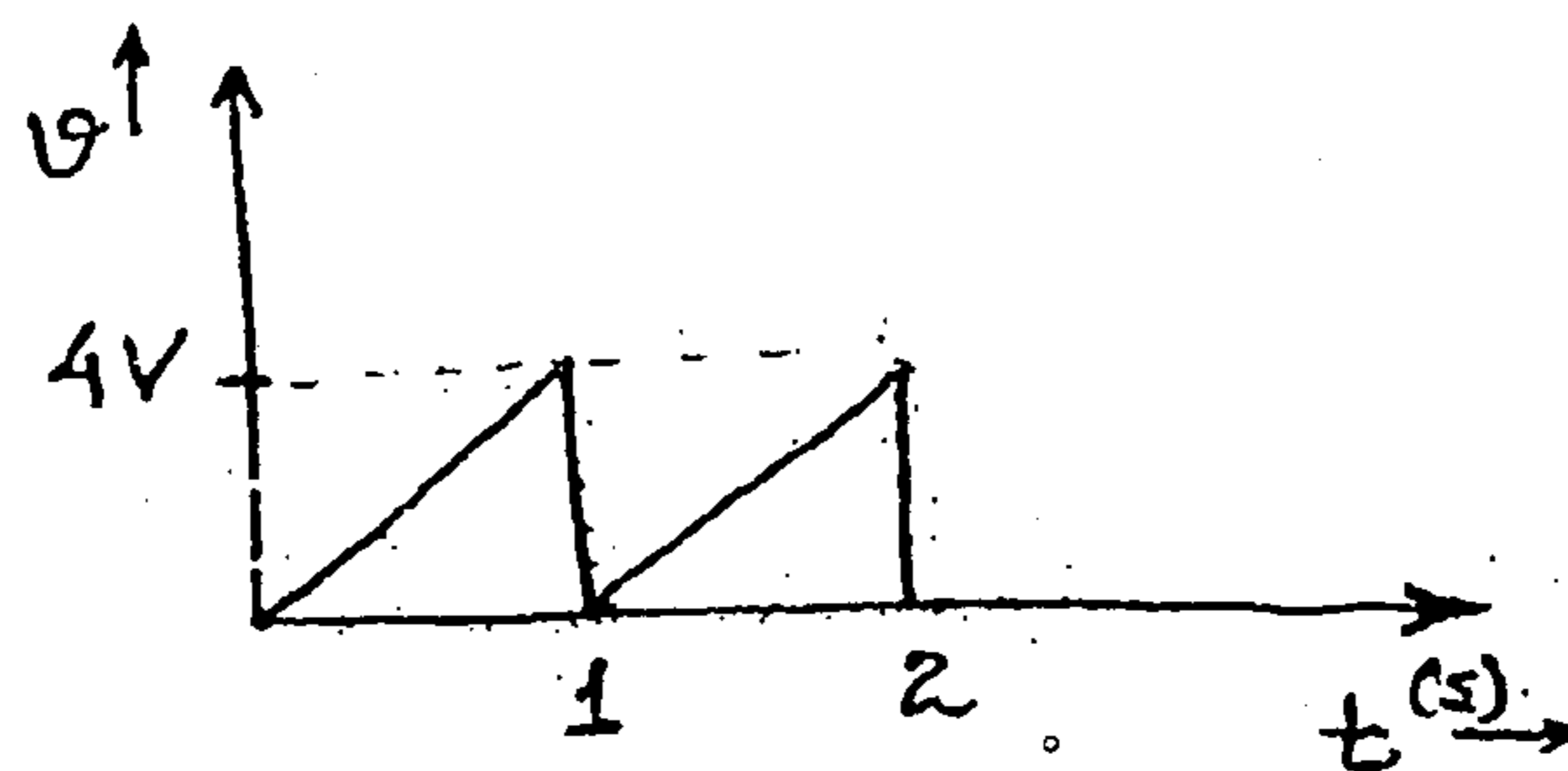
1. (a) Convert the given circuit into a single current source in parallel with a single resistance between points A and B. 3



- (b) Find voltage  $V_{AB}$  using super position theorem. 3



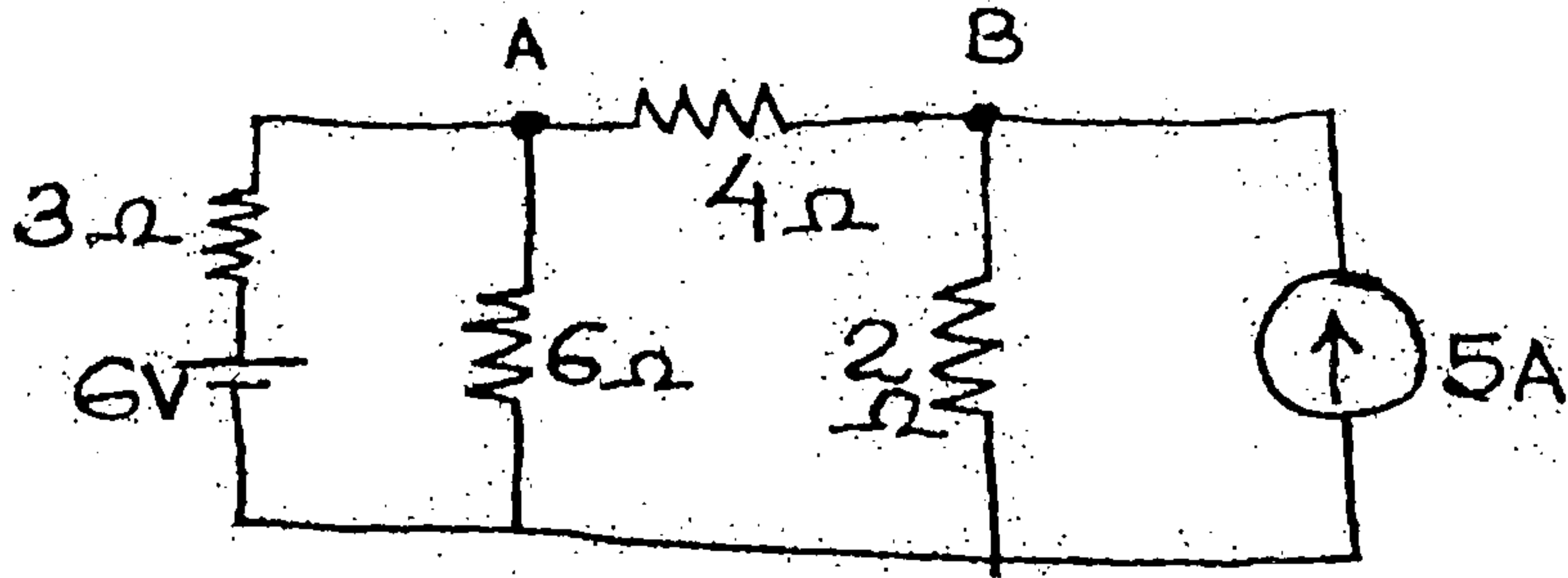
- (c) Find the average value of the following waveform :— 3



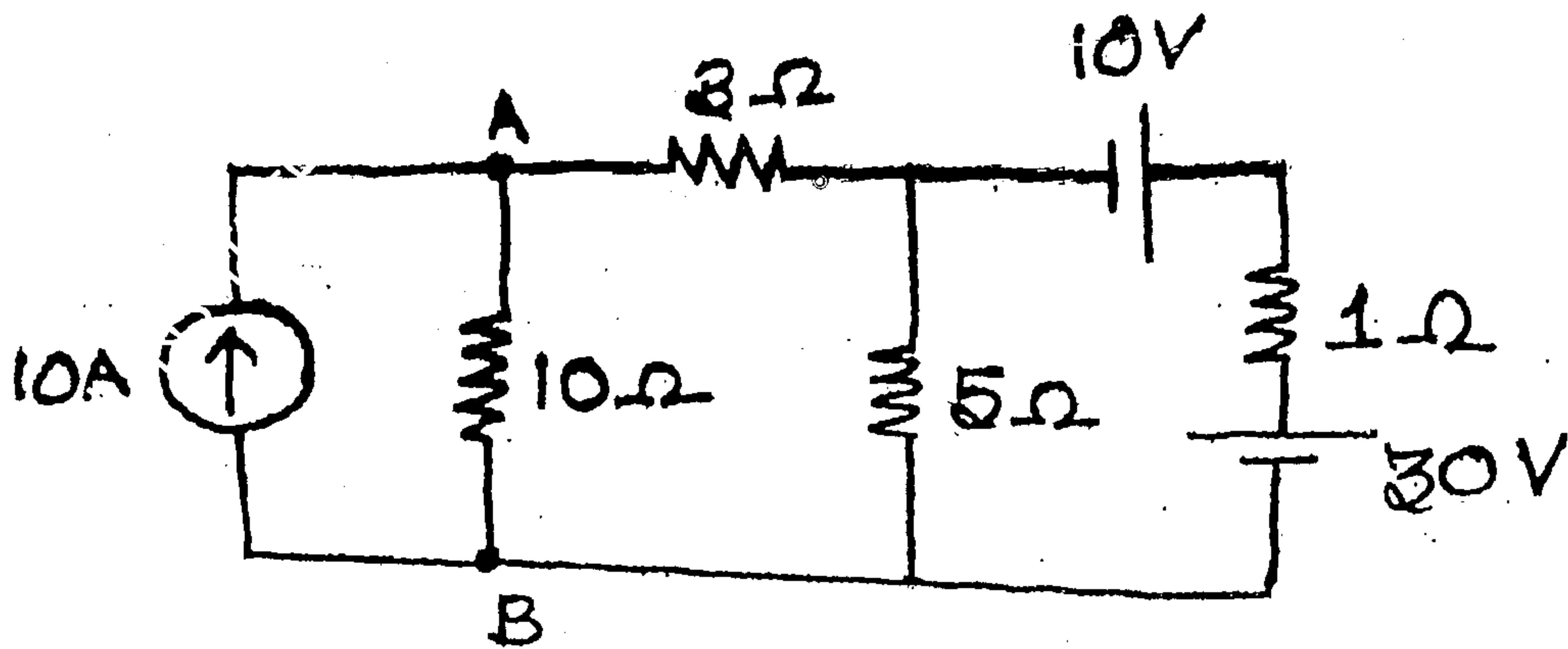
- (d) For a series RLC circuit having  $R = 10 \Omega$ ,  $L = 0.01 \text{ H}$  and  $C = 100 \mu\text{F}$ , find the resonant frequency, quality factor and bandwidth. 3
- (e) Draw the phasor diagram for 3-phase star connected load with a leading power factor. Indicate line and phase voltages and currents. 2
- (f) A 5 kVA, 240/2400 V, 50 Hz single phase transformer has the maximum value of flux density as 1.2 Tesla. If the e.m.f. per turn is 8 V. Calculate the number of primary and secondary turns and the primary and secondary current at full load. 4
- (g) Draw the circuit diagram and the input and output waveforms for a full wave bridge rectifier. 2

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2. (a) Find the current through  $4\ \Omega$  resistance using Nodal analysis. 6



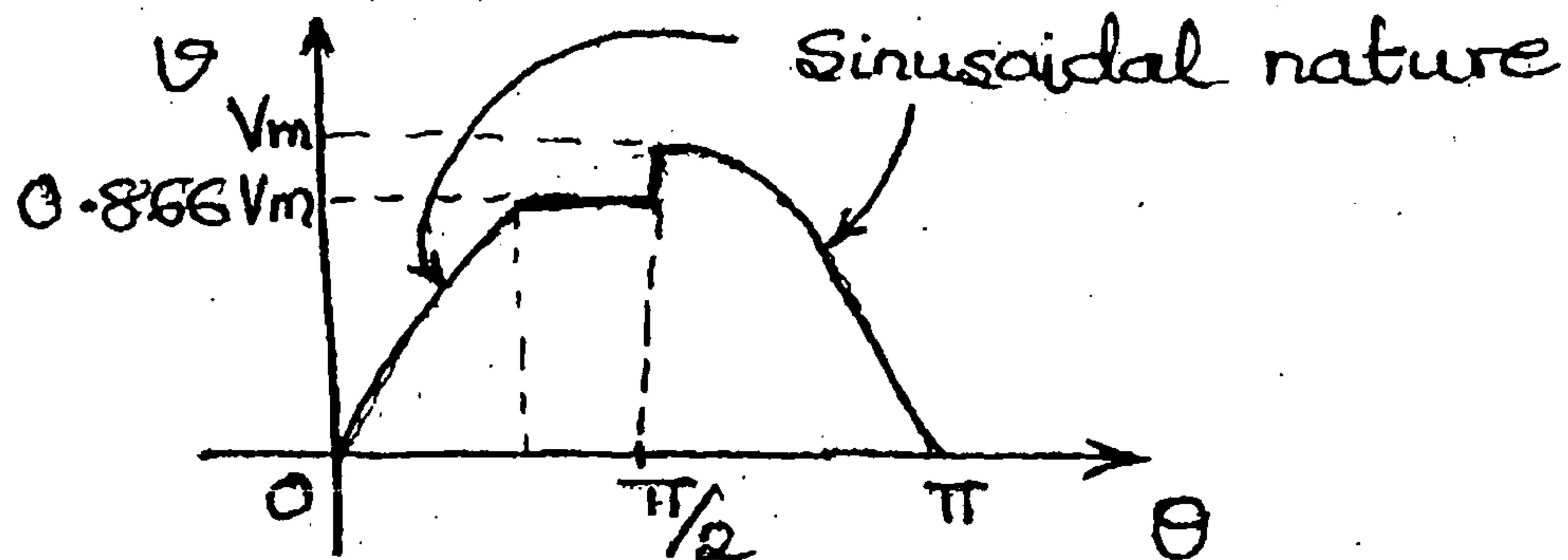
- (b) Two coils are connected in series across a 200 V, 50 Hz ac supply. The power input to the circuit is 2 kW and 1.15 kVAR. If the resistance and the reactance of the first coil are  $5\ \Omega$  and  $8\ \Omega$  respectively, calculate the resistance and reactance of the second coil. Calculate the active power and reactive power for both the coils individually. 8
- (c) Explain the principle of working for a single phase transformer and derive the e.m.f. equation for the same. 6
3. (a) A balanced 3-phase load consists of 3 coils, each of resistance  $4\ \Omega$  and inductance  $0.02\ \text{H}$ . It is connected to a 440 V, 50 Hz,  $3\phi$  supply. Find the total power consumed when the load is connected in star and the total reactive power when the load is connected in delta. 8
- (b) With the help of a neat diagram explain how open circuit test is conducted on a single phase transformer. 6
- (c) Draw the circuit diagram of a half wave rectifier with capacitor filter and the corresponding input and output waveforms for the same. 2
- (d) With help of a neat diagram explain the input characteristics of an NPN transistor in the common emitter configuration. 4
4. (a) Using source transformation find the current flowing through the  $10\ \Omega$  resistance. 7



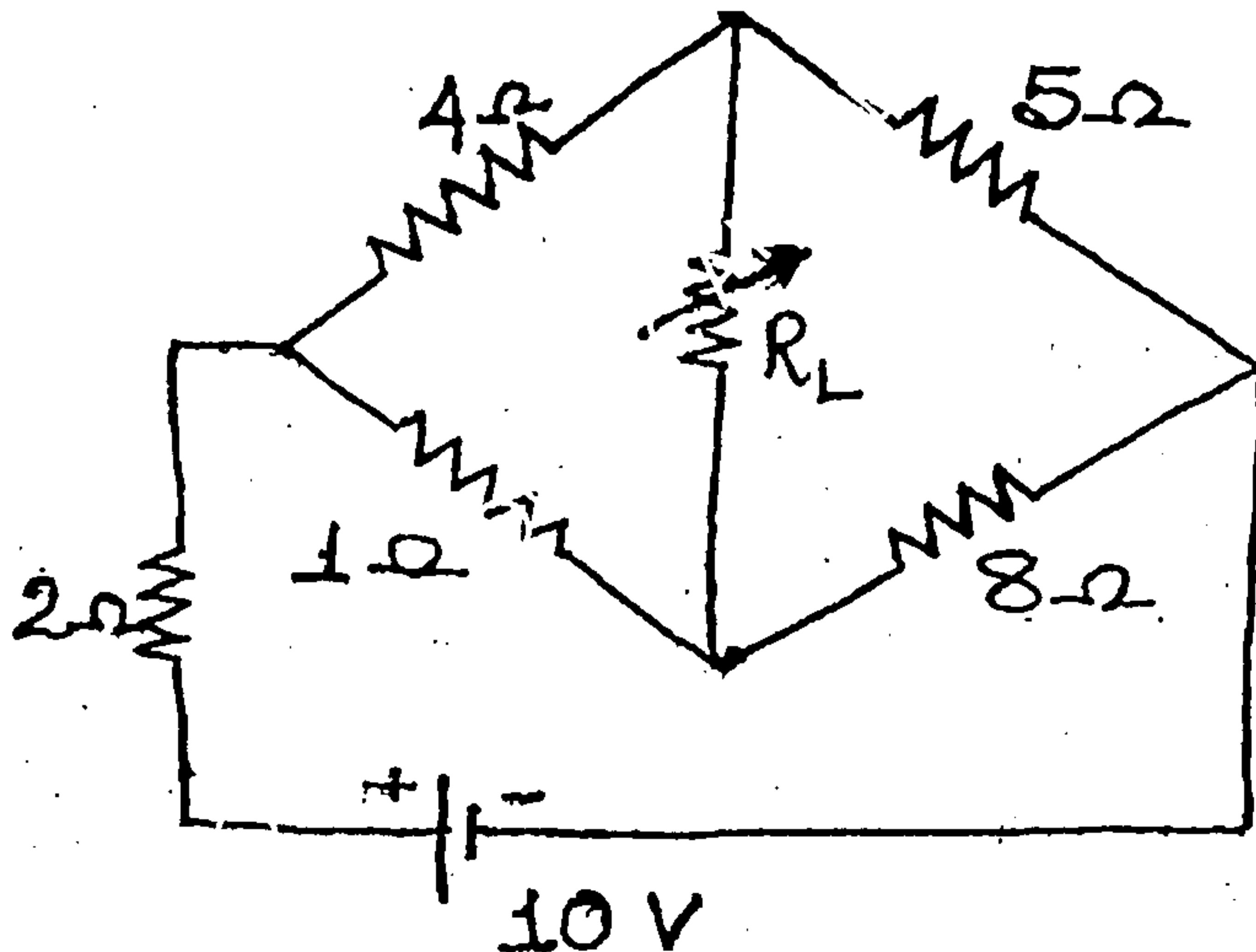
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- (b) Find the r.m.s. value for the given waveform.

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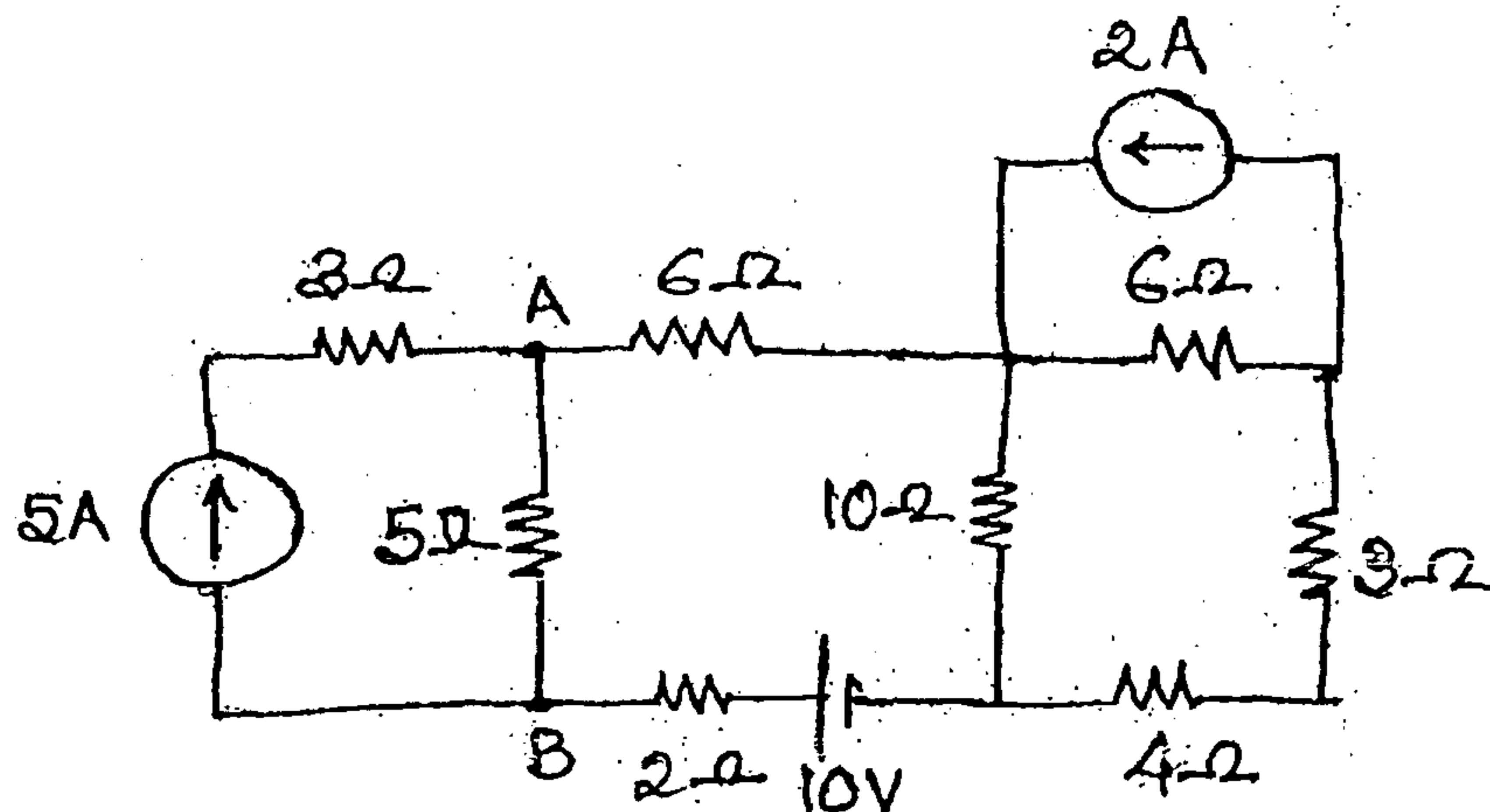
- (c) Two wattmeters are used to measure power in a  $3\phi$  balanced star connected load using the two wattmeter method. The readings of the 2 wattmeters are 8 kW and 4 kW respectively. Calculate the total power consumed by the  $3\phi$  load and the power factor. 4
- (d) With the help of a neat circuit diagram and input and output waveforms explain the working of a fullwave centre tapped rectifier. 4
5. (a) For the given circuit find the value of  $R_L$  for maximum power transfer and calculate the maximum power absorbed by  $R_L$ . 8



- (b) The voltage and current in a circuit are given by  $e = 100 \sin(\omega t + 30^\circ)$  and  $i = 50 \sin(\omega t + 60^\circ)$ . Determine the impedance of the circuit. Assuming the circuit to contain 2 elements in series find resistance, reactance and power factor of the circuit. 4
- (c) A 30 kVA, 2400/120V, 50Hz transformer has high-voltage winding resistance of  $0.1\Omega$  and leakage reactance of  $0.22\Omega$ . The low voltage winding resistance is  $0.035\Omega$  and leakage reactance is  $0.012\Omega$ . Calculate equivalent resistance as referred to primary and secondary, equivalent reactance as referred to primary and secondary, equivalent impedance as referred to primary and secondary. Copper loss at full load and at 75% of full load. 8

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6. (a) Find the value of current flowing through the  $5\ \Omega$  resistance using Superposition Theorem. 7



- (b) An inductive coil having a resistance of  $20\ \Omega$  and inductance of  $0.2\ \text{H}$  is connected in parallel with a  $20\ \mu\text{F}$  capacitor with variable frequency and  $230\ \text{V}$  supply. Find the frequency at which the total current drawn from supply is in phase with the supply voltage. Find the value of the current and the impedance of the circuit at this frequency. 7
- (c) With the help of a neat circuit diagram and phasor diagram explain the 2-wattmeter method to measure power in a 3-phase balanced delta connected load. 6

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

1. Attempt any five of the following :—

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- Identify the type of lattice and number of atoms per unit cell for CsCl and BaTiO<sub>3</sub> (above 120°C) crystal structure.
- Fermi Energy for Silver is 5.5 eV. Find out the energy for which the probability of occupancy at 300 K is 0.9.
- Explain the formation of depletion region in an unbiased p-n junction.
- Write three distinct differences between ionic and orientational polarization.
- Draw the variation of permeability against external magnetic field for a paramagnetic and ferromagnetic material (below Curie temperature).
- Mention only one solution for each of the following acoustical problems in a hall (i) echo (ii) dead spot and (iii) inadequate loudness.
- What is piezoelectric effect? Why ferro-electrics are preferred than quartz for the production of ultrasonic waves?

2+1

2. (a) What is effective mass? Why the effective mass of holes is more than the effective mass of electrons?

2+2

Draw the diagrams only (fully labelled and self explanatory) to show the variation of Fermi energy with (i) temperature and (ii) impurity concentration at high level, for an n-type semiconductor.

2+2

(b) Define space lattice and basis. A metal crystallizes with a density of 2.7 gm/cc and has a packing fraction of 0.74. Determine the mass of one atom if the nearest neighbour distance is 2.86 Å.

1+1+5

3. (a) Explain the variation in magnetic induction with magnetic field for a ferromagnetic material, using the domain theory and with the help of a graph. A magnetic field of 1800 Amp/m produces a magnetic flux of  $3 \times 10^{-4}$  Wb in an iron bar of cross-sectional area 0.2 cm<sup>2</sup>. Calculate the susceptibility and the permeability.

3+5

(b) How the variation in glancing angle is achieved while determining the crystal structure using (i) rotating crystal method and (ii) powder method?

3+4

Calculate Bragg angle if (200) planes of a BCC crystal with lattice parameter 2.814 Å give second order reflection with X-rays of wavelength 0.71 Å.

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4. (a) Calculate the critical radius ratio of an ionic crystal in ligancy 4 configuration. 5
- (b) Determine the concentration of conduction electron in a sample of Silicon if one in every million Silicon atom is replaced by a Phosphorous atom. Assume every Phosphorous atom to be singly ionized. Si has a molar mass of 0.028 kg/mole and density of 2300 kg/m<sup>3</sup>. 5
- (c) If a gas contains  $1.2 \times 10^{27}$  atoms/m<sup>3</sup> and radius of atom is 0.53 Å, then calculate electronic polarizability and dielectric constant. Find the capacitance of a parallel plate capacitor having this gas inside, with plate area 1 cm<sup>2</sup> and plate separation 0.12 cm. 5
5. (a) Find Miller Indices of a plane whose intercepts are a, 4a and a, where a is the lattice constant. Draw (102), [201] and  $(0\bar{4}0)$  in a cubic unit cell. 5
- (b) In a semiconductor with Hall coefficient 145 cc/C having width of 2 cm and thickness 0.2 cm with a magnetic field induction of 2T along the smaller dimension, a current of 150 mA is passing. Calculate the current density and Hall voltage. 5
- (c) Write Sabine's formula explaining each term. Explain how this formula can be used for the determination of absorption coefficient of a given material. 1+4
6. (a) Write five distinct differences between Frenkel and Schottky defect. 5
- (b) Explain how a voltage difference is generated in a p-n junction when it is used in a photovoltaic solar cell. 5
- (c) Explain the principle, construction and working of a magnetostriction oscillator to produce ultrasonic waves. 1+1+3



**(REVISED COURSE)****QP Code :11932**

(3 Hours)

Total Marks : 80

N. B. : (1) Q. No.1 is compulsory.

(2) Attempt any three questions from question no.2 to question no.6.

(3) Figures to the right indicate full marks.

1. (a) If  $\tanh x = \frac{2}{3}$ , find the value of  $x$  and then  $\cosh 2x$  3
- (b) If  $u = \tan^{-1}\left(\frac{y}{x}\right)$ , Find these value of  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$  3
- (c) if  $x = r \cos \theta$ ,  $y = r \sin \theta$  3  
Find  $\frac{\partial(x, y)}{\partial(r, \theta)}$
- (d) Prove that  $\operatorname{logsec} x = \frac{1}{2}x^2 + \frac{1}{12}x^4 + \frac{1}{45}x^6 + \dots$  3
- (e) Show that every square matrix can be uniquely expressed as the sum of Hermitian matrix and a skew Hermitian matrix. 4
- (f) Find the  $n^{\text{th}}$  derivative of 4  
 $y = \sin x \sin 2x \sin 3x$
2. (a) Solve the equation  $x^6 + 1 = 0$  6
- (b) Reduce the matrix to normal form and find its rank, where 6
- $$A = \begin{bmatrix} 1 & -1 & 3 & 6 \\ 1 & 3 & -3 & -4 \\ 5 & 3 & 3 & 11 \end{bmatrix}$$
- (c) State and prove Eulers theorem for a homogeneous function in two variables: 8  
Hence verify the Eulers theorem for
- $$u = \frac{\sqrt{xy}}{\sqrt{x} + \sqrt{y}}$$
3. (a) Test the consistency of the following equations and solve them if they are consistent. 6  
 $2x - y + z = 8, \quad 3x - y + z = 6$   
 $4x - y + 2z = 7, \quad -x + y - z = 4$
- (b) Find the stationary values 6  
 $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$
- (c) Separate into real and imaginary parts of  $\sin^{-1}(e^{i\theta})$  8

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4. (a) If  $x = uv$ ,  $y = \frac{u}{v}$  prove that  $J.J = 1$  6

(b) Show that for real values of  $a$  and  $b$ ,  $e^{2ai \cot^{-1} b} \left[ \frac{bi-1}{bi+1} \right]^{-a} = 1$  6

(c) Solve the following equations by Gauss-seidel method 8  
 $27x + 6y - z = 85$   
 $6x + 15y + 2z = 72$   
 $x + y + 54z = 110$

5. (a) Expand  $\cos^7 \theta$  in a series of cosines of multiple of  $\theta$  6

(b) If  $\lim_{x \rightarrow 0} \frac{a \sinh x + b \sin x}{x^3} = \frac{5}{3}$ , find  $a$  and  $b$  6

(c) If  $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$  then prove that  $(1-x^2) y_{n+1} - (2n+1) x y_n - n^2 y_{n-1} = 0$  8

6. (a) Examine whether the vectors 6  
 $x_1 = [3, 1, 1]$   $x_2 = [2, 0, -1]$   
 $x_3 = [4, 2, 1]$  are linearly independent.

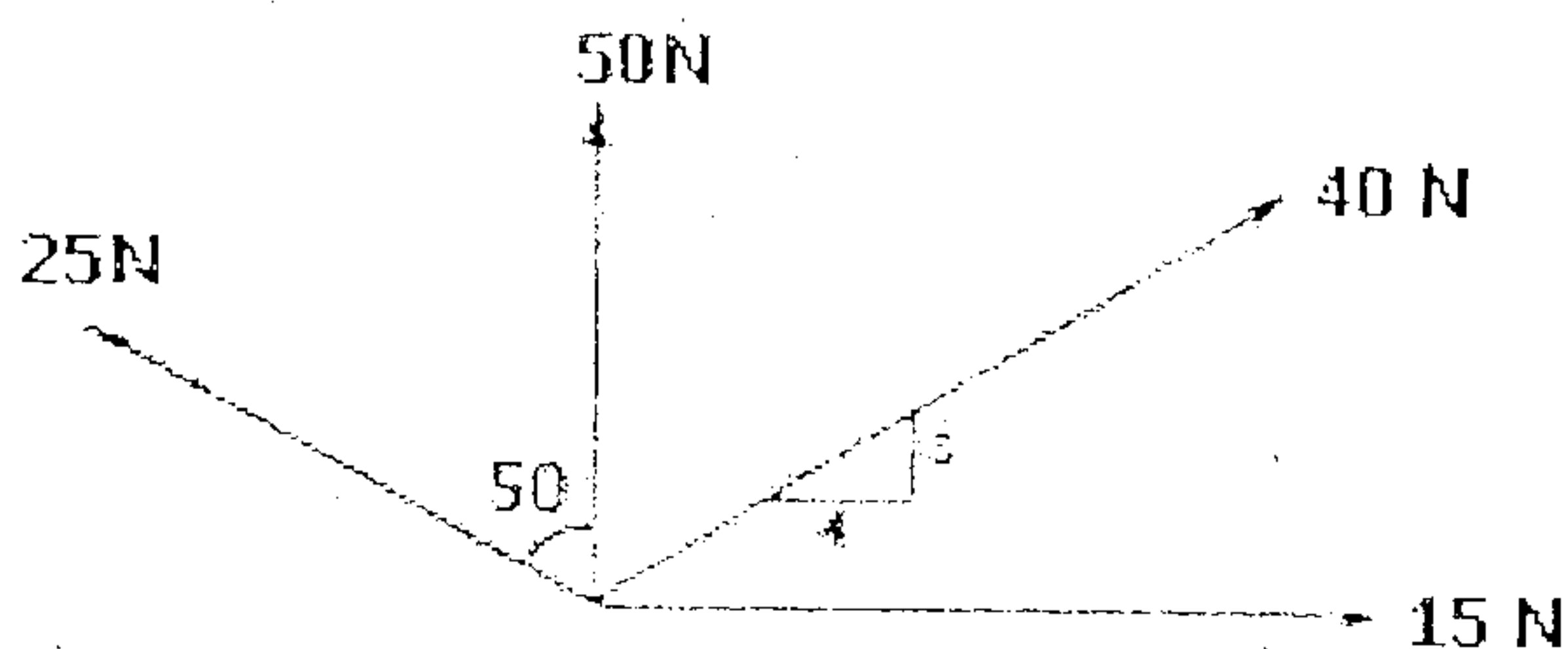
(b) If  $u = f(x-y, y-z, z-x)$  then show that  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$  6

(c) Fit a straight line for the following data 8

x	1	2	3	4	5	6
y	49	54	60	73	80	86

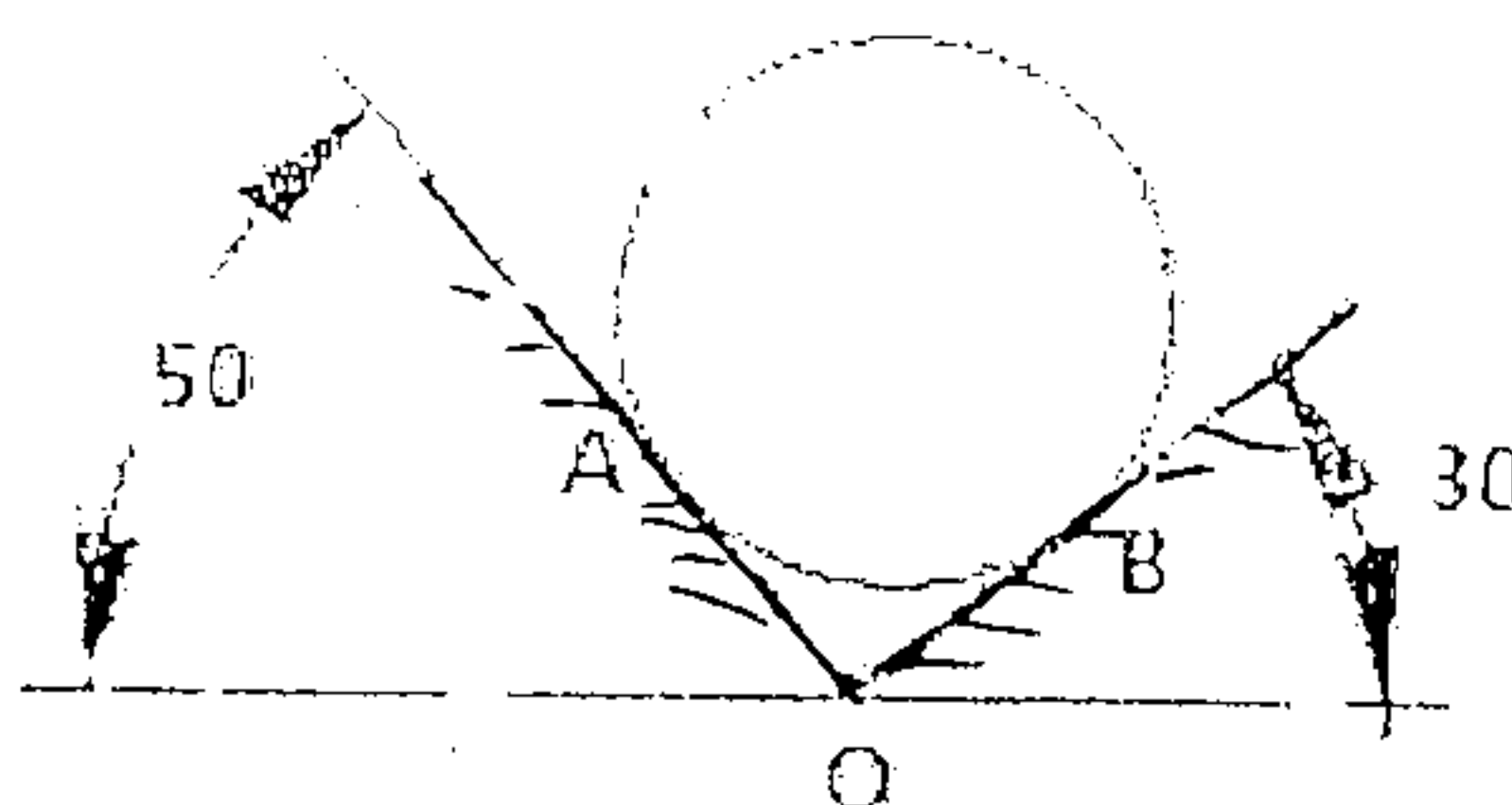
- N.B.: (1) Question No. 1 is compulsory.  
 (2) Attempt any three questions from remaining five questions.  
 (3) Assume suitable data if necessary and mention the same clearly.  
 (4) Take  $g=9.81 \text{ m/s}^2$

Q.1 a. Four concurrent forces act at a point as shown. Find their resultant. [4]



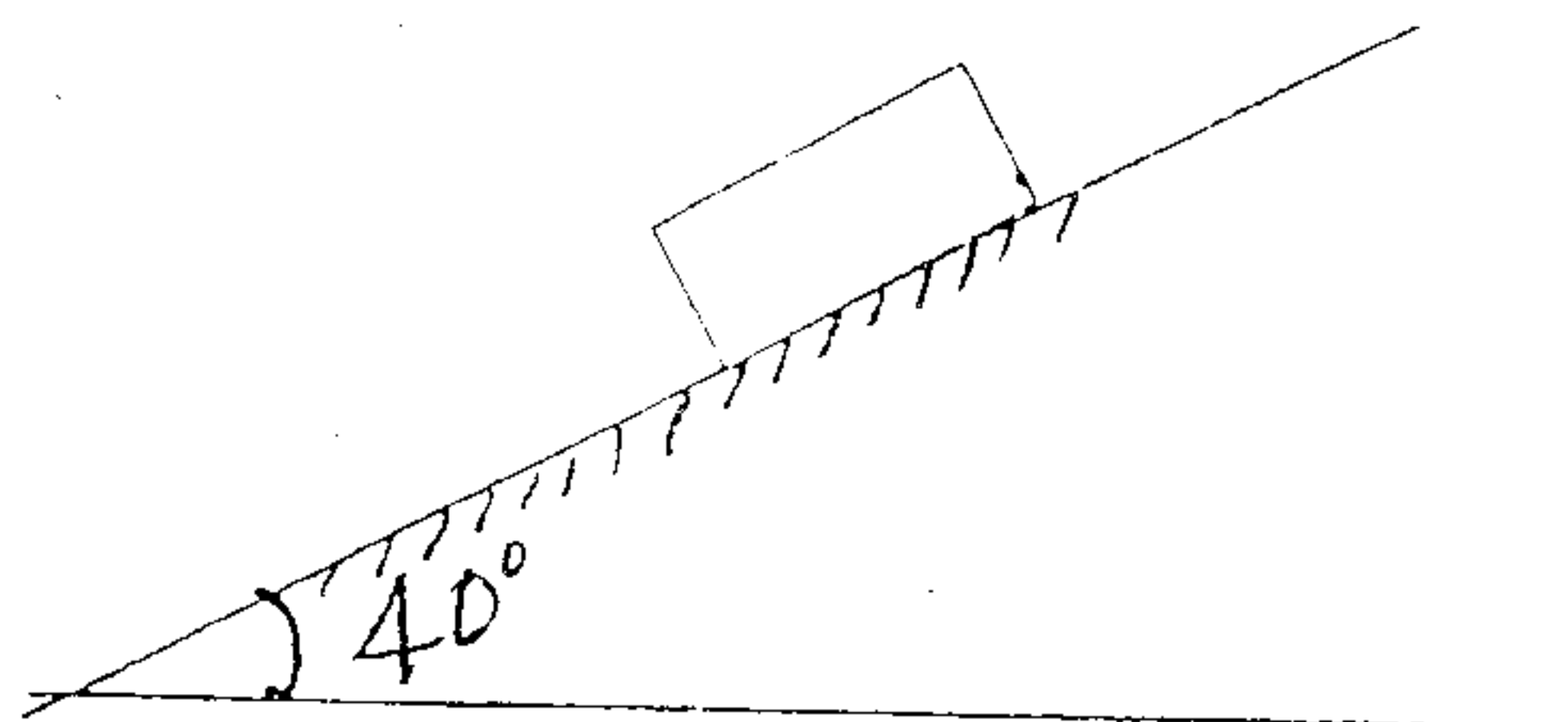
b. Define Angle of friction and Angle of Repose. Show that Angle of friction is equal to Angle of Repose. [4]

c. A cylinder of weight 500 N is kept on two inclined planes as shown in the figure. Determine the reactions at the contact points A and B [4]

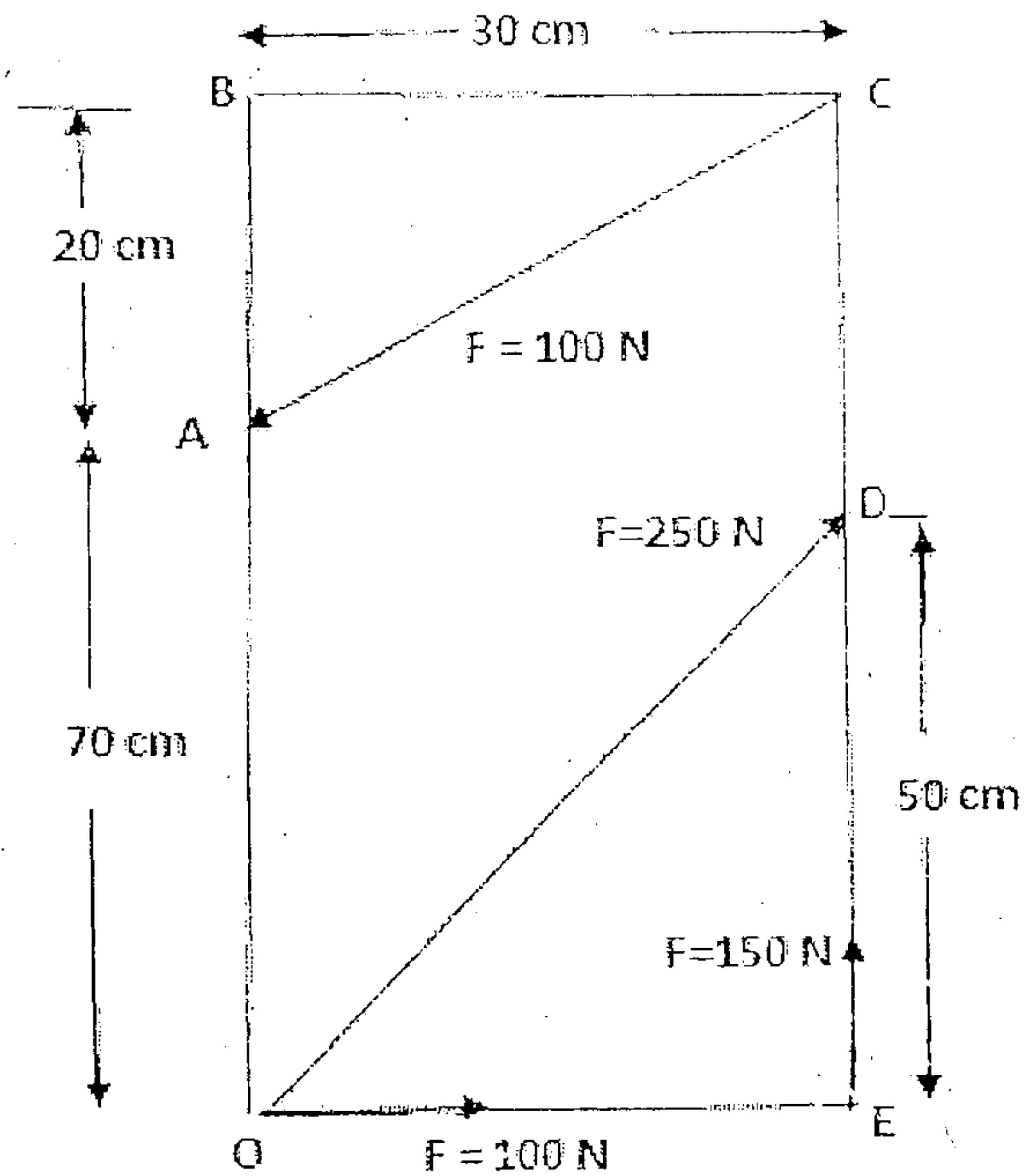


d. Acceleration of a particle moving along a straight line is represented by the relation  $a = 30 - 4.5x^2 \text{ m/s}^2$ . The starts with zero initial velocity at  $x = 0$ . Determine (a) the velocity when  $x=3 \text{ m}$  (b) the position when the velocity is again zero (c) the position when the velocity is maximum. [4]

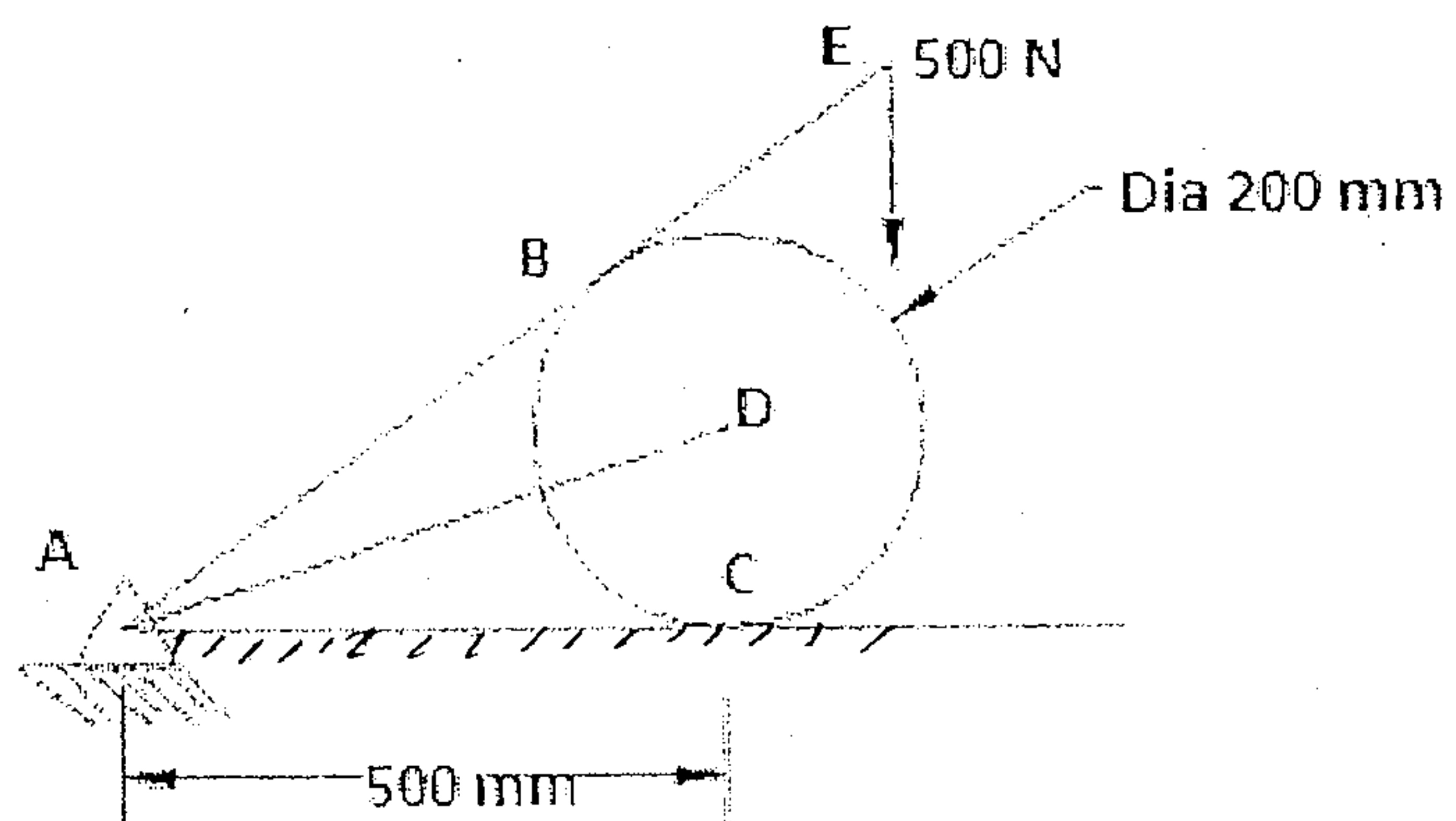
e. A block of mass 5kg is released from rest along a 40 degree inclined plane. Determine the acceleration of the block when it travels a distance of 3m using D'Alemberts principle. Take coefficient of friction as 0.2. [4]



- Q.2 a. For given system find resultant and its point of application with respect to point O on the X-axis (X intercept). Force, along CA = 100 N, along OD = 250 N, along ED = 150 N, along OE = 100 N. An clockwise moment of 5000 N-cm is also acting at the point O. [6]



- b. A Cylinder of weight 300 N is held in equilibrium as shown in figure given [8] below. Determine the tension in the string AD and reaction at C and B. The length of AE = 750 mm

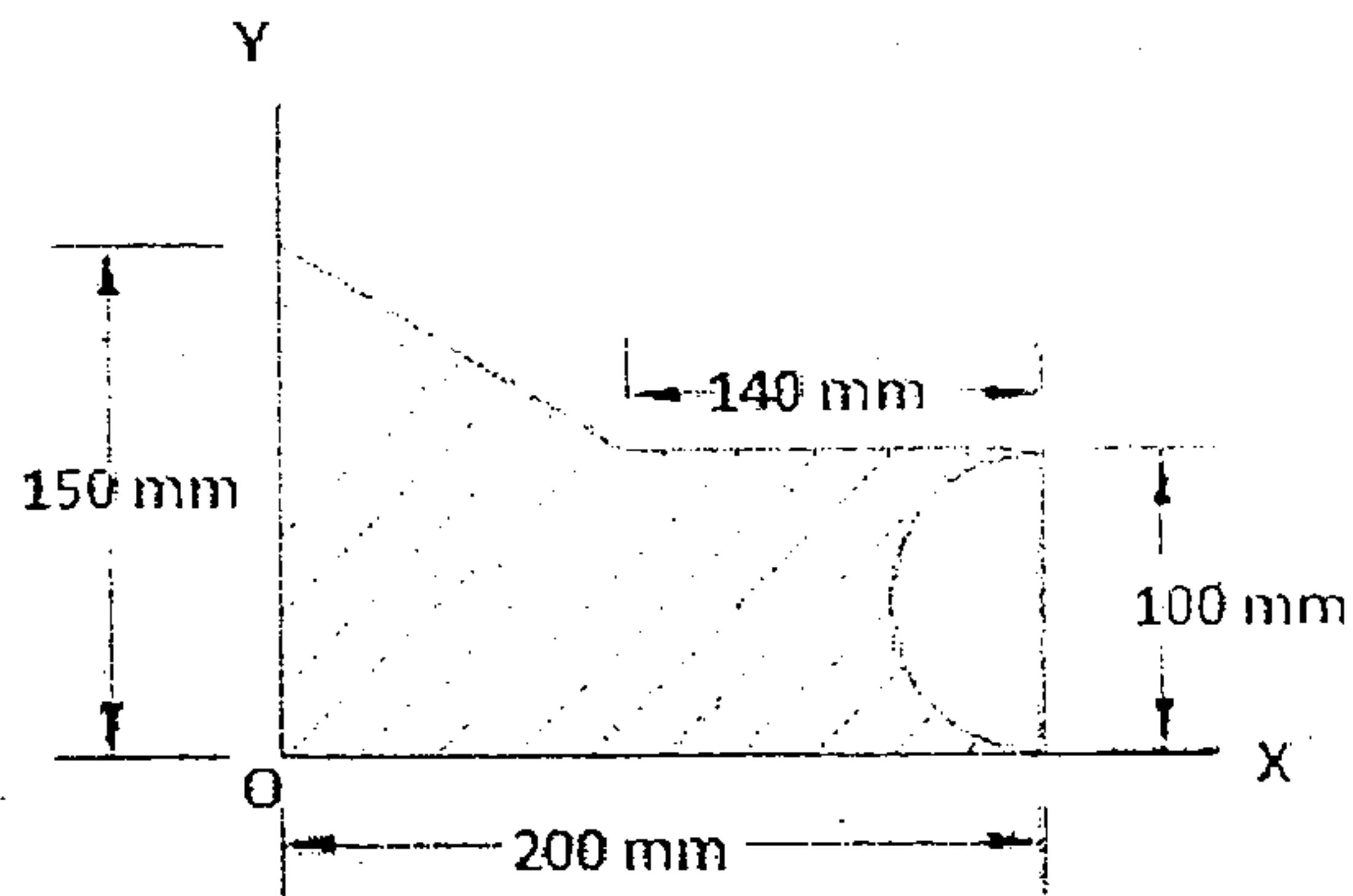


- c. If a ball is thrown vertically down with a velocity of 10 m/s from a height of 3m. Find the maximum height it can reach after hitting the floor, if the coefficient of restitution is 0.7. [6]

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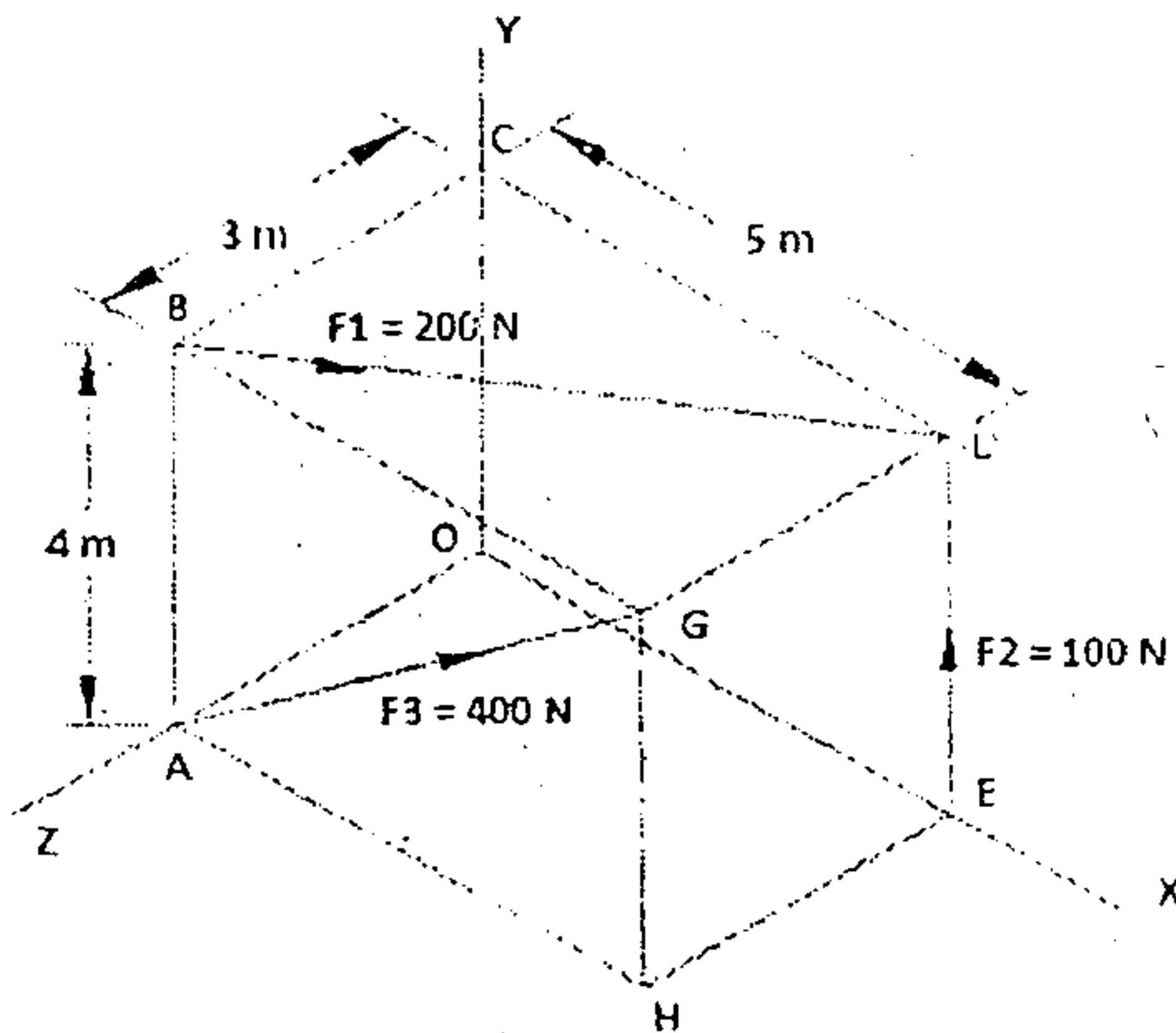
Q.3 a. Find Centroid of shaded area.

[8]

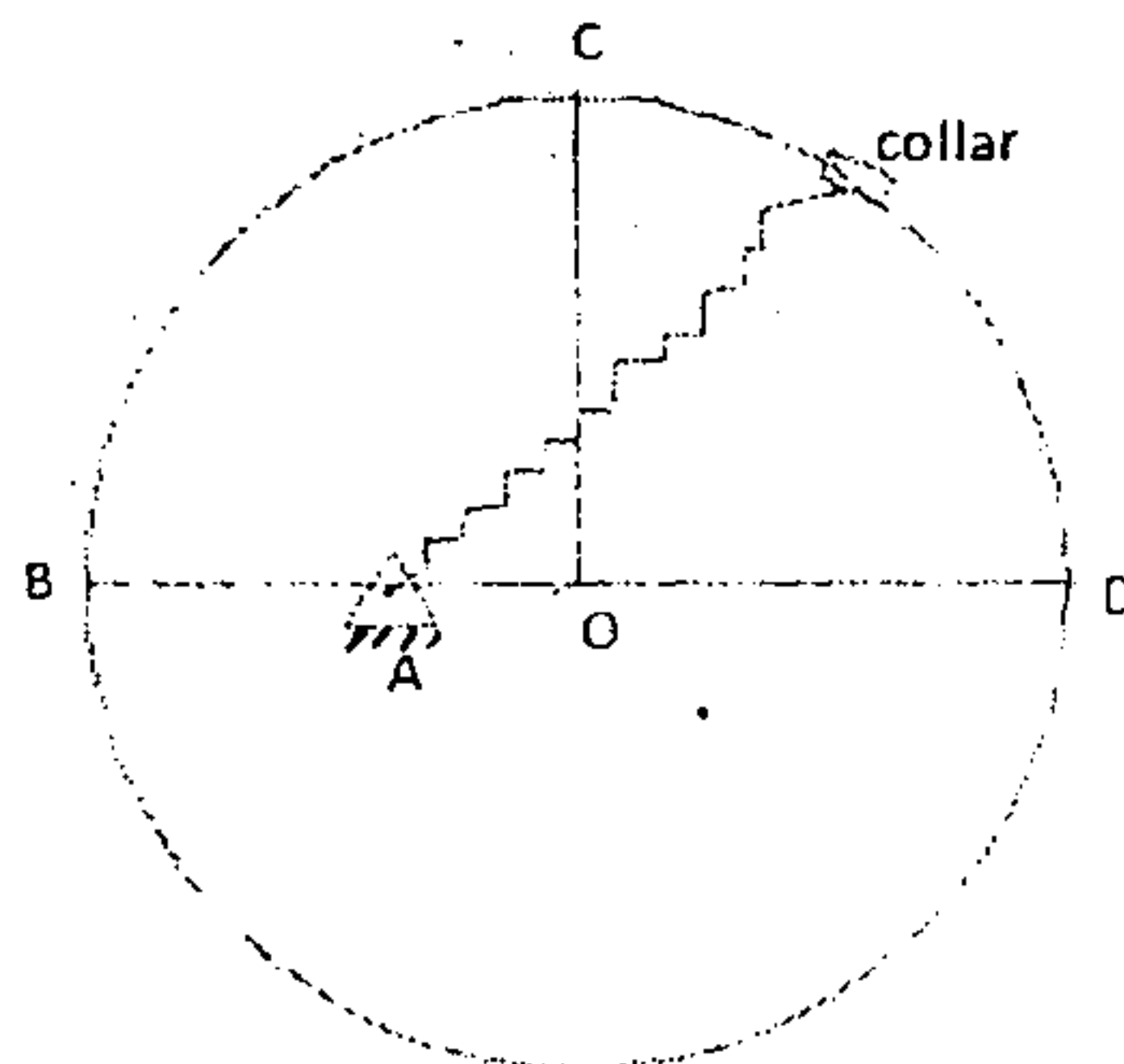


b. A rectangular parallelepiped carries Three forces shown in fig. Reduce the force system to a resultant force applied at the origin and a moment around origin.

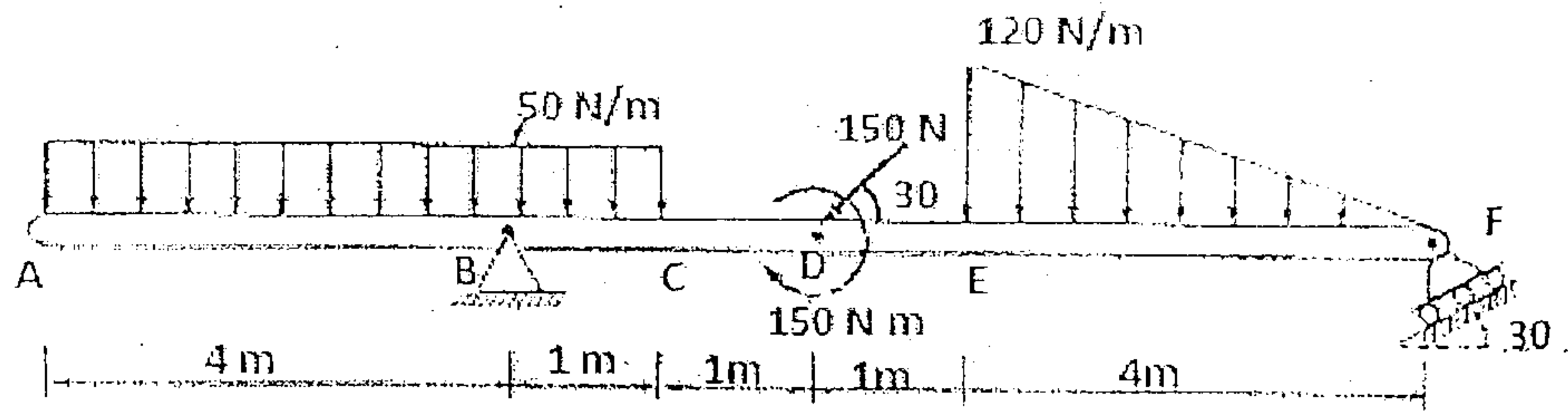
[6]



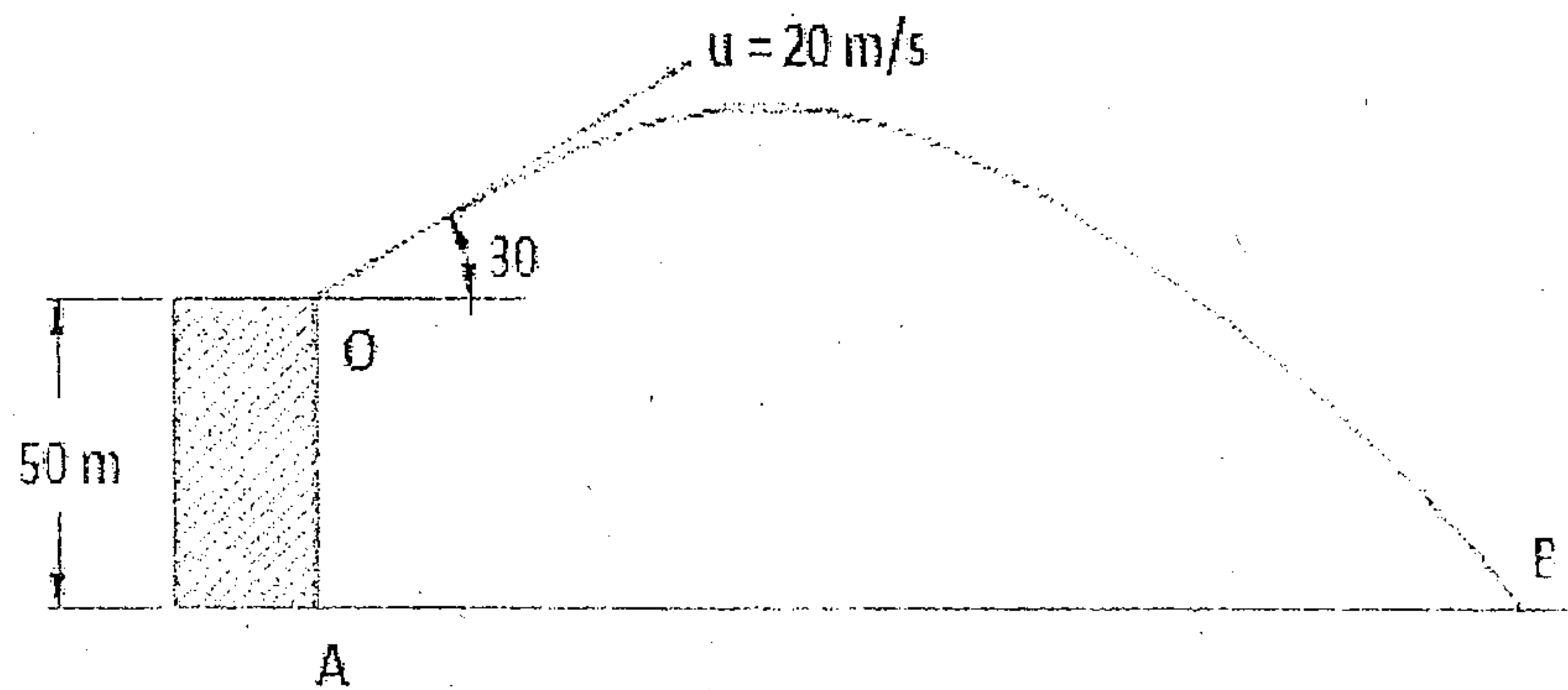
c. A collar of mass 1 kg is attached to a spring and slides without friction along a circular rod which lies in a horizontal plane. The spring is undeformed when the collar is at B. knowing that the collar is passing through the point D with a speed of 1.8 m/s, determine the speed of the collar when it passes through point C and B. Take Stiffness of the spring,  $k = 250 \text{ N/m}$ , Radius of the circular path = 300 mm and distance  $OA = 125 \text{ mm}$ .



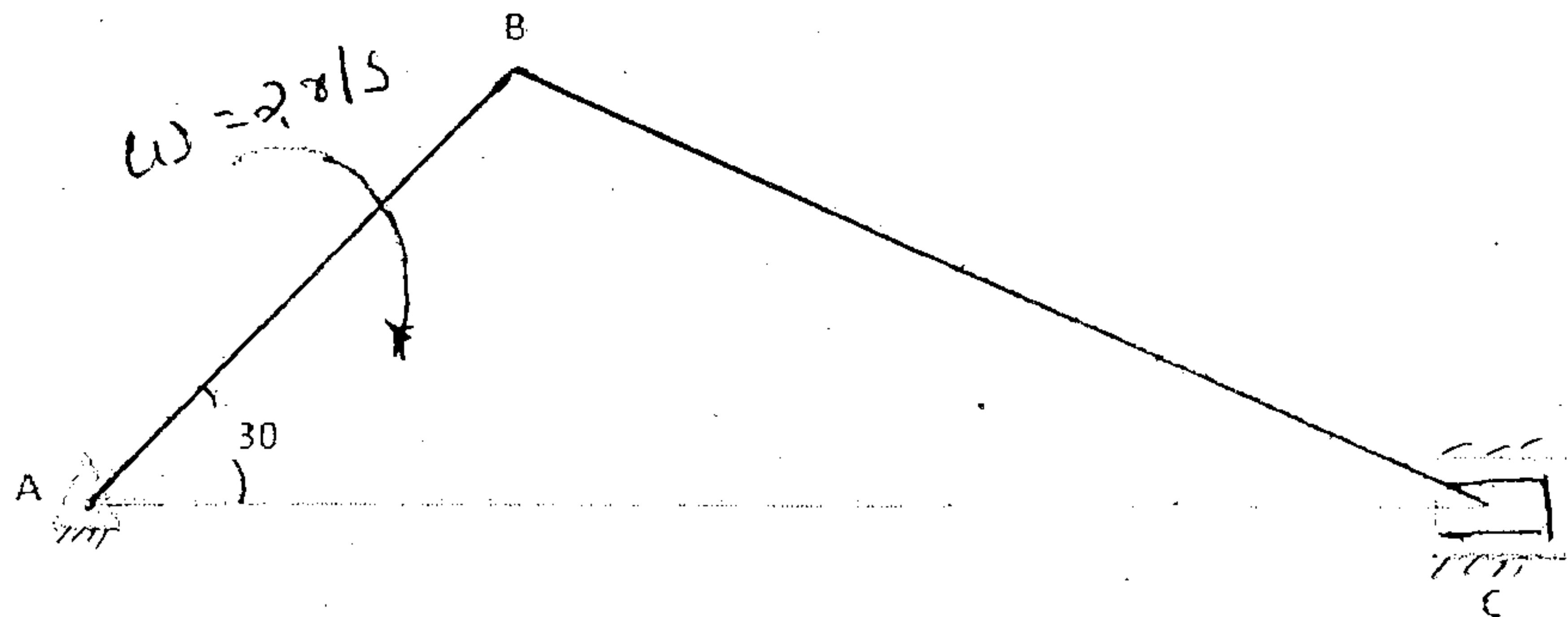
- Q.4 a. Find the reactions at supports B and F for the beam loaded as shown in the figure below. [8]



- b. A particle is projected from the top of a tower of height 50 m with a velocity of 20 m/sec at an angle 30 degrees to the horizontal. Determine : [6]
- 1) Horizontal distance AB it travel from the foot of the tower.
  - 2) The velocity with which it strikes the ground at B.
  - 3) Total time taken to reach point B.

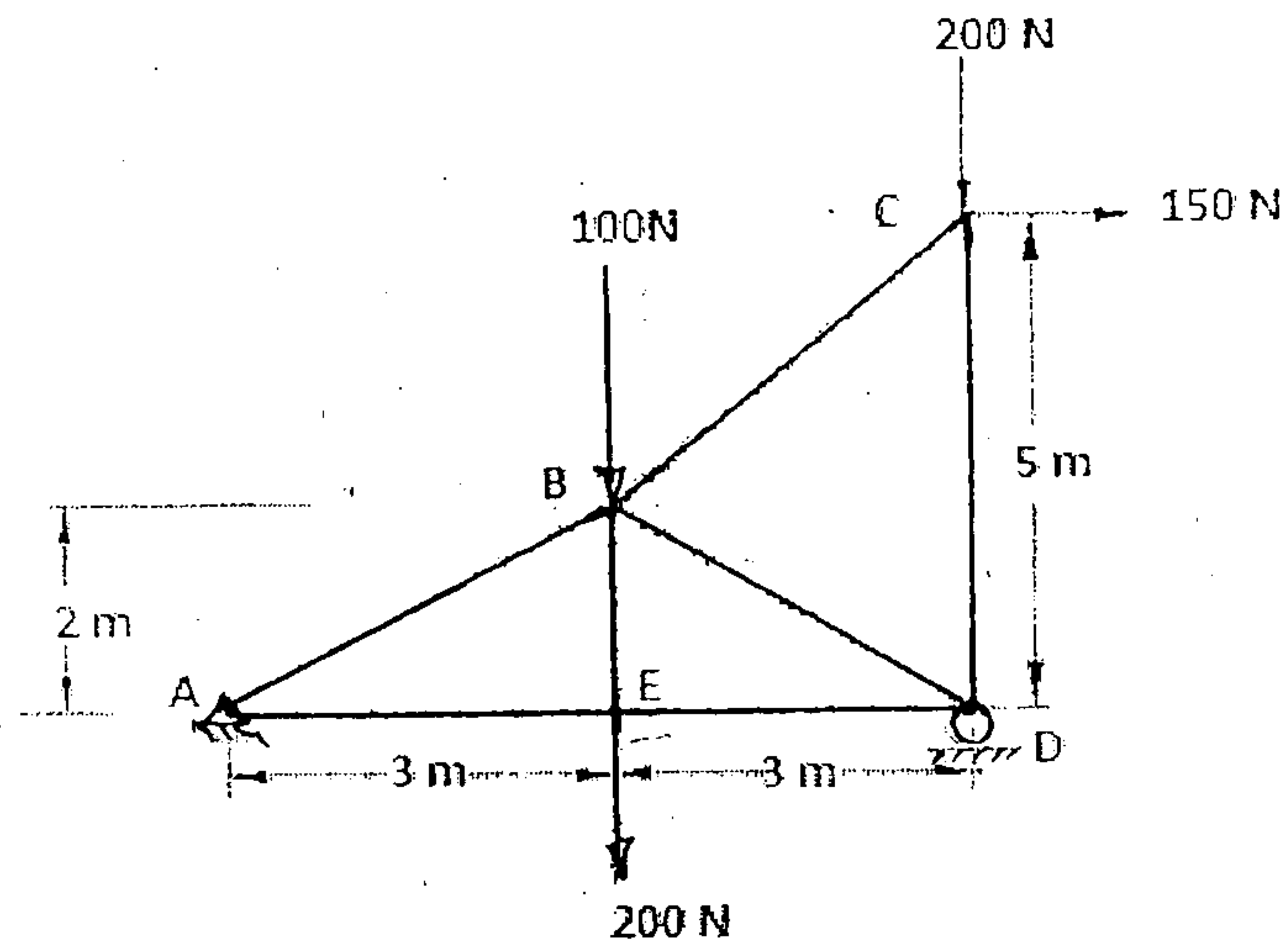


- c. Figure shows the crank and connecting rod mechanism. The crank AB rotates with an angular velocity of 2 rad/sec in clockwise direction. Determine the angular velocity of Connecting Rod BC and the velocity of Piston C using ICR method. AB = 0.3m and CD = 0.8m. [6]

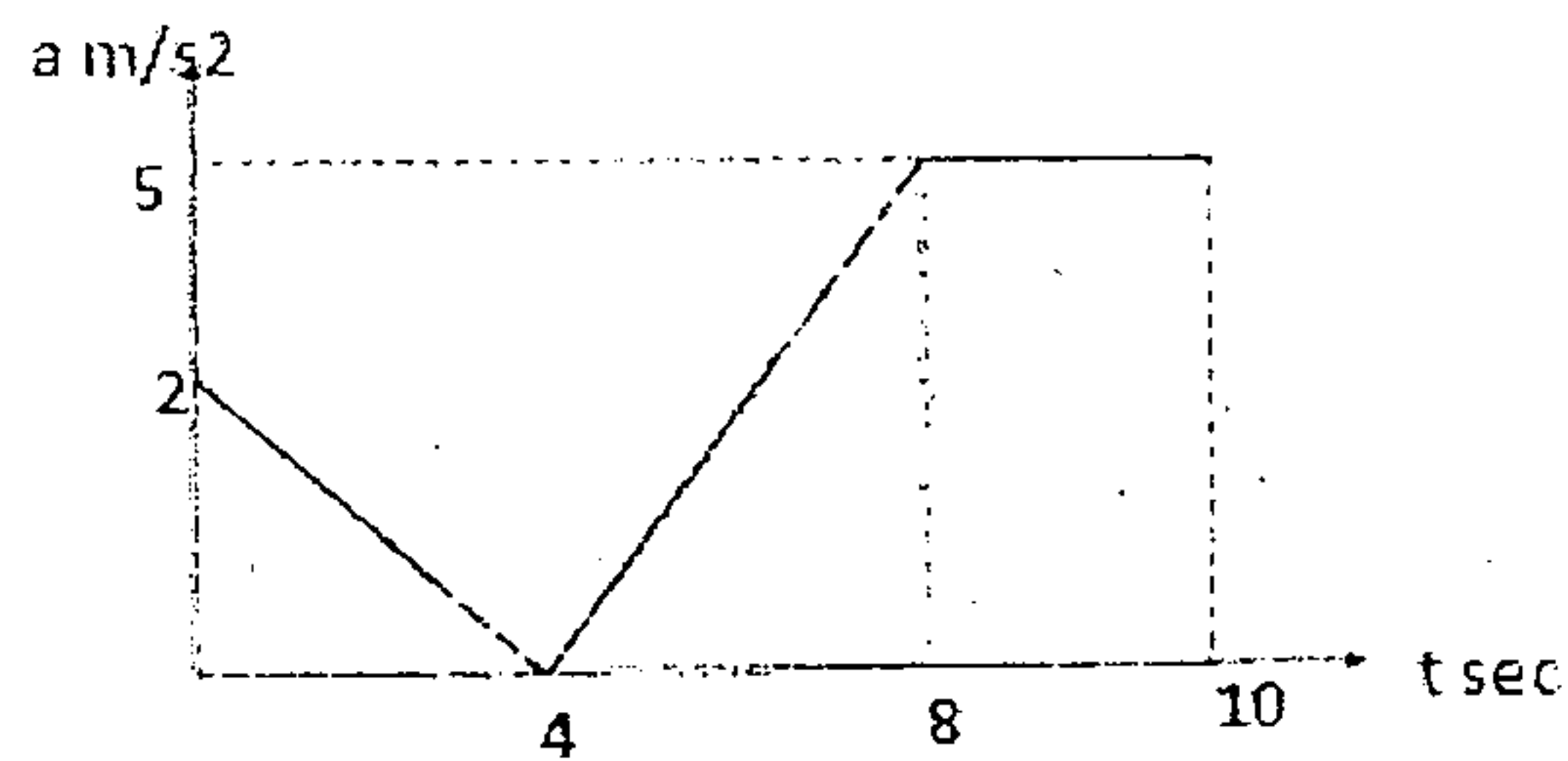


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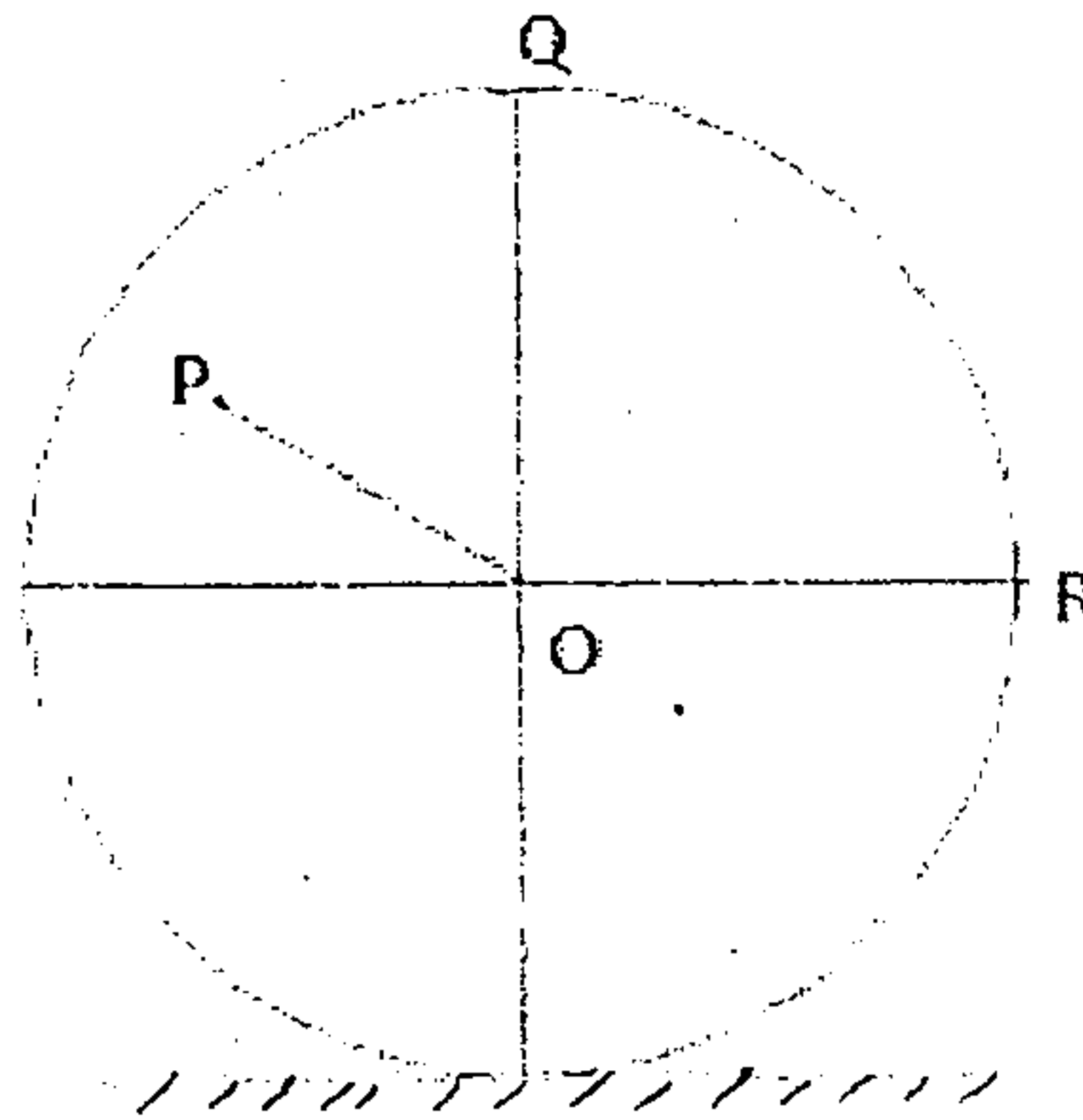
- Q.5 a. A truss is loaded as shown in the diagram given below. Determine : [8]
- 1) Support reactions
  - 2) Forces on BC, BD by Method of section.
  - 3) Forces on AB, AE and BE by Method of joints.



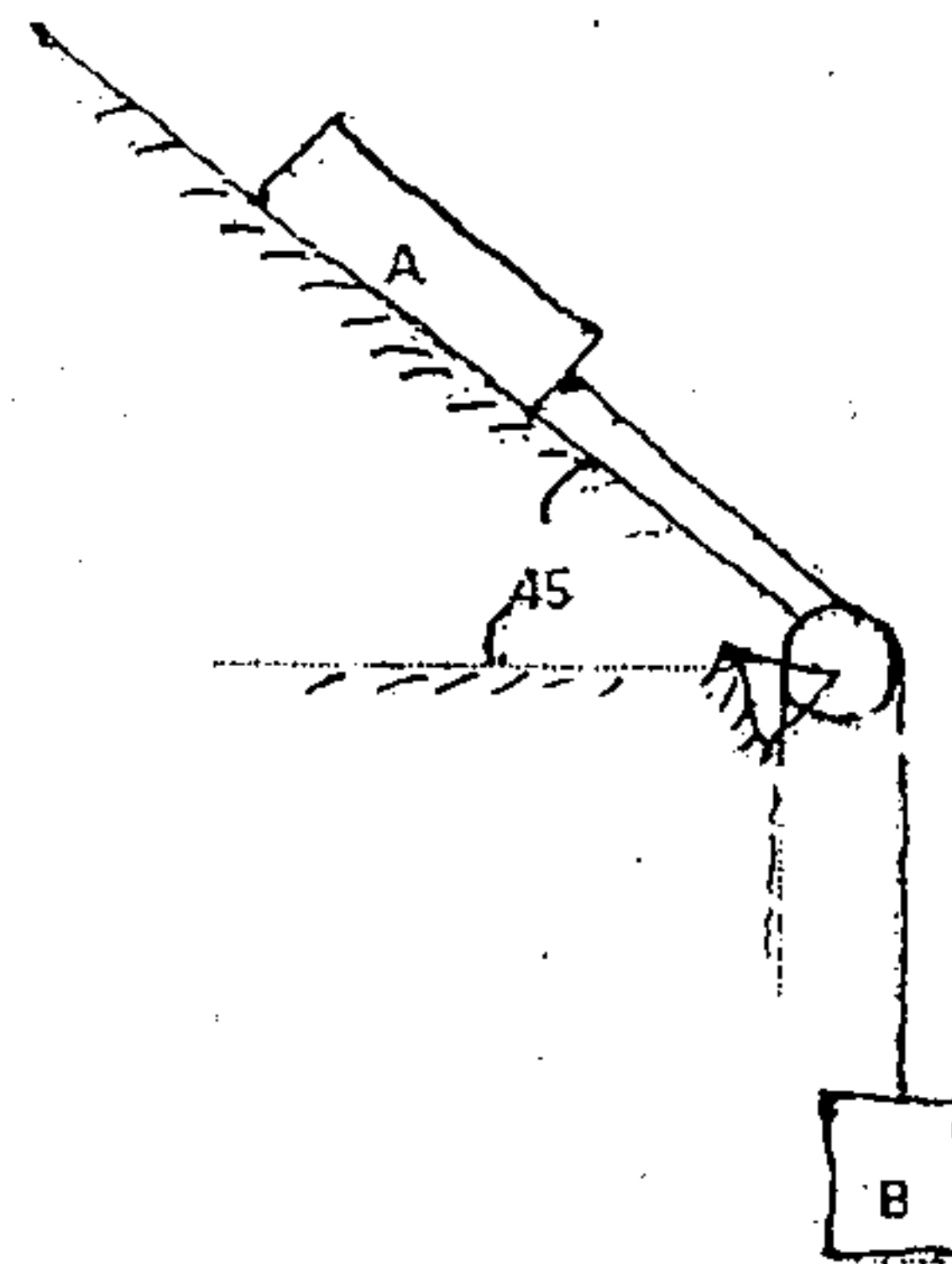
- b. A particle is projected with an initial velocity of  $2\text{m/s}$  along a straight line. [6]  
The relation between acceleration and time is given in the diagram. Draw v-t and s-t diagram



- c. A wheel of  $2\text{m}$  diameter rolls without slipping on a flat surface. The center of the wheel is moving with a velocity  $4\text{m/s}$  towards the right. Determine the angular velocity of the wheel and velocity of points P, Q and R on the wheel [6]



- Q.6 a. A force of 100 N acts at a point  $P(-2,3,5)$ m has its line of action passing through  $Q(10,3,4)$ m. Calculate moment of this force about origin  $(0,0,0)$ . [4]
- b. A ladder AB of length 3m and weight 25 kg is resting against a vertical wall and a horizontal floor. The ladder makes an angle 50 degrees with the floor. A man of weight 60 kg tries to climb the ladder. How much distance along the ladder he will be able to climb if the coefficient of friction between ladder and floor as 0.2 and that between ladder and wall as 0.3. Also find the angle the ladder should make with the horizontal such that the man can climb till the top of the ladder. [8]
- c. A particle moves along a track which has a parabolic shape with a constant speed of 10m/sec. The curve is given by  $y = 5 + 0.3x^2$ . Find the components of velocity and normal acceleration when  $x=2$ m. [4]
- d. Two blocks A and B connected as shown in the diagram. The string is inextensible. Mass of A and B are 3kg and 5kg respectively. If the coefficient of friction between A and inclined plane is 0.25 determine the tension on the strings and accelerations of A and B. [4]





FE (Sem. I) (E.) (CBCRS) - 26/12/14  
Environmental Studies

**(REVISED COURSE)**

(2 Hours)

QP Code : **11962**

[ Total Marks : 60

- N.B. :** (1) Question No.1 is **compulsory**.  
(2) Answer any **three** from questions nos. 2 to 6.  
(3) **Draw** neat labelled diagrams wherever **necessary**.

1. Solve any **five** of the following :— 15
- (a) Explain ecological pyramid.
  - (b) Define sustainable Development.
  - (c) What are different air pollutants?
  - (d) What is meant by E- pollution?
  - (e) What is the role of ministry of Environmental and forests?
  - (f) What are renewable and non-renewable resources?
  - (g) How indoor pollution is caused?
2. Solve the following:—
- (a) List out objectives of Environmental Education. 5
  - (b) What is solid waste management? Explain solid waste management by Land Filling. 5
  - (c) Explain briefly how photovoltaic cells are useful in harnessing solar energy. 5
3. Solve the following :—
- (a) With the help of neat diagram, Explain working of bag house filter. 5
  - (b) What are important functions and powers of central pollution control board? 5
  - (c) Explain the concepts and objectives of green building. 5
4. Solve the following :—
- (a) Explain the terms producers, consumers and decomposers. 5
  - (b) Explain salient features of Environmental Protection Act. 5
  - (c) What is hydel energy? Explain briefly the process of hydropower generation. 5
5. Solve the following :—
- (a) How resource utilization as per carrying capacity is important for sustainable development? 5
  - (b) Explain briefly industrial waste water treatment. 5
  - (c) Draw rough sketch and explain how electricity can be generated from wind energy. 5
6. Solve the following :—
- (a) Explain need and importance of environmental studies. 5
  - (b) Define terms noise pollution and explain its sources as well as ill effects. 5
  - (c) Explain various techniques for managing earthquakes. 5