

- N. B :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions from the remaining six questions.
 (3) **Figures** to the **right** indicate marks.

1. (a) Prove that the fourth power of $(1 + 7i)(2 - i)^{-2}$ is a negative real number. 3
 (b) If $Y = \frac{x}{(x+1)^4}$, find Y_n . 3
 (c) Show that $[\bar{d} \times (\bar{a} \times \bar{b})] \cdot (\bar{a} \times \bar{c}) = [\bar{a} \bar{b} \bar{c}] (\bar{a} \cdot \bar{d})$ 3
 (d) If $x = (1 - y)(1 - 2y)$, prove that $Y = 1 + x - 2x^2 + \dots$ 3
 (e) If $u = (1 - 2xy + y^2)^{1/2}$, prove that $x u_x - Y u_y = Y^2 u^3$. 4
 (f) Find the maximum value of xy subject to the condition $x + y = 16$ using Lagrange's method of undetermined multiplier. 4

2. (a) Show that : $\tan 7\Theta = \frac{7 \tan \Theta - 35 \tan^3 \Theta + 21 \tan^5 \Theta - \tan^7 \Theta}{1 - 21 \tan^2 \Theta + 35 \tan^4 \Theta - 7 \tan^6 \Theta}$. 6
 (b) Separate into real and imaginary parts $\log \frac{(1+i)}{(1-i)}$ 6
 (c) If Z is homogeneous function of two variables x and y of degree 'n' then prove that : 8

$$x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = n(n-1)z.$$

Hence find the value of $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} + x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y}$ at $x = 1, y = 2$.

$$\text{Where } Z = \frac{x^3 + y^3}{y \sqrt{x}} + \frac{1}{x^7} \sin^{-1} \left(\frac{x^2 + y^2}{x^2 + 2xy} \right).$$

3. (a) Find the value of 'C' in the conclusion of Lagrang's Mean value theorem for the function x^3 on $[2, 3]$. 6
 (b) If \bar{a}, \bar{b} are constants and $\bar{r} = \bar{a} \cos nt + \bar{b} \sin nt$, prove that : 6

$$(i) \bar{r} \times \frac{d\bar{r}}{dt} = n(\bar{a} \times \bar{b})$$

$$(ii) \frac{d^2 \bar{r}}{dt^2} + n^2 \bar{r} = 0.$$

- (c) (i) Prove that $\sec^2 x = 1 + x^2 + \frac{2x^4}{3} + \dots$ 4
- (ii) Prove that $\sin(e^x - 1) = x + \frac{x^2}{2} - \frac{5}{24}x^4 + \dots$ 4
4. (a) Prove that $x^5 - 1 = (x - 1) \left(x^2 + 2x \cos \frac{\pi}{5} + 1 \right) \left(x^2 + 2x \cos \frac{3\pi}{5} + 1 \right) = 0$. 6
- (b) Test the convergence of the series $2 + \frac{3}{2}x + \frac{4}{3}x^2 + \frac{5}{4}x^3 + \dots$, $x > 0$. 6
- (c) If $Y = e^{a \sin^{-1} x}$, prove that : 8
- $$Y_{2m}(0) = a(a^2 + 2^2)(a^2 + 4^2) \dots (a^2 + (2m-2)^2).$$
- $$Y_{2m+1}(0) = a^2(a^2 + 1^2)(a^2 + 3^2) \dots (a^2 + (2m-1)^2)$$
5. (a) If $Y = \frac{\log x}{x}$, prove that $Y_5 = \frac{5!}{x^6} \left[1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} - \log x \right]$. 6
- (b) Evaluate $\lim_{x \rightarrow a} \left(2 - \frac{x}{a} \right)^{\tan \left(\frac{\pi x}{2a} \right)}$. 6
- (c) (i) Show that if $(x y z)^b (x^a i + y^a j + z^a k)$ is an irrotation vector then either $b = 0$ or $a = -1$. 4
- (ii) If \bar{r} is the position vector of a point (x, y, z) and r is the modulus of \bar{r} then prove that $r^n \bar{r}$ is an irrotational vector for any n but Solenoidal only if $n = -3$. 4
6. (a) If $u = f(x^2 + 2y^2, y^2 + 2zx)$, prove that : 6
- $$\left(Y^2 - zx \right) \frac{\partial u}{\partial x} + \left(x^2 - Yz \right) \frac{\partial u}{\partial y} + \left(z^2 - xy \right) \frac{\partial u}{\partial z} = 0.$$
- (b) Find the directional derivative of $\phi = x^2 y + y^2 z + z^2 x$ at $(2, 2, 2)$ in the direction of the normal to the surface $4x^2 y + z x^2 = 2$ at the point $(2, -1, 3)$. 6
- (c) If $x + iy = C \cdot \cot(u + iv)$ show that 8
- $$\frac{X}{\sin 2u} = \frac{-Y}{\sin h 2v} = \frac{C}{\cosh 2V - \cos 2u}.$$
7. (a) If $u = x^2 y$ and $x^2 + xy + y^2 = 1$, find $\frac{dy}{dx}$. 6
- (b) Find the maximum and minimum values of $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$. 6
- (c) Show that $\tan^{-1} i \left(\frac{x-a}{x+a} \right) = \frac{i}{2} \log \frac{x}{a}$. 8

Con. 6879-13.

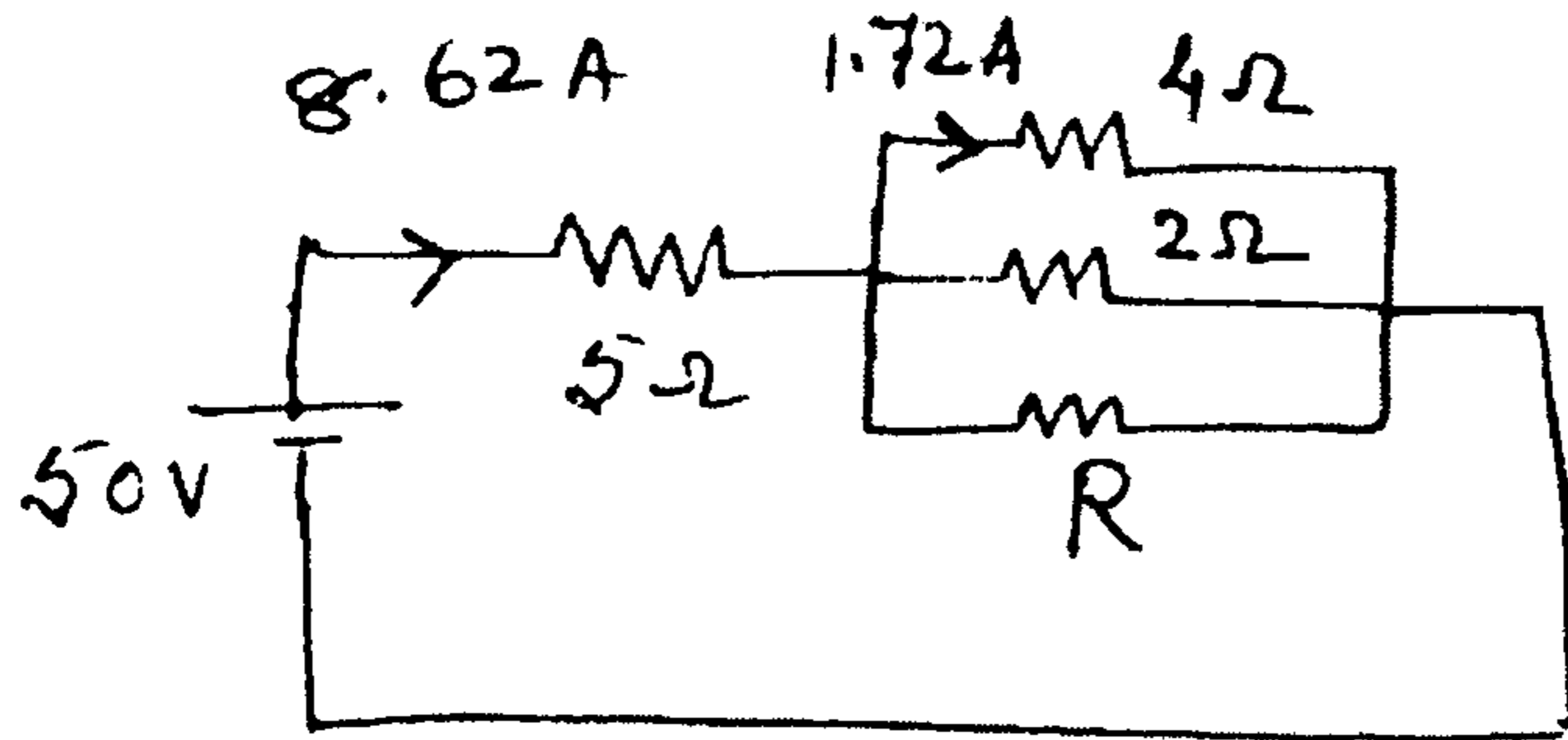
LJ-10073

(3 Hours)

[Total Marks : 100]

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

1. (a) Write down the conditions of series resonance. Plot frequency versus current. 3
 (b) Find the value of unknown resistor 3



- (c) 3
-

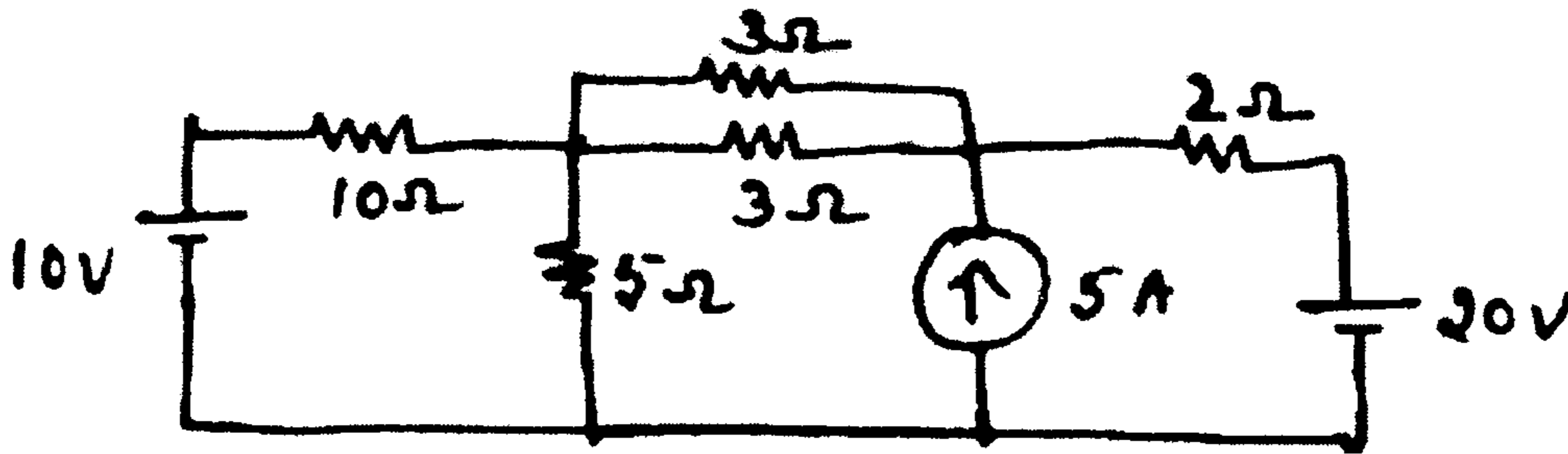
Find the Thevenin's equivalent circuit across A B.

- (d) Define R.M.S. value. 2
 (e) Write down the phase-line relationship in star and delta connection. 2
 (f) Derive the e.m.f. equation of a single phase transformer. 3
 (g) What is the working principle of DC generator? 2
 (h) Draw and explain the V-I characteristics of Zener diode. 2

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2. (a) Determine the current through 10Ω resistor using Nodal analysis

6



- (b) An ac circuit consists of a pure resistance and an inductive coil connected in series. The power dissipated in the resistance and in the coil are 1000 W and 200 W respectively. The voltage drop across the resistance and the coil are 200 V and 300 V respectively. Calculate the following :-

6

- (i) Resistance of the pure resistor.
- (ii) Resistance and reactance of the coil.
- (iii) Power factor of the coil and the total circuit.

- (c) Each phase of star connected load consist of a 50 mH inductor connected in series with 50Ω resistor. The load is connected to a three phase 400 V, 50 Hz supply.

8

Find :-

- (i) Phase current
- (ii) Line current
- (iii) Power drawn
- (iv) Power factor.

3. (a) The open circuit and short circuit test reading of a 10KVA, 450/120 V, 50 Hz single phase ac transformer are as follows :-

8

O.C test (L.V side) $V_o = 120V$, $I_o = 4.2 A$, $W_o = 80W$ S.C test (H.V side) $V_{sc} = 9.65V$, $I_{sc} = 22.2A$ $W_{sc} = 120W$

Compute the following :-

- (i) Draw the equivalent circuit and mark the circuit constants.
- (ii) Efficiency and regulation at full load and 0.8 pf lag.
- (iii) The maximum efficiency at 0.8 pf lag.

- (b) Derive condition for maximum efficiency of a single phase transformer.

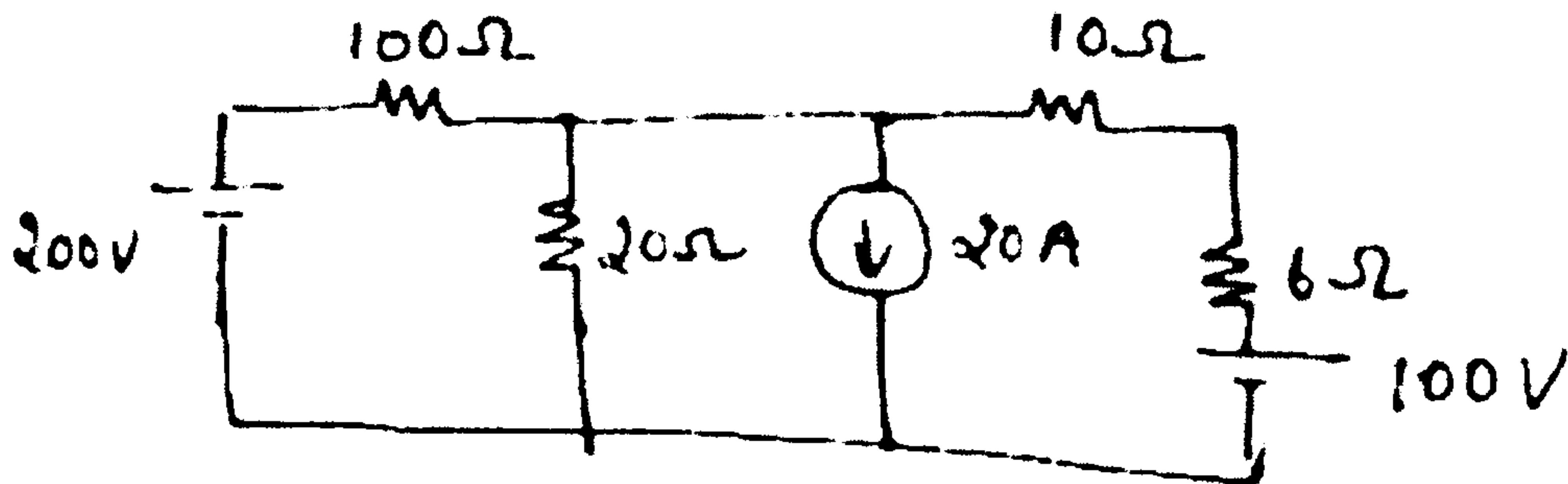
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- (c) Explain the generation of rotating magnetic field in a three phase induction motor.

8

4. (a) Find current through 100Ω using superposition theorem.

7



- (b) A coil of resistance 20Ω and inductance 0.1H is connected in series with a capacitor of $200\mu\text{F}$ capacitance across a supply voltage of 230V , 50Hz ac. Find the resonance frequency. Also calculate the current through the circuit.

4

- (c) Two watt meters are used for measuring the power input and the power factor of a load. If the reading of the meters are $W_1 = 2\text{ kW}$ and $W_2 = 7\text{ kW}$, find power input and power factor.

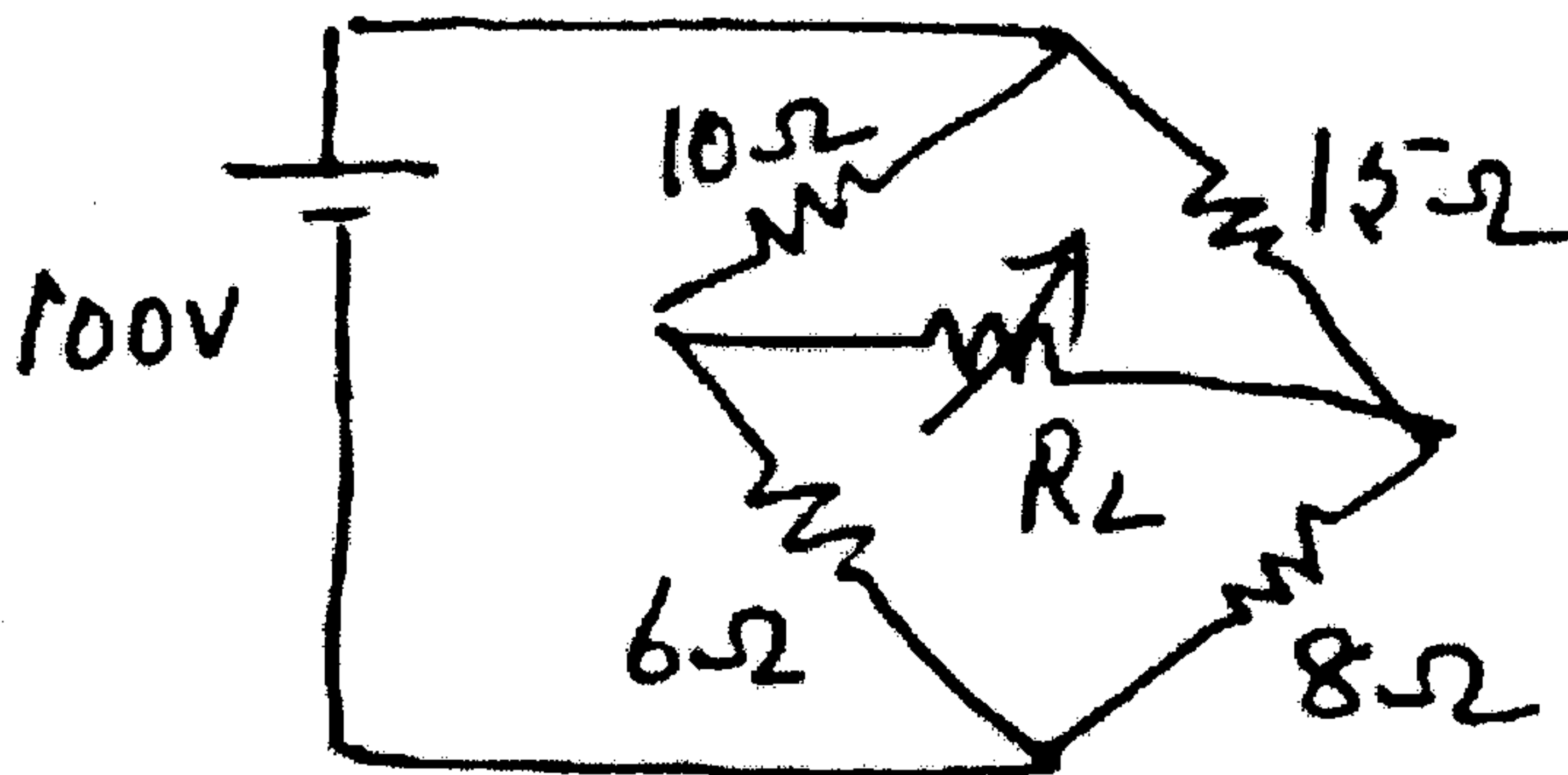
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- (d) Draw and explain the working of a single phase bridge rectifier. Derive the expression of ripple factor.

5

5. (a)

7



Find the value of R_L which deliver maximum power across it and what is the maximum power.

- (b) In an R-L-C series circuit current lags behind applied voltage by 45° . The voltage across the inductance has maximum value equal to twice the maximum value of voltage across capacitance. The voltage across inductance is $300 \sin(1000t)$ and $R = 20\Omega$. Find the values of inductance and capacitance.

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(c) A 5kVA distribution transformer has a full load efficiency of 95% at which copper loss is equal to iron loss. The transformer is loaded in a 24 hour period as follows :- 8

No load for 10 hrs.

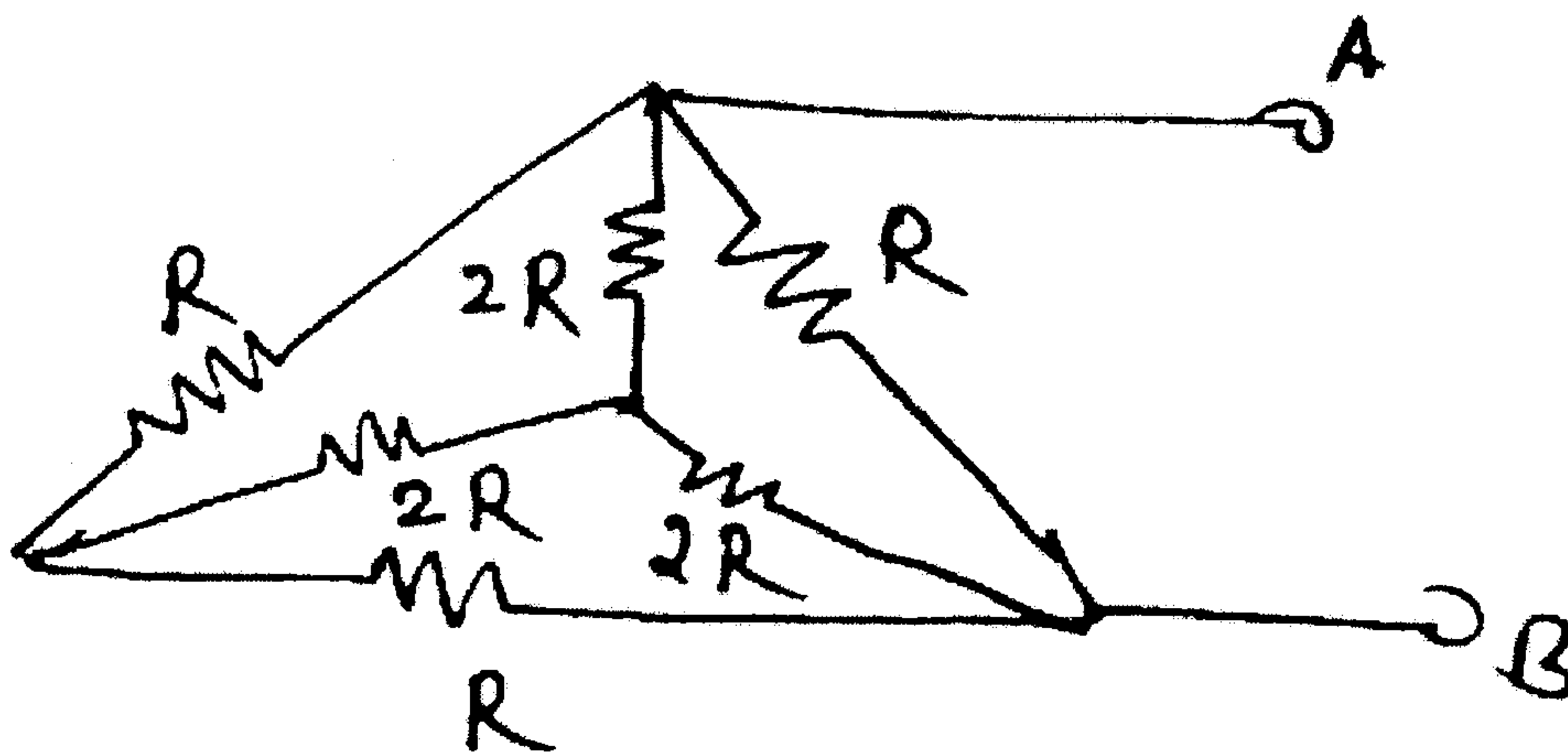
$\frac{1}{4}$ full load for 7 hrs.

$\frac{1}{2}$ full load for 5 hrs.

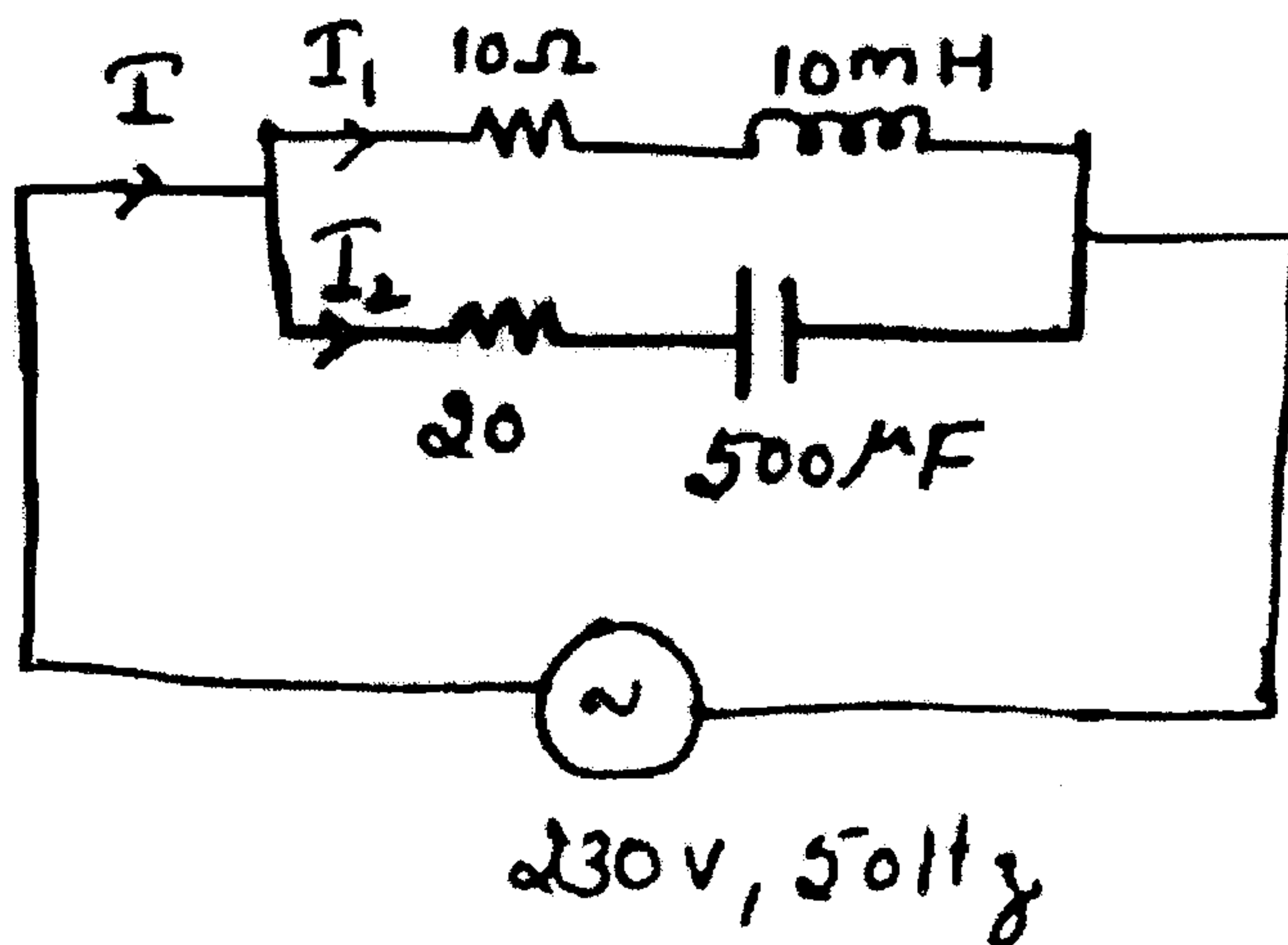
Full load for 2 hours.

Calculate the All-day efficiency of the transformer.

6. (a) Determine the resistance between A and B. 7



(b) Find I , I_1 , I_2 and power factor of the whole circuit. 7



(c) Show that sum of the reading of wattmeter in a two wattmeter power measurement method gives active power. Draw circuit diagram and phasor diagram. 6

Con. 6879-LJ-10073-13.

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7. (a) Draw complete phasor diagram of a single phase transformer connected to a lagging load. **5**
- (b) Explain double field revolving theory for single phase induction motor. **5**
- (c) Draw the experimental setup of a common emitter configuration and explain input and output characteristics. **5**
- (d) Draw power triangle for R-L circuit and mark all the sides. Write down the equation and units of all power. **2**
- (e) Define cycle, time period, frequency, phase and phase difference with respect to an ac circuit. **3**
-

Con. 6885-13.

LJ-10080

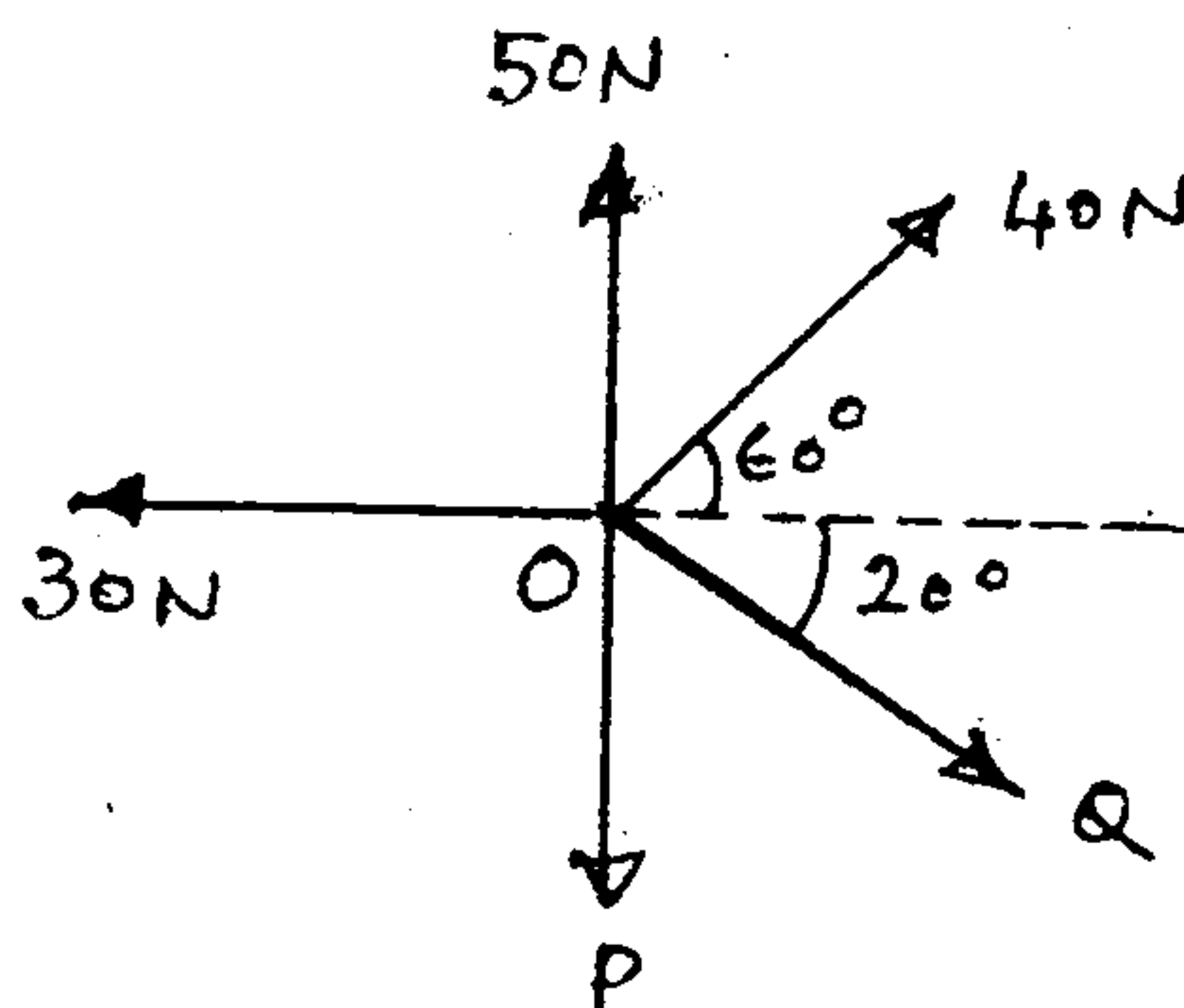
(OLD COURSE)

(3 Hours)

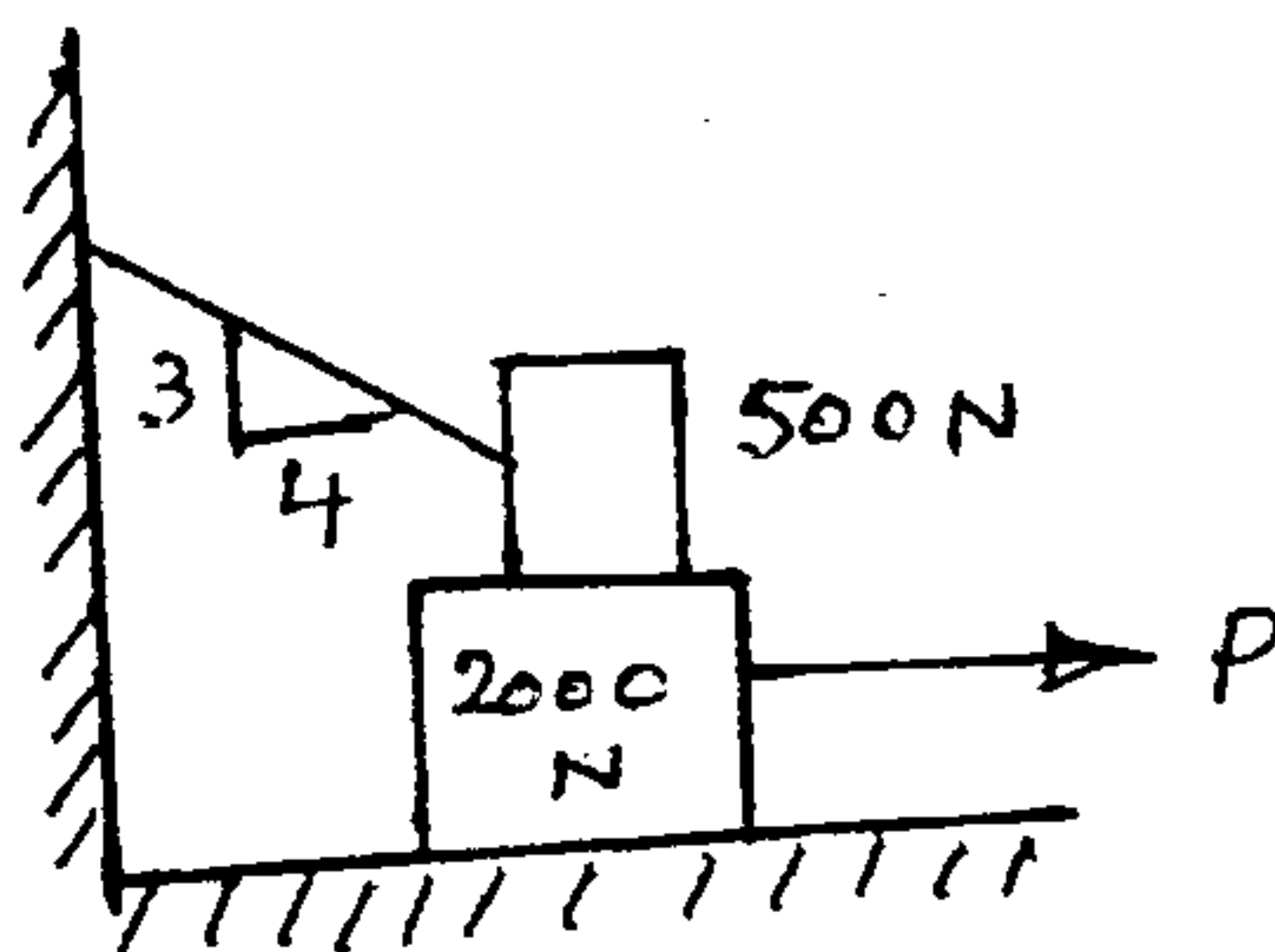
[Total Marks : 100

- N.B. : (1) Question No. 1 is compulsory.
(2) Answer any four questions from the remaining six.
(3) Assume suitable data if necessary.

1. Attempt all five questions :- 20
- Determine the resultant of three forces originating from point (3, -3) and passing through the points as indicated. 126 N through (8, 6), 183 N through (2, -5) and 269 N through (-6, 3).
 - Explain the method of identifying zero force members in truss with example.
 - Prove $\frac{T_1}{T_2} = e^{\mu\theta}$ in case of belt drive.
 - Water flows from a horizontal pipe fixed at a height of 2 m from the ground. If water falls at a distance of 3 m horizontally, find the speed of water as it leaves the pipe.
 - Write short notes on coefficient of restitution.
2. (a) Five forces act on a body as shown in figure. Find the magnitude of forces P and Q 8
such that the resultant of five forces is zero.



- (b) In the system shown determine the horizontal force P and tension in the rope T for pulling the lower block. Take $\mu = 0.3$ for all contact surfaces. Weight of upper and lower blocks are 500 N and 2000 N. 6



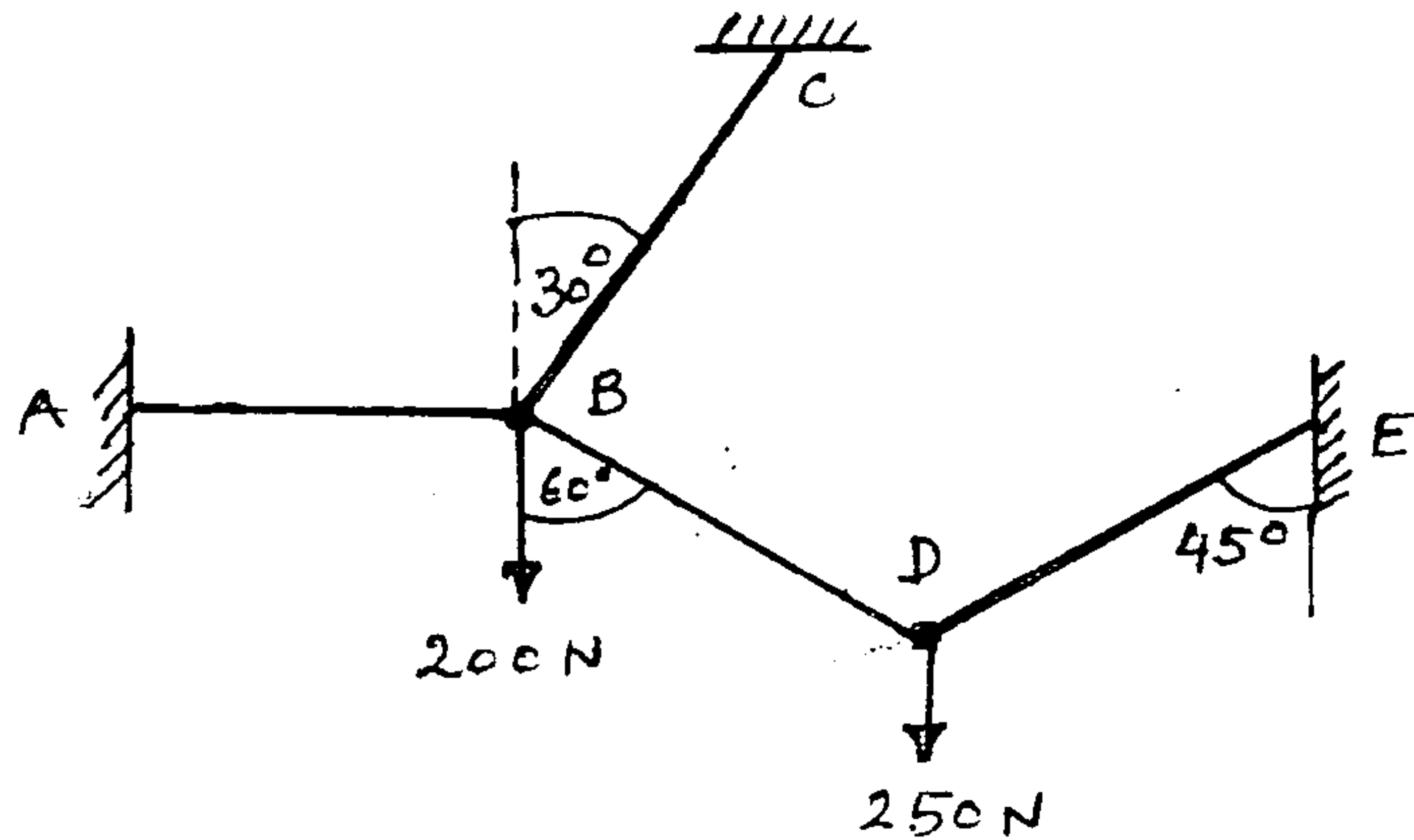
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Con. 6885- LJ-10080-13.

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(c) From Fundamentals obtain the maximum range of projectile. Sketch the figure neatly. 6

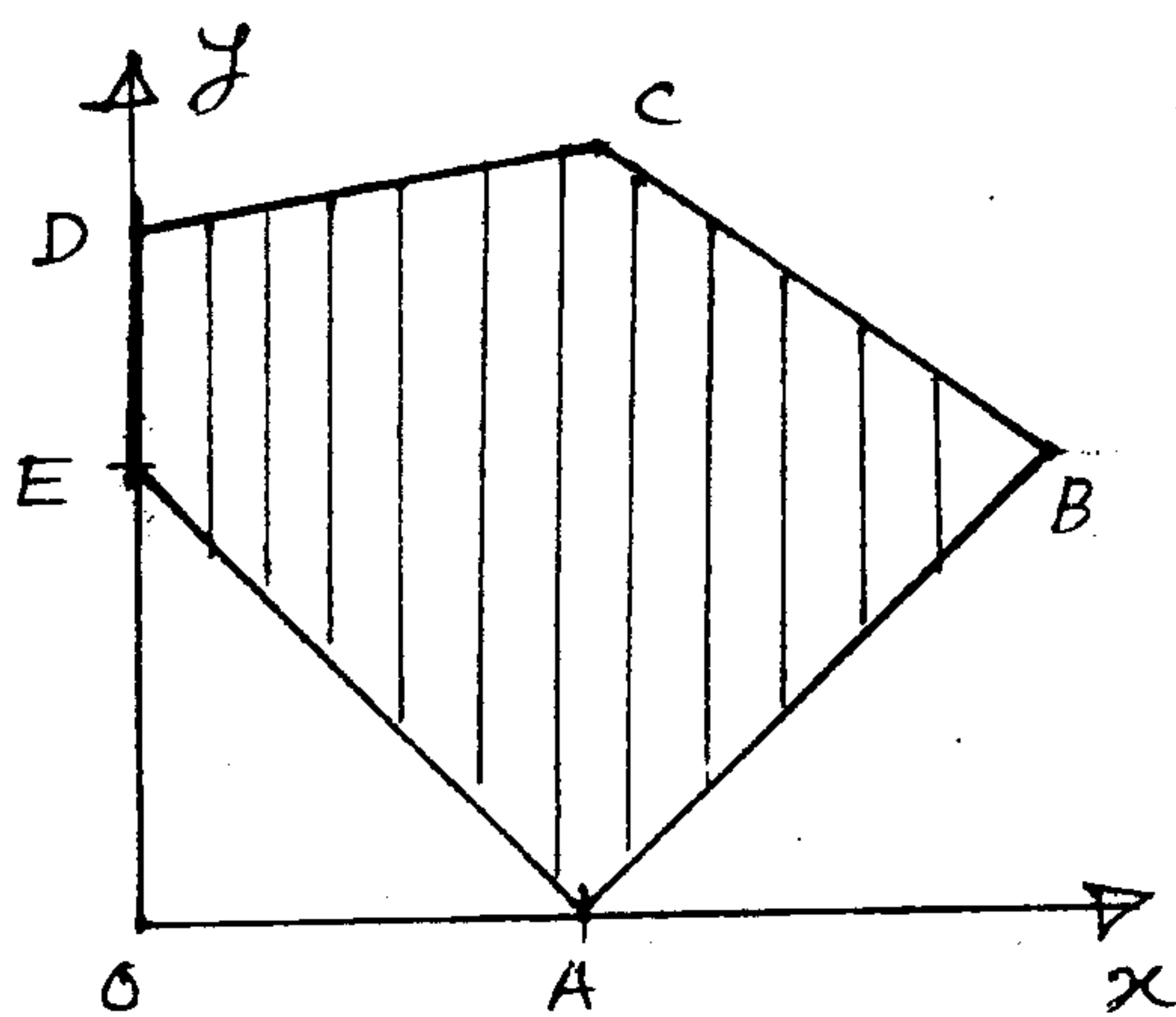
3. (a) Determine the forces in various segments of the cable. Vertical forces 200 N and 250 N acts at point B and D. 8



(b) A car starts from rest on a curved road of radius 250 m and accelerates at a constant tangential acceleration of $0.6 \frac{m}{s^2}$. Determine the distance and the time for which it will travel before the magnitude of the total acceleration attained by it becomes $0.75 \frac{m}{s^2}$. 6

(c) A wheel of 2 m diameter rolls without slipping on a flat surface. The centre of the wheel is moving with a velocity of 4 m/s towards right. Determine the angular velocity of the wheel. Which point on the wheel will have maximum velocity and which point of wheel has zero velocity? Sketch the arrangement. 6

4. (a) Determine X coordinate of centroid of lamina shown in figure. 4



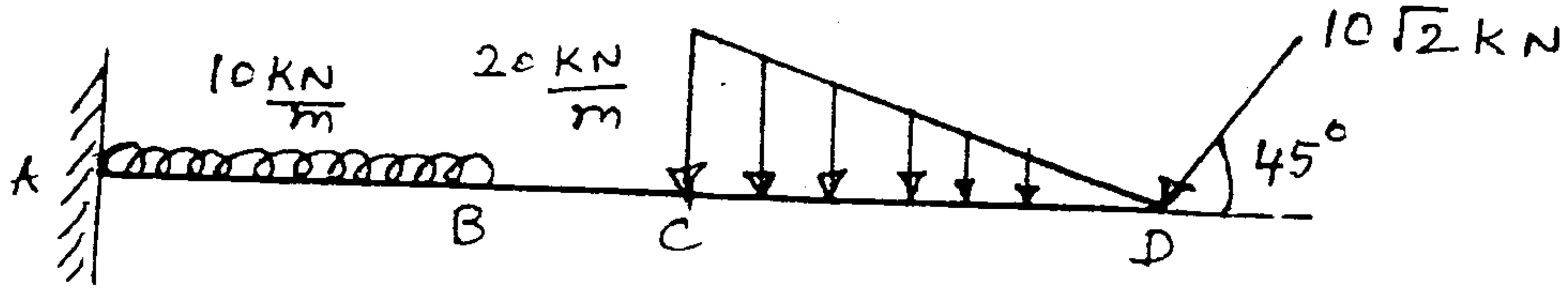
Coordinates are

- O → [0, 0]
- A → [75, 0]
- B → [175, 100]
- C → [75, 200]
- D → [0, 150]
- E = [0, 100]

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3

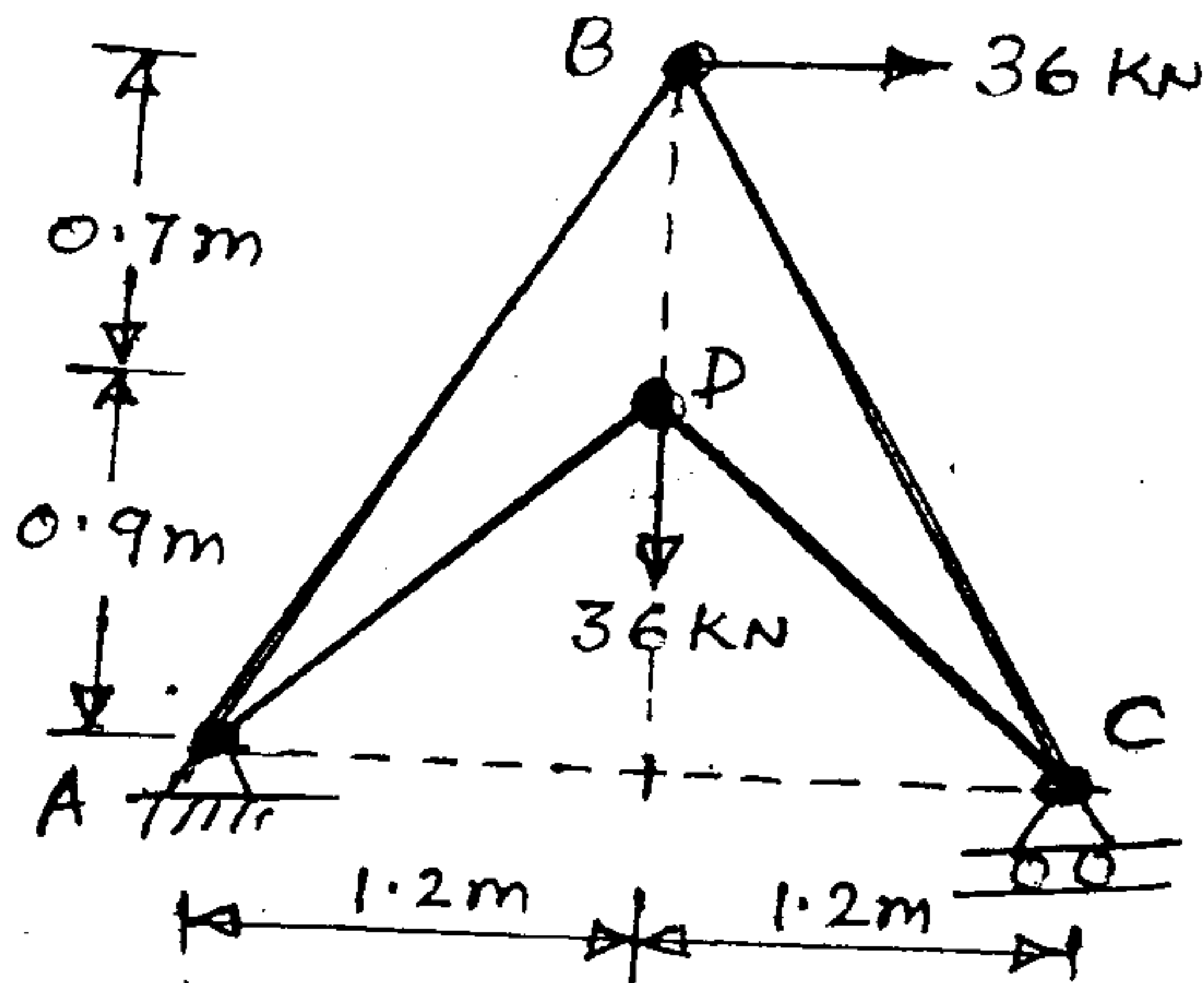
(b) Determine the support reactions of the beam loaded as shown in figure. 8



Take $AB = 4m$, $BC = 2m$ and $CD = 6m$

(c) Velocity of the particle starting from rest is given by $V = (3 + 4t) \frac{m}{s}$. Determine the distance travelled by the particle in the 6th second. What is its acceleration at the end of 5 seconds. At what time its velocity becomes $33 \frac{m}{s}$? 8

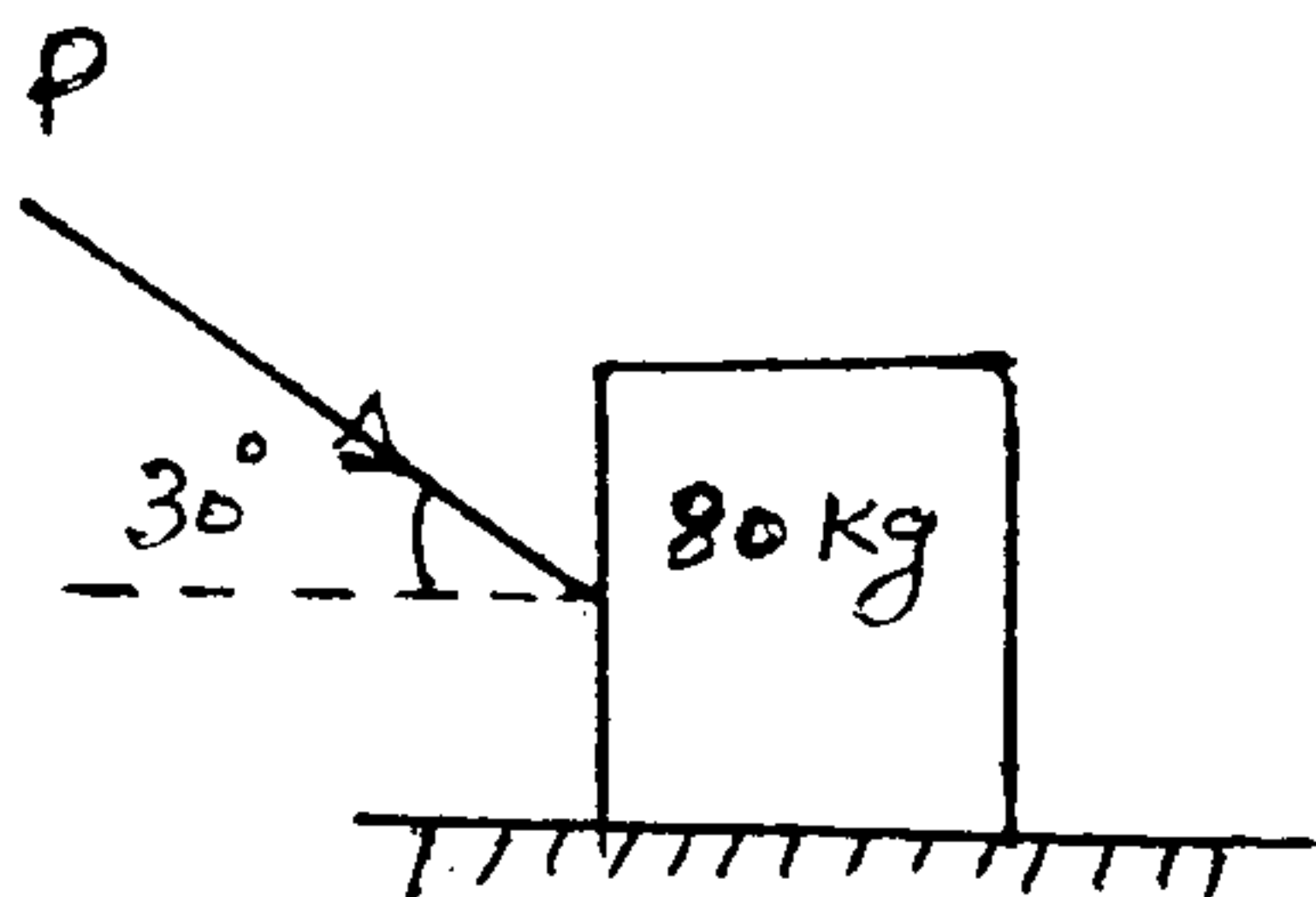
5. (a) Analyse the following truss :- 6



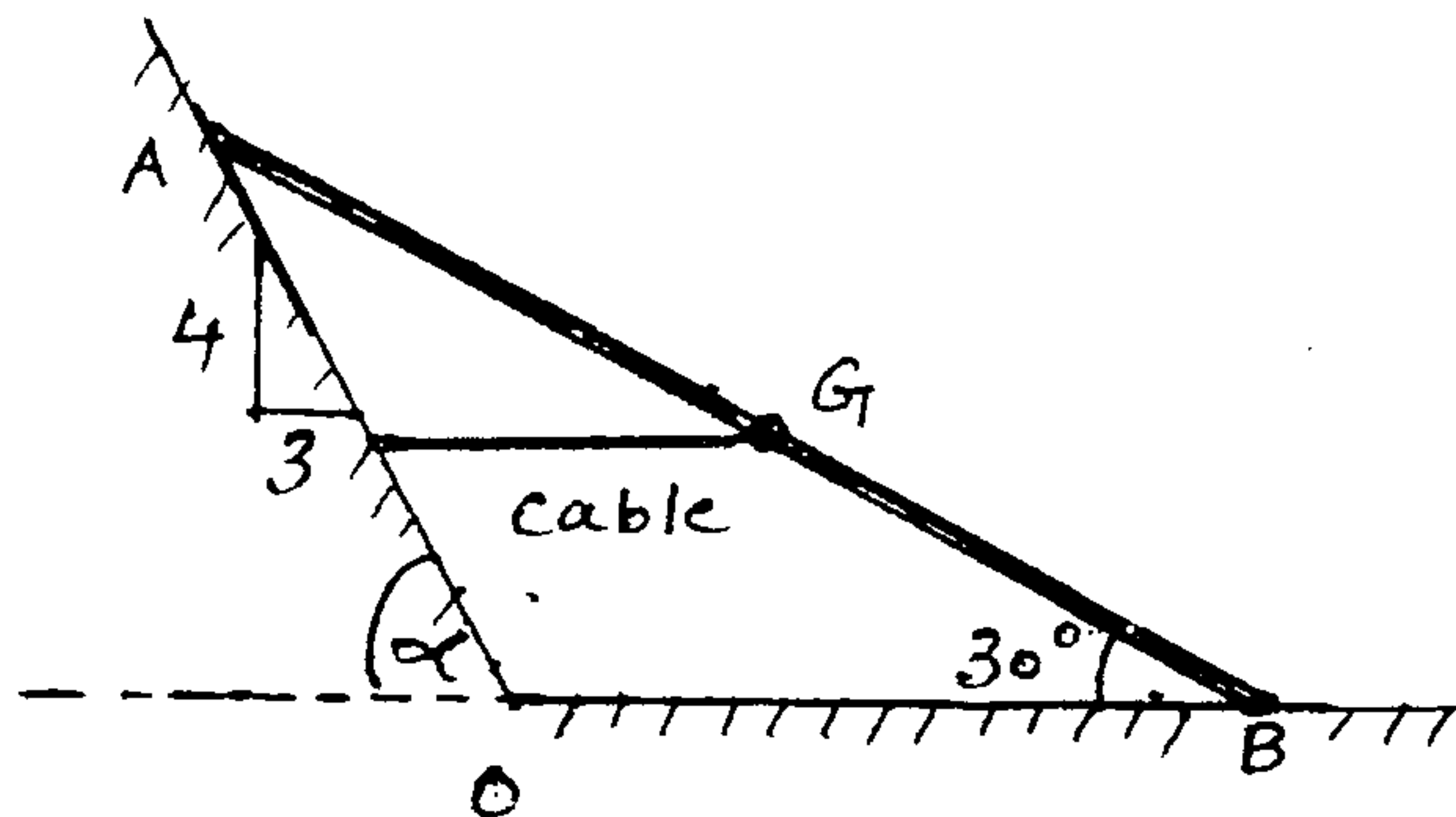
(b) Find the power transmitted by belt having following data. 8

- Angle of contact = 180° , Coefficient of friction = 0.2
- Weight of Belt = $4 \frac{N}{m}$, Maximum allowable Tension = 1300 N
- Belt Velocity = $20 \frac{m}{s}$

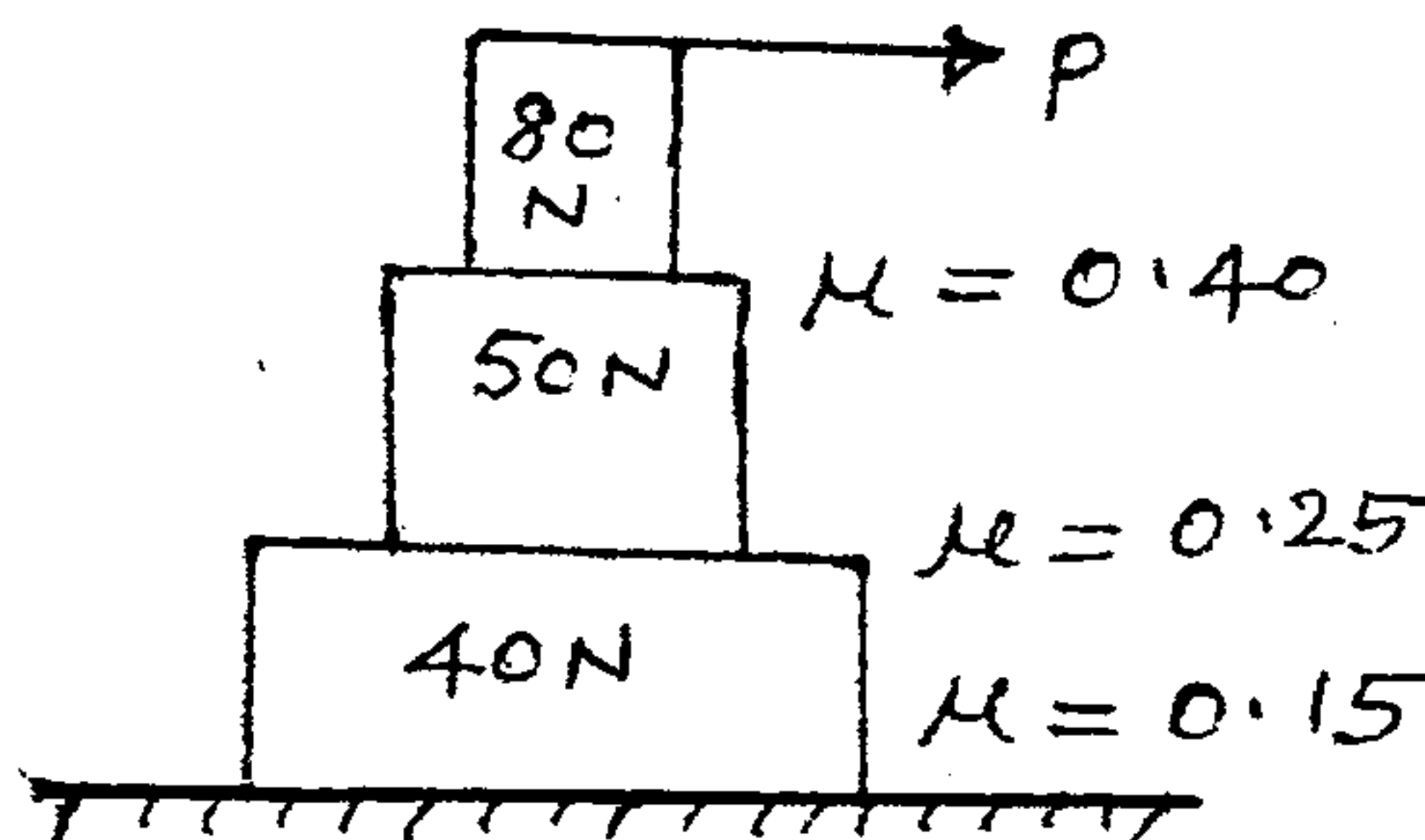
- (c) A 80kg block rests on a horizontal plane. Find the magnitude of force P required to give the block an acceleration of $2.5 \frac{m}{s^2}$ to the right. Take $\mu_k=0.25$ 6



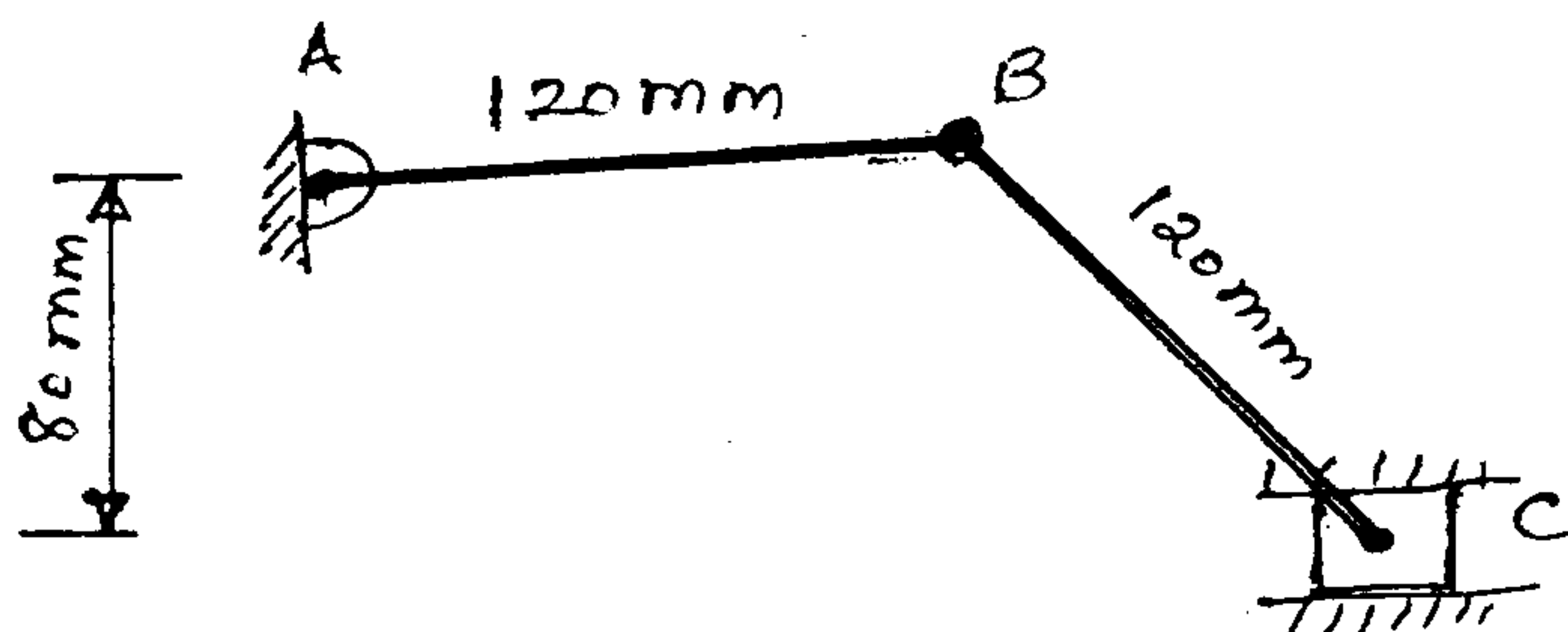
6. (a) Determine the mass of the pipe that can be supported as shown in figure. The maximum allowable tension in rope is 20kN. Neglect friction. Take. $AG = BG = 1.5$ m. 8



- (b) Three blocks are resting as shown in figure. Determine maximum value of P that will destroy the equilibrium. 6



- (c) At the position shown, the crank AB has an angular velocity of 3 r/s clockwise. Find the velocity of slider at C and angular velocity of rod CD. AB Horizontal. 6



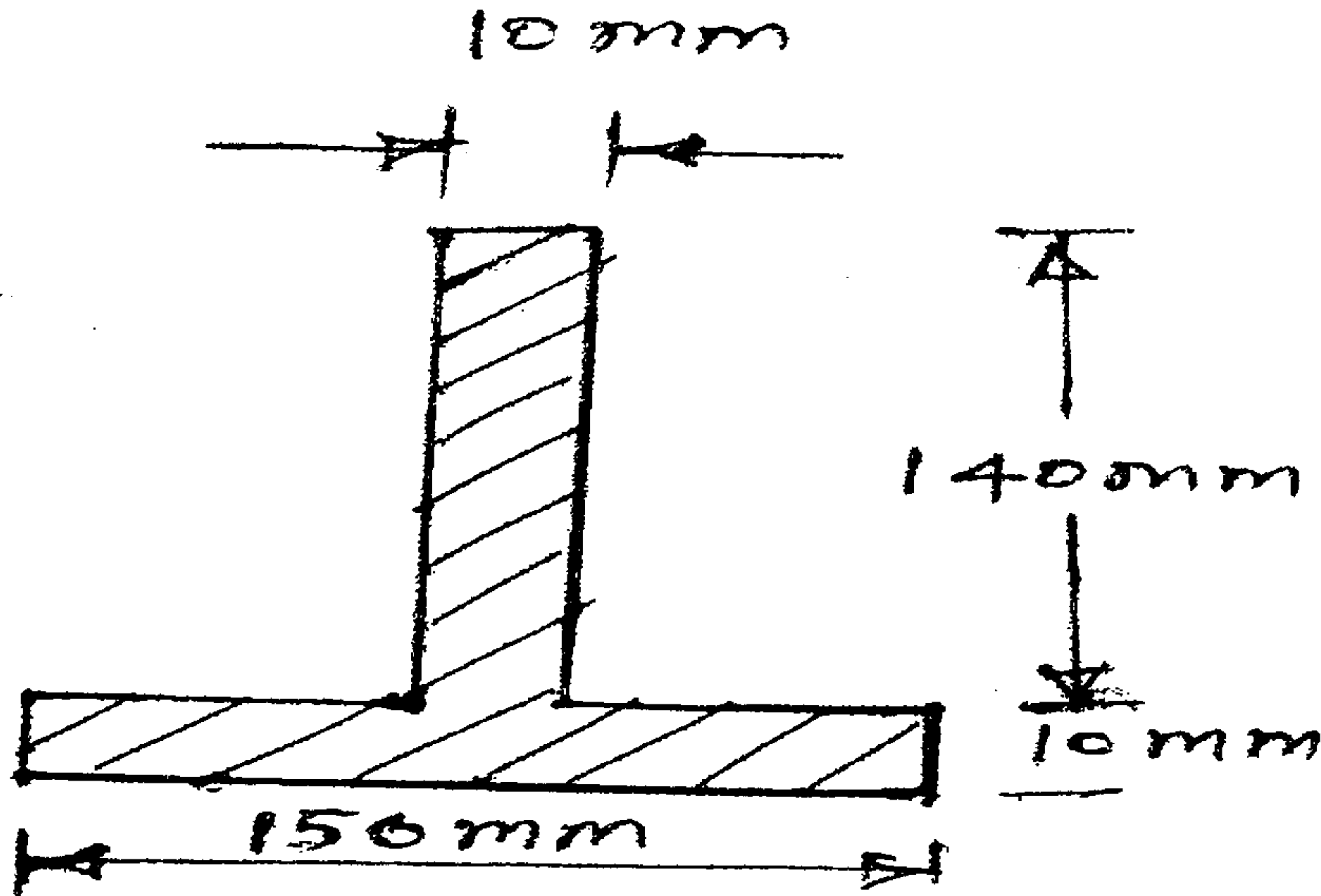
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Con. 6885- LJ-10080-13.

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7. (a) Find the moment of inertia about centroidal x-axis and y-axis.

6



(b) A collar of mass 15 kg starting from rest goes up due to applied force. The attached 8

spring has $K=3000 \frac{n}{m}$ and underformed length $l_0 = 1m$. Determine the velocity of collar when it has moved up by 0.9 m. Force is applied at an angle and magnitude of Force is 800 N. Neglect friction.

(c) A ball of mass 1 kg moving with a velocity of 3 m/s strikes a ball of mass 5 kg 6
moving with a velocity of 0.6 m/s in the same direction. Show that the direction of motion of the first ball is reversed. Find the loss of kinetic energy. Assume $e = 0.75$.

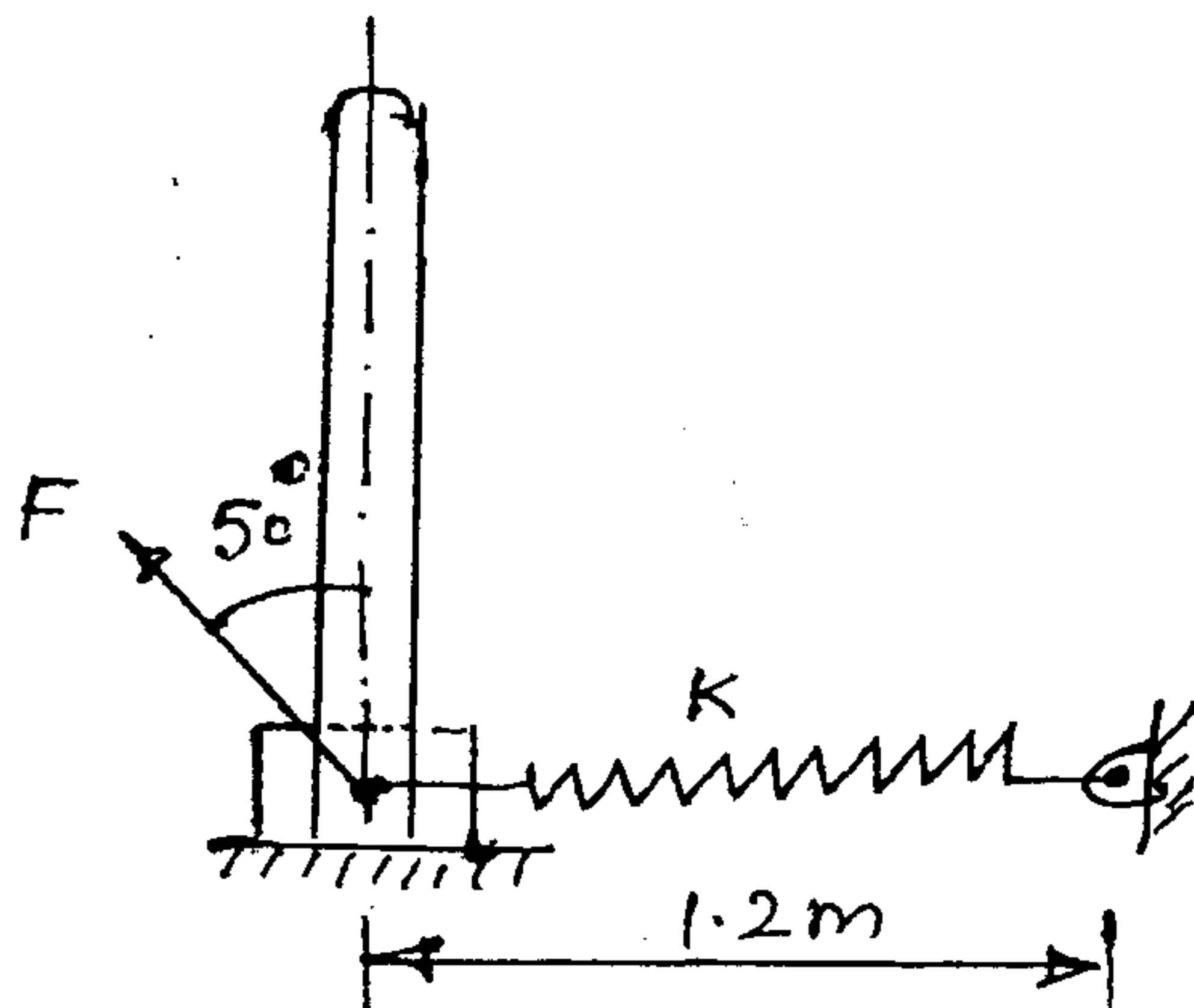


Fig. Q. 7 (b)

Con. 5555-13.

LJ-10090

(OLD COURSE)

(2 Hours)

[Total Marks : 75

- N. B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions from question. No. 2 to 7.
 (3) Use **suitable** data wherever **necessary**.
 (4) **Figures** to the **right** indicate **full** marks.
 (5) **Illustrate** your answer with **sketches** wherever **necessary**.

1. Attempt any **five** from the following:— 15
- (a) Calculate the lattice parameter of FCC lattice with molecular weight 60.2 and density 6250 kg/m^3 .
 - (b) State direct and inverse piezo-electric effect.
 - (c) Explain how crystal acts as 3-D diffraction grating for the incident X-rays ?
 - (d) What is fermi energy ? Explain the variation of fermi level with temperature in metal ?
 - (e) Write the difference between type-I & type-II superconductors ?
 - (f) State and explain Sabine's formula.
 - (g) Represent the following in cubic unit cell (120), (321) [101].
2. (a) State and explain Hall effect. Derive an expression for Hall voltage. Give its applications. 8
 (b) Calculate the distance between two adjacent atoms of NaCl crystal of FCC structure, which has density 2.818 gm/cm^3 and atomic weight of Na = 23 and Cl = 35.5. 7
3. (a) Explain the construction and working of CRT with neat labeled diagram. 8
 (b) Superconducting tin has critical temperature of 3.7 K at magnetic field and a critical field of 0.0306 tesla. Find the critical field at 2K. 7
4. (a) Explain different phases of Liquid crystals. 5
 (b) What are extrinsic semiconductors ? Explain variation of fermi level with impurity concentration with energy level diagram. 5
 (c) The volume of room is 1500 m^3 . The wall area of room is 260 m^2 , the floor area is 140 m^2 , an ceiling area is 140 m^2 . The sound absorption coefficient for the wall is 0.03, for ceiling is 0.8 and for the floor is 0.06. Calculate the absorption coefficient and reverberation time. 5
5. (a) Explain NaCl structure. 5
 (b) Explain the formation of depletion region in un-biased P-N junction diode. 5
 (c) Certain piezo-electric crystal of thickness 4 mm produces ultrasonic waves of frequency 400 kHz. Calculate the thickness of this crystal to produce ultrasonic frequency of 500 kHz. 5
6. (a) X-Rays are diffracted in the first order from (110) plane of calcite crystal with lattice constant 3.03 \AA at a glancing angle 9.6° . Calculate wavelength of X-rays. 5
 (b) Explain SQUIDS ? 5
 (c) Explain cavitation effect and echo sounding in case of ultrasonics. 5
7. (a) What is imperfection ? Explain point imperfections ? 5
 (b) Calculate the increase in the acoustic intensity level in dB. When the sound is doubled. 5
 (c) Write short note on Miller Indices of atomic plane. 5

Con. 6550-13.

LJ-10103

(2 Hours)

[Total Marks : 75]

- N.B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions from remaining **six**.
 (3) **Figures to the right** indicate **full** marks.

Atomic Weights :

H = 1, C = 12, O = 16, N = 14, S = 32, Cl = 35.5, Na = 23, Ca = 40, Mg = 24, Al = 27, Fe = 56

1. Answer any **five** :— 15
- Define BOD and COD. Give their significance.
 - What is crystallinity of a polymer? How are crystalline polymers different from amorphous polymers?
 - Under what conditions are semi solid lubricants used?
 - What are plain carbon steels? Give their classification with one property each.
 - Distinguish between conventional and non-conventional energy sources.
 - Explain the structure and properties of fullerenes.
 - Find the acid value of a used lubricating oil sample whose 10 ml required 5 ml of N/50 KOH during titration. State whether the oil is suitable for lubrication or not.
(Density of oil = 0.91 g/c.c.)
2. (a) Calculate lime (95% pure) and soda (90% pure) required for softening one million litres of water containing the following constituents :— 6
 $\text{Ca}(\text{HCO}_3)_2 = 81 \text{ ppm}$, $\text{Mg}(\text{HCO}_3)_2 = 73 \text{ ppm}$, $\text{CaSO}_4 = 68 \text{ ppm}$, $\text{H}_2\text{SO}_4 = 14.7 \text{ ppm}$,
 $\text{CO}_2 = 11.1 \text{ ppm}$.
- Name the different moulding methods for plastics. Explain extrusion moulding with a neat labelled diagram. 5
 - Describe the working of solar heating system using Flat plate collector. 4
3. (a) Give the synthesis, properties and uses of any **two** of the following :— 6
- Urea formaldehyde
 - Buna-N
 - Polymethylmethacrylate.
- Explain hydrodynamic lubrication Mechanism with the help of an example. 5
 - Describe the production of carbon nanotubes by the laser ablation method. 4
4. (a) Explain the following properties of lubricants with their significance :— 6
- Viscosity and viscosity index.
 - Cloud point and pour point.
- What is the reduced phase rule? Explain its application to the Pb-Ag system with the help of a phase diagram. 5
 - 0.5 gm of CaCO_3 was dissolved in dilute HCl and the solution diluted to 1 litre, with distilled water. 25 ml of this solution required 24 ml of EDTA. 50 ml of a hard water sample required 22.5 ml of same EDTA. 100 ml of the same water sample after boiling required 12 ml of same EDTA. Calculate all types of hardness in the water. 4

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Con. 6550–LJ-10103-13.

2

5. (a) Draw the phase diagram of water system. Derive all degrees of freedom from phase rule and correlate with the derivations from the phase diagram. **6**
- (b) Explain the process of demineralisation of water with the help of diagram and reactions. **5**
- (c) Define glass transition temperature. Explain the factors affecting it. **4**
6. (a) Classify carbon nanotubes. Give their applications in the following fields : Catalysis, Electronics and Medicine. **6**
- (b) Explain activated sludge method of treatment of wastewater with a flow chart. **5**
- (c) Write a note on Nickel-Hydrogen batteries. **4**
7. (a) Write short notes on any **two** :— **6**
- (i) Conducting polymers.
- (ii) Compounding of plastics.
- (iii) Polymer composite materials.
- (b) Discuss the process of reverse osmosis with a diagram. Compare with ultrafiltration. **5**
- (c) Write a short note on special steels. **4**

F.E. - Sem I - CP-1 - (old)
24/12/2013

shilpa-2nd half-(b)13-65

Con. 5559-13.

(OLD COURSE)

LJ-10111

(3 Hours)

[Total Marks : 100

- N. B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions from the **remaining** questions.

1. (a) Find the output of the following :-

10

- (i)

```
# include < iostream.h >
int main ( )
{
    int a = 8 ;
    cout << "value =" << - a ;
    a = - a ;
    cout << "value =" << - a ;
    return 0 ;
}
```
- (ii)

```
# include < iostream.h >
# include < conio.h >
void main ( )
{
    int a, b, c ;
    a = 21 ; b = 37 ;
    c = a & b ;
    cout << "operand 1 and operand 2" << c ;
}
```
- (iii)

```
# include < stdio.h >
main ( )
{
    char c [2] = "A" ;
    printf ( "\n% c", c[0] ) ;
    printf ( "\n% s", c ) ;
}
```

[TURN OVER

- (iv) Point out the errors, if any, in the following programs –

```
# include < stdio.h >
main ( )
{
    struct
    {
        char name [25] ;
        int language [10] ;
    } ;
    struct employee e = {"Hacker", "c"} ;
    printf ( "\n% s% d", e.name, e.language ) ;
}
```

- (v) Ten float values are to be stored in memory what would you prefer, an array or a structure ?

- (b) Explain scope resolution operator in c++. 5
- (c) Explain are the benefits of object oriented programming. 5
2. (a) Explain ternary operators with example. 5
- (b) Explain the concept of Parameterized constructor. 5
- (c) Write a program to print the following pattern using control structures – 10
- ```

A B C D C B A
 A B C B A
 A B A
 A
```
3. (a) Explain pre / post Increment Decrement operator with example. 5
- (b) What is recursion ? Write a recursive program to find factorial of a given number. 5
- (c) Write a program to check whether the given string is Palindrome or not. 5
- (d) What is Union ? Explain it with example ? 5
4. (a) Write a program to find largest of three numbers using conditional operator. 5
- (b) Explain operator overloading of binary operator with using friend function. 5
- (c) Write a program to find area and perimeter of rectangle using pure virtual function. 10

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5. (a) Explain the static storage class. 5  
(b) Write a program to find sum of diagonal elements of matrix. 5  
(c) Write a program to find cube and square of a square using dynamic binding. 5  
(d) Explain the concept of copy constructor. 5
6. (a) Write a program to swap two numbers using pointers. 5  
(b) Define a structure within structure consisting of following elements – 5  
    Employee code  
    Employee name  
    Employee salary  
    Employee date  
Write a program to read at least 3 records and display them.
- (c) What is an operator function ? Describe the syntat of operator function. 5  
(d) What is virtual function ? What is the need of virtual function ? 5
7. (a) Write a short note on Data abstraction and Data Encapsulation. 5  
(b) Write a c++ program to implement single inheritance. 5  
(c) What are the various visibility specifier ? When do we use the protected visibility specifier to a class member ? 5  
(d) Differentiate between c and c++. 5

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