C

10035

Reg. No:_______________ Name:______________________

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST/SECOND SEME[illegible]EE EXAMINATION JULY 2016.

BE 100 - ENGINEERING MECHANICS

Time : 3 Hours Maximum Marks : 100

Part – A

Answer all the questions. Each question carries 5 Marks (8 X 5 = 40 Marks)

1. Explain the conditions of equilibrium of two force and three force members.
2. Calculate the reactions at A and B of the given loaded beam (Fig.1).

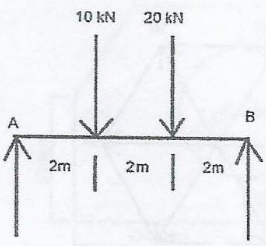


Fig.1

3. Locate the centroid of the 'T' section shown in Fig.2

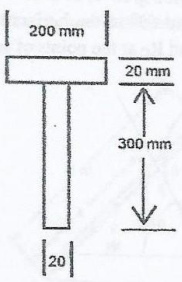


Fig.2

4. Define angle of friction, coefficient of friction and cone of friction.
5. State and explain D'Alembert's principle

C

6. Explain the concepts of instantaneous centre with figure.
7. Explain the following terms with respect to a simple harmonic motion

(a) amplitude (b) time period (c) frequency

8. How can we connect two springs in series? Draw a diagram. Stiffness of two springs are k_1 and k_2. Then what will be the stiffness of the combined system in series? Arrive at the expression.

Part – B

Answer two questions from each SET

SET I

Each question carries 10 Marks (2 X 10 = 20 Marks)

9. Concurrent forces 1, 3,5,7,9 and 11N are applied at the centre of regular hexagon acting towards its vertices as shown in Fig. 3. Determine the magnitude and direction of the resultant.

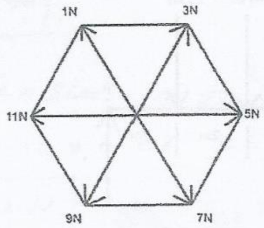


Fig.3

10. A ball of weight 120N rests in a right angled groove, as shown in Fig.4. The sides of the groove are inclined at an angle of 30° and 60° to the horizontal. If all the surfaces are smooth, then determine the reaction R_A and R_C at the points of contact.

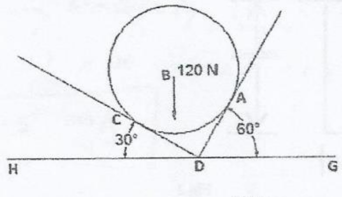


Fig.4

C

11. A system of parallel forces is acting on a rigid bar as shown in Fig.5. Reduce this system to a) a single force b) a single force and a couple at A.

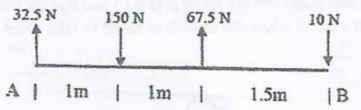


Fig.5

SET 2

Answer any 2 questions. Each question carries 10 Marks (2 X 10 = 20 Marks)

12. Find the centroid of the given Fig.6.

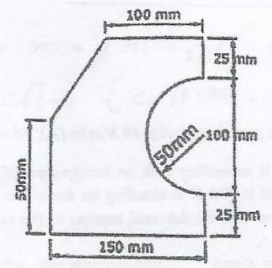


Fig.6

13. A uniform ladder of 4m length rests against a wall which it makes an angle 45° as shown in Fig.7. The coefficient of friction between the ladder and the wall is 0.4 and that between the ladder and floor is 0.5. If the man whose weight is on half of that of ladder ascends it, how high will he when the ladder slips?

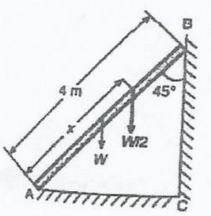


Fig.7

C

14. Two blocks A and B of weights 500 N and 1000 N are placed on an inclined plane (Fig.8). The blocks are connected by a string to the parallel plane. The coefficient of friction between the inclined plane and the block A is 0.15 and that for the block B is 0.4. Find the inclination of the plane when the motion is about to take place. Also calculate the tension in the string.

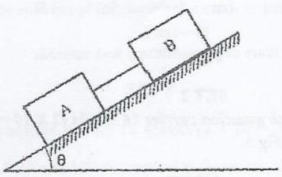


Fig.8

SET 3

Answer any 2 questions. Each question carries 10 Marks (2 X 10 = 20 Marks)

15. An elevator weighing 5000 N is ascending with an acceleration of 3 m/s^2. During this ascent its operator whose weight is 700 N is standing on the scales placed on the floor. What is the scale reading? What will be the total tension in the cables of the elevator during this motion?
16. A weight of 50N suspended from a spring vibrates vertically with amplitude of 8cm and a frequency of 1 oscillation per second. Find (a) the stiffness of the spring. (b) The maximum tension induced in the spring and (c) the maximum velocity of the weight
17. A weight of 100N suspended from a spring vibrates vertically with amplitude of 8cm and a frequency of 1oscillation per second. Find

(a) The stiffness of the spring
(b) The maximum tension induced in the spring
(c) The maximum velocity of the weight

K.T.U. July 2016 B.E. 100 Engg. Mechanics

Part A.

1. Explain the Conditions of equilibrium of two force and three force members

Ans: A body is said to be in equilibrium when all the forces exerted on the body are in balance

1) $\Sigma F = 0$, $\Sigma F_x = 0$; $\Sigma F_y = 0$ $\boxed{\Sigma F = 0, \Sigma M = 0}$

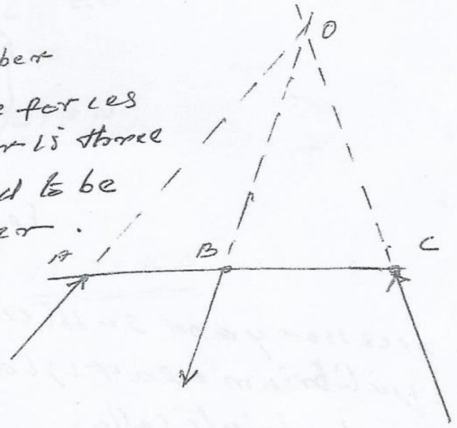
2) The sum of moments of all the forces acting on the body about any point is zero, $\Sigma M = 0$

Two force member

Two forces: same magnitude, opposite direction same line of action (colinear)

Three - force member

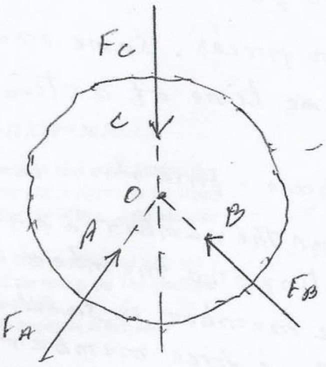
when the number of forces acting on a member is three the member is said to be a three force member.



Three forces are Concurrent

$\Sigma M_O = 0$

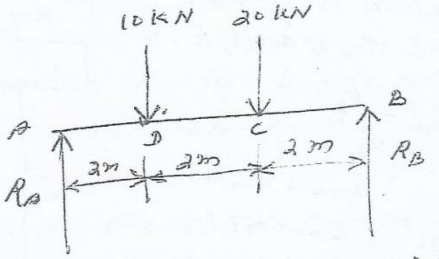
For a three force body to be in equilibrium all the three forces must be Concurrent forces (Line of action of all the forces must meet at a single point). The magnitude of the forces F_A, F_B and F_C should be such that ΣF should be zero. For this the resultant of any two forces must be equal and opposite to the third force. For example the magnitude of force F_C should be equal and opposite to the resultant of the other two forces F_A and F_B



The necessary and sufficient conditions for the equilibrium of a rigid body can be expressed analytically

$\Sigma F_x = 0$, $\Sigma F_y = 0$ and $\Sigma M = 0$

3) Calculate the reactions at A and B of the given loaded beam



Solution

Consider the free body diagram of beam as shown in fig

$$\boxed{\begin{aligned} R_A &= 13.33\ kN \\ R_B &= 16.67\ kN \end{aligned}}$$

For $\Sigma F_V = 0$

$R_A - 10 - 20 + R_B = 0$

$R_A + R_B = 30 \quad -(1)$

For $\Sigma M = 0$, taking moment about A

$10 \times 2 + 20 \times 4 - R_B \times 6 = 0$

$20 + 80 - 6R_B = 0$

or $R_B = \frac{100}{6} = 16.67\ kN$

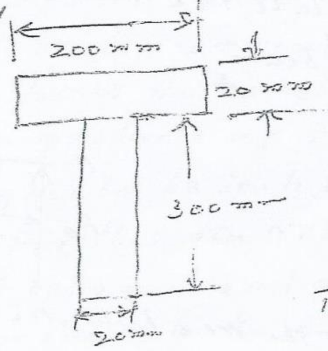
$R_A + R_B = 30$

$R_A + 16.67 = 30$

$R_A = 30 - 16.67 = \underline{\underline{13.33\ kN}}$

3 a) Locate the centroid of the T section shown in fig

Since the section is symmetrical with respect to the y axis, $\bar{x} = 0$



$$\bar{y} = \frac{a_1 y_1 + a_2 y_2}{a_1 + a_2}$$

$a_1 = 300 \times 20 = 6000\ mm^2$

$a_2 = 200 \times 20 = 4000\ mm^2$

$y_1 = \frac{300}{2} = 150\ mm$

$y_2 = 300 + \frac{20}{2} = 310\ mm$

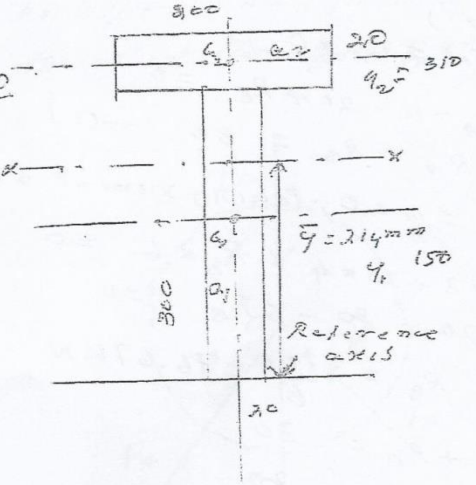
$\frac{310}{4}$ 124^0

$$\therefore \bar{y} = \frac{6000 \times 150 + 4000 \times 310}{6000 + 4000}$$

$$= \frac{900 + 1240}{10}$$

$$= 90 + 124 = 214\ mm$$

$$\boxed{\bar{y} = 214\ mm}$$



4) Define angle of friction, coefficient of friction and cone of friction

Coefficient of friction :-

The magnitude of limiting friction bears a constant ratio to the normal reaction between the two surfaces i.e the limiting friction is proportional to the normal reaction at the contact surface. This constant of proportionality is called coefficient of friction

Limiting friction, F is proportional to to the normal reaction R_N

$F \propto R_N$

$F = \mu R_N$

$\mu = \frac{F}{R_N}$, μ is the coefficient of friction at the contact surface

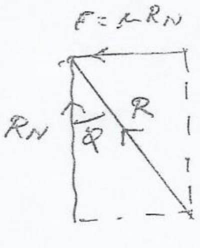
Angle of friction

It is the angle between the normal reaction and the resultant at the contact surface and the resultant of normal reaction and limiting friction

It is denoted by ϕ

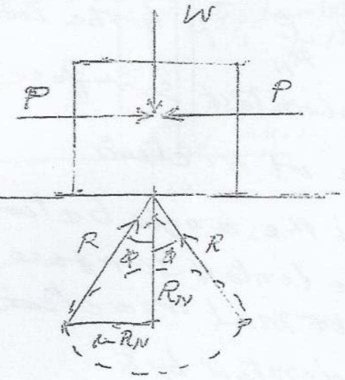
$\tan\phi = \frac{F}{R_N} = \frac{\mu R_N}{R_N} = \mu$

Angle of friction $\phi = \tan^{-1}\mu$



Cone of friction

when the direction of external force is ~~gradually~~ changed the direction of resultant changes but the angle between the normal reaction and the resultant force will be the same. Thus when the direction of external force is gradually changed through 360^0, the resultant R generates a right circular cone with semi cone angle equal to ϕ. This cone is called friction cone or cone of friction. The axis of this cone will be the normal reaction and the generators are the resultant force and base radius equal to the limiting frictional force



5. state and explain D'Alembert principle

- Application of Newtons second law of motion
- A problem in dynamics can be converted into a static equilibrium problem using D'Alemberts principle

ie $F = Ma$ can be written as $F - ma = 0$

The term $(-Ma)$ is called inertia force

$$\boxed{F + (-ma) = 0}$$

The statement of the above equation is known as D'Alembert's principle which states that the resultant of a system of force acting on a body in motion is in dynamic equilibrium with inertia force

Every body has a tendency to continue its state of rest or of uniform motion. This tendency is called inertia

6) Explain the concepts of instantaneous centre with figure.

Concept of instantaneous centre

The motion of rotation and translation of a body, at a given instant, can be considered as that of pure rotation of the body about a point. This point about which the body can be assumed to be rotating at the given instant is called instantaneous centre of rotation. Since the velocity of this point at the given instant is zero, this point is called instantaneous centre of zero velocity.

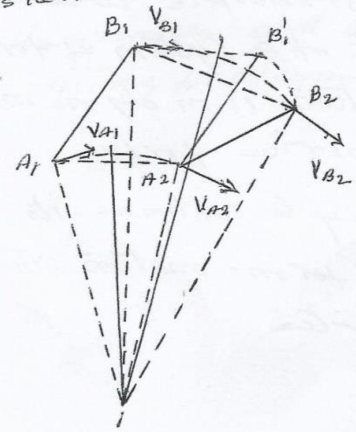


Fig.

This point is not a fixed point, and when the body changes its position, the position of the instantaneous centre also changes. The locus of the instantaneous centre as the body goes on changing its position is called centroid.

properties of instantaneous centre are

i. The magnitude of velocity of any point on a body is proportional to its distance from the instantaneous centre and is equal to the angular velocity times the distance

ii. The direction of velocity of any point on a body is perpendicular to the line joining that point and the instantaneous centre

The above properties are used to locate the instantaneous centre of a body.

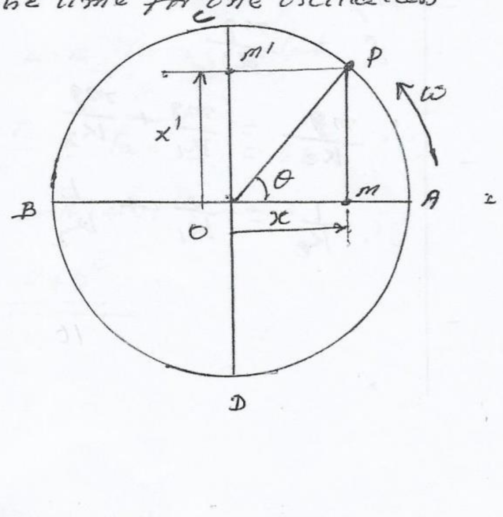
7. Explain the following terms with respect to a simple harmonic motion.

a. amplitude b. time period c. frequency.

Ans:

a. Amplitude : It is the distance between extreme and mean position of the particle executing SHM. It is the maximum displacement of the particle from the mean position.

b. Time period : It is the time for one oscillation It is denoted by t_p



From figure

$\theta = \omega t$

For one oscillation:

$t = t_p$ and $\theta = 2\pi$

$$2\pi = \omega t_p$$

$$t_p = \frac{2\pi}{\omega}$$

c. Frequency

The number of cycles per unit time is called frequency

If t_p is the time period in seconds and f is the frequency in Hz, then $f = \frac{1}{t_p}$

8 Ans: In a spring mass model the springs can be attached to the mass in series

Two springs of stiffness K_1 and K_2 arranged in series. Let δ_1 and δ_2 be the elongation of each spring due to body of mass m

static deflection of mass, $\delta = \delta_1 + \delta_2$. Let δe be the static deflection of the same mass when it is attached to the single spring of stiffness Ke

For this single spring to be equivalent to the two springs in series, the reqd condition is

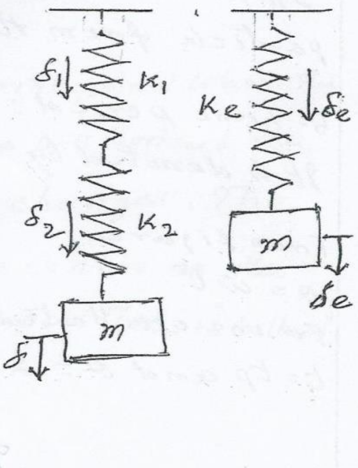
$$\delta_e = \delta = \delta_1 + \delta_2$$

$$mg = K\delta$$

$$\delta = \frac{mg}{K}$$

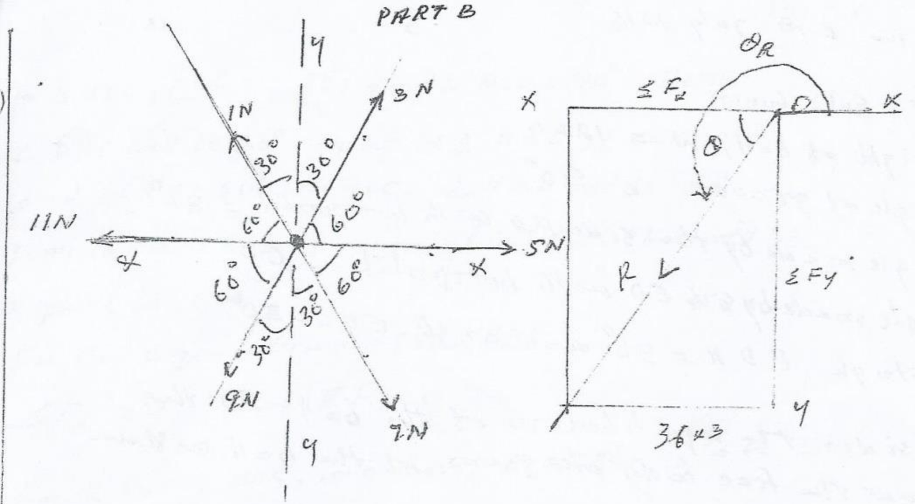
$$\therefore \frac{mg}{Ke} = \frac{mg}{K_1} + \frac{mg}{K_2}$$

$$\therefore \frac{1}{K_e} = \frac{1}{K_1} + \frac{1}{K_2}$$



PART B

9)



solution

Resolving the forces along x axis

$$\Sigma F_x = 5 + 3\cos 60 - 1\cos 60 - 11 - 9\cos 60 + 7\cos 60 = 0$$

$$= -6 + (3 - 1 - 9 + 7)\cos 60 = -6N$$

Resolving the forces along y axis

$$\Sigma F_y = 3\cos 30 + 1\cos 30 - 9\cos 30 - 7\cos 30$$

$$= (4 - 16)\cos 30 = -12 \times \frac{\sqrt{3}}{2} = -6\sqrt{3}$$

Resultant $R = \sqrt{\Sigma F_x^2 + \Sigma F_y^2} = \sqrt{(-6)^2 + (-6\sqrt{3})^2}$

$$R = \sqrt{36 + 108} = \sqrt{144} = 12\ N$$

Inclination of resultant with horizontal

$$\theta = \tan^{-1}\left|\frac{\Sigma F_y}{\Sigma F_x}\right| = \tan^{-1}\frac{6\sqrt{3}}{6} = \tan^{-1}\sqrt{3} = 60^\circ$$

Inclination of resultant with +ve x axis

$$\theta_R = 180 + \theta = 180 + 60 = \underline{\underline{240^\circ}}$$

d
.75

P.10. Sol: Given
Weight of ball, W = 120 N
Angle of groove = 90°
Angle made by the side FD with horizontal = 30°
Angle made by side ED with horizontal = 60°
∴ Angle FDH = 30° and angle EDG = 30°

Consider the equilibrium of the ball. For this draw the free body diagram of the ball as shown in fig 1-b
The forces acting on the isolated ball will be
i) weight of the ball = 120 N and acting vertically downwards
ii) Reaction R_C acting at C and normal to FD
iii) Reaction R_A acting at A and normal to DE
The reactions R_A and R_C will pass through B i.e. Centre of the ball. The angle made by R_A and R_C at point B with be obtained as shown in fig 1-c

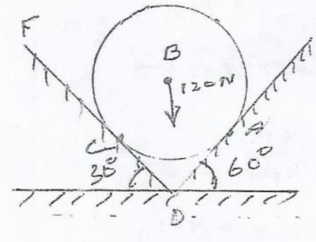


Fig 1-a

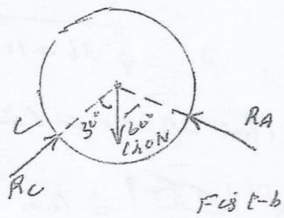


Fig 1-b

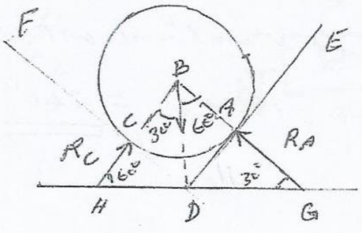


Fig 1-c

In Δ HDC, $\angle$CDH = 30^0, and $\angle$ DCH = 90^0. Hence $\angle$ DHC will be 60^0. Now in Δ HBL, $\angle$ BLH = 90^0 and $\angle$LHA = 60^0. Hence $\angle$HBL will be 30^0 similarly $\angle$ABL may be calculated. This will be equal to 60^0

For the equilibrium of the ball

$\Sigma F_x = 0$ and $\Sigma F_y = 0$

For $\Sigma F_x = 0$, we, we have $R_c \sin 30 - R_A \cos 60 = 0$

or $R_c \sin 30 = R_A \sin 60$

or $R_c = R_A \dfrac{\sin 60}{\sin 30} = R_A \times \dfrac{0.866}{0.5} = 1.732\ R_A$ —1

$R_c = 1.732\ R_A$

For $\Sigma F_y = 0$ we have $120 - R_A \cos 60 - R_c \cos 30 = 0$

or $120 = R_A \cos 60 + R_c \cos 30$

$= R_A \times 0.5 + 1.732\ R_A \times 0.866 = 2R_A$ (1.5)

$\therefore R_A = \dfrac{120}{2} = 60\,N$ Ans

substituting this value in equ. 1, we get

$R_C = 1.732 \times 60 = 103.92\,N$ Ans

$$\boxed{R_A = 60\,N,\ R_c = 103.92\,N}$$

B.E.100 E.M July 2016

Q.11

P52-53: R.K. Bansal

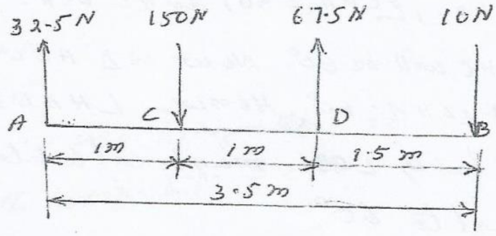


Fig 1-a

To find

a) a single force

b) a single force and a couple at A

Sol: Given

Forces at A, C, D and B are 32.5N, 150N, 67.5N and 10N respectively

Distance AC = 1m, CD = 1m, and BD = 1.5m

i. Single force system: The single force system will consist only resultant force in magnitude and location. All the forces are acting in the vertical direction and hence their resultant R in magnitude is given by

$R = 32.5 - 150 + 67.5 - 10 = -60\ N$

Negative sign shows that resultant is acting vertically downwards

Let x = Distance of resultant from A towards right. To find location of the resultant take the moments of all the forces about A, we get moment of resultant about A

= Algebraic sum of moments of all the forces about A.

or $R \times x = -150 \times AC + 67.5 \times AD - 10 \times AB$

(taking clock wise moment -ve and anticlockwise moment +ve)

or $-60 \times x = -150 \times 1 + 67.5 \times 2 - 10 \times 3.5$ $[\because R = -60]$

$-60x = -150 + 135 - 35 = -50$

$x = \frac{-50}{-60} = 0.833\ m$

Hence the given system of parellel forces is equivalent to a single force 60 N acting vertically downwards at point E at a distance of 0.833 m from A shown in fig'

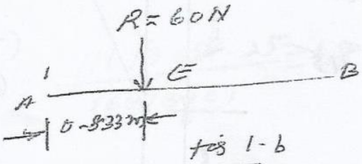


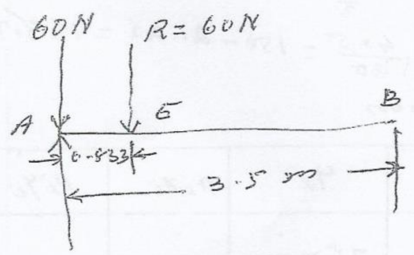
fig 1-b

b) A single force and a couple at A. The resultant force R acting at point E as shown in fig can be replaced by an equal force applied at point A in the same direction together with a couble. This is shown in fig 1-c

The moment of the Couple = 60 x 0.833 N m (clock wise)

$= -49.98\ Nm$

(-ve sign is due to clockwise)



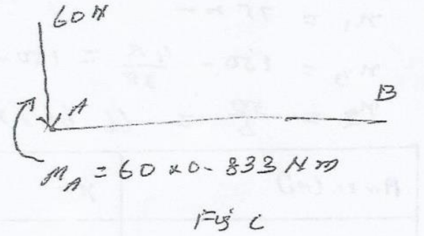


Fig c

12

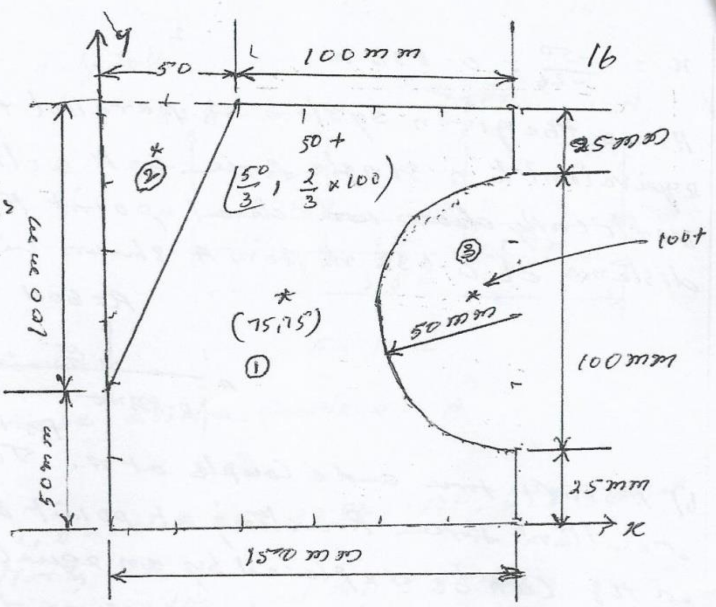
$y_1 = 75\,mm$

$y_2 = 150 - \frac{100}{3}$

$= 150 - 33.333$

$= 116.667$

$y_3 : 75$



Area 2 and 3 to be substracted

To find centroid :

A_1 = Area of square : $150 \times 150 = 22500\ mm^2$

A_2 = Area of Triangle $= \frac{1}{2} \times 50 \times 100 = 2500\,mm^2$

A_3 = Area of semicircle $= \frac{\pi R^2}{2} = \frac{\pi (50)^2}{2} = 3926.99\,mm^2$

$x_1 = 75\,mm$ $\qquad x_2 = \frac{150}{3}$

$x_3 = 150 - \frac{4R}{3\pi} = 150 - \frac{4 \times 50}{3\pi} = 150 - 21.22 = 128.78\,mm$

$x_2 = \frac{50}{3} = 16.667\,mm$

Area (Ai)	x_i	y_i	$A_i x_i$	$A_i y_i$
$A_1 = 22500\,mm^2$	75 mm	75 mm	1687500	1687500
$A_2 = 2500\,mm^2$ (-)	16.667 mm	116.667 mm	(-) 41667.5	(-) 291667.5
$A_3 = 3926.99\,mm^2$ (-)	128.98	75 mm	(-) 505717.77	(-) 294524.25
16073.01			1140114.73	1101308.25

$$x_c = \frac{A_1x_1 - A_2x_2 - A_3x_3}{A_1 - A_2 - A_3} =$$

$$= \frac{1687500 - 41667.5 - 505717.77}{22500 - 2500 - 3926.99} = \frac{1140114.73}{16073.01}$$

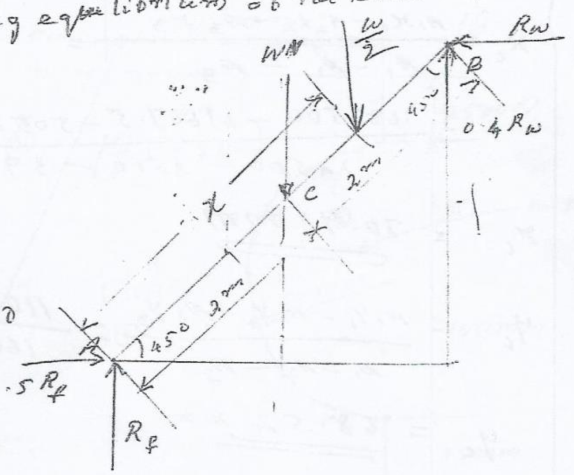
$$x_c = \underline{\underline{70.93\ mm}}$$

$$y_c = \frac{A_1y_1 - A_2y_2 - A_3y_3}{A_1 - A_2 - A_3} = \frac{1101308.25}{16073.01} = \cancel{68}.519\,mm$$

$$y_c = \underline{\underline{68.52}}\ mm$$

Centroid of the fig $(x_c, y_c) = (\underline{\underline{70.93\,mm, 68.52\,mm}})$

13 Consider the limiting equilibrium of the Ladder



For $\Sigma F_H = 0$

$0.5 R_f - R_w = 0$

$R_f = 2 R_w$

For $\Sigma F_y = 0$

$R_f - 0.5 w - w + 0.4 R_w = 0$

$2R_w - 1.5 w + 0.4 R_w = 0$

$R_w = \frac{1.5 W}{2.4} = 0.625 W$

for $\Sigma m = 0$, taking moment about A

$0.5 w x \cos 45 + w \times 2 \cos 45 - 0.4 R_w \times 4 \cos 45 - R_w \times 4 \sin 45 = 0$

$(0.5 x w + 2 w - 1.6 R_w) \cos 45 = \frac{4 R_w}{2.5} \sin 45$ $\quad \tan 45 = 1$

$0.5 x w + 2 w - 1.6 \times 0.625 w = 4 \times 0.625 w \frac{\sin 45}{\cos 45}$

$0.5 x + w = 2.5 w$

$0.5 x w = 1.5 w$

$x = \frac{1.5}{0.5} = 3$

$0.5 w \times x \cos 45 + w \times 2 \cos 45 - 0.4 R_w \times 4 \cos 45 - R_w \times 4 \sin 45 = 0$ $\quad (R_w = 0.625W)$

$0.5 w \times x + (2 w - w) = 2.5 w \frac{\sin 45}{\cos 45} = 2.5 w \tan 45$

$0.5 x = 1.5$

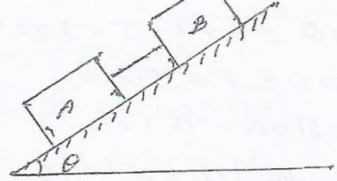
$x = \frac{1.5}{.5} = \underline{3 m}$

Sol: weight of first body

$W_1 = 500\,N$

Weight of second body

$W_2 = 1000\,N$



Coefficient of friction for first body, $\mu_1 = 0.15$

Coefficient of friction for second body, $\mu_2 = 0.40$

Let θ = inclination of plane

T = tension in ~~chord~~ the string

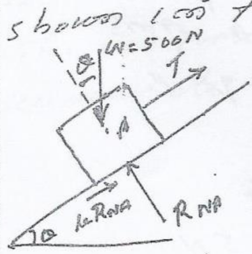
R_1 = normal reaction for 1st body.

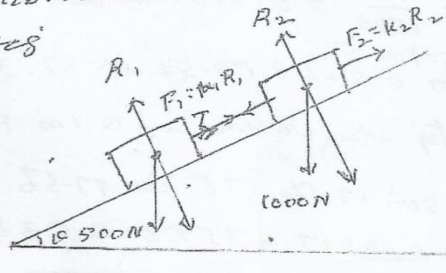
R_2 = normal reaction for 2nd body

F_1 = Force of friction between 1st body and plane $= \mu_1 R_1$

F_2 = Force of friction between 2nd body and plane $= \mu_2 R_2$

As the motion of the two bodies is about to take place down the inclined plane, the force of friction F_1 and F_2 will be acting upward. The two bodies are in equilibrium under the action of forces shown in fig.





Forces on the first body

Resolving forces along the plane

$500 \sin\theta = T + F_1 = T + \mu_1 R_1 = T + 0.15 R_1$ — 1

Resolving forces normal to the plane

$500 \cos\theta = R_1$

substituting the value of R_1 in equation 1

$500 \sin\theta = T + 0.15 \times 500 \cos\theta = T + 75 \cos\theta$

$500 \sin\theta = T + 75 \cos\theta$

$T = 500 \sin\theta - 75 \cos\theta$ —ii

Forces on the second body

Resolving forces along the plane

$1000 \sin\theta + T = F_2 = \mu_2 F_2 = 0.40 R_2$ —iii

Resolving forces normal to the plane

$R_2 = 1000 \cos\theta$

substituting the value of R_2 in eqn iii

$1000 \sin\theta + T = 0.4 \times 1000 \cos\theta$

$T = 400 \cos\theta - 1000 \sin\theta$ —iv

Equating the values of T given by eqn ii & iv

$500 \sin\theta - 75 \cos\theta = 400 \cos\theta - 1000 \sin\theta$

$500 \sin\theta + 1000 \sin\theta = 400 \cos\theta + 75 \cos\theta$

$1500 \sin\theta = 475 \cos\theta$

or $\frac{\sin\theta}{\cos\theta} = \frac{475}{1500} = 0.3166$ or $\tan\theta = 0.3166$

$\therefore \theta = \tan^{-1} 0.3166 = 17.56^\circ$ or $17^\circ 34'$ Ans

substituting the value of θ in eqn ii

$T = 500 \sin 17.56 - 75 \cos 17.56$

$T = 500 \times 0.3017 - 75 \times 0.9534$

$= 150.85 - 71.505 = 79.345 N$

$\underline{\underline{T = 79.345 N}}$

Q.15 Sol. Given

weight of the elevator, $W_1 = 5000N$

Acceleration of the elevator, $a = 3 m/s^2$

weight of the operator, $W_2 = 700 N$

when the operator is standing on the scale, placed on the floor of the elevator, the reading of the scale will be equal to the reaction R offered by the floor on the operator

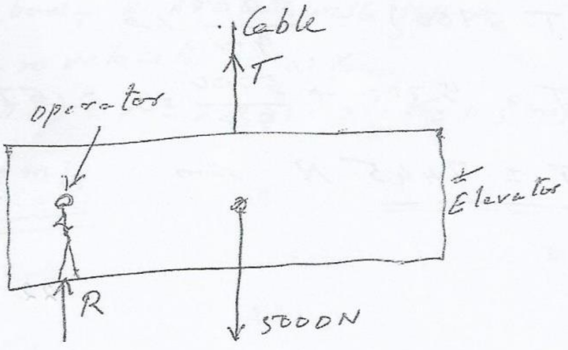
Hence let R = Reaction offered by floor on operator. This is also equal to the reading of scale

T - total tension in the Cables of elevator

Consider the motion of operator. The operator is moving upwards along with the elevator with an acceleration of $3 m/s^2$

$a = 3 m/s^2$

The net force on the operator is acting upwards



Net upward force on operator = Reaction offered by floor on operator − weight of operator = $(R-700)$

Mass of operator = $\dfrac{\text{weight of operator}}{g} = \dfrac{700}{g}$

Net force = Mass × Acceleration

$(R-700) = \dfrac{700}{9.8} \times 3$ (where acceleration = $3\ m/s^2$)

$R = 700 + \dfrac{700}{9.8} \times 3 = 700 + 214.28 = \underline{\underline{914.28\ N}}$ Ans.

Total tension in the Cables of elevator

Let T = Total tension in the cables of elevator

W = Total weight (i.e. weight of elevator + weight of operator

$W = 5000 + 700 = 5700\ N$

As the elevator with the operator is moving upwards with an acceleration, $a = 3\ m/s^2$, the net force will be acting on the elevator and operator in the upward direction

net upward force on elevator & operator } = Total tension in the cables − total weight of elevator & operator

$= (T - 5700)$

mass of elevator and operator = $\dfrac{\text{Total wt}}{g} = \dfrac{5700}{9.8}$

Net force = mass × acceleration

$(T - 5700) = \dfrac{5700}{9.8} \times 3$

$T = 5700 + \dfrac{5700}{9.8} \times 3 = 5700 + 1745$

$\underline{\underline{T = 7445\ N}}$ Ans

16) To find

i) stiffness of the spring, $K = 4\pi^2 f^2 m$

ii) maximum tension in the spring $= Kx$

iii) For S.H.M. max. velocity $= \omega x$

Given : $m = \frac{w}{g} = \frac{50}{9.81} =$

$x = 8cm = 0.08m$

$f = 1 CPS$

a) $f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$

$f^2 = \frac{1}{2^2\pi^2} \times \frac{K}{m}$

$\therefore K = f^2 \times 4 \times \pi^2 \times m = 1 \times 4 \times \pi^2 \times \frac{50}{9.81}$

$K = \underline{\underline{201.22}}\ N/m$ | $\because K$ - stiffness of the spring.

b) maximum tension in the spring $= Kx$

$= 201.22 \times 0.08 = \underline{\underline{16.1\ N}}$

c) Since the body vibrates with S.H.M

The maximum velocity $= \omega x$

$= (2\pi f) \times x = 2 \times \pi \times 1 \times 0.08 = 0.5\ m/s$

$V_{max} = 0.5\ m/s$

17) Solution

$m = \frac{w}{g} = \frac{100}{9.81}$

$x = 8cm = 0.08m$

$f = 1 cps$

a) The stiffness of the spring, k

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$; $f^2 = \frac{1}{2^2\pi^2} \times \frac{k}{m}$

$k = f^2 \times 4 \times \pi^2 \times m = 1 \times 4 \times \pi^2 \times \frac{100}{9.81} = 402.43$

$\boxed{k = 402.43 \ \frac{N}{m}}$

b) maximum tension in the spring = kx

$T_{max} = 402.43 \times 0.08 = 32.2 N$

$\boxed{T_{max} = 32.2 N}$

c) Since the body vibrates with S.H.M

The maximum velocity, $V_{max} = \omega x$

$V_{max} = (2\pi f) \times x = 2\pi \times 1 \times 0.08 = 0.5 m/s$

$\boxed{V_{max} = 0.5 \ m/s}$