Adda247

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BARC 2023

GATE

COUNTDOWN BEGINS

Engineering Mechanics **ME**

6 April 2023 Live @ 10AM

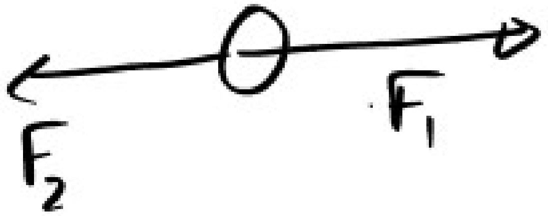
KANISTH SIR

If the maximum and minimum resultant forces of the two forces acting on a particle are 40 kN and 10 kN respectively, then the two forces in question would be

(a) 25 kN and 15 kN (b) 20 kN and 20 kN

(c) 20 kN and 10 kN (d) 20 kN and 5 kN

[CSE PRE]



$F_1 + F_2 = 40$ — (i)

$F_1 - F_2 = 10$ — (ii)

$2F_1 = 50$

$F_1 = 25\,kN$

$F_2 = 15\,kN$

Consider the following statements :

1. Two couples in the same plane can be added algebraically
2. Coplanar and concurrent forces are the ones which do neither lie in one plane nor meet at a point
3. Non-concurrent forces are the ones which do not meet at a point
4. A single force may be replaced by a force and couple

Which of these statements are correct?

(a) 1, 2 and 4 (b) 2, 3 and 4

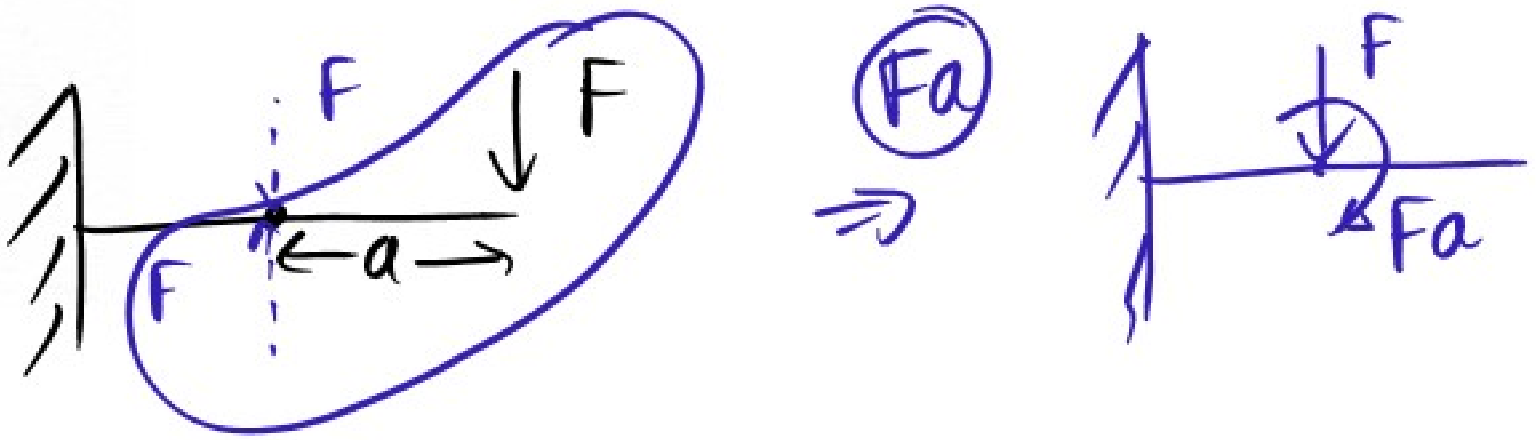
(c) 1, 2 and 3 (d) 1, 3 and 4

$\vec{M} = \vec{r} \times \vec{F}$

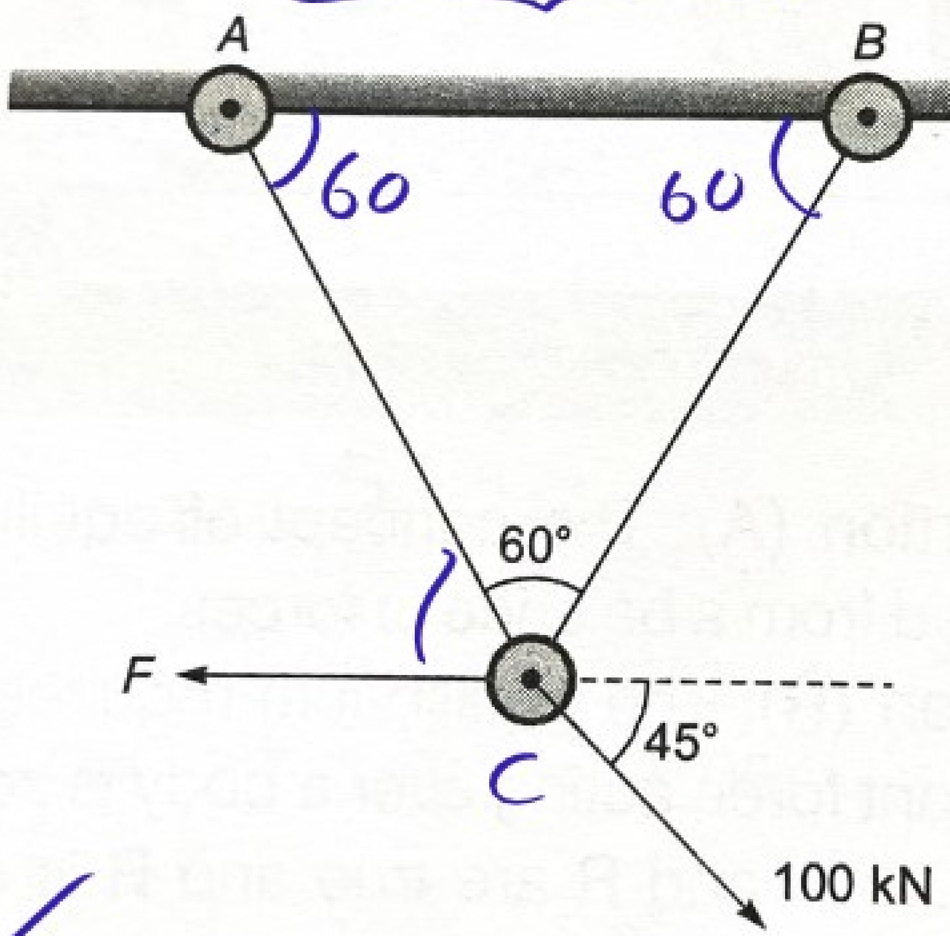
COPLANAR

CONCURRENT

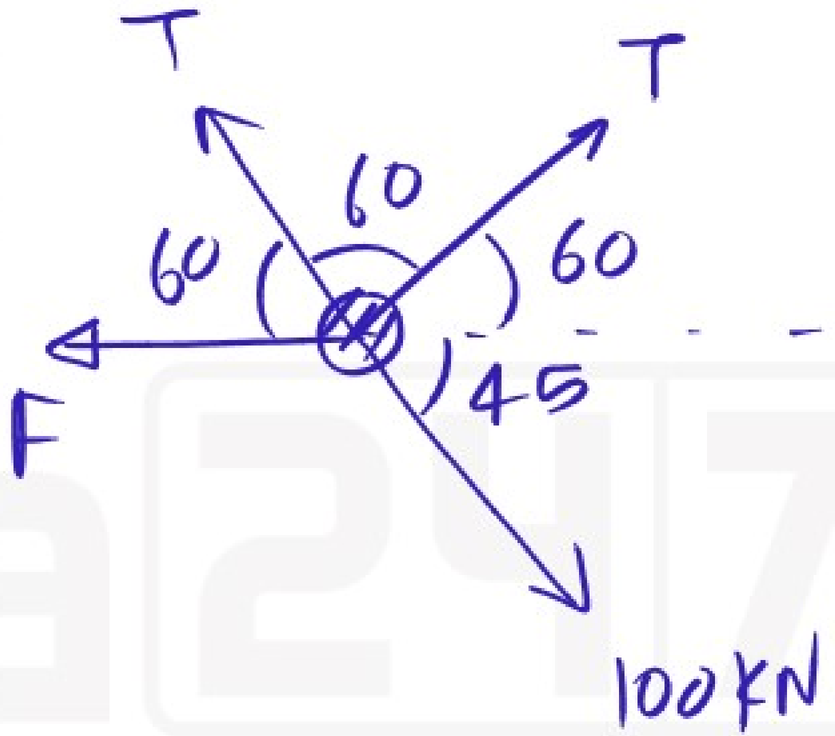
COUPLE ⇒ FREE VECTOR



The force F such that both the bars AC and BC (AC and BC are equal in length) as shown in the figure are identically loaded, is



(a) 70.7 N (b) 100 N
(c) 141.4 N (d) 168 N

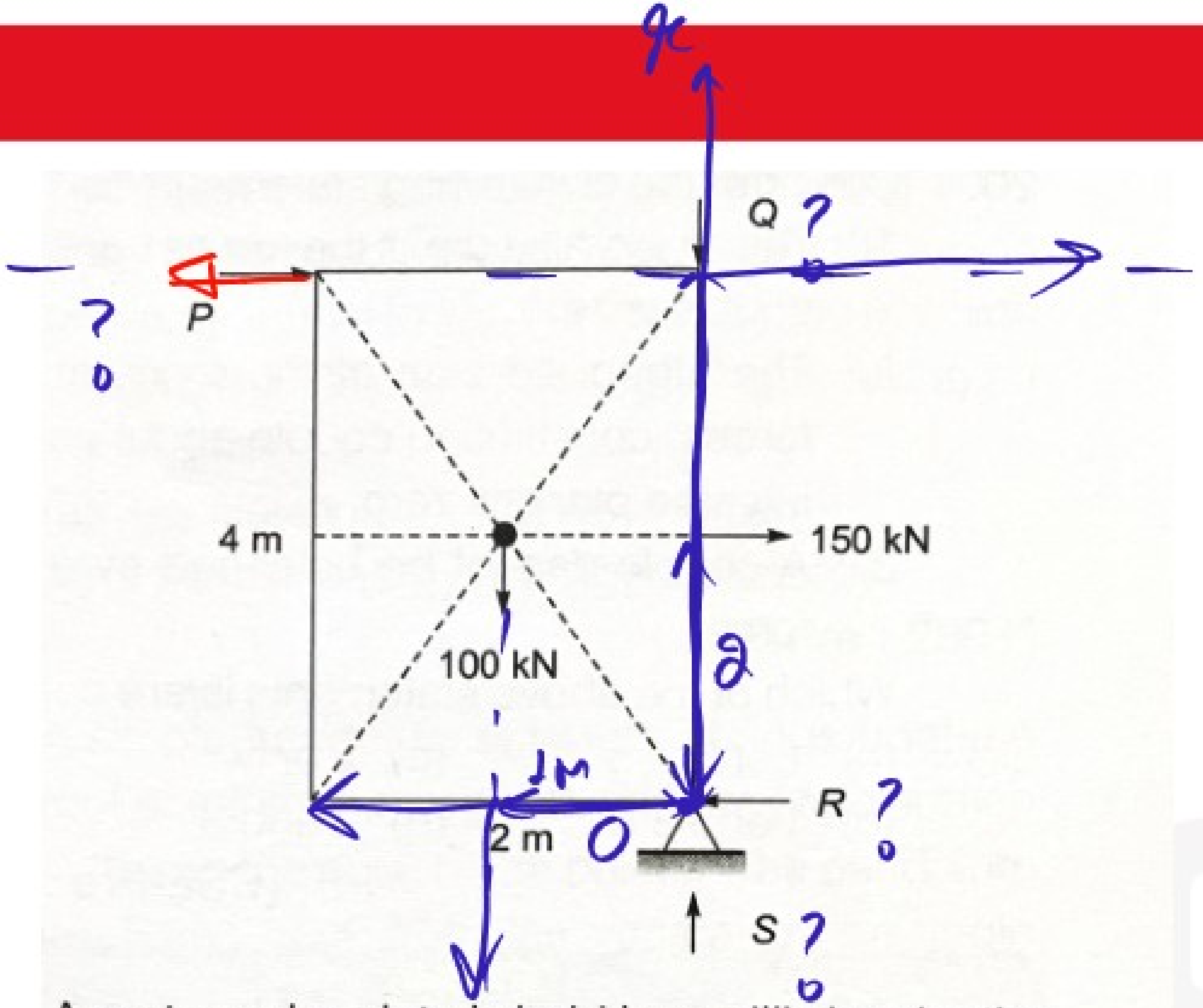


$\Sigma F_x = 0$

$-F - T\cos 60 + T\cos 60 + 100\cos 45 = 0$

$F = 100 \times \frac{1}{\sqrt{2}}$

$= 70.7\ N$



A rectangular plate is held in equilibrium by the application of forces as shown in the figure. What is the magnitude of the force P?

(a) 35 kN (b) 50 kN

(c) 100 kN (d) 200 kN

$$\Sigma M_O = 0$$

$$P \times 4 + 150 \times 2 - 100 \times 1 = 0$$

$$P = 100 - 300$$

$$= -\frac{200}{4} = -50$$

$$P = -50\text{ kN}$$

Which one of the following can completely represent a force graphically ?

(a) Magnitude, time of application and direction

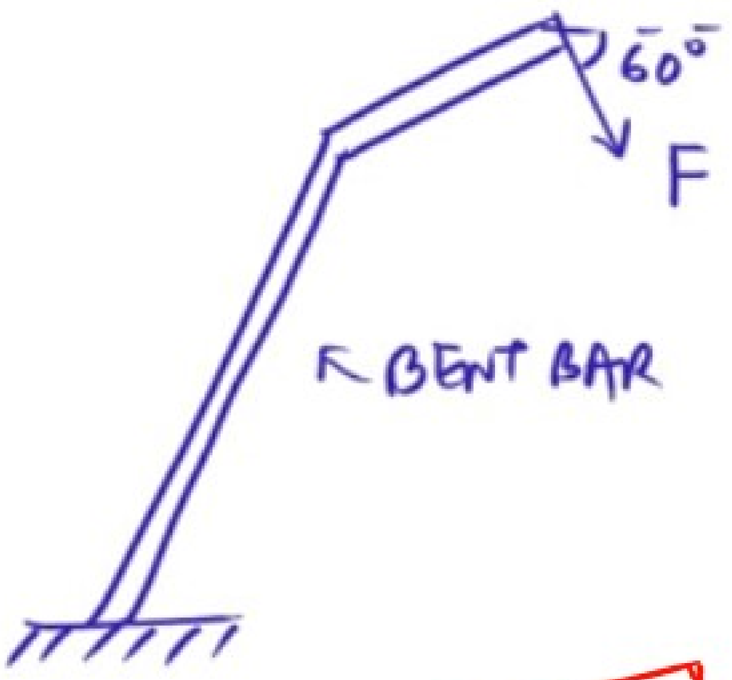
(b) Time of application, point of application and direction

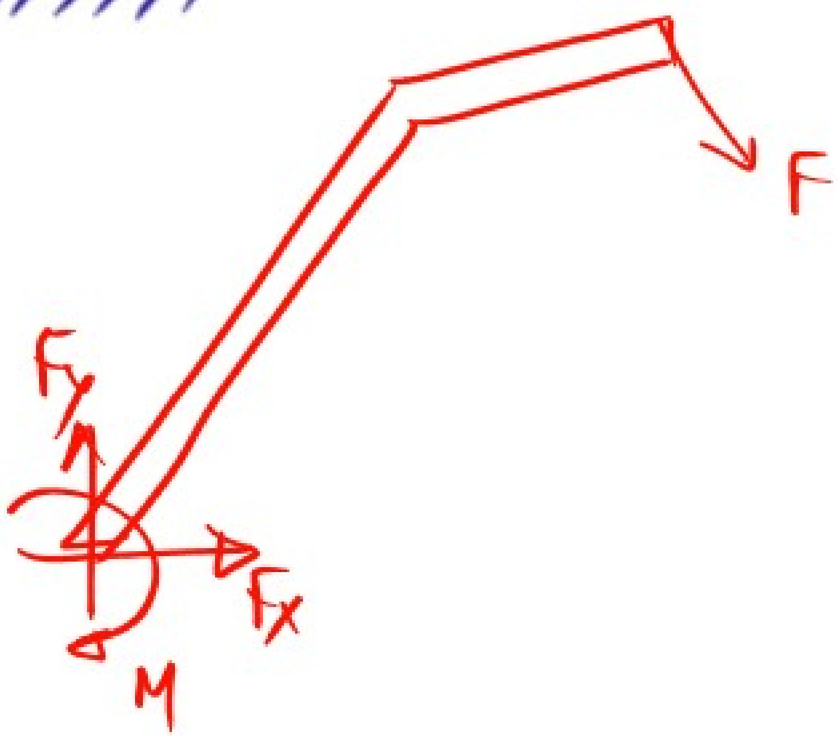
(c) Point of application, direction and magnitude

(d) Magnitude, time of application and point of application

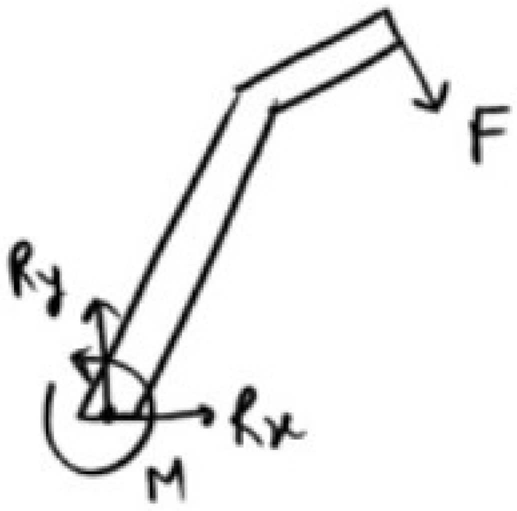
GATE 2016 Q:-

CORRECT FREE BODY DIAGRAM ?

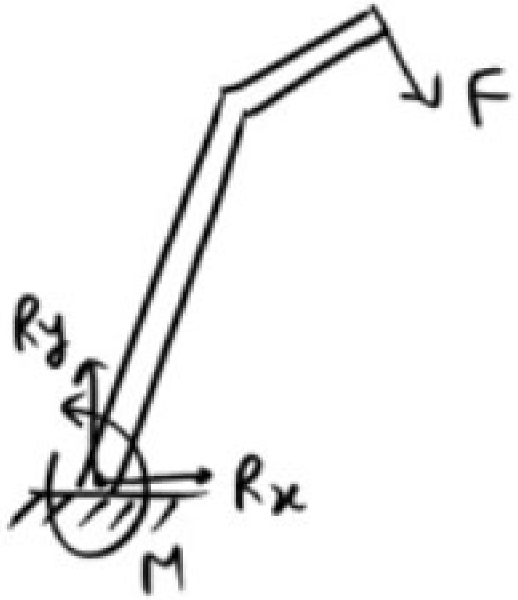




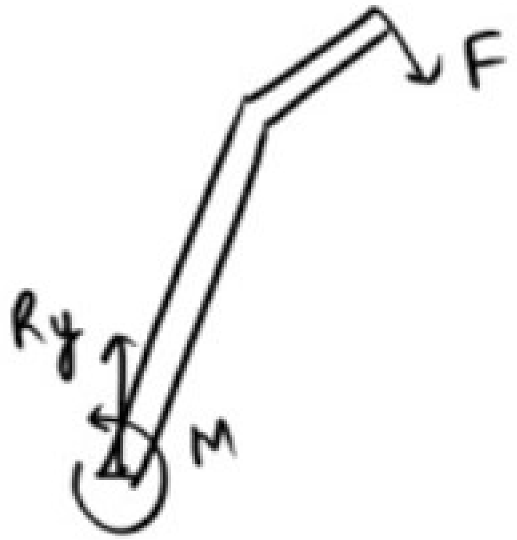
(A)



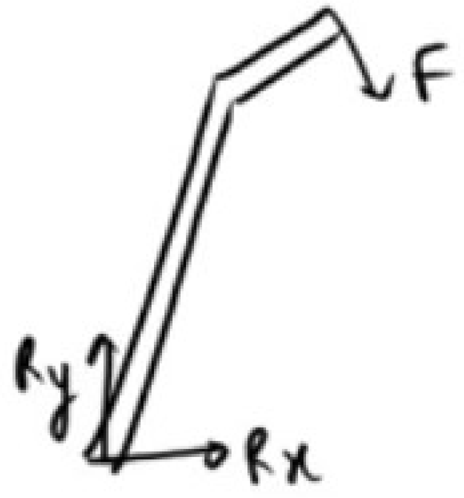
(B)



(C)



(D)



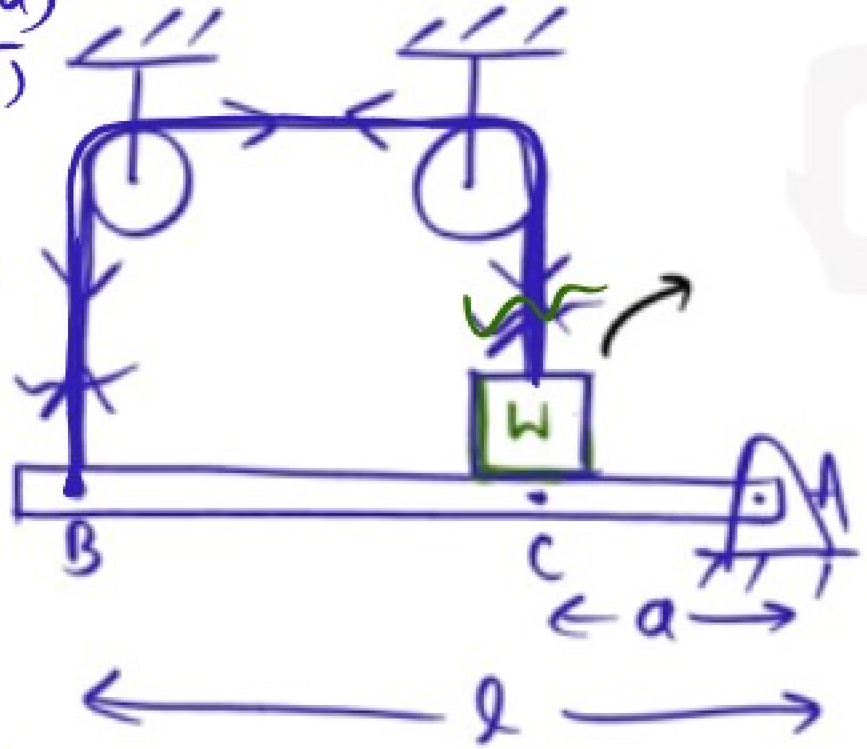
Q:- WEIGHTLESS BAR AB IS SUPPORTED BY A HINGE AT A. AND WIRE PASSING OVER TWO FRICTIONLESS & MASSLESS PULLY AS SHOWN. FIND REACTIONS AT A?

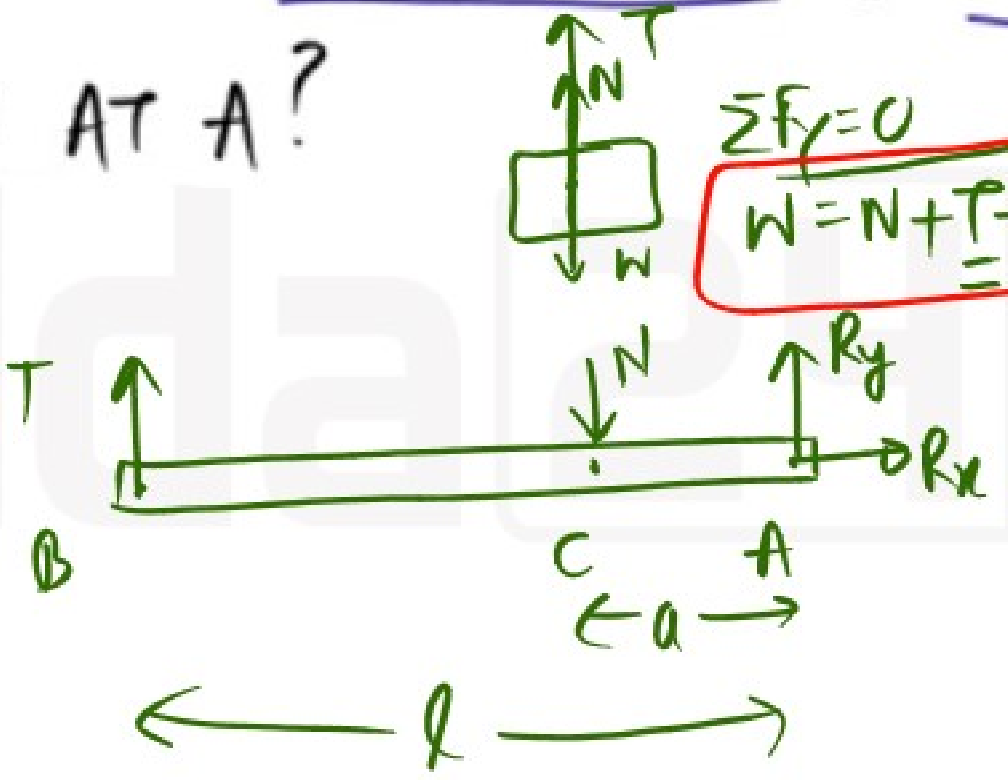
(A) $R_x = 0$, $R_y = \frac{W(l-a)}{(l+a)}$

(B) $R_x = W$, $R_y = \frac{W(l+a)}{(l-a)}$

(C) $R_x = Wl$, $R_y = 0$

(D) $R_x = 0$, $R_y = 0$





$\Sigma F_y = 0$

$W = N + T$ — (III)

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

$R_x = 0$

$\Sigma M_A = 0$

$T + R_y = N$ — (I)

$N \times a = T \times l$ — (II)

$W = N + T$

$\frac{Na}{l} = T$

$R_y = N - T$

$W = N + \frac{Na}{l}$

$N + R_y = 2N$

$W = \frac{N(l+a)}{l}$

$$T = W - N$$

$$\frac{Wl}{(l+a)} = N$$

$$W + R_y = 2N$$

$$W + R_y = 2 \times \frac{Wl}{l+a}$$

$$R_y = -W + \frac{2Wl}{(l+a)} = \left(\frac{Wl + Wa - 2Wl}{l+a}\right)$$

$$= \left(\frac{-Wl + Wa}{l+a}\right) = \frac{W(a+l)}{(a+l)}$$

$$R_y = \frac{W(l-a)}{(l+a)}$$

Consider the following statements:

For a particle in plane in equilibrium

1. sum of the forces along X-direction is zero.
2. sum of the force along Y-direction is zero.
3. sum of the moments of all forces about any point is zero.

Of these statements

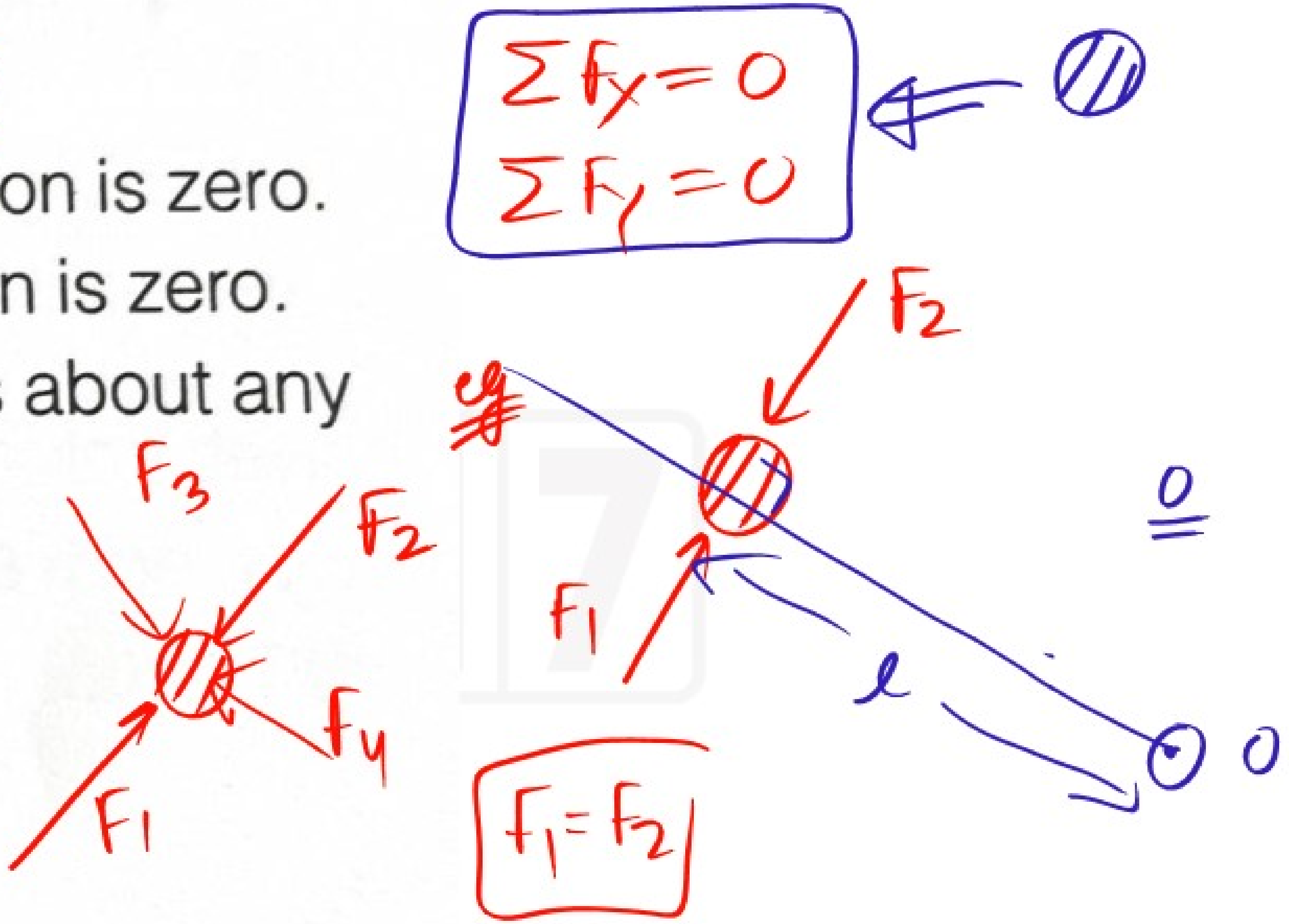
(a) 1 and 3 are correct

(b) 2 and 3 are correct

(c) 1 and 2 are correct

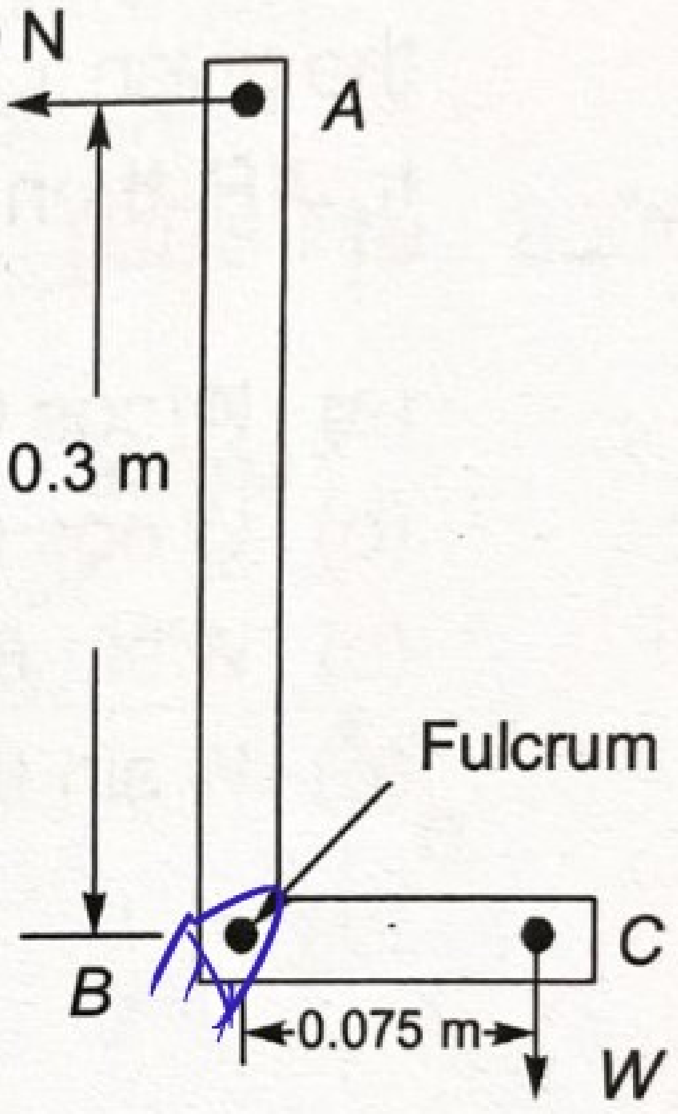
(d) 1, 2 and 3 are correct

[CSE-Pre : 1998]



A horizontal force of 200 N is applied at '*A*' to lift the weight '*W*' at *C* as shown in the given figure. The value of weight '*W*' will be

(a) 200 N
(b) 400 N
(c) 600 N
(d) 800 N

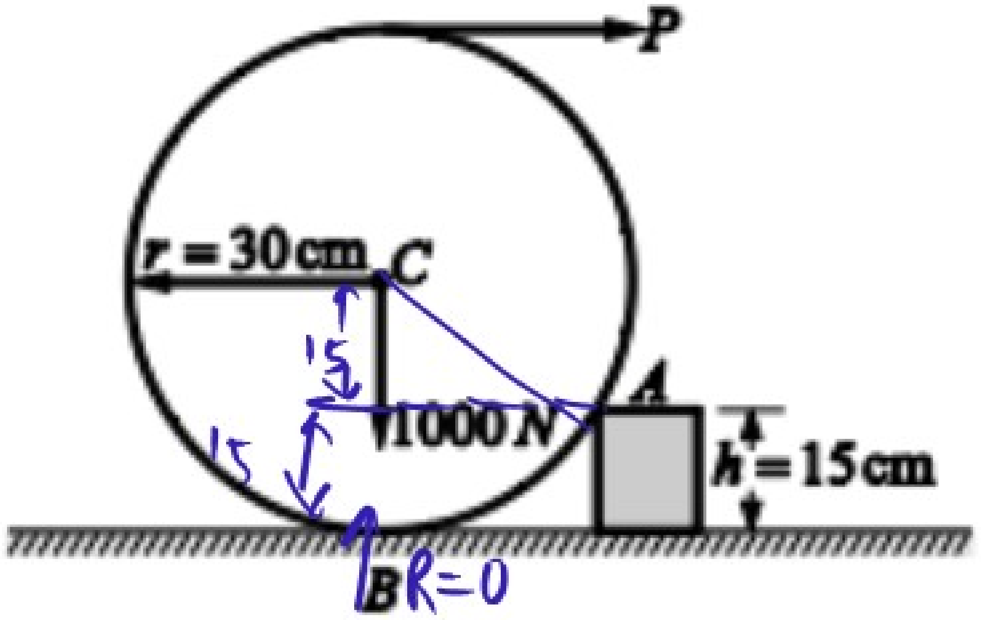


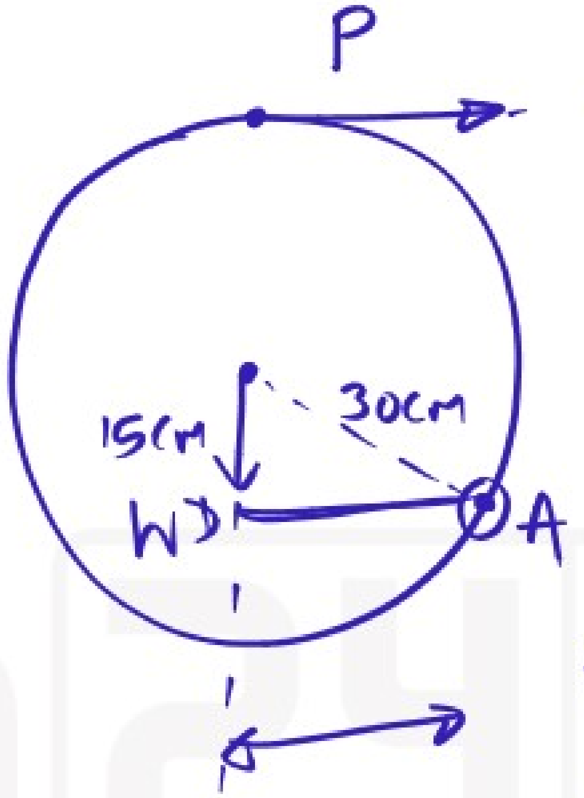
[CSE-Pre : 1999]

$W \times .075 = 200 \times 0.3$

$W = 800\,N$

A uniform wheel of 60.0 cm diameter and weighing 1000 N rests against a rectangular block 15 cm high lying on a horizontal plane as shown in the figure. It is to be pulled over this block by a horizontal force P applied to the end of a string wound round the circumference of the wheel. Find the force P when the wheel is just about to roll over the block ___________.





$\Sigma M_A = 0$

$W \times AD = P \times 45$

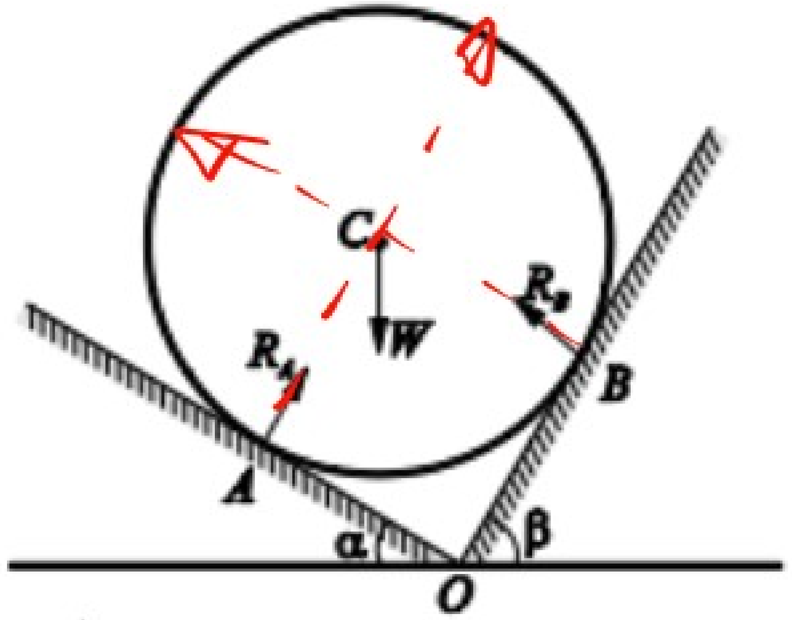
$\dfrac{1000 \times \left(\sqrt{30^2 - 15^2}\right)}{45} = P$

$AD = \sqrt{30^2 - 15^2}$

$AD =$

$P = 577.3 N$

A smooth circular cylinder of weight W and radius r rests in a V - shaped grove whose sides are inclined at angle α and β to the horizontal as shown. Find the reactions R_A and R_B at the points of contact. Given $\alpha = 25^0, \beta = 65^0, W = 500\text{N}$.



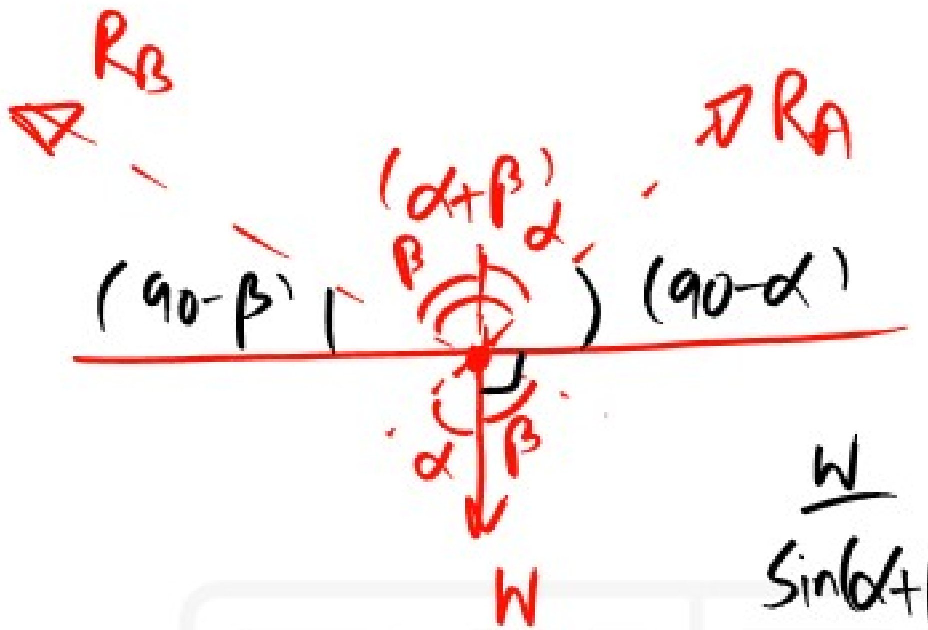
$\alpha = 25^0$
$\beta = 65^0$
$W = 5$

(A) $R_A = 453\text{N}, R_B = 211\text{N}$

(B) $R_A = 650\text{N}, R_B = 320\text{N}$

(C) $R_A = 770\text{N}, R_B = 550\text{N}$

(D) $R_A = 900\text{N}, R_B = 900\text{N}$



$$\frac{W}{\sin(\alpha+\beta)} = \frac{R_A}{\sin(180-\beta)} = \frac{R_B}{\sin(180-\alpha)}$$

$$R_A = \frac{500 \sin(180-\beta)}{\sin(25+65)}$$

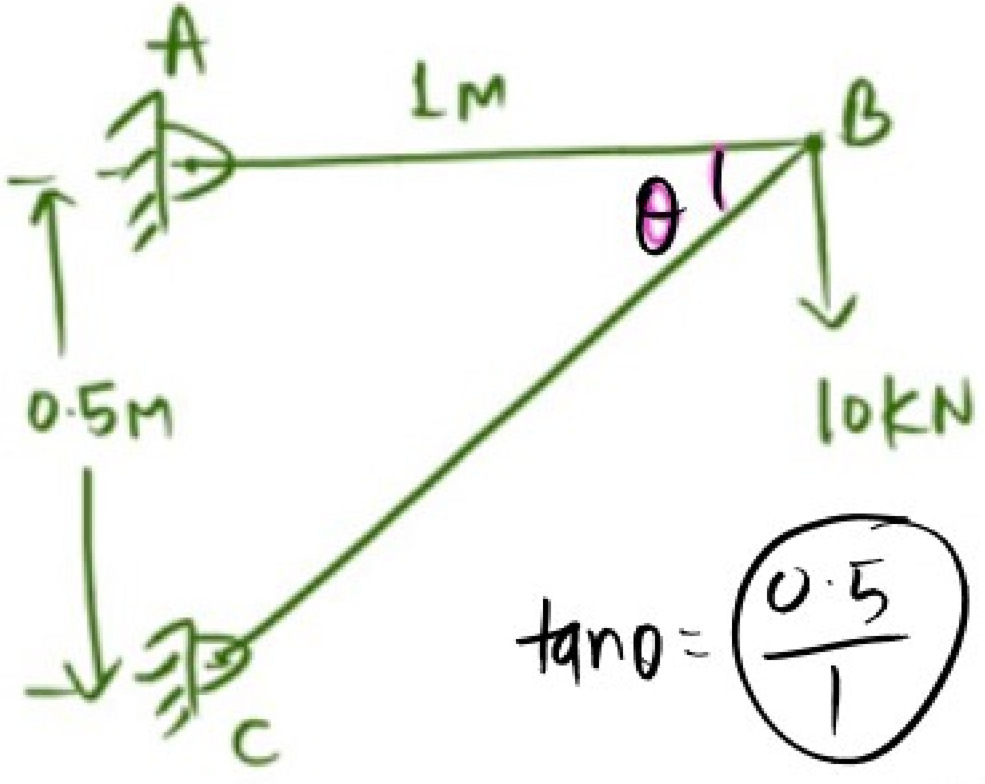
$$R_B = \frac{500 \sin(180-\alpha)}{\sin(25+65)}$$

GATE 2014

Q:

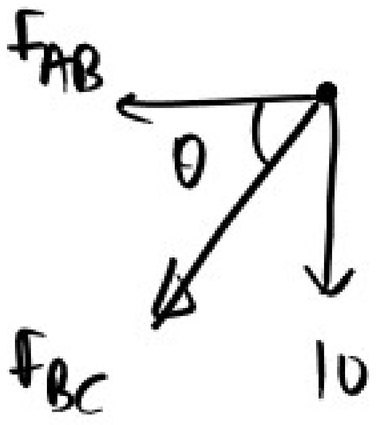
ABC → TRUSS

FORCE TRANSMITTED IN MEMBER AB ?



$\tan\theta = \frac{0.5}{1}$

$\theta =$



$\Sigma F_x = 0$

$-F_{AB} - F_{BC}\cos\theta = 0$ — (1)

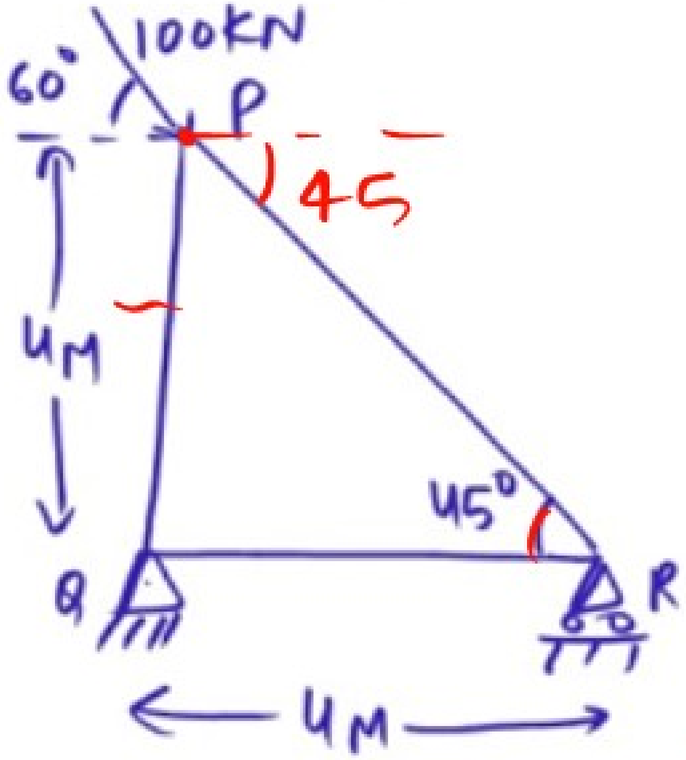
$-F_{BC}\sin\theta - 10 = 0$

$F_{BC} = -\frac{10}{\sin\theta}$

$-F_{AB} + 10\frac{\cos\theta}{\sin\theta} = 0$

$F_{AB} = \frac{10}{0.5} = 20\text{KN}$

GATE 2015 **Q:-** FOR THE TRUSS SHOWN IN FIGURE, THE MAGNITUDE OF FORCE IN MEMBER PR AND THE SUPPORT REACTION AT R ARE RESPECTIVELY?

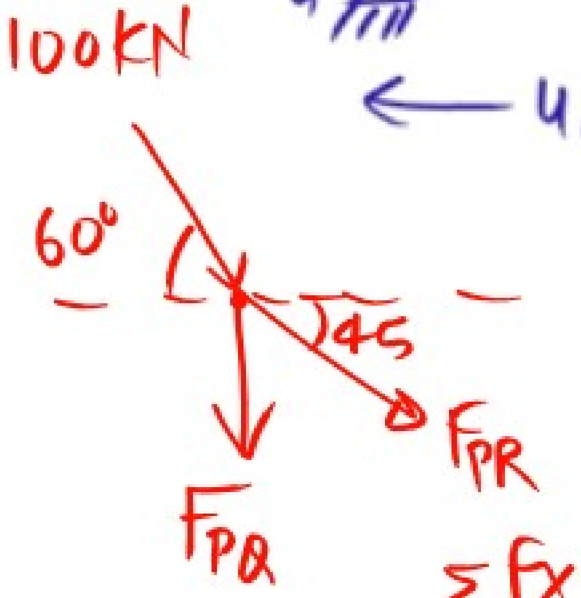


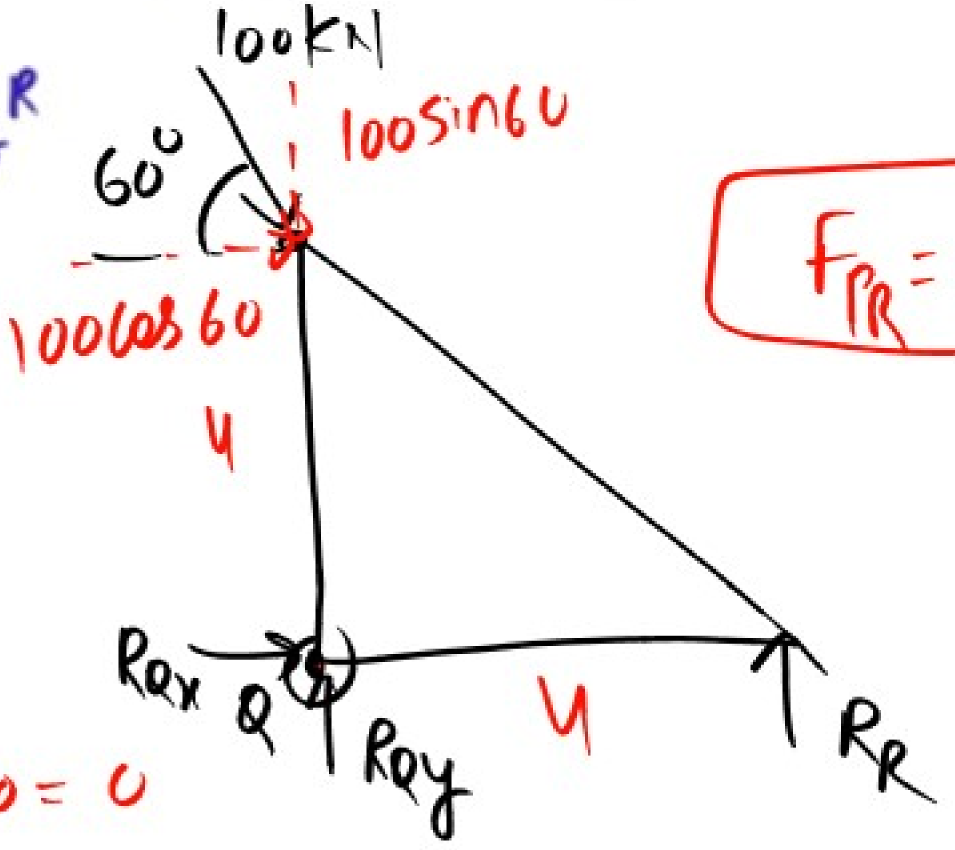
(A) 122.47 KN & 50 KN

(B) 70.71 KN & 100 KN

(C) 70.71 KN & 50 KN

(D) 81.65 KN & 100 KN





$\Sigma F_x = 0$

$F_{PR}\cos\theta + 100\cos 60 = 0$

$F_{PR} = \frac{100}{1} \times \frac{\sqrt{2}}{2}$

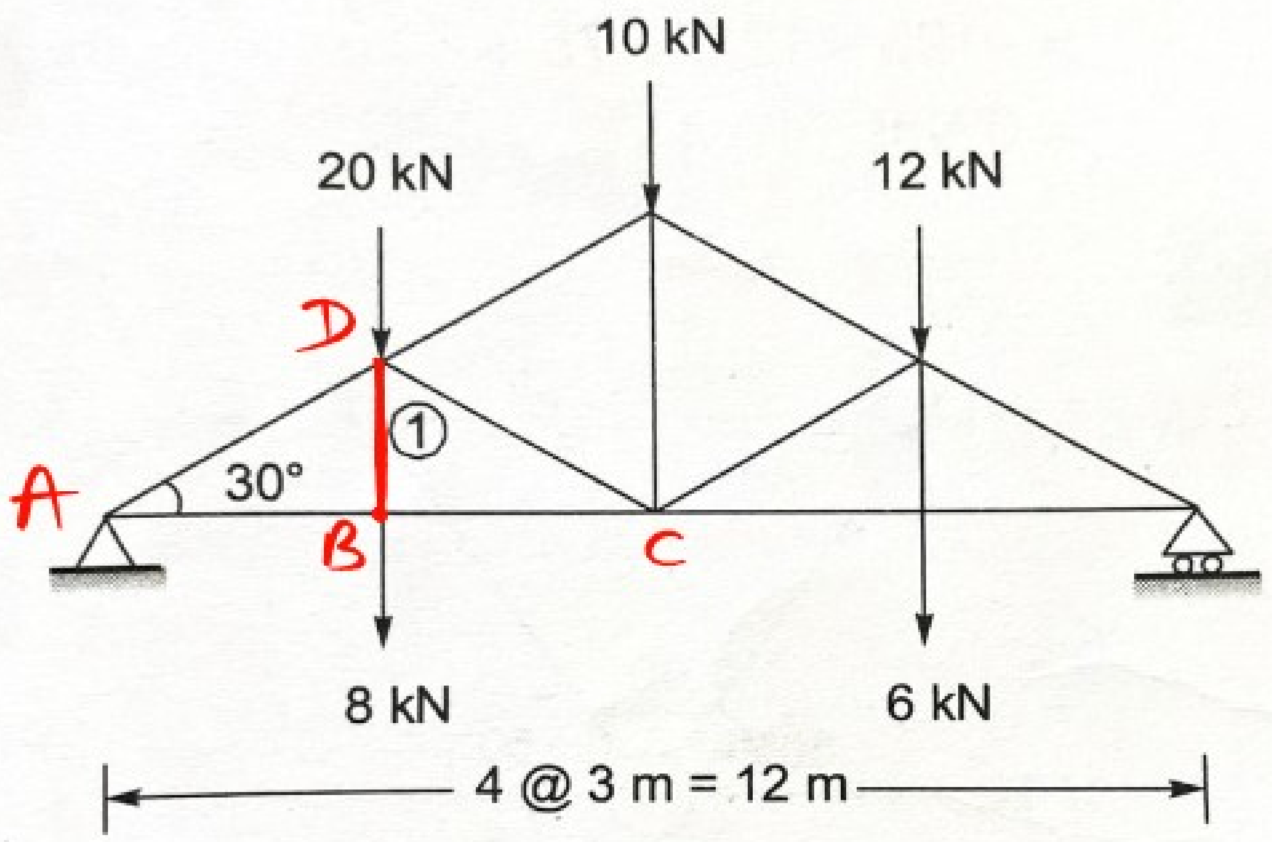
$\Sigma M_Q = 0 \Rightarrow 100\cos 60 \times 4 - R_R \times 4 = 0$

$F_{PR} = -70.71\ KN$

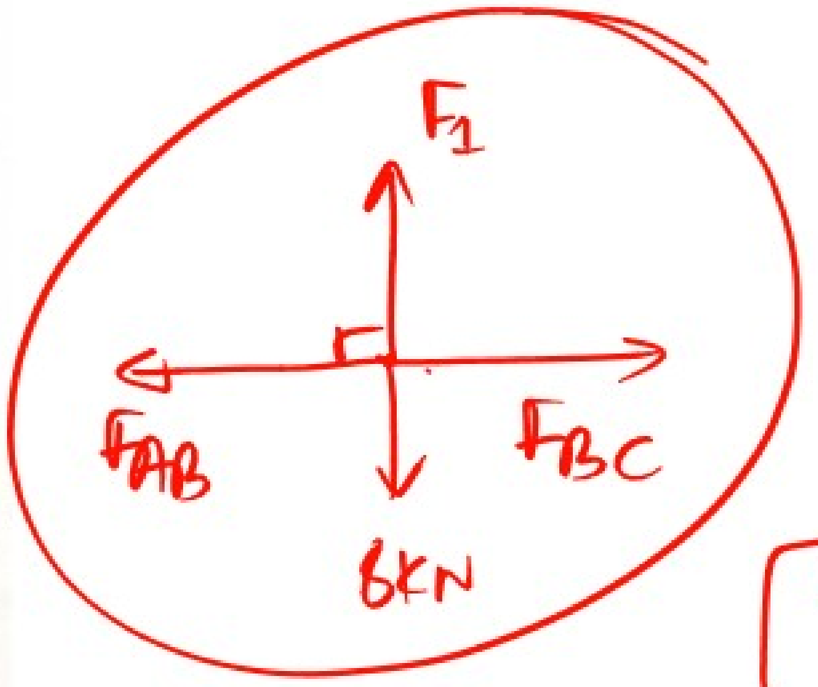
$R_R = 100 \times \frac{1}{2}$

$R_R = 50\ KN$

Q) The force in the number 1 of the truss shown in the figure is



(a) 12 kN compressive
(b) 28 kN tensile
(c) 8 kN tensile ✓
(d) 20 kN compressive

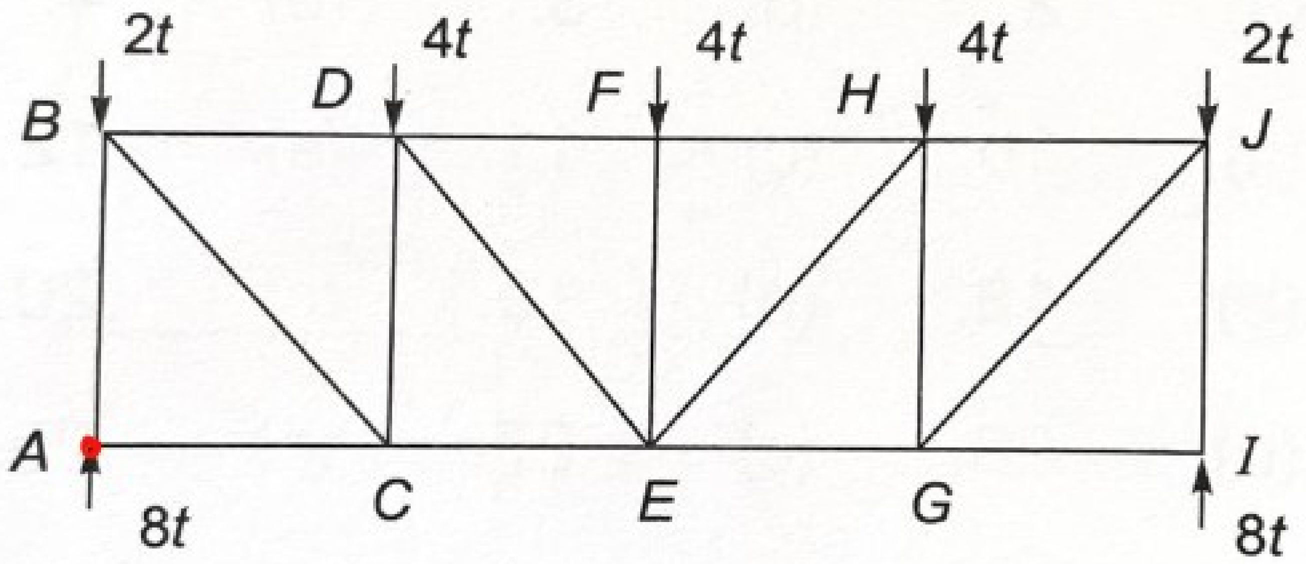


$\Sigma F_y = 0$ ✓

$F_1 = 8\,kN$

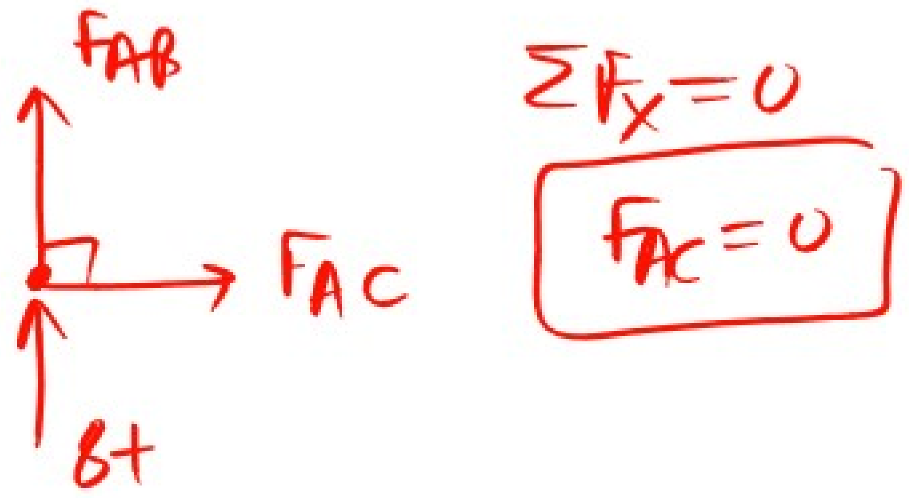
$F_{AB} = F_{BC}$

The given figure shows the loading pattern on a truss. The force in the member AC is

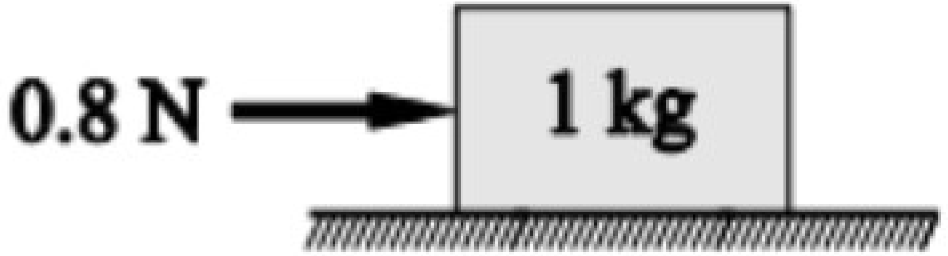


(a) zero (b) $2t$

(c) $8t$ (d) statically indeterminate



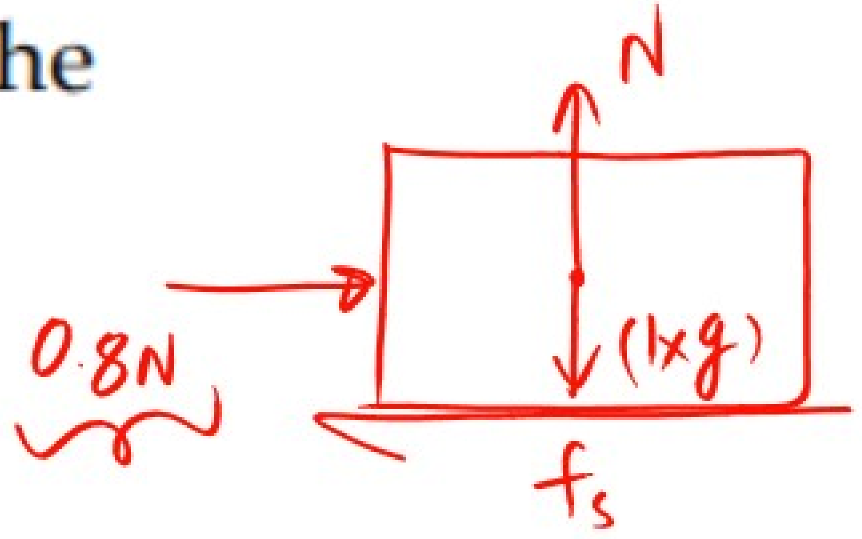
A 1 kg block is resting on a surface with coefficient of friction $\mu = 0.1$. A force of 0.8 N is applied to the block as shown in the figure. The friction force is



(A) 0 (B) 0.8 N

(C) 0.98 N (D) 1.2 N

[GATE 2011 : IIT Madras]



$N = mg$

$N = 9.8$

$(f_s)_{MAX} = \mu_s N$

$= 0.1 \times 9.8$

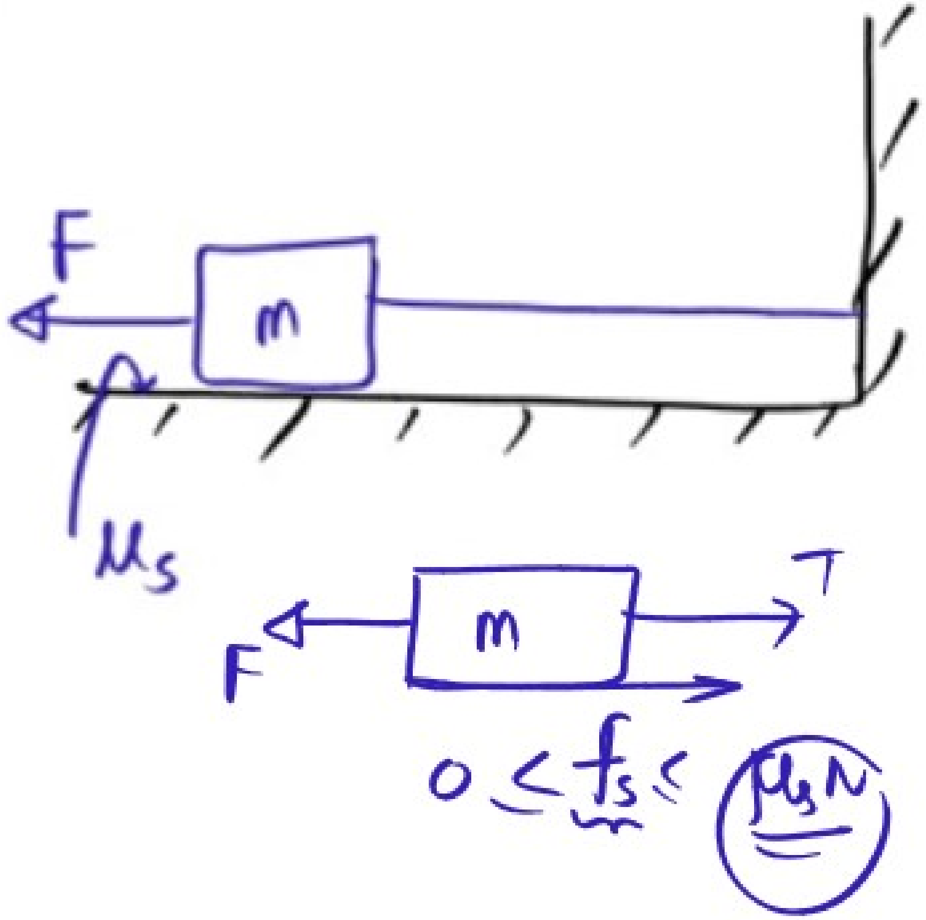
$(f_s)_{MAX} = 0.98$

$0 \le f_s \le \mu_s N$

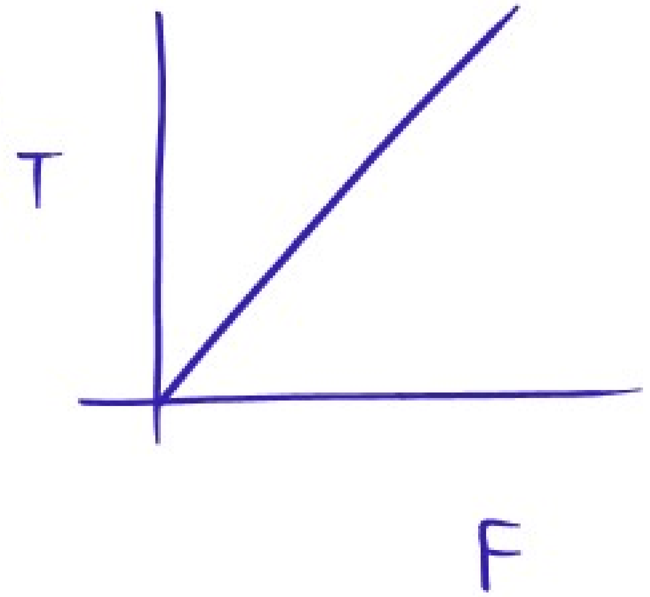
$0.8 - f_s = 0$

$f_s = 0.8\ N$

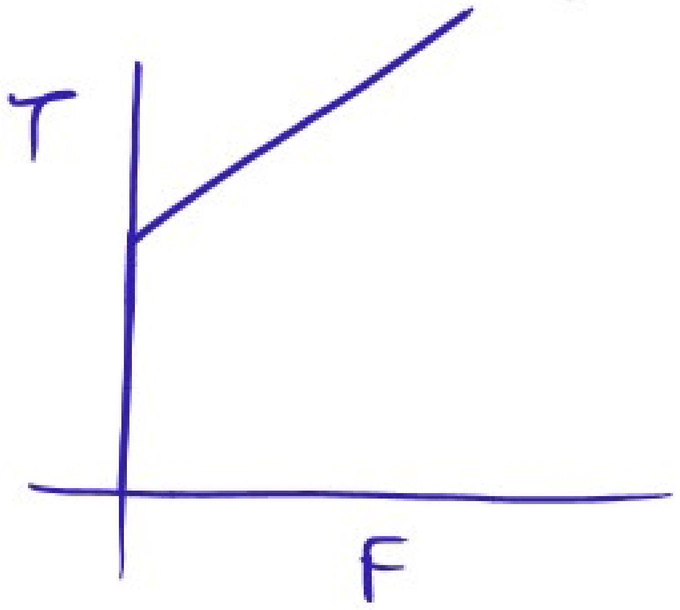
Q:- IN THE GIVEN FIGURE, FORCE, F IS GRADUALLY INCREASED FROM ZERO. DRAW GRAPH B/W APPLIED FORCE AND TENSION T IN THE SPRING.



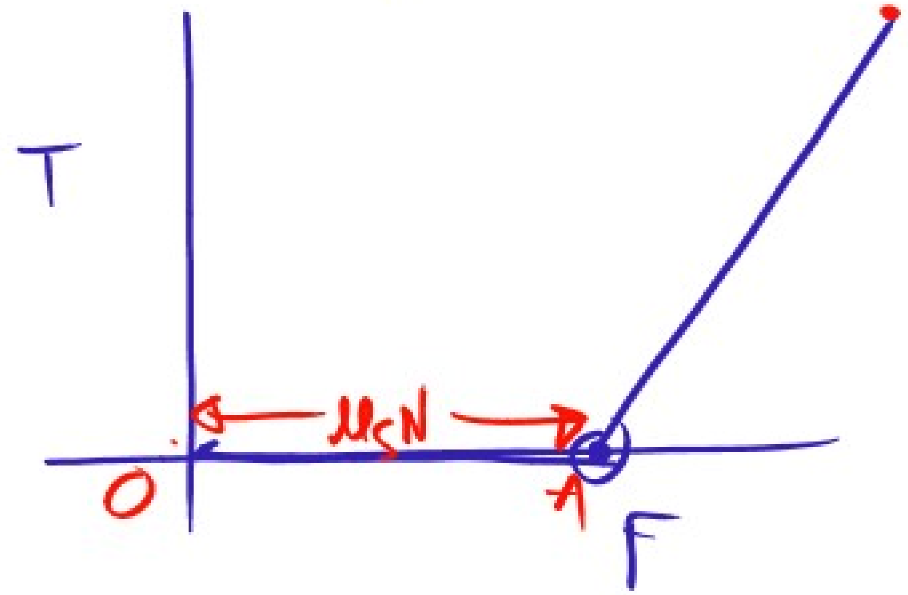
(A)



(B)



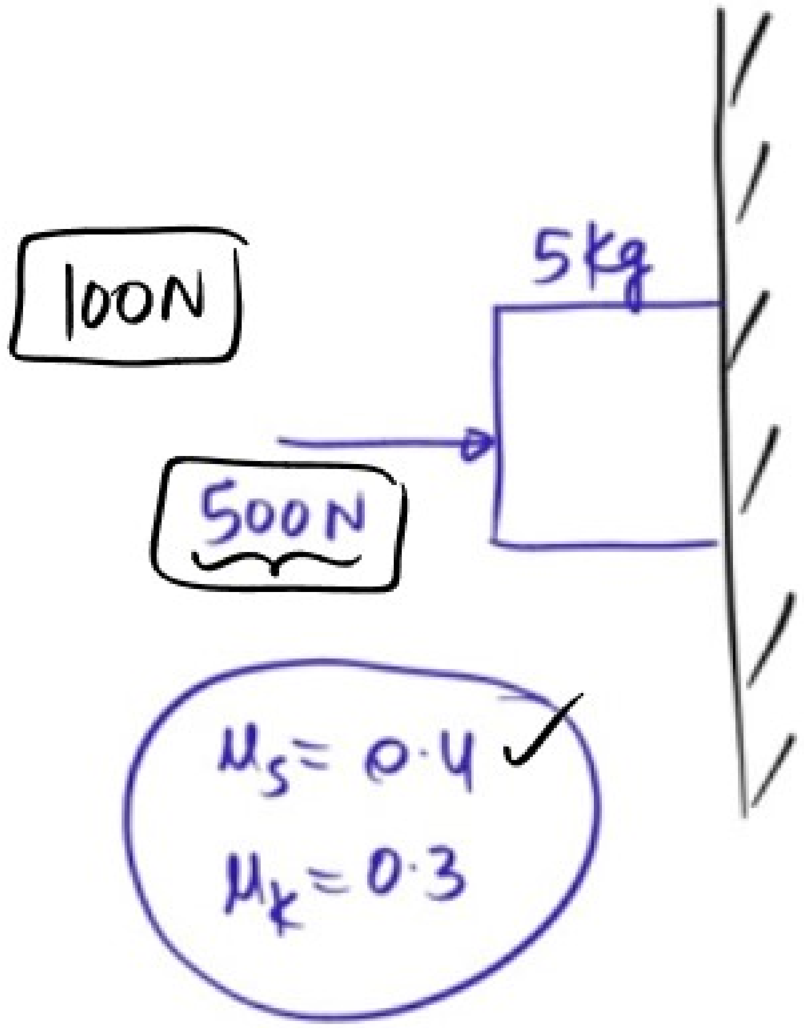
(C)

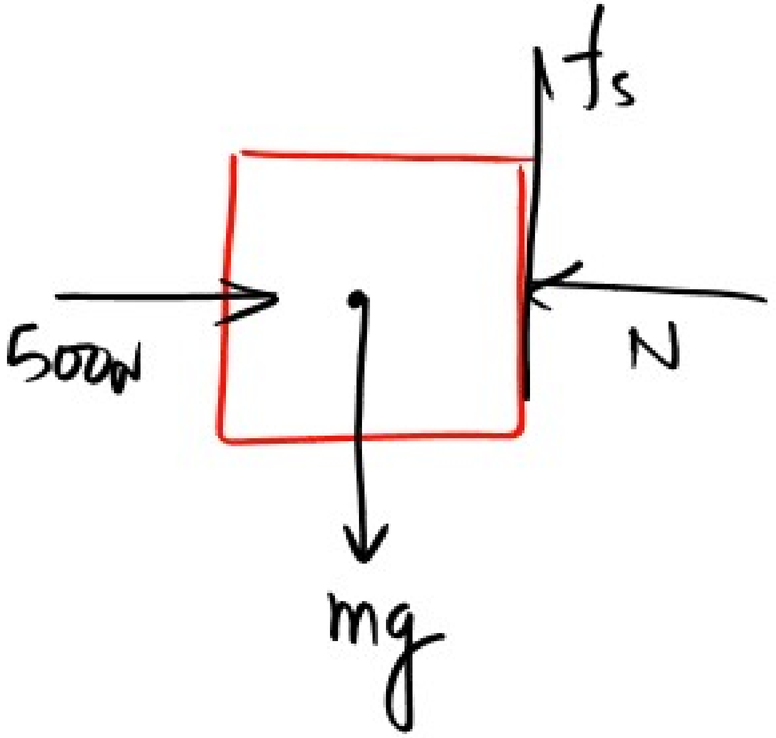


(D) NONE

Q2 :- DETERMINE THE MAGNITUDE OF FRICTIONAL FORCE AND ACC^n OF THE BLOCK.

$g = 10\ m/s^2$





$$mg - (f_s)_{MAX} = ma$$

$\Sigma F_x = 0$

$N = 500N$

$mg \Rightarrow 5 \times 10 \Rightarrow \underline{50}$

$(f_s)_{MAX} = \mu_s N$

$= 0.4 \times 500$

$= 200$

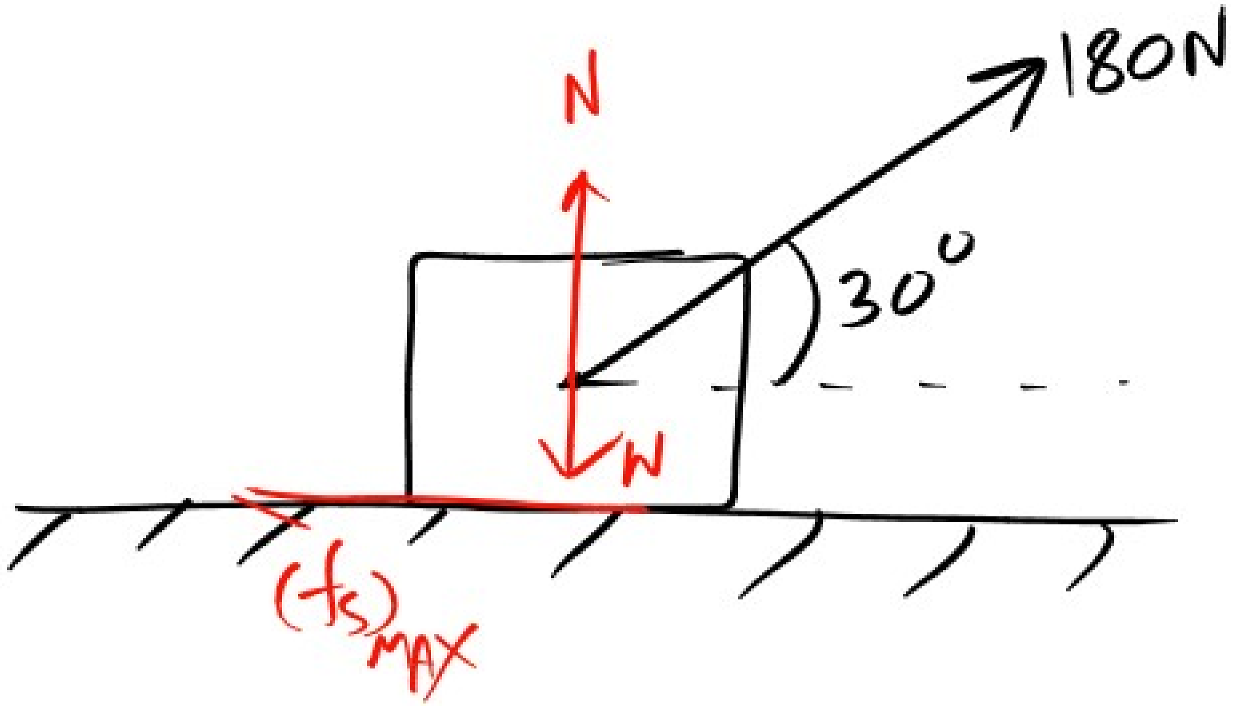
HERE $mg < (f_s)_{MAX}$

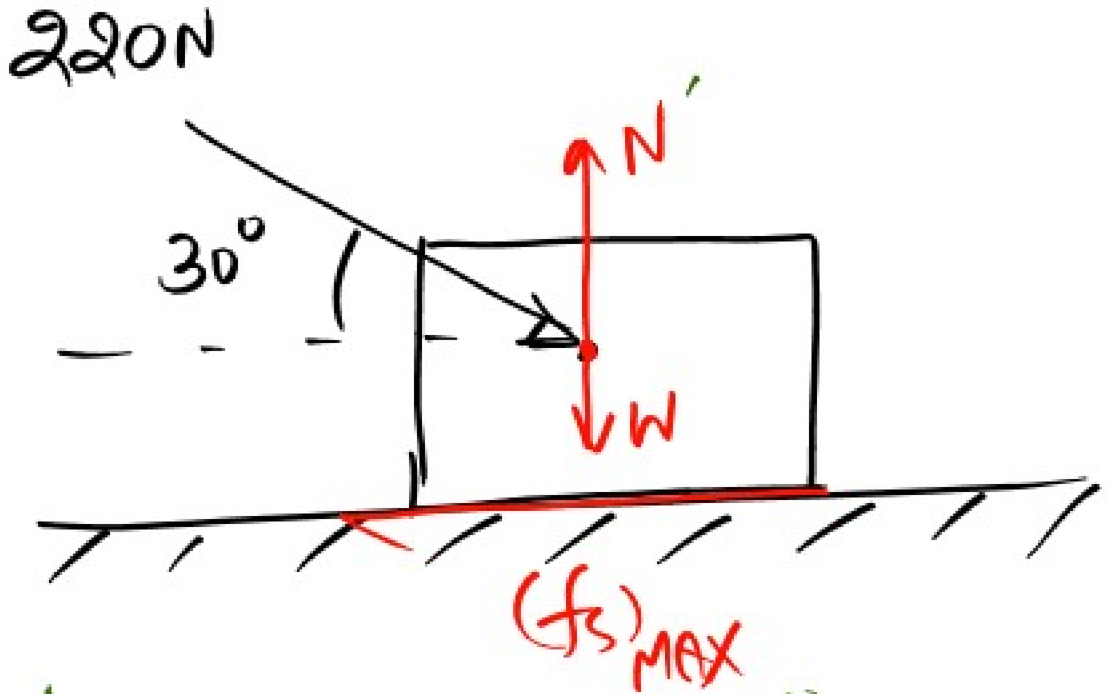
$$f_s = mg = 50 \quad , \quad a = 0$$

A body, resting on a rough horizontal plane required a pull of 180 N inclined at 30^0 to the plane just to move it. It was found that a push of 220 N inclined at 30^0 to the plane just moved the body.

Q.2 The weight of the body is ______________N.

Q.3 The coefficient of friction ______________.





$\Sigma F_y = 0$ $\qquad N + 180\sin 30 - W = 0$

$$N = W - 180 \times \tfrac{1}{2}$$

$$N = W - 90 \quad — (1)$$

$\Sigma F_x = 0$ $\qquad 180\cos 30^\circ - (f_s)_{MAX} = 0$

$$180\cos 30 - \mu_s N = 0$$

$$180\cos 30 = \mu_s (W - 90) \quad — (A)$$

$$N - 220\sin 30 - W = 0$$

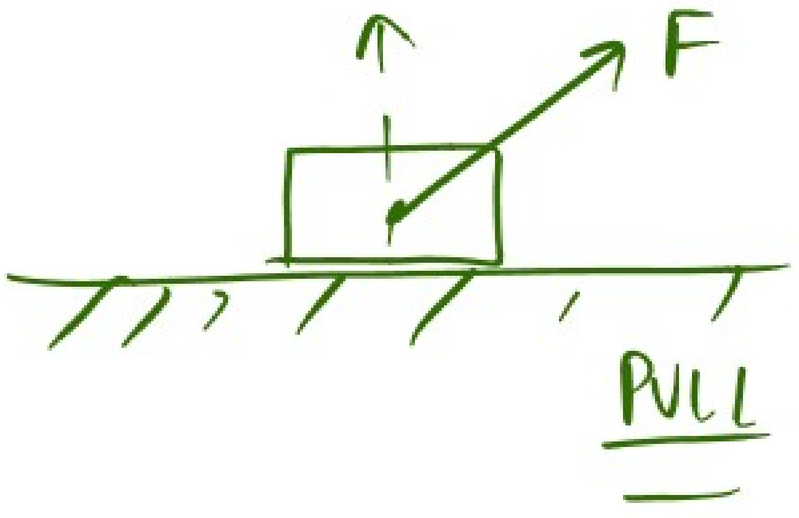
$$N' = W + 110 \quad — (II)$$

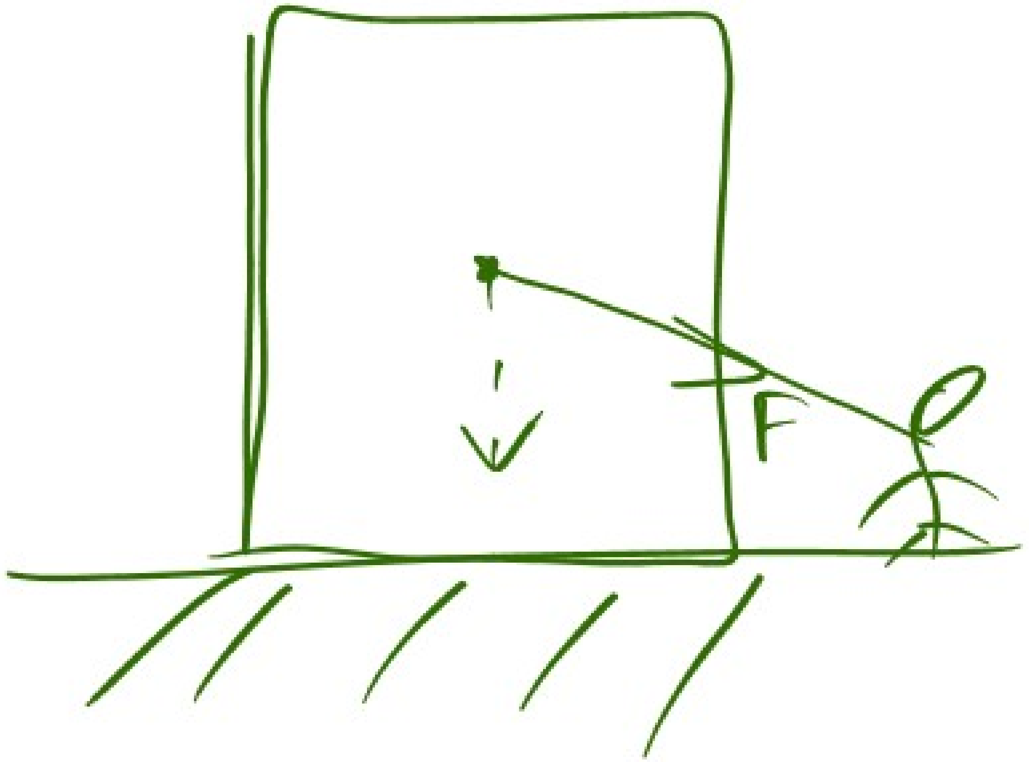
$$220\cos 30 - \mu_s (N') = 0$$

$$220\cos 30 = \mu_s (W + 110) \quad — (B)$$

(A) & (B)

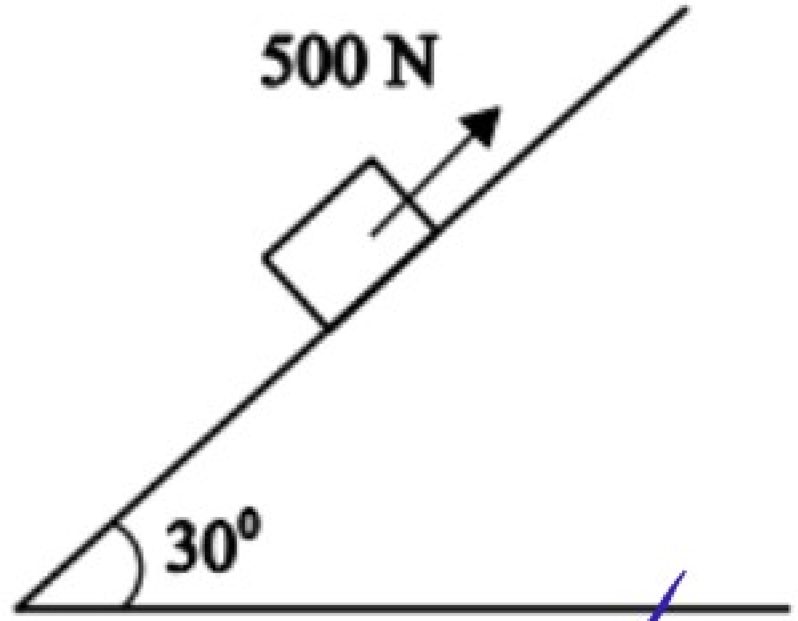
$$W = 990\text{ N}$$
$$\mu_s = 0.173$$



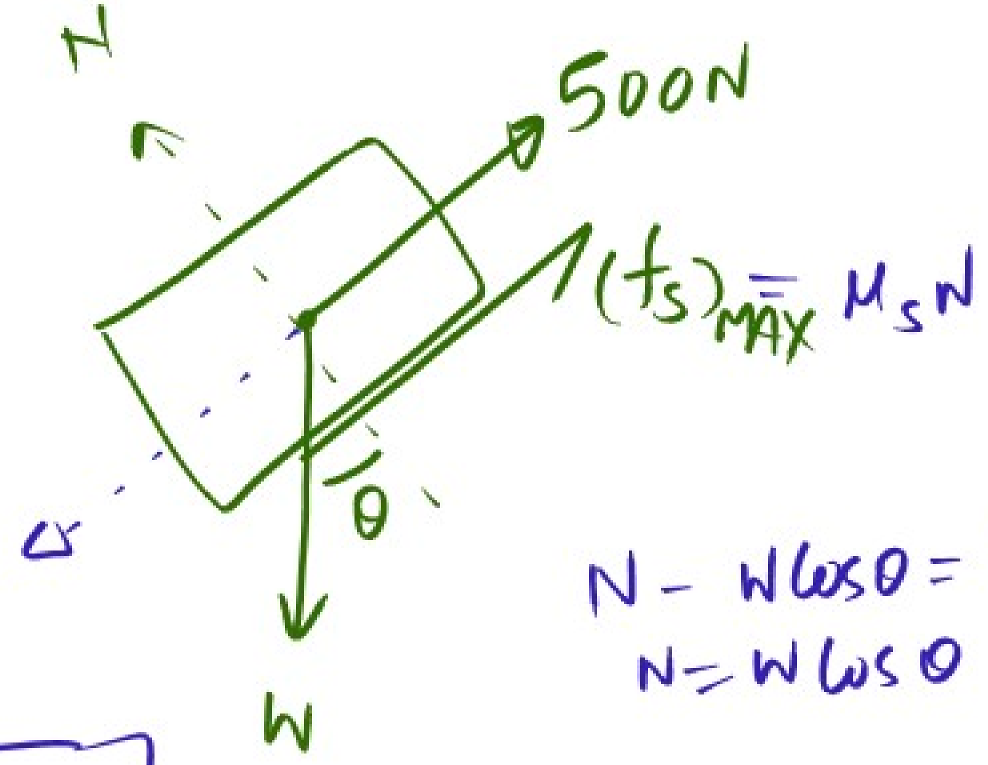


$\mu_s N = f_s$

The block shown in the given figure is kept in equilibrium and prevented from sliding down by applying a force of 500 N. The coefficient of friction is $\frac{\sqrt{3}}{5}$. The weight of the block would be



(A) 4000 N (B) 2500 N
(C) 1000 N (D) 500 N



$N - W\cos\theta = 0$

$N = W\cos\theta$

$W \sin\theta - 500 - \mu_s N = 0$

$W = \frac{500 + \mu_s N}{\sin\theta}$

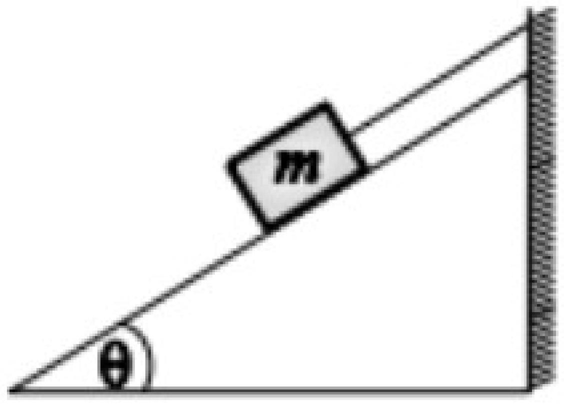
$= \frac{500 + \frac{\sqrt{3}}{5} \times 500}{\sin 30}$

W = 2500N

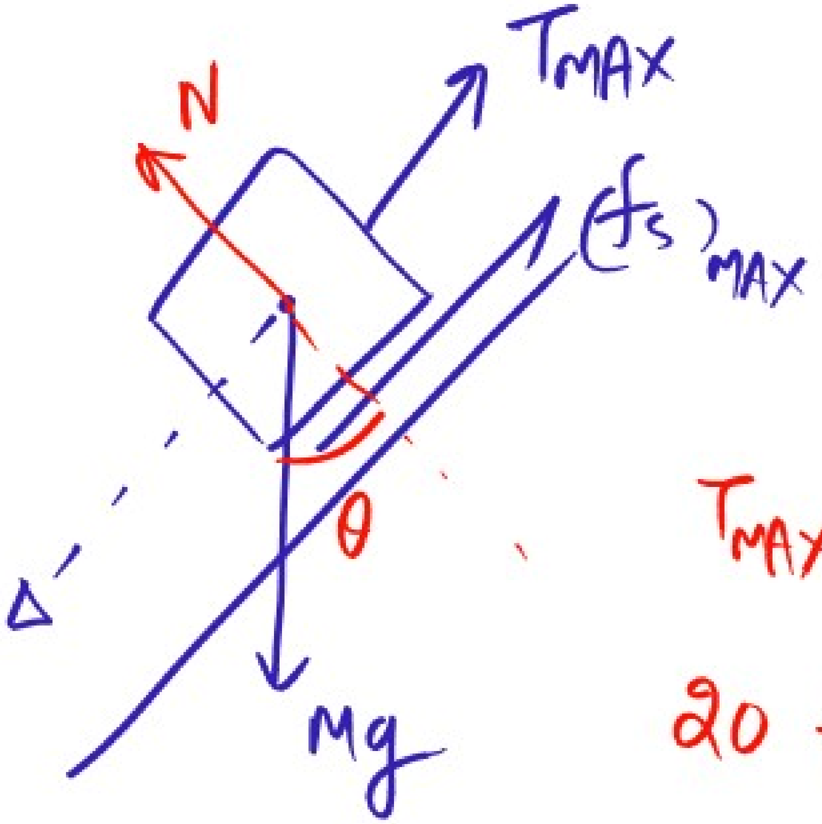
A block of mass m rests on an inclined plane and is attached by a string to the wall as shown in the figure. The coefficient of static friction between the plane and the block is 0.25. The string can withstand a maximum force of 20 N. The maximum value of the mass (m) for which the string will not break and the block will be in static equilibrium is _______ kg.

Take $\cos\theta = 0.8$ and $\sin\theta = 0.6$.

Acceleration due to gravity $g = 10 \text{m/s}^2$



[GATE 2016 : IISc Bangalore]



$N - Mg\cos\theta = 0$

$N = Mg\cos\theta$

$T_{MAX} + (f_s)_{MAX} - Mg\sin\theta = 0$

$20 + \mu_s N = Mg\sin\theta$

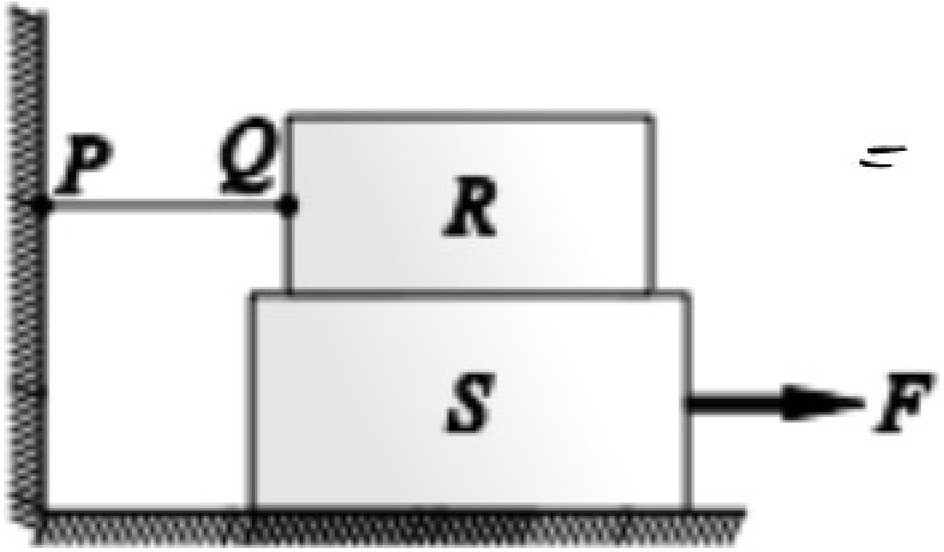
$20 + 0.25 \times Mg\cos\theta = Mg\sin\theta$

$20 = Mg(\sin\theta - 0.25\cos\theta)$

$2 = m(0.6 - 0.25 \times 0.8)$

$m = \frac{2}{0.4} = 5 \text{ kg}$

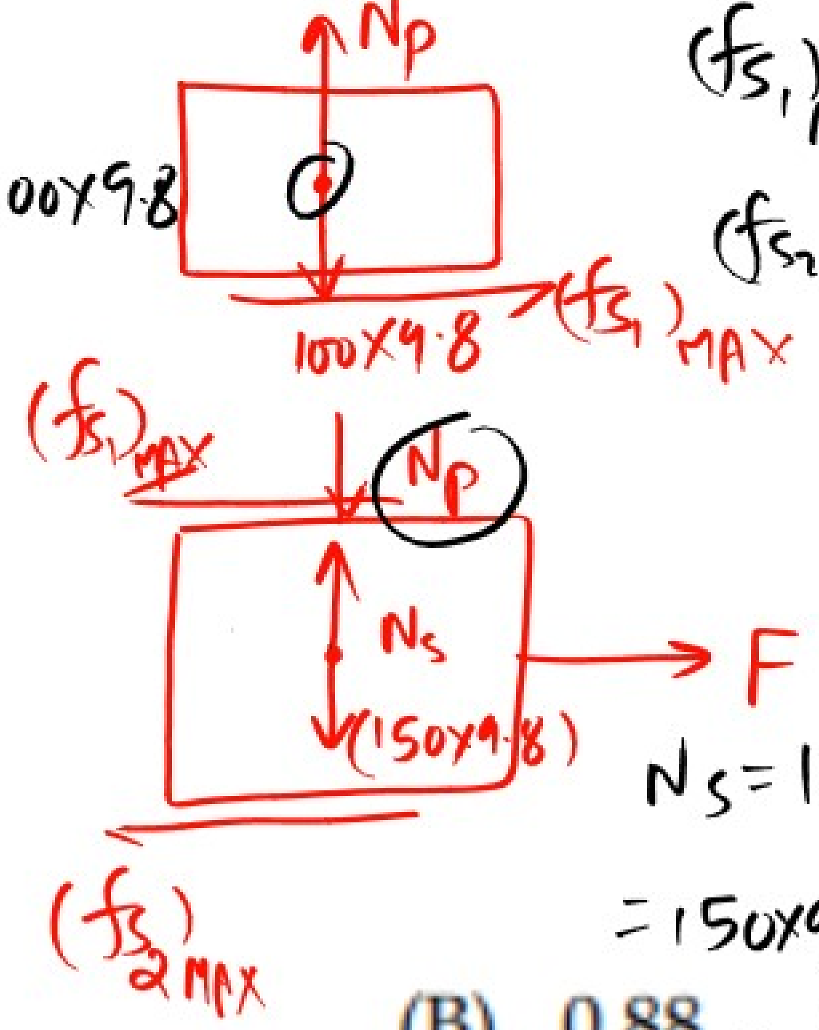
Q. A block R of mass 100 kg is placed on a block S of mass 150 kg as shown in the figure. Block R is tied to the wall by a massless and inextensible string PQ. If the coefficient of static friction for all surfaces is 0.4, the minimum force F (in kN) needed to move the block S is



(A) 0.69 (B) 0.88

(C) 0.98 (D) 1.37

[GATE 2014 : IIT Kharagpur]



$N_P = 100 \times 9.8$

$(f_{s_1})_{MAX} = \mu_s N_P$

$(f_{s_2})_{MAX} = \mu_s N_s$

$N_s = 150 \times 9.8 + N_P$

$= 150 \times 9.8 + 100 \times 9.8$

$= 250 \times 9.8$

$F = (f_{s_1})_{MAX} + (f_{s_2})_{MAX}$

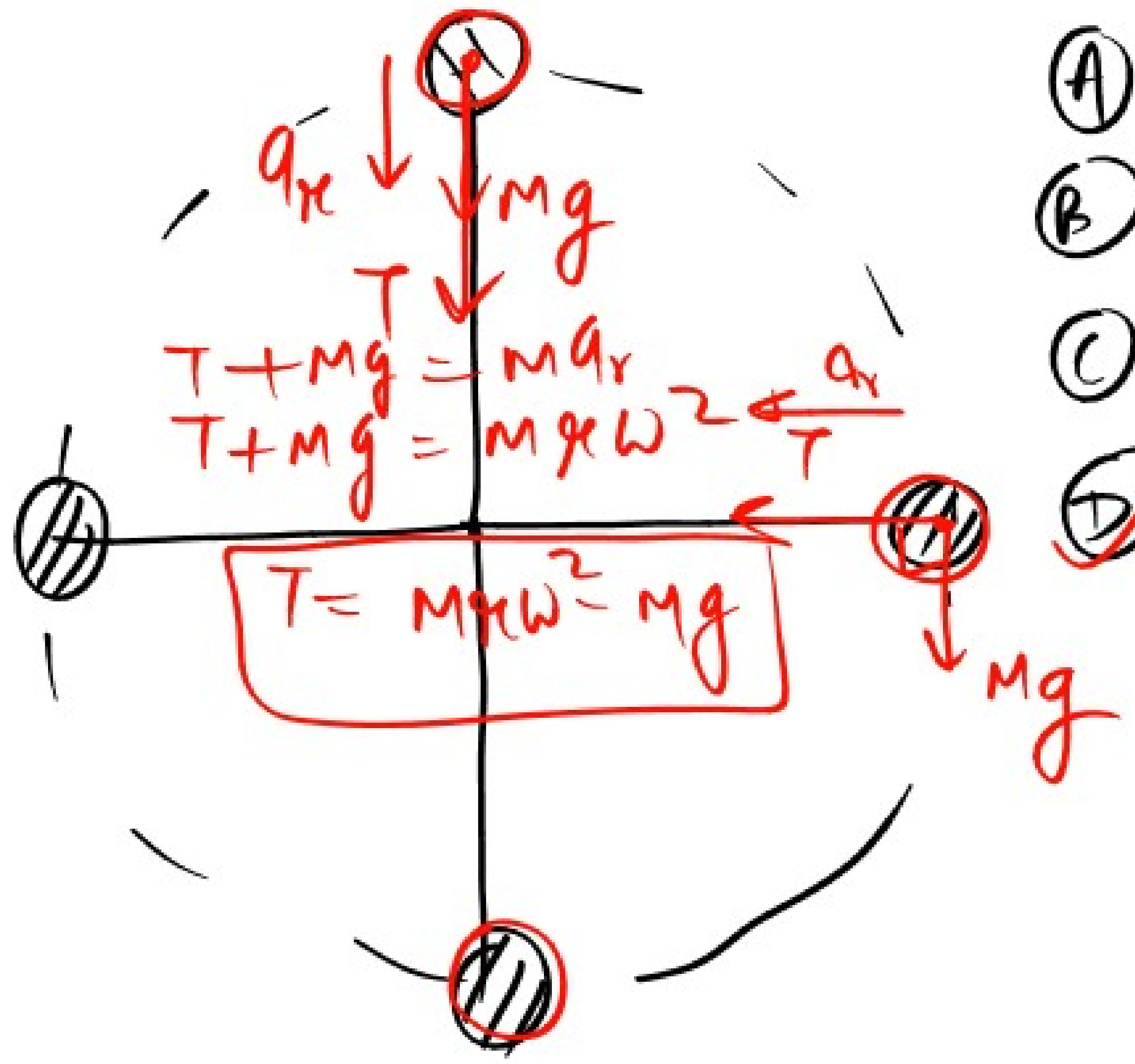
$= \mu_s N_P + \mu_s N_s$

$\Rightarrow \mu_s (100 \times 9.8 + 250 \times 9.8)$

$F = 1370 \text{ N} = 1.37 \text{ kN}$

Q:- A WHEEL OF RADIUS 2 M ROLLS FREELY ON A SURFACE. IF $V_A = 6 M/s$, $a_A = 20 M^2$. FIND THE VELOCITY AND ACC^n OF POINT B.

Q: A STONE OF MASS 'm' AT THE END OF A STRING OF LENGTH 'l' IS WHIRLED IN A VERTICAL CIRCLE AT A CONSTANT ω THE TENSION IN THE STRING WILL BE MAXIMUM WHEN THE STONE IS



(A) AT THE TOP OF THE CIRCLE

(B) HALF WAY DOWN FROM TOP

(C) QUARTER WAY DOWN

(D) AT THE BOTTOM OF CIRCLE ✓

$T = ma_r$

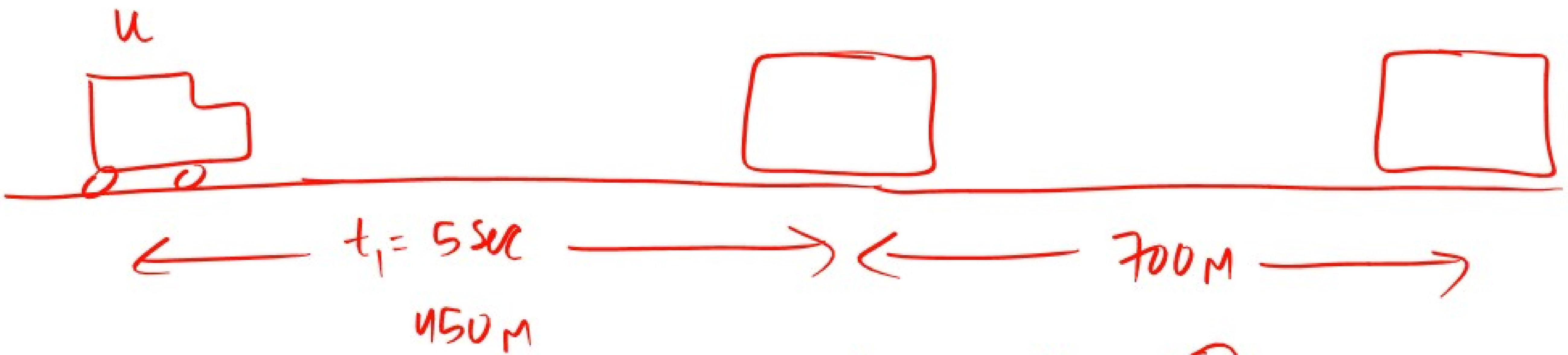
$T = mr\omega^2$

$T - mg = mr\omega^2$

$T = mr\omega^2 + mg$

GATE 1998

Q:- A CAR MOVING WITH UNIFORM ACCELERATION COVERS 450 M IN 5 sec AND COVERS 700 M IN NEXT 5 seconds. THE ACC^n OF CAR IS ____.



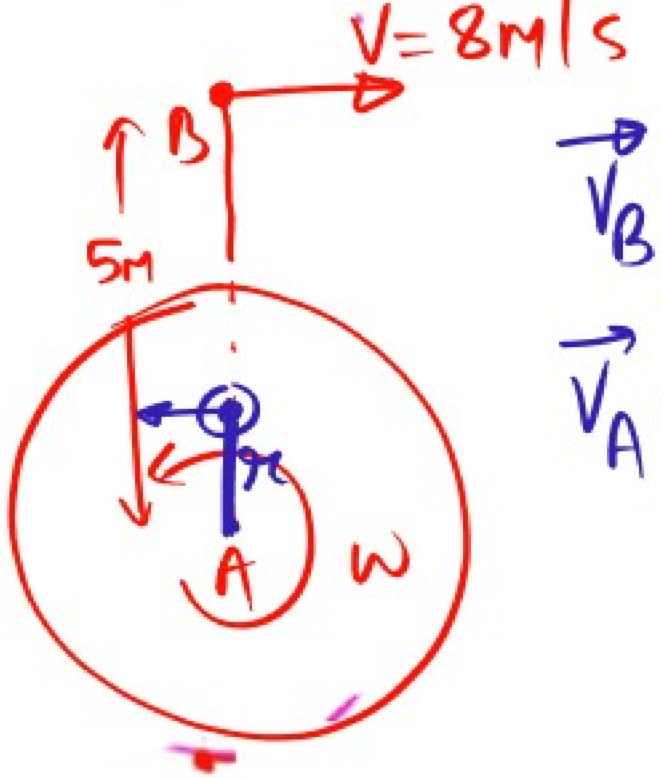
$$S_1 = ut + \frac{1}{2}at^2 \Rightarrow 450 = u \times 5 + \frac{1}{2}a \times (5)^2 \quad \text{— (I)}$$

$$S_2 = ut + \frac{1}{2}at^2 \Rightarrow (450 + 700) = u \times (5+5) + \frac{1}{2}a(5+5)^2 \quad \text{— (II)}$$

$$u = 65\,\text{m/s},\ a = 10\,\text{m/s}^2$$

1999

Q:- AS SHOWN IN FIGURE, A PERSON A IS STANDING AT THE CENTRE OF A ROTATING PLATFORM. PERSON B WHO IS RIDING A BICYCLE HEADING EAST. AT THE INSTANT UNDER CONSIDERATION, WHAT IS THE APPARENT VELOCITY OF B AS SEEN BY A ?



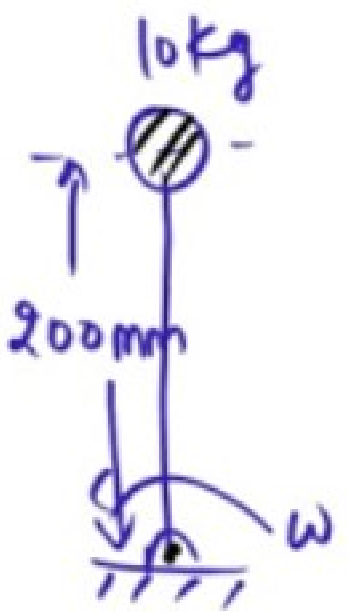
$\vec{V}_B = 8\hat{i}$

$\vec{V}_A = 0$

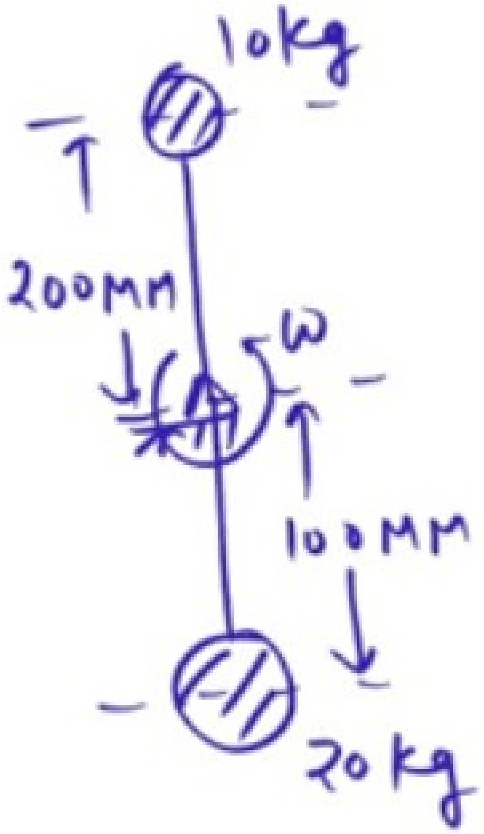
(A) 3 M/S HEADING EAST
(B) " " WEST
(C) 8 M/S " EAST ✓
(D) 13 M/S " EAST

$$\vec{V}_{B/A} = \vec{V}_B - \vec{V}_A = 8\hat{i} - 0$$
$$= \underline{8\hat{i}}$$

GATE 2004 ⑧ A RIGID BODY SHOWN IN FIGURE A HAS A MASS OF 10 Kg. IT ROTATES WITH AN UNIFORM ANGULAR VELOCITY ω. A BALANCING MASS OF 20 Kg IS ATTACHED AS SHOWN. THE PERCENTAGE INCREASE IN MASS MOI AS A RESULT OF THIS ADDITION IS ___



(I)



$MOI_1 = mr^2$

$= 10 \times (.2)$

$= .4$

$MOI_2 = 10(.2)^2 + 20(.1)^2$

$= 0.4 + 0.2 = 0.6$

$\frac{0.6 - 0.4}{0.4} \times 100 \Rightarrow 50\%$

GATE'2005

Q1:- THE TIME VARIATION OF THE POSITION OF A PARTICLE IN RECTILINEAR MOTION IS GIVEN BY $x = 2t^3 + t^2 + 2t$

$v \rightarrow$ velocity, $a = acc^n$

H.W.

Answer → D

THE MOTION STARTED WITH

(A) $v = 0, a = 0$

(B) $v = 0, a = 2$

(C) $v = 2, a = 0$

(D) $v = 2, a = 2$

GATE 2005

Q1: A SIMPLE PENDULUM OF LENGTH 5 M WITH A BOB OF MASS 1 kg IS IN SIMPLE HARMONIC MOTION. AS IT PASSES THROUGH IT'S MEAN POSITION THE BOB HAS A SPEED OF 5 M/S. THE NET FORCE ON THE BOB AT THE MEAN POSITION IS ___

(a) ZERO

(b) 2.5 N

(c) 5 N

(d) 25 N

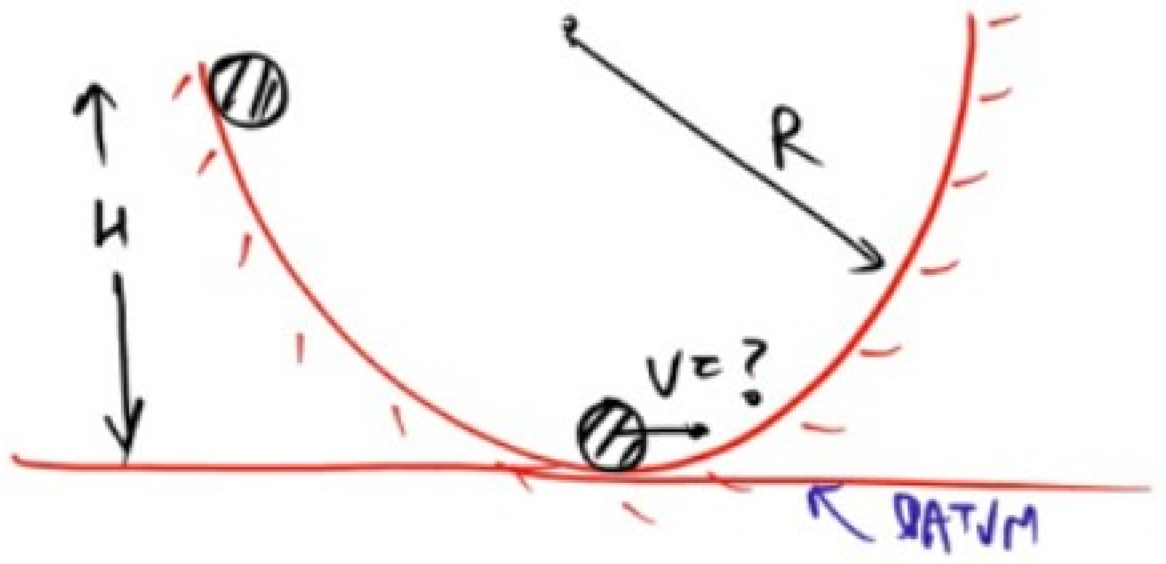
2014 **Q:-** A MASS m_1 OF 100kg TRAVELLING WITH AN UNIFORM VELOCITY OF 5 m/s ALONG COLLIDES WITH A STATIONARY MASS m_2 OF 1000kg. AFTER COLLISION BOTH THE MASSES TRAVEL TOGETHER WITH THE SAME VELOCITY, THE COEFF. OF RESTITUTION IS ______

GATE 2015

Q:- A SMALL BALL OF 1 Kg MOVING WITH A VELOCITY OF 12 m/s UNDERGOES A DIRECT CENTRAL IMPACT WITH A STATIONARY BALL OF MASS 2 Kg. THE IMPACT IS PERFECTLY ELASTIC. THE SPEED (IN m/s) OF 2 Kg MASS BALL AFTER THE IMPACT WILL BE ______.

Q:- A BALL OF MASS 0.1 kg, INITIALLY AT REST, DROPPED FROM HEIGHT OF 1M. BALL HITS THE GROUND AND BOUNCES OFF THE GROUND. UPON IMPACT WITH THE GROUND THE VELOCITY REDUCES BY 20%. THE HEIGHT (IN m) TO WHICH THE BALL WILL RISE IS ______

2016
Q :- A POINT MASS 'm' IS RELEASED FROM REST AND SLIDES DOWN A SPHERICAL BOWL OF A RADIUS 'R' FROM A HEIGHT 'H' AS SHOWN IN FIGURE. THE SURFACE OF THE BOWL IS SMOOTH. THE VELOCITY OF THE MASS AT THE BOTTOM OF THE BOWL IS ________

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