MINISTRY OF EDUCATION AND TECHNICAL EDUCATION

وزارة التربية والتعليم والتعليم الفني

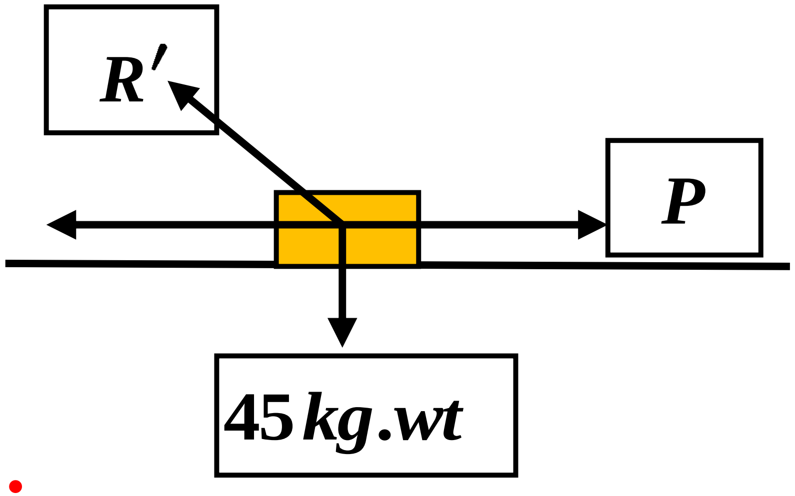
Math.

Third Sec.

Example

In the opposite figure

A body of weight 45 kg.wt is placed on a rough horizontal plane , the coefficient of static friction between the body and the plane is $\frac{\sqrt{3}}{3}$. If the body is about to move .



Then $P + R' = ...kg.wt$

(a) 45 (b) $45\sqrt{3}$ (c) $30\sqrt{3}$ (d) $15\sqrt{3}$

$$P = \mu_s R \qquad \therefore P = \frac{\sqrt{3}}{3} \times 45 = 15\sqrt{3} \ kg\,wt$$

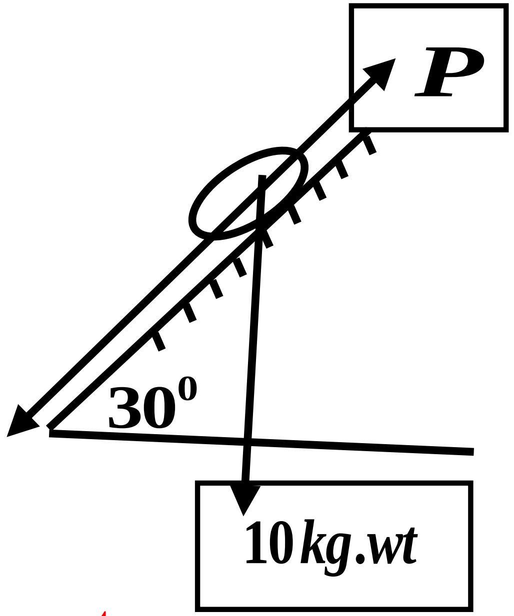
$$R' = R\sqrt{1+\mu^2} \qquad \therefore R' = 45\sqrt{1+\frac{1}{3}} = 30\sqrt{3} \ kg\,wt$$

$$\therefore P + R' = 15\sqrt{3} + 30\sqrt{3} = 45\sqrt{3} \ kg\,wt \qquad Ans.(b)$$

Example

In the opposite figure

A body of weight $10kg.wt$ is placed on a rough inclined plane , inclined to the horizontal at an angle of measure 30^0 and the body is about to slide , then the force parallel to the plane and makes the body about to move up the plane = …. kg.wt



$(a)5$ $(b)10$ $(c)15$ $(d)20$

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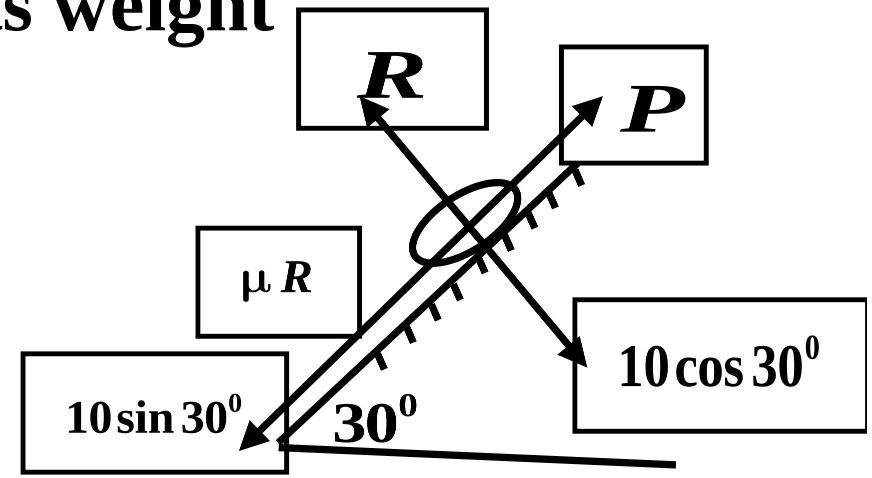
The body about to slide under the action of its weight

$\therefore \lambda = \theta = 30^0 \qquad \therefore \mu = \tan 30^0 = \frac{\sqrt{3}}{3}$

$\therefore R = w\cos 30^0 = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}\ kg.wt$

$\therefore P = w\sin 30^0 + \mu R = 10 \times \frac{1}{2} + 5\sqrt{3} \times \frac{\sqrt{3}}{3} = 10\ kg.wt \qquad Ans.(b)$



Example

If the force $\vec{F} = n\hat{i} + m\hat{j} - 2\hat{k}$ acts at point A whose position vector with the origin point is $\vec{r} = (3, 1, 1)$, and the two components of the moment of $\vec{F}$ about x – axis and y – axis are – 1 , – 8 respectively . Then n + m = …….

$(a) -14$ $(b) -1$ $(c) -15$ $(d) 14$

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$$\overrightarrow{M}=\vec{r}\times\overrightarrow{F}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & 1 & 1\\ n & m & -2\end{vmatrix}=-\hat{i}-8\hat{j}+(3m-n)\hat{k}$$

$$\therefore(-2-m)\hat{i}-(-6-n)\hat{j}=-\hat{i}-8\hat{j}$$

$\therefore(-2-m)=-1$ $\therefore m=-1$, $-(-6-n)=-8$ $\therefore n$

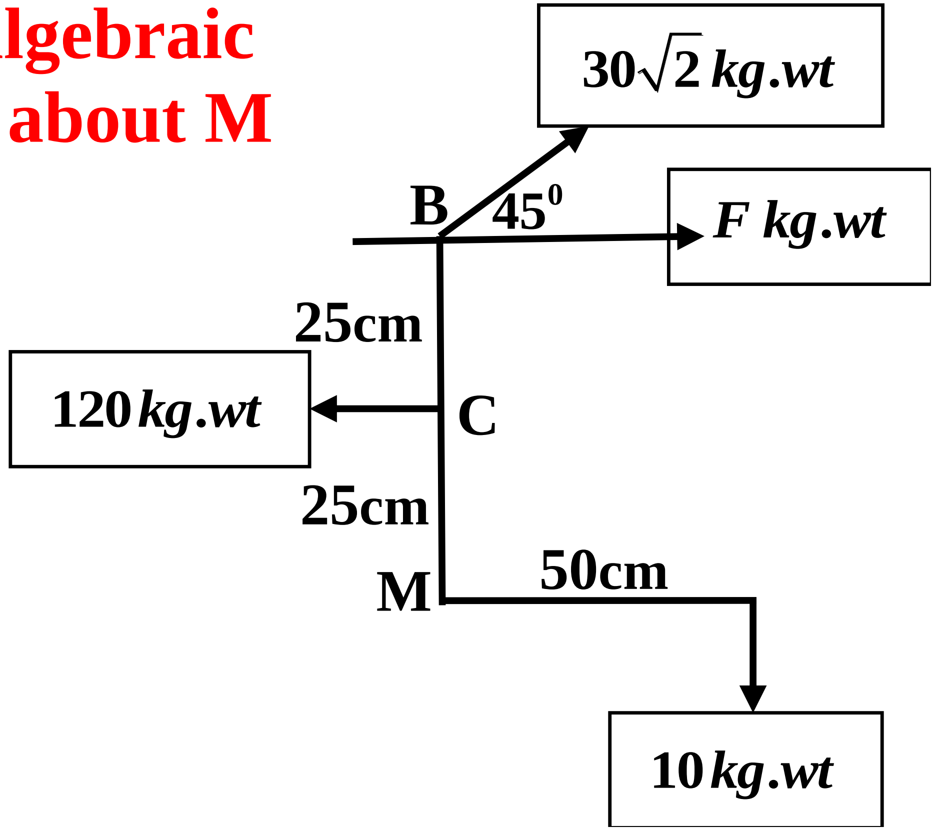
$\therefore-(-6-n)=-8$ $\therefore n=-14$ $\therefore n+m=-15$ $Ans.(c)$

Example

In the opposite figure

AMB is a rod of a negligible weight , if algebraic sum of moment of these forces vanished about M

Then F = ………… kg.wt



$(a)\ 10\sqrt{2}$ $(b)\ 15$

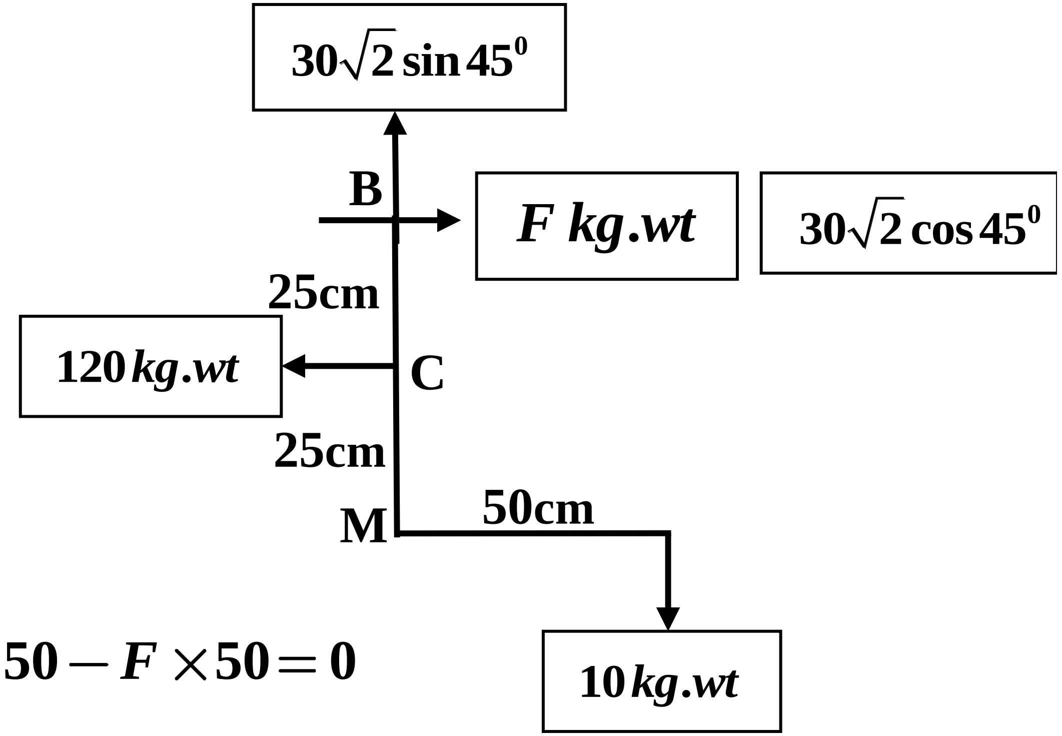
$(c)\ 20$ $(d)\ 10$

By resolving the force $30\sqrt{2}$ into the two Components

$30\sqrt{2}\cos 45^0$ **horizontally**

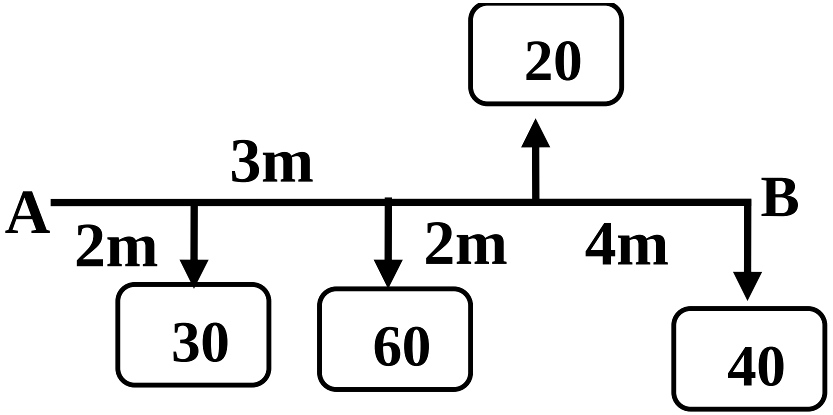
And $30\sqrt{2}\cos 45^0$ **vertically**

$\because M_M = 0$



$$-10\times 50 + 120\times 25 - 30\sqrt{2}\times\frac{1}{\sqrt{2}}\times 50 - F\times 50 = 0$$

$F\times 50 = 1000$ $\therefore F = 20$ $Ans.(c)$



Example

In the opposite

If all forces are parallel and perpendicular to $\overline{AB}$. Then the point of action of the resultant is at a distance ….. m from the point A

(a) 7 **(b) 5** **(c) 6** **(d) 5.5**

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$R = 30 + 60 + 40 - 20 = 110$

Let $\overrightarrow{R}$ acts at point $M \in \overleftrightarrow{AB}$

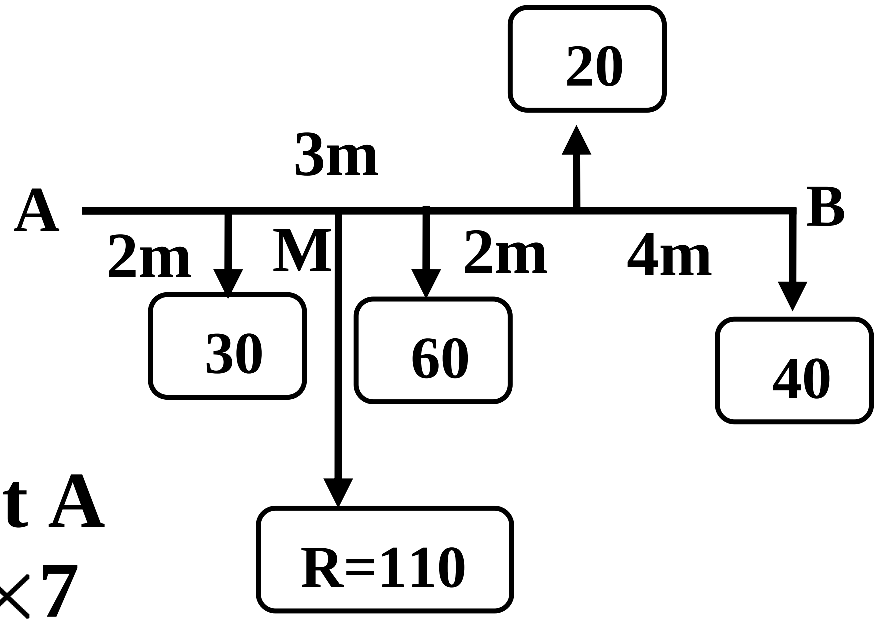
Where $\overrightarrow{R}$ acts perpendicular downwards

The sum of moments of the forces

about A = the moment of the resultant about A

$-110\,AM = -30\times 2 - 60\times 5 - 40\times 11 + 20\times 7$

$-110\,AM = -660$ $\therefore AM = 6$ $Ans.(c)$



Example

If $\overrightarrow{F_1} = (3, -1)$ acts at the point A (1 ,2) , $\overrightarrow{F_2}$ acts at the point B (– 1 , 1) , and the two forces form a couple . Then the algebraic moment of the couple = ... moment unit

$(a)\,5$ $(b)\,2$ $(c)\,-5$ $(d)\,-2$

The moment of the couple = the moment of one of the two forces about a point on the line of action of the other force

$$\overrightarrow{BA} = A - B = (2,1)$$

$$\overrightarrow{M} = \vec{r} \times \overrightarrow{F} = (2,1) \times (3,-1) = -5\hat{k}$$

$Ans.(c)$

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Example

ABCD is a rectangle in which AB = 12 cm , BC = 8 cm , H is the midpoint of $\overline{AB}$,the forces 33 , 24 ,30 , 20 , 25 Newton in $\overrightarrow{BA}$, $\overrightarrow{AD}$, $\overrightarrow{DH}$, $\overrightarrow{CB}$, $\overrightarrow{HC}$ respectively . prove that the system of these forces equivalent a couple and find the norm of its moment

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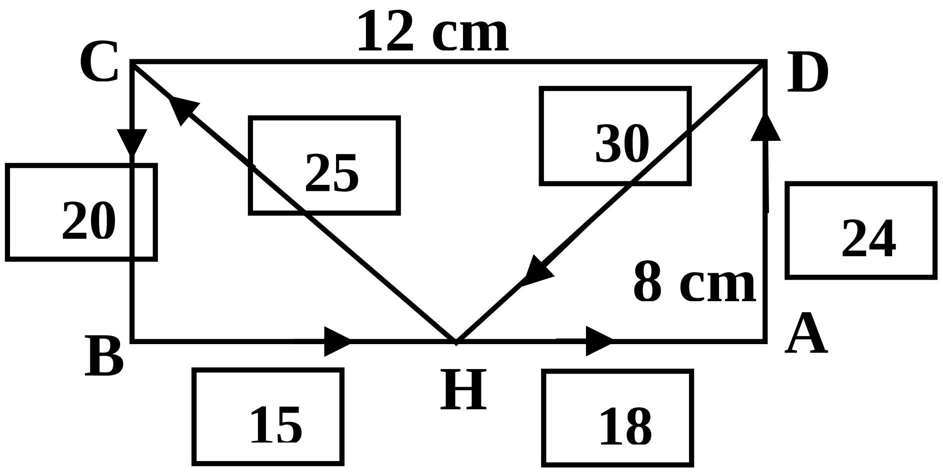
Divide the force 33 N which acts at $\overrightarrow{BA}$ to two forces , 15 N at $\overrightarrow{BH}$

And 18 N at $\overrightarrow{HA}$



In triangle HAD , HD = 10 cm

The forces in one cyclic round

And $\frac{18}{6} = \frac{24}{8} = \frac{30}{10} = 3$ $\quad \therefore m = 3$

Then the forces form a couple its moment = 2 area of triangle $\times m$

$$M = 2\left(\frac{1}{2} \times 6 \times 8\right) \times 3 = 144 \, N.cm$$

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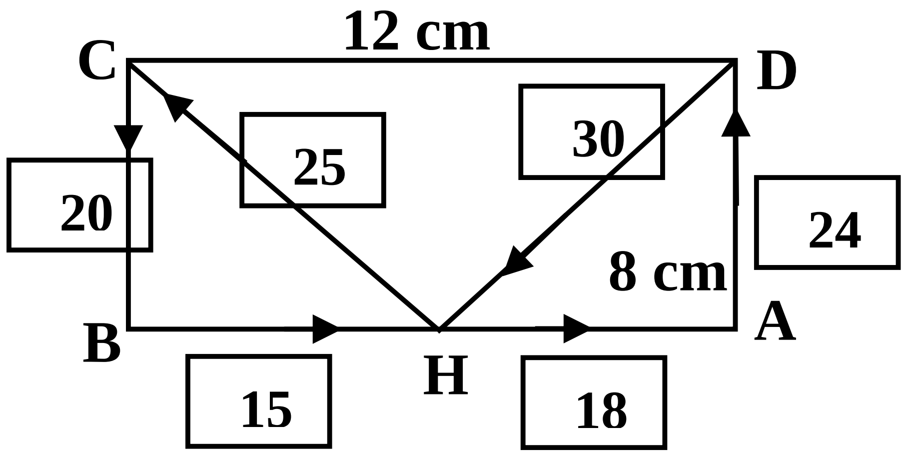
In triangle HBC , HC = 10 cm
The forces in one cyclic round



And $\frac{15}{6}=\frac{20}{8}=\frac{25}{10}=2.5$ $\therefore m=2.5$

Then the forces form a couple its moment = 2 area of triangle $\times\, m$

$$M=2(\frac{1}{2}\times 6\times 8)\times 2.5=120N.cm$$

Then the system form a couple its moment

$$M=144+120=264N\,cm$$

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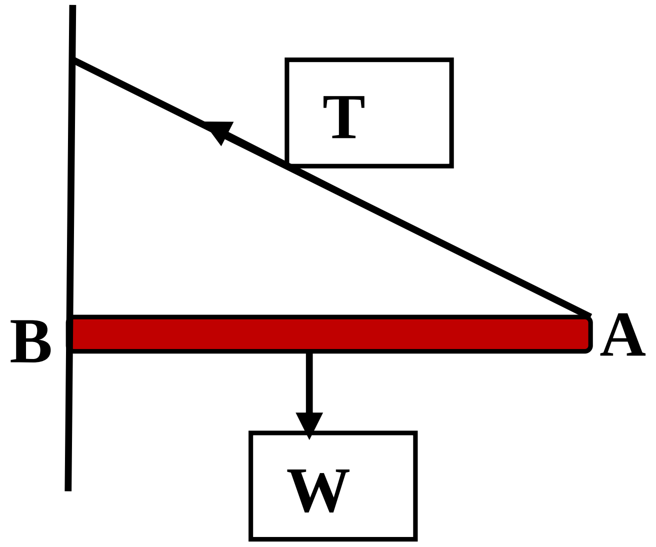
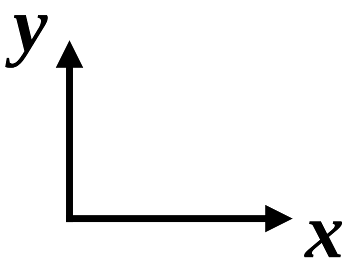
Example

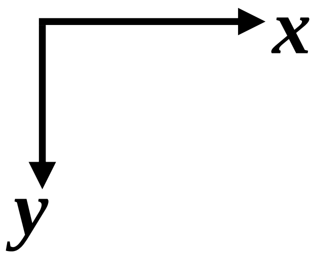
The opposite figure represents a uniform rod in equilibrium position , then the direction of the components of the reaction of the hinge at B will be …………



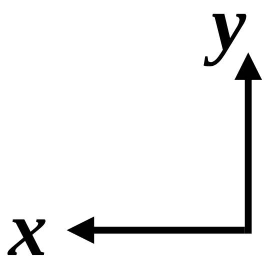
(a)



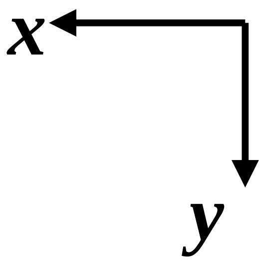
(b)



(c)



(d)



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When we resolve the tension (T) their a horizontal force $T\cos\theta$ in direction of $\overrightarrow{AB}$, and a vertical component $T\sin\theta$, perpendicular to $\overrightarrow{AB}$

Then the reaction at B resolved to two perpendicular components like (a) **Ans.(a)**

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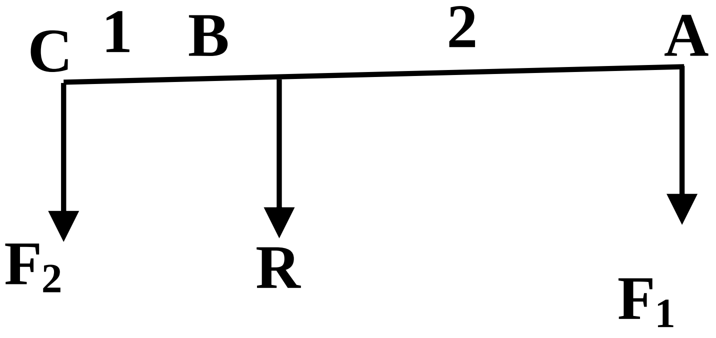
$\overrightarrow{F_1} \,//\, \overrightarrow{F_2}$ in the same direction



$\because \overrightarrow{R} = \overrightarrow{F_1} + \overrightarrow{F_2}$ $\qquad\qquad \therefore \overrightarrow{R} = 6\hat{i} - 9\hat{j}$

$\because \overrightarrow{F_2} = 2\overrightarrow{F_1}$

$\therefore \overrightarrow{R}$ divides AB in the ratio 2 : 1

$$C = \left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right) = \left(\frac{-2+2}{3}, \frac{-6+3}{3}\right) = (0, -1)$$

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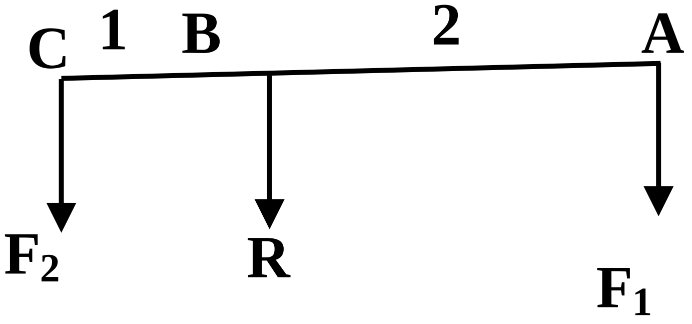

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الأستاذ / سامي فاضل كبير معلمي الرياضيات

مع تمنياتنا بالتوفيق

الإدارة العامة للتعليم الإلكتروني