Final Revision
Statics (Part 1)

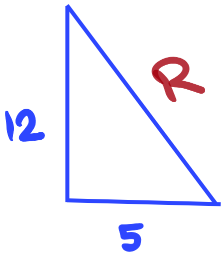
Choose the correct answer

The magnitudes of two perpendicular forces are 5 and 12 newton , they are acting at a point , then their resultant = ... newton.

(a) 13 (b) 7 (c) 17 (d) 12

$R = \sqrt{(12)^2 + (5)^2}$

$= 13$ N



Two forces 2 F , 3 F acting at a point and their resultant is F , then the measure of the angle between them is ……………°

(a) zero (b) 60 (c) 120 (d) 180

$R = |F_2 - F_1|$

$F = 3F - 2F$

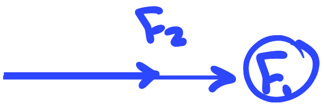
$\therefore$ The two forces in the opposite direction

$\therefore \alpha = 180^\circ$

If magnitude of the resultant of two forces is maximum , then the measure of the angle between them is ....°

(a) zero (b) 60 (c) 90 (d) 180

R_{max} " The two forces act in the same direction"



$\alpha = \text{zero}^\circ$

Two forces intersecting at a point , their magnitudes are 8 and 5 newton , then the largest magnitude of their resultant is .... newton.

(a) 13 (b) 26 (c) 3 (d) 6

$R_{max} = F_1 + F_2$

$= 8 + 5 = 13 \text{ N}$

Two forces intersecting at one point , their magnitudes of 5 F , 3 F newton , if their resultant has maximum value of 40 newton , then their resultant has minimum value of .... newton.

(a) 40 (b) 20 (c) 11 (d) 10

$R_{max} = 5F + 3F = 40$

$8F = 40$

$\therefore F = \frac{40}{8} = 5 \text{ N}$

$R_{min} = 5F - 3F = 2F$

$= 2(5) = 10 \text{ N}$

F_1 and F_2 are magnitudes of two forces intersecting at a point , $F_1 > F_2$ and their resultant $R \in [6 , 16]$, then $(F_1 , F_2) = \cdots\cdots\cdots\cdots$

(a) (16 , 6) (b) (9 , 7) (c) (11 , 5) (d) (12 , 4)

$R_{min} = F_1 - F_2 = 6 \longrightarrow (1)$

$R_{max} = F_1 + F_2 = 16 \longrightarrow (2)$

By solving (1) & (2)

$\therefore F_1 = 11 \qquad F_2 = 5$

$\therefore (F_1 , F_2) = (11 , 5)$

The magnitudes of two forces are 5 , 12 newton and the measure of the angle between them is θ where $\theta \in [\frac{\pi}{2}, \pi[$, then the magnitude of their resultant ∈ ....

(a)]7 , 12] (b)]7 , 13] (c) [13 , 17[(d)]13 , 17]

$\theta \in [\frac{\pi}{2}, \pi[$

$F_1 \perp F_2$

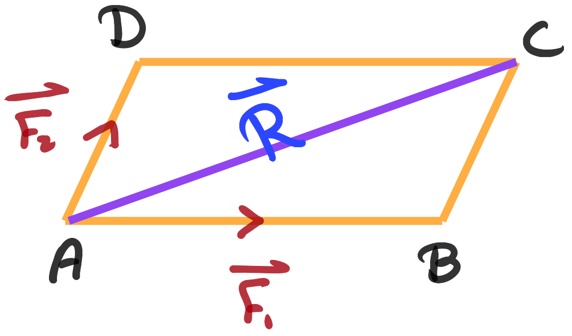
R_{min}

$R \in [\sqrt{5^2+12^2}, |5-12|[$

$R \in]7, 13]$

ABCD is a parallelogram , if $\overrightarrow{AB}$ and $\overrightarrow{AD}$ represent geometrically the two forces $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ respectively , then the resultant of these two forces is represented by ·········

(a) $\overrightarrow{AC}$ (b) $\overrightarrow{CA}$ (c) $\overrightarrow{BD}$ (d) $\overrightarrow{DB}$

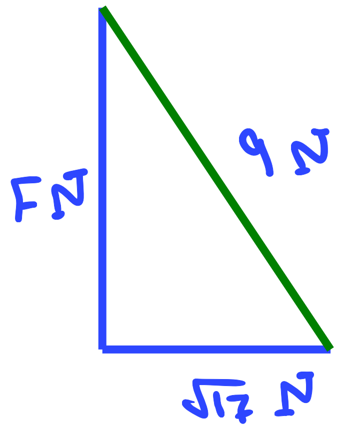


Two perpendicular forces acting at a point , the magnitude of their resultant is 9 newton and magnitude of one of them is $\sqrt{17}$ newton , then the magnitude of the other = ... newton.

(a) $2\sqrt{22}$ (b) $7\sqrt{2}$ (c) $9\sqrt{17}$ (d) 8

$F = \sqrt{(9)^2 - (\sqrt{17})^2}$

$F = 8$ N



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Two perpendicular forces of magnitude (2 F – 5) , (F + 2) newton , acting at a point and their resultant is $3\sqrt{5}$ newton , then F = ………….. newton.

(a) 2 (b) 3 (c) 4 (d) 5

$$F_1^2 + F_2^2 = R^2$$

$$(2F-5)^2 + (F+2)^2 = (3\sqrt{5})^2$$

$$4F^2 - 20F + 25 + F^2 + 4F + 4 = 45$$

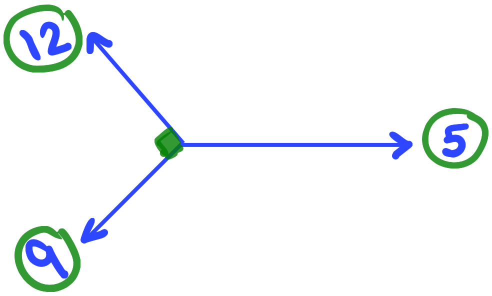
$$5F^2 - 16F - 16 = 0$$

$$F = 4 \qquad F = -\frac{4}{5} \text{ (ref.)}$$

The magnitudes of 3 coplaner forces intersect at one point are 5 , 12 , 9 newton. the three forces acting at a point such that measure of the angle between the second and third forces equals 90° , then the maximum value of their resultant equals .... newton.

(a) 26 (b) 22 (c) 20 (d) 18

$R_{2,3} = \sqrt{(12)^2 + (9)^2} = 15 \text{ N}$



$R_{max} = 15 + 5 = 20 \text{ N}$

Two forces equal in magnitudes. the magnitude of their resultant is $4\sqrt{3}$ newton and makes an angle of measure 30° with one of them , then the magnitude of each force equals .... newton.

(a) 4 (b) 8 (c) $8\sqrt{3}$ (d) $4\sqrt{3}$

$$R = 2F\cos\frac{\alpha}{2} = 2F\cos\theta$$

$$4\sqrt{3} = 2F\cos 30$$

$$4\cancel{\sqrt{3}} = \cancel{\sqrt{3}}F$$

$$\therefore F = 4\ N$$

The magnitudes of two forces are 10 , F kg.wt. and measure of the angle between them $\in]0, \pi[$ If the resultant bisects the angle between them , then F = ... kg.wt.

(a) 10 (b) 11 (c) 13 (d) 20

$F_1 = F_2 = 10$ kg.wt

Two forces (2 F – 1) , (F + 3) newton acting at a point and their resultant bisects the angle between them , then F = ……………. newton.

(a) 3 (b) 4 (c) 5 (d) 6

$F_1 = F_2$

$2F - 1 = F + 3$

$2F - F = 3 + 1$

$F = 4$ N

Two equal forces acting at a point and measure of the angle between them is 60° , and their resultant is R_1. If the two forces are doubled and measure of the angle between them becomes 120° , and their resultant is R_2 , then $R_1 : R_2 = \cdots\cdots\cdots$

(a) $\sqrt{3} : 2$ (b) $1 : 2$ (c) $2 : 1$ (d) $1 : 1$

$R_1 = 2F\cos\frac{\alpha}{2}$

$R_1 = 2F\cos 30$

$R_1 = \sqrt{3}F$

$R_2 = 2(2F)\cos 60$

$R_2 = 2F$

$R_1 : R_2 = \frac{\sqrt{3}\cancel{F}}{2\cancel{F}} = \sqrt{3} : 2$

The magnitudes of two forces are 3 , 5 newton and the magnitude of their resultant is 7 newton , then the measure of the angle between the two forces = ...°

(a) 90 (b) 120 (c) 110 (d) 60

$$R^2 = F_1^2 + F_2^2 + 2F_1F_2 \cos\alpha$$

$$(7)^2 = (3)^2 + (5)^2 + 2(3)(5)\cos\alpha$$

$$49 = 34 + 30\cos\alpha$$

$$49 - 34 = 30\cos\alpha$$

$$30\cos\alpha = 15$$

$$\cos\alpha = \frac{15}{30} = \frac{1}{2}$$

$$\alpha = \cos^{-1}\left(\tfrac{1}{2}\right) = 60^\circ$$

Two forces of magnitudes (5 F – 3) , (3 – F) intersecting at a point and magnitude of their resultant 4 F , then measure of the angle between their lines of action equals ....°

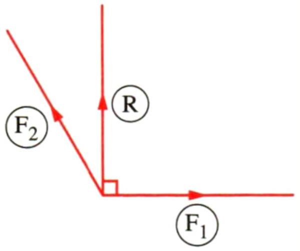
(a) zero (b) 45 (c) 90 (d) 180

$$R = F_1 + F_2$$

$$4F = 5F - \cancel{3} + \cancel{3} - F$$

$$\therefore R_{max} \qquad \therefore \alpha = zero$$

By using the opposite figure



(a) $F_1 > F_2$

(b) $F_1 = F_2$

(c) $F_1 < F_2$

(d) $F_1 \geq F_2$

$\because R \perp F_1$

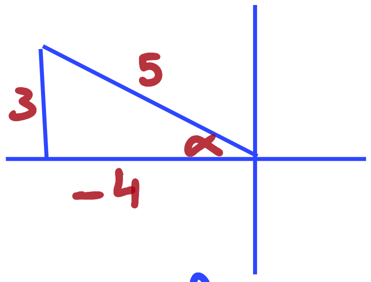
$\therefore F_2 > F_1$

$F_2 > R$

12 and 15 newton are two forces acting on a particle and included an angle θ between their lines of actions such that $\cos\theta = \frac{-4}{5}$, then the measure of the angle between their resultant and the first force = ...°

(a) zero (b) 30 (c) 90 (d) 120

$$\tan\theta_1 = \frac{F_2 \sin\alpha}{F_1 + F_2 \cos\alpha}$$



$$= \frac{15\left(\frac{3}{5}\right)}{12 + 15\left(-\frac{4}{5}\right)} = \frac{9}{\text{Zero}} = \text{undefined}$$

$$\therefore \theta_1 = 90^\circ$$

The magnitudes of two forces are 6 , F kg.wt. they are acting on a particle and measure of the angle between them is 135°. If the line of action of their resultant inclined at an angle of 45 to the line of action of the force F , then F = ... kg.wt.

(a) 6 (b) $6\sqrt{3}$ (c) $6\sqrt{2}$ (d) 10

$\alpha = 135$, $\theta_2 = 45$

$$\tan\theta_2 = \frac{F_1 \sin\alpha}{F_2 + F_1 \cos\alpha}$$

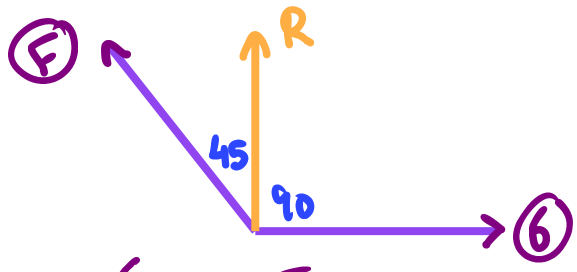
$$\frac{\tan 45}{1} = \frac{6 \sin 135}{F + 6\cos 135}$$

$$F - 3\sqrt{2} = 3\sqrt{2}$$

$$F = 3\sqrt{2} + 3\sqrt{2}$$

$$F = 6\sqrt{2} \text{ kg.wt}$$

Another sol.



$$\frac{6}{\sin 45} = \frac{F}{\sin 90} = \frac{R}{\sin 135}$$

$$\therefore F = \frac{6 \sin 90}{\sin 45} = 6\sqrt{2} \text{ kg.wt}$$

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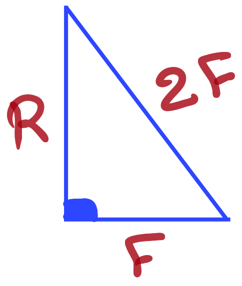
If the resultant R of two forces F , 2 F newton is perpendicular to one of them , then R = ... newton.

(a) F (b) 3 F (c) $\sqrt{3}$ F (d) $\sqrt{5}$ F

$R = \sqrt{(2F)^2 - (F)^2}$

$R = \sqrt{4F^2 - F^2} = \sqrt{3F^2}$

$R = \sqrt{3}\,F$

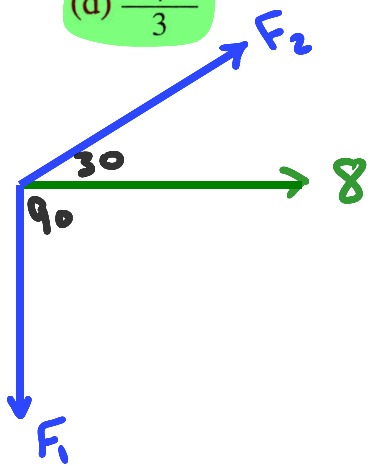


A force of magnitude 8 newton acts due east has been resolved into two components , measure of the angle between the two components is 120° , then its components acting due south = ... newton.

(a) $8\sqrt{3}$ (b) 8 (c) 16 (d) $\frac{8\sqrt{3}}{3}$

$$\frac{F_1}{\sin 30} = \frac{F_2}{\sin 90} = \frac{8}{\sin 120}$$

$$F_1 = \frac{8 \sin 30}{\sin 120} = \frac{8\sqrt{3}}{3} \text{ N}$$

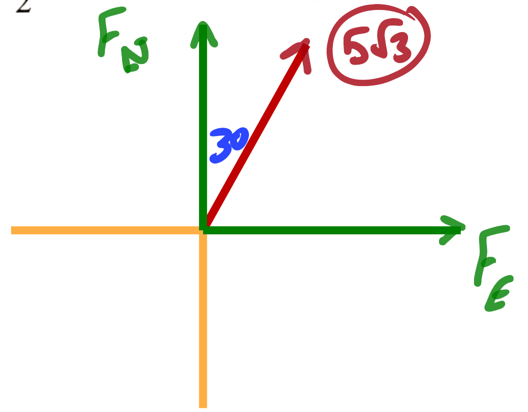


A force of magnitude $5\sqrt{3}$ newton acts in direction 30° east of the north. the force has been resolved into two perpendicular components , then its component acts due east equals .... newton.

(a) $\frac{5\sqrt{3}}{2}$ (b) $\frac{15}{2}$ (c) $\frac{15\sqrt{3}}{2}$ (d) $15\sqrt{3}$

$F_e = R \sin \theta$

$F_e = 5\sqrt{3} \sin 30 = \frac{5\sqrt{3}}{2}$ N



If a force of magnitude 60 newton has been resolved into two equal forces F , F and the measure of the angle between their directions is 60° , then F = ... newton.

(a) $20\sqrt{3}$ (b) $5\sqrt{3}$ (c) $10\sqrt{3}$ (d) 30

$$R = 2F\cos\frac{\alpha}{2}$$

$$60 = 2F\cos 30$$

$$60 = \sqrt{3}\,F \Rightarrow F = \frac{60}{\sqrt{3}} = 20\sqrt{3}\ N$$

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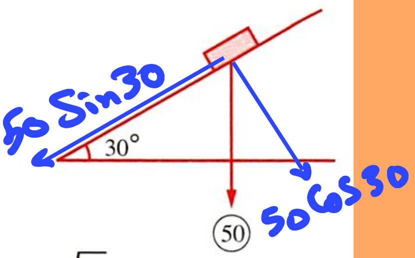
In the opposite figure :

A body of weight 50 newton is placed on an inclined plane that makes an angle of measure 30° with the horizontal , then the component of weight in direction of a line of greatest slope downward = ... newton.

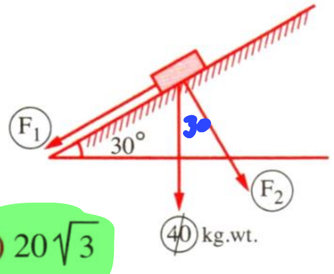


(a) 25 (b) $25\sqrt{3}$ (c) 50 (d) $50\sqrt{3}$

$50 \sin 30 = 25$ N

In the opposite figure :

A body of weight 40 kg.wt. is placed on an inclined plane makes an angle of measure 30° to the horizontal , then the component perpendicular to the plane F_2 = ... kg.wt.



(a) 40 (b) 30 (c) $40\sqrt{3}$ (d) $20\sqrt{3}$

$F_2 = 40 \cos 30 = 20\sqrt{3}$ Kg.wt

If $\overrightarrow{F_1} = 3\,\overrightarrow{i} + 4\,\overrightarrow{j}$, $\overrightarrow{F_2} = 5\,\overrightarrow{i} - 2\,\overrightarrow{j}$, $\overrightarrow{F_3} = -2\,\overrightarrow{i} + 6\,\overrightarrow{j}$ are three coplanar forces intersecting at one point , then the magnitude of their resultant = ... force unit.

(a) 10 (b) 14 (c) 100 (d) $6\,\overrightarrow{i} + 8\,\overrightarrow{j}$

$$\overrightarrow{R} = \overrightarrow{F_1} + \overrightarrow{F_2} + \overrightarrow{F_3}$$

$$= (3,4) + (5,-2) + (-2,6)$$

$$= (6,8)$$

$$\|\overrightarrow{R}\| = \sqrt{6^2 + 8^2} = 10 \text{ F.U.}$$

If $\overrightarrow{F_1} = 3\,\vec{i} - 2\,\vec{j}$, $\overrightarrow{F_2} = a\,\vec{i} - \vec{j}$, $\overrightarrow{F_3} = 4\,\vec{i} - b\,\vec{j}$, their resultant $\vec{R} = 6\,\vec{i} - 4\,\vec{j}$, then (a , b) = ...

(a) (1 , – 1) (b) (– 1 , 1) (c) (– 1 , – 1) (d) (1 , 1)

$\overrightarrow{R} = \overrightarrow{F_1} + \overrightarrow{F_2} + \overrightarrow{F_3}$

$(6,-4) = (3,-2) + (a,-1) + (4,-b)$

$(6,-4) = (a+7, -b-3)$

$a+7=6$ $-b-3=-4$

$a=-1$ $b=1$

$(a,b) = (-1,1)$

If $\overrightarrow{F_1} = 5\,\vec{i} + 3\,\vec{j}$, $\overrightarrow{F_2} = a\,\vec{i} + 6\,\vec{j}$, $\overrightarrow{F_3} = -14\,\vec{i} + b\,\vec{j}$ are three coplanar forces intersecting at a point and their resultant $\vec{R} = \left(10\sqrt{2} , \frac{3}{4}\pi\right)$, then a + b = ...

(a) zero (b) 2 (c) – 2 (d) 3

$\vec{R} = \vec{F_1} + \vec{F_2} + \vec{F_3}$

$(10\sqrt{2}\cos 135 , 10\sqrt{2}\sin 135) = (5,3) + (a,6) + (-14,b)$

$(-10 , 10) = (a - 9 , b + 9)$

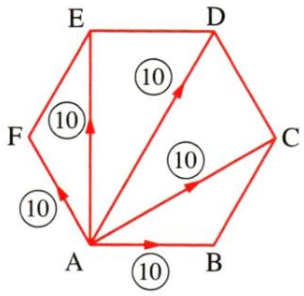
$a - 9 = -10$ $b + 9 = 10$

$a = -1$ $b = 1$

$a + b = \text{Zero}$

In the opposite figure :

Five equal forces the magnitude of each if 5 newton acting at the vertices of a regular hexagon in the direction shown in the figure , then the resultant of these forces = ... newton.



(a) 50

(b) 20

(c) $30\sqrt{3}$

(d) $\left(20+10\sqrt{3}\right)$

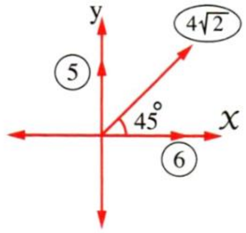
$R_1(\overrightarrow{AB}, \overrightarrow{AF}) = 2(10)\cos\frac{120}{2} = 10\ N$

$R_2(\overrightarrow{AC}, \overrightarrow{AE}) = 2(10)\cos\frac{60}{2} = 10\sqrt{3}\ N$

$R_3(\overrightarrow{AD}) = 10\ N$

$\therefore R = 10 + 10\sqrt{3} + 10 = (20 + 10\sqrt{3})\ N$

The opposite figure represents a set of forces intersecting at one point and measured in newton , then the magnitude of their resultant = ... newton.



(a) $\sqrt{181}$ (b) $\sqrt{223}$

(c) $\sqrt{159}$ (d) $\sqrt{313}$

$\vec{F_1} = (6, 0^\circ)$

$\vec{F_2} = (4\sqrt{2}, 45^\circ)$

$\vec{F_3} = (5, 90^\circ)$

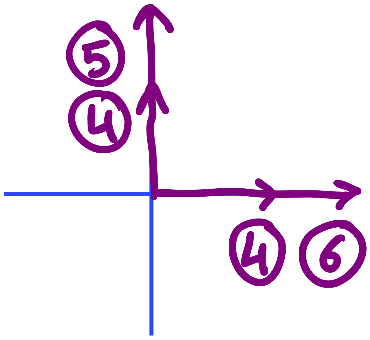
$X = 6\cos 0^\circ + 4\sqrt{2}\cos 45 + 5\cos 90^\circ = 10$

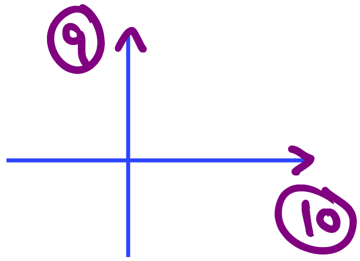
$y = 6\sin 0^\circ + 4\sqrt{2}\sin 45 + 5\sin 90 = 9$

$R = \sqrt{(10)^2 + (9)^2}$

$= \sqrt{181}$ N

Another Sol.





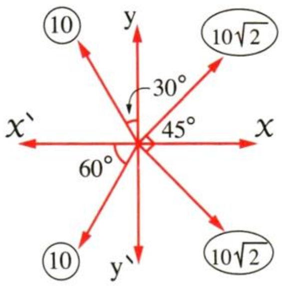
$R = \sqrt{(10)^2 + (9)^2}$

$= \sqrt{181}$ N

In the opposite figure :

The resultant of the forces

R = ... newton.



(a) 20 (b) $10\sqrt{2}$

(c) 10 (d) zero

$(10\sqrt{2}, 10\sqrt{2}) \Rightarrow R_1 = 2(10\sqrt{2}) \cos\frac{90}{2} = 20$

$(10, 10) \Rightarrow R_2 = 2(10) \cos\frac{120}{2} = 10$

$R = |R_1 - R_2| = 20 - 10 = 10$ N

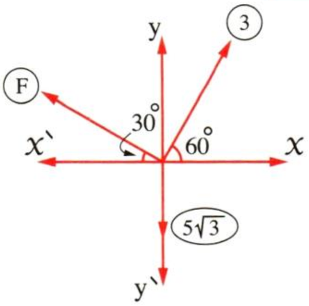
If the resultant of the forces shown in the opposite figure acts along the y-axis , then F = ... kg.wt.

(a) 5

(b) 7

(c) 3

(d) $\sqrt{3}$



$(3, 60^\circ)$, $(F, 150^\circ)$, $(5\sqrt{3}, 270^\circ)$

$X = 0$

$3\cos 60^\circ + F\cos 150^\circ + 5\sqrt{3}\cos 270 = 0$

$\frac{3}{2} - \frac{\sqrt{3}}{2}F = 0 \qquad (\times 2)$

$3 - \sqrt{3}F = 0$

$\sqrt{3}F = 3$

$\therefore F = \frac{3}{\sqrt{3}} = \sqrt{3}$ Kg.wt.

In the opposite figure :

If the forces are in equilibrium

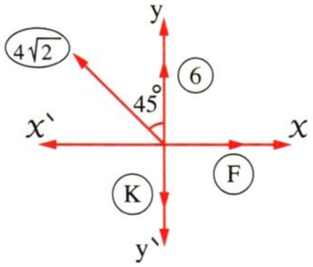
, then F + k = ...

(a) 5

(b) 14

(c) 18

(d) 40



$(F, 0°)$, $(6, 90°)$, $(4\sqrt{2}, 135°)$, $(K, 270°)$

$X = F\cos 0° + 6\cos 90 + 4\sqrt{2}\cos 135 + K\cos 270 = 0$

$F - 4 = 0 \Rightarrow F = 4$

$y = F\sin 0 + 6\sin 90 + 4\sqrt{2}\sin 135 + K\sin 270 = 0$

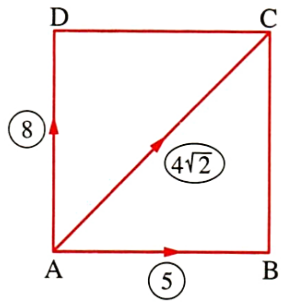
$10 - K = 0 \Rightarrow K = 10$

$\therefore F + K = 4 + 10 = 14$

In the opposite figure :

ABCD is a square.

The resultant of the forces 5 , $4\sqrt{2}$, 8 newton in the polar form is ....



(a) (5 , 54°) (b) (15 , 60°)

(c) (13 , 90°) (d) (15 , 53° 8̀)

$(5, 0°)$, $(4\sqrt{2}, 45)$, $(8, 90)$

$x = 5\cos 0 + 4\sqrt{2}\cos 45 + 8\cos 90$

$x = 9$

$y = 5\sin 0 + 4\sqrt{2}\sin 45 + 8\sin 90$

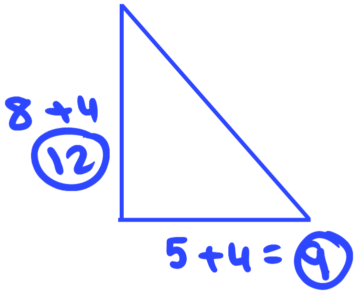
$y = 12$

$\vec{R} = 9\hat{i} + 12\hat{j}$

$\|\vec{R}\| = \sqrt{9^2 + 12^2} = 15\,N$

$\theta = \tan^{-1}\left(\frac{12}{9}\right) = 53° 8'$

$\vec{R} = (15, 53° 8')$



$R = \sqrt{9^2 + 12^2} = 15$

$\theta = \tan \frac{12}{9} = 53° 8'$

$\vec{R} = (15, 53° 8')$

In the opposite figure :

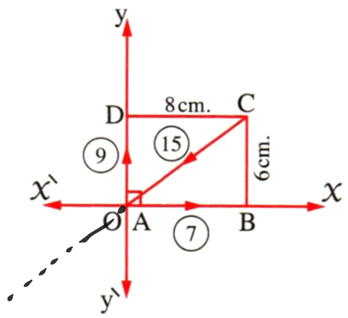
ABCD is a rectangle in which BC = 6 cm. , CD = 8 cm.

, then the component of the resultant

in $\overrightarrow{AB}$ direction = ……………

(a) 3 (b) – 5

(c) 12 (d) – 12

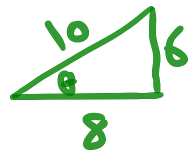


$(7, 0^\circ)$, $(9, 90^\circ)$, $(15, 180+\theta)$

$x = 7\cos 0^\circ + 9\cos 90 + 15\cos(180+\theta)$

$x = 7 - 15\cos\theta$

$x = 7 - 15\left(\frac{8}{10}\right) = 7 - 12 = -5$



$\cos\theta = \frac{8}{10}$

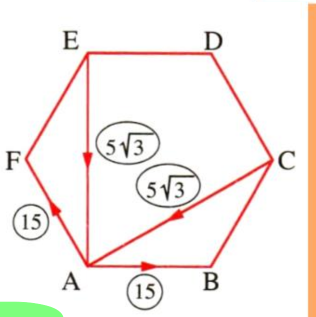
$\sin\theta = \frac{6}{10}$

Three forces equal in magnitude and in equilibrium intersecting at one point , then the measure of the angle between any two lines of actions of these forces = ...°

(a) 90 (b) 60 (c) 120 (d) 150

In the opposite figure :

ABCDEF is a regular hexagon forces of magnitudes 15 , $5\sqrt{3}$, $5\sqrt{3}$, 15 newton acts in directions of $\overrightarrow{AB}$, $\overrightarrow{CA}$, $\overrightarrow{EA}$, $\overrightarrow{AF}$, then the magnitude of the resultant = ... newton.



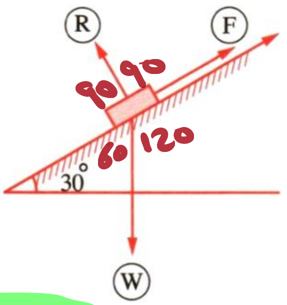
(a) 5 (b) 10 (c) 25 (d) zero

$(\overrightarrow{AB}, \overrightarrow{AF}) = 2(15)\cos\frac{120}{2} = 15$ in $\overrightarrow{AD}$ direction

$(\overrightarrow{CA}, \overrightarrow{BA}) = 2(5\sqrt{3})\cos\frac{60}{2} = 15$ in $\overrightarrow{DA}$ direction

$\therefore \overrightarrow{R} = \text{Zero}$

In the opposite figure :



A body of weight 18 newton is placed on a smooth inclined plane and makes an angle of measure 30° to the horizontal. It is kept in equilibrium under action of force $\vec{F}$ acts in direction parallel to a line of greatest slope of the plane upward

, then F + R = ……………

(a) $6\sqrt{3}$ (b) $9\sqrt{3}$ (c) $18\sqrt{3}$ (d) $9 + 9\sqrt{3}$

$$\frac{W}{\sin 90} = \frac{F}{\sin 150} = \frac{R}{\sin 120}$$

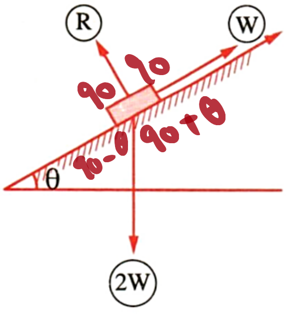
$$\frac{18}{1} = \frac{F}{\frac{1}{2}} = \frac{R}{\sqrt{3}/2}$$

$F = \frac{1}{2}(18) = 9$, $R = \frac{\sqrt{3}}{2}(18) = 9\sqrt{3}$

$\therefore F + R = 9 + 9\sqrt{3}$

In the opposite figure :

If the body is kept in equilibrium under action of the forces shown in the figure , then m (∠ θ) = ...°



(a) 30 (b) 45

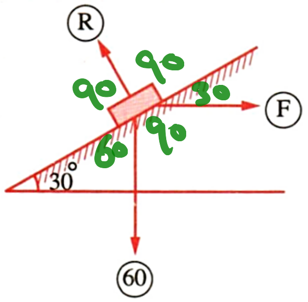
(c) 60 (d) 15

$$\frac{\cancel{w}}{\sin(180-\theta)} = \frac{2\cancel{w}}{\sin 90}$$

$$\frac{1}{\sin\theta} = \frac{2}{1} \Rightarrow \sin\theta = \frac{1}{2}$$

$$\theta = \sin^{-1}\left(\frac{1}{2}\right) = 30^\circ$$

In the opposite figure :



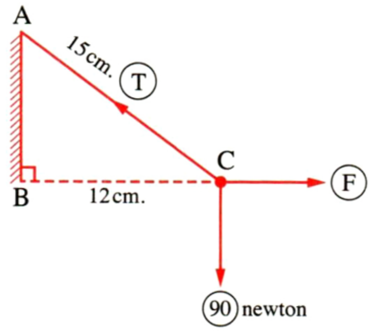
A body of weight 60 gm.wt. is placed on a smooth plane incligneds at an angle of measure 30° to the horizontal and is kept in equilibrium by a horizontal force F newton

, then $\frac{F}{R}$ = ...

(a) $\frac{1}{2}$ (b) $\sqrt{3}$ (c) $\frac{\sqrt{3}}{2}$ (d) 2

$$\frac{F}{\sin 150} = \frac{R}{\sin 90} \Rightarrow \frac{F}{R} = \frac{\sin 150}{\sin 90} = \frac{1}{2}$$

In the opposite figure :



A body of weight 90 newton and in equilibrium

, then T – F = ·············· newton.

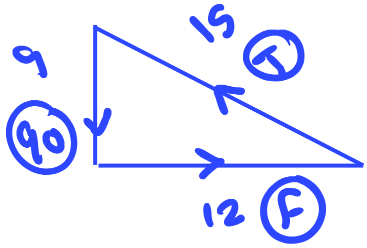
(a) 30

(b) 50

(c) 120

(d) 150

$AB = \sqrt{15^2 - 12^2} = 9 \sim$

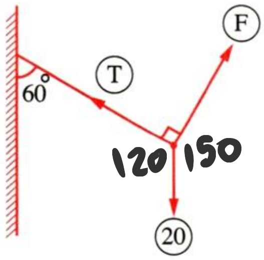


$\therefore T = 150\ N \quad , \quad F = 120\ N$

$T - F = 150 - 120 = 30\ N$

In the opposite figure :

A body of weight 20 newton is suspended at the end of a rope the body is kept in equilibrium by a force perpendicular to the rope and the rope makes an angle of measure 60° to the vertical , then T = ... newton.



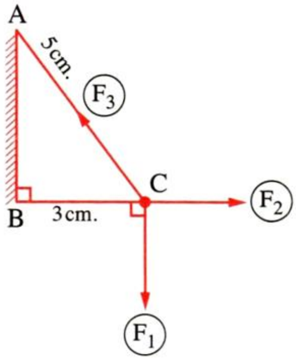
(a) $10\sqrt{3}$ (b) 10 (c) 20 (d) $20\sqrt{3}$

$$\frac{F}{\sin 120} = \frac{T}{\sin 150} = \frac{20}{\sin 90}$$

$$T = \frac{20 \sin 150}{\sin 90} = 10 \text{ N}$$

In the opposite figure :

A body kept in equilibrium under action of the given forces, then $F_1 : F_2 : F_3 =$ ....



(a) 3 : 4 : 5 (b) 3 : 5 : 4

(c) 4 : 5 : 3 (d) 4 : 3 : 5

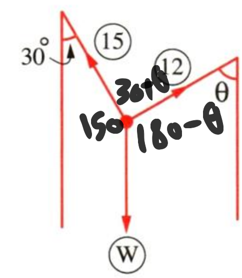
$$\frac{F_1}{AB} = \frac{F_2}{BC} = \frac{F_3}{CA}$$

$$\therefore F_1 : F_2 : F_3 = 4 : 3 : 5$$

In the opposite figure :

$360-(150+180-\theta)$

$30+\theta$



A body of weight (W) newton is hanged by two light strings inclined to the vertical at angle of measures θ , 30°. the body is in equilibrium when the tensions in the two strings are 12 , 15 newton respectively , then θ ≃ ....°

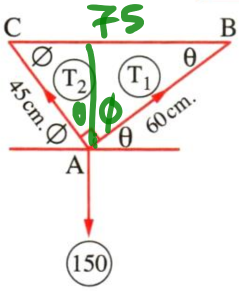
(a) 35 (b) 39 (c) 45 (d) 60

$$\frac{W}{\sin(30+\theta)} = \frac{12}{\sin 150} = \frac{15}{\sin \theta}$$

$$\sin\theta = \frac{15 \sin 150}{12} = \frac{5}{8}$$

$$\theta = \sin^{-1}\left(\frac{5}{8}\right) \simeq 39^\circ$$

In the opposite figure :



A body of weight 150 gm.wt. hanged in equilibrium by two strings , their lengths 60 cm. and 45 cm. and the other ends of the strings B and C are on the same horizontal level , then T_2 = ... gm.wt.

(a) 120 (b) 60 (c) 90 (d) 30

$BC = \sqrt{60^2 + 45^2} = 75$

$\sin\theta = \frac{45}{75} = \frac{3}{5}$

$\sin\phi = \frac{60}{75} = \frac{4}{5}$

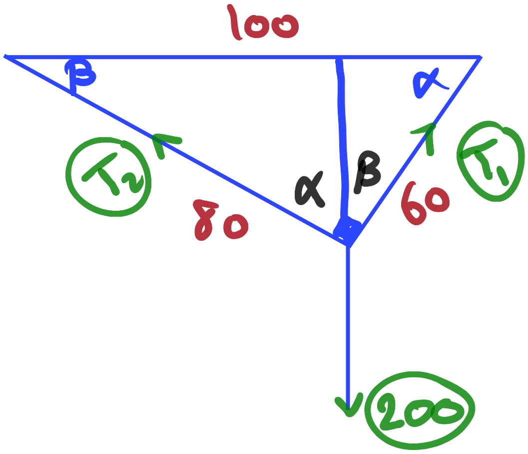
$\frac{T_1}{\sin\theta} = \frac{T_2}{\sin\phi} = \frac{150}{\sin 90}$

$T_2 = \frac{75\left(\frac{4}{5}\right)}{\sin 90} = 60$ gm.wt.

A body of weight 200 gm.wt. is suspended by two strings their lengths are 60 cm. , 80 cm. and the other two ends are fixed to two points on the same horizontal line and the distance between them is 100 cm. , then the magnitude of the tensions in the two strings = ... gm.wt.

(a) 100 , 130 (b) 160 , 120 (c) 120 , 180 (d) 150 , 160

$$\frac{T_1}{\sin\alpha} = \frac{T_2}{\sin\beta} = \frac{200}{\sin(\alpha+\beta)}$$



$$\frac{T_1}{\frac{80}{100}} = \frac{T_2}{\frac{60}{100}} = \frac{200}{1}$$

$$T_1 = \frac{80}{100} \times 200 = 160 \text{ gm.wt}$$

$$T_2 = \frac{60}{100} \times 200 = 120 \text{ gm.wt}$$

In the opposite figure :

If the sphere is in equilibrium and the wall is smooth

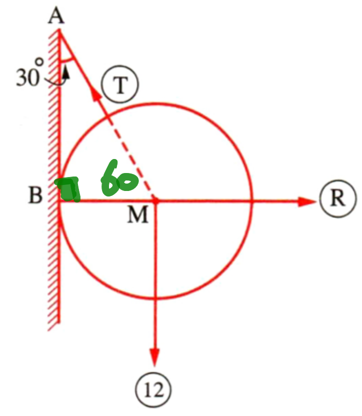
, then T – R = …………… newton.

(a) $8\sqrt{3}$

(b) $4\sqrt{3}$

(c) 4

(d) 8



$$\frac{T}{\sin 90} = \frac{R}{\sin 30} = \frac{12}{\sin 60}$$

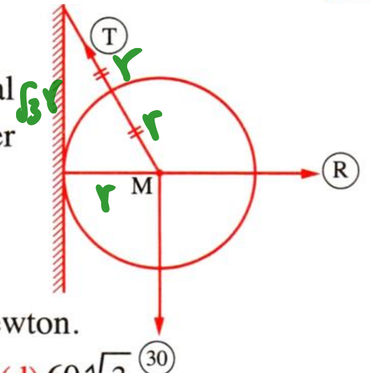
$$T = \frac{12 \sin 90}{\sin 60} = 8\sqrt{3}\ N$$

$$R = \frac{12 \sin 30}{\sin 60} = 4\sqrt{3}\ N$$

$$T - R = 4\sqrt{3}\ N$$

In the opposite figure :

A smooth ball has weight 30 newton. It rests on a smooth vertical wall and hanged from a point on its surface by a string , the other end of the string is fixed to a point on the wall vertically above the point of contact between the ball and the wall. If the length of the string equals the radius of the wall , then the magnitude of the tension in the string in equilibrium position = ... newton.



(a) $5\sqrt{3}$ (b) $10\sqrt{3}$ (c) $20\sqrt{3}$ (d) $60\sqrt{3}$

$$\frac{30}{\sqrt{3}} = \frac{R}{1} = \frac{T}{2}$$

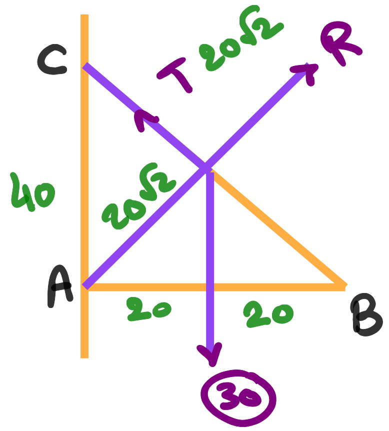
$$T = \frac{30 \times 2}{\sqrt{3}} = 20\sqrt{3} \text{ N}$$

$\overline{AB}$ is a uniform rod , its length is 40 cm. and weight 30 newton. the rod is hinged at A and kept horizontally by means of a rope , one of its ends tied at B and the other end fixed to point C where C is vertically above A , AC = 40 cm. then the reaction of the hinge = ... newton.

(a) 15 (b) $15\sqrt{2}$ (c) $40\sqrt{2}$ (d) 20

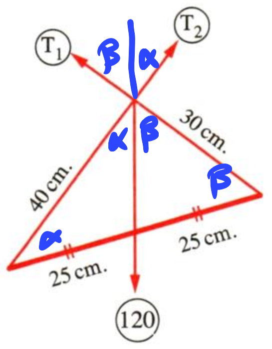
$$\frac{30}{40} = \frac{R}{20\sqrt{2}}$$

$$R = \frac{30 \times 20\sqrt{2}}{40} = 15\sqrt{2}\ N$$



In the opposite figure :

A uniform rod has length 50 cm. and weight 120 gm.wt.
It is hanged freely from both ends by two strings the other two ends of the strings are fixed to a single point the length of the two strings are 30 cm. , 40 cm. , then $T_2 - T_1 =$ ………….. gm.wt.



(a) 12 (b) 24

(c) 72 (d) 96

$\sin\alpha = \frac{3}{5}$

$\sin\beta = \frac{4}{5}$

$$\frac{T_1}{\sin\alpha} = \frac{T_2}{\sin\beta} = \frac{120}{\sin 90}$$

$$T_1 = \frac{120\left(\frac{3}{5}\right)}{1} = 72 \text{ gm.wt}$$

$$T_2 \quad \frac{120\left(\frac{4}{5}\right)}{1} = 96 \text{ gm.wt}$$

$$T_2 - T_1 = 96 - 72 = 24 \text{ gm.wt}$$

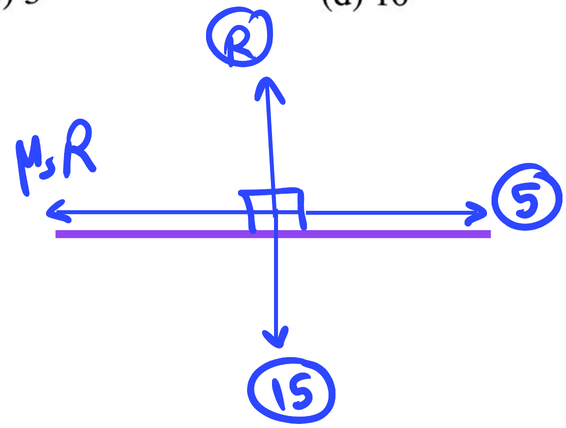
The magnitude of a horizontal force is 5 kg.wt. It acts on a body of weight 15 kg.wt. the body is placed on a horizontal rough plane. If the body is about to move , then the coefficient of static friction between the body and the plane = ...

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) 3 (d) 10

$R = 15$ kg.wt

$\mu_s R = 5$

$\mu_s = \frac{5}{15} = \frac{1}{3}$



A body of weight (w) kg.wt. is placed on a rough horizontal plane and the coefficient of static friction between the body and the plane = $\frac{2}{5}$

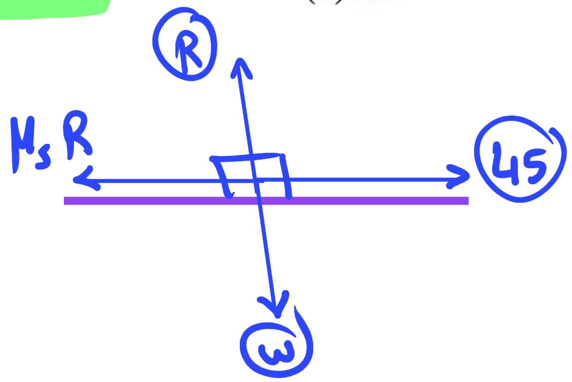
If a horizontal force of magnitude 45 kg.wt. acts on the body and make it about to move , then the weight of the body = ... kg.wt.

(a) 22.5 (b) 90 (c) 112.5 (d) 225

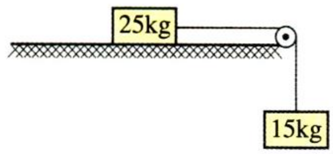
$45 = \frac{2}{5} R$

$R = W = 45 \div \frac{2}{5}$

$= 112.5$ kg.wt



In the opposite figure :



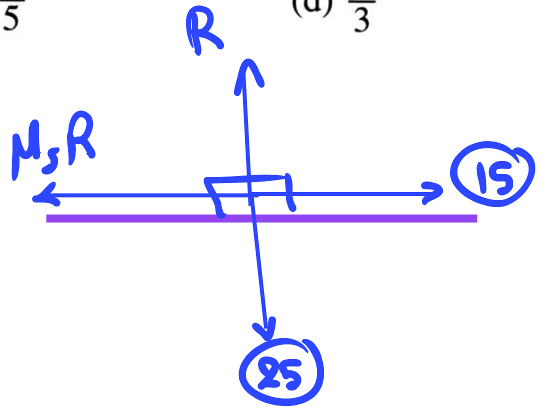
The pulley is smooth , the horizontal plane is rough , the system is about to move , then the coefficient of static friction = ...

(a) $\frac{3}{4}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) $\frac{5}{3}$

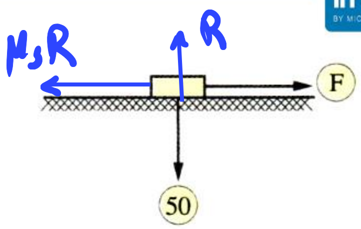
$R = 25$ Kg.wt

$\mu_s \times 25 = 15$

$\mu_s = \frac{15}{25} = \frac{3}{5}$



In the opposite figure :

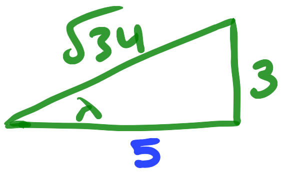


A body of weight 50 kg.wt. is placed on a rough horizontal plane. A horizontal force of magnitude F kg.wt. acts on it and makes the body about to move.

If the sine of angle of friction equals $\frac{3}{\sqrt{34}}$, then F = ... kg.wt.

(a) $25\sqrt{34}$ (b) $50\sqrt{34}$ (c) 30 (d) 50

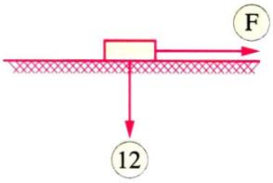
$\sin\lambda = \frac{3}{\sqrt{34}}$



$\tan\lambda = \frac{3}{5}$ $\therefore \mu_s = \frac{3}{5}$

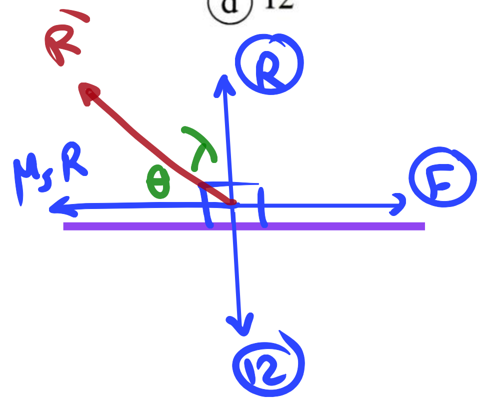
$$F = \mu_s R = \frac{3}{5}(50) = 30 \text{ Kg.wt}$$

In the opposite figure :



A body of weight 12 kg.wt. placed on a rough horizontal plane , a horizontal force $\vec{F}$ (measured by kg.wt.) acted on the body to make it about to move , if the measure of the angle between the limiting static friction force and the resultant reaction is θ where $\tan\theta = \frac{3}{4}$, then the resultant reaction $\grave{R}$ = ... kg.wt.

(a) 9 (b) 20 (c) 15 (d) 12



$\lambda + \theta = 90$

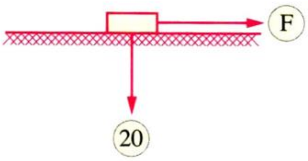
$\lambda = 90 - \theta$

$\tan\lambda = \tan(90 - \theta)$

$\tan\lambda = \cot\theta = \frac{4}{3}$

$\grave{R} = R\sqrt{1 + \tan^2\lambda} = 12\sqrt{1 + \left(\frac{4}{3}\right)^2} = 20$ kg.wt

In the opposite figure :



A body of weight 20 kg.wt. is placed on a rough horizontal plane.

A horizontal force acts on the body to make it about to move when the resultant reaction = 25 kg.wt. , then the coefficient of statics friction between the body and the plane = ...

(a) $\frac{4}{5}$ (b) $\frac{4}{3}$ (c) $\frac{3}{5}$ (d) $\frac{3}{4}$

$$R' = R\sqrt{1+\mu_s^2}$$

$$25 = 20\sqrt{1+\mu_s^2}$$

$$\therefore \sqrt{1+\mu_s^2} = \frac{5}{4} \Rightarrow 1+\mu_s^2 = \frac{25}{16}$$

$$\mu_s^2 = \frac{25}{16} - 1 = \frac{9}{16}$$

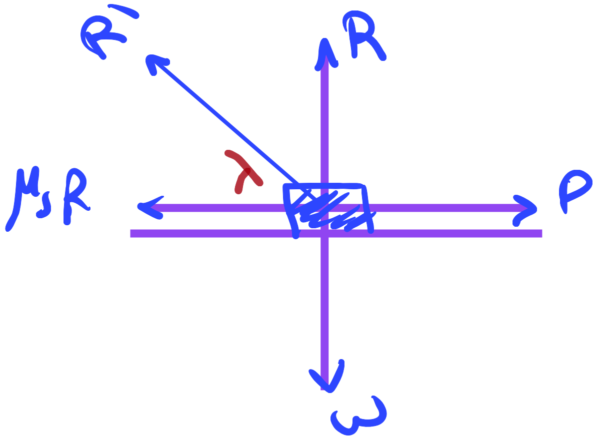
$$\mu_s = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

If λ is the measure of the angle between force of limiting friction and resultant reaction , then μ (the coefficient of static friction) = ……………

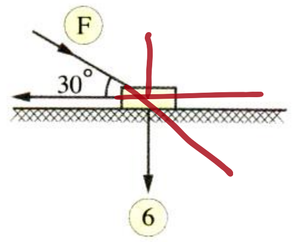
(a) $\tan\lambda$ (b) $\sin\lambda$ (c) $\cos\lambda$ (d) $\cot\lambda$

$\mu_s = \tan(90 - \lambda)$

$\mu_s = \cot\lambda$

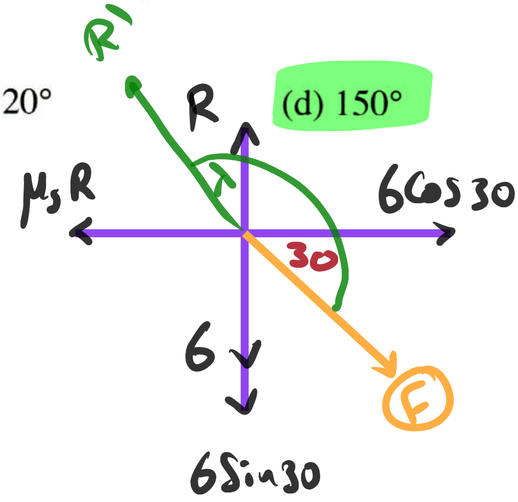


In the opposite figure :



A body of weight 6 N. is placed on a rough horizontal plane.
A force of magnitude 6 N. acts on the body and acts in direction inclined with the horizontal at an angle of measure 30°
The body becomes about to move , then the measure of the angle between the resultant reaction ($\grave{R}$) and the force (F) equals ....

(a) 30° (b) 60° (c) 120° (d) 150°



$R = 6 + 6\sin 30 = 9$

$\mu_s R = 6\cos 30$

$\mu_s = \frac{6\cos 30}{9} = \frac{\sqrt{3}}{3}$

$\therefore \mu_s = \tan\lambda = \frac{\sqrt{3}}{3} \Rightarrow \lambda = 30$

$\theta = 30 + 90 + 30 = 150°$

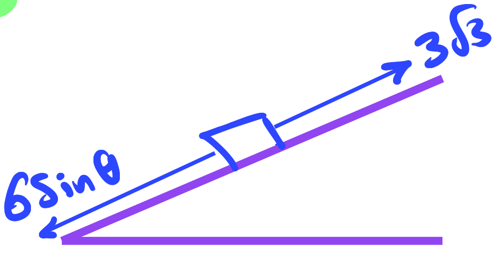
A body of weight 6 N. was placed on a rough inclined plane so it was about to slide if the limiting friction was $3\sqrt{3}$ N. , then the measure of the inclination angle of the plane to the horizontal equals ……………°

(a) 30 (b) 45 (c) 60 (d) 90

$6 \sin\theta = 3\sqrt{3}$

$\sin\theta = \frac{3\sqrt{3}}{6} = \frac{\sqrt{3}}{2}$

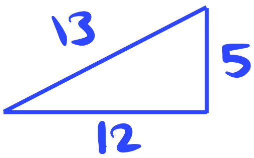
$\theta = \sin^{-1}\left(\frac{\sqrt{3}}{2}\right) = 60°$



A body is placed on a rough inclined plane makes an angle of measure $\sin^{-1} \frac{5}{13}$ and it was about to slide under effect of its weight only , then the coefficient of static friction between the body and the plane equals ……………

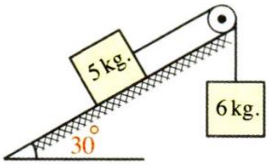
(a) $\frac{5}{13}$ (b) $\frac{5}{12}$ (c) $\frac{12}{13}$ (d) $\frac{12}{5}$

$$\mu_s = \tan\lambda = \tan\theta = \frac{5}{12}$$



In the opposite figure :

A 5 kg. body is placed on a rough inclined plane, connected with light string passes over a smooth. pulley at the edge of the plane and the other end of the string tied to a body of mass 6 kg. If the system is in equilibrium, then the magnitude and the direction of the friction force is ....



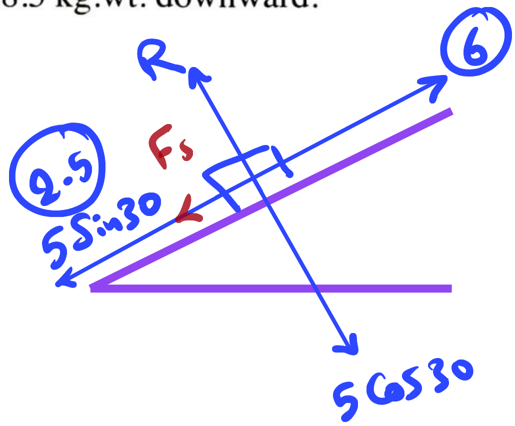
(a) 3.5 kg.wt. upward.

(b) 3.5 kg.wt. downward.

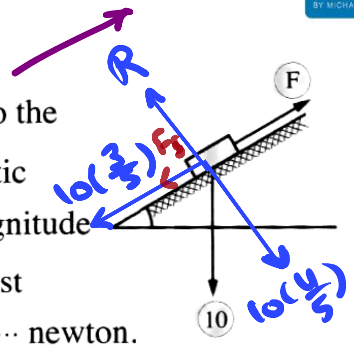
(c) 8.5 kg.wt. upward.

(d) 8.5 kg.wt. downward.

$F_s = 6 - 2.5$
$= 3.5$



In the opposite figure :



A body of weight 10 newton is placed on a rough plane inclined to the horizontal by an angle whose sine is $\frac{3}{5}$, the coefficient of the static friction between the body and the plane equals $\frac{1}{4}$, a force of magnitude F newton acts on the body in the direction of the line of the greatest slope upward to make it about to move upward , then F = ... newton.

(a) 8 (b) 10 (c) 6 (d) 4

$R = 10(\frac{4}{5}) = 8$

$F = 10(\frac{3}{5}) + \frac{1}{4}(8)$

$F = 6 + 2 = 8 \text{ N}$