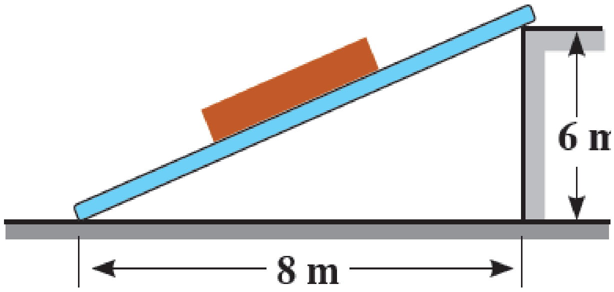
Choose the correct answer

(1) In the opposite figure:
The body is about to move downwards then the measure of the angle of the static friction equals .....



ⓐ **36.87°** ⓑ **41.41°**
ⓒ **48.59°** ⓓ **53.13°**

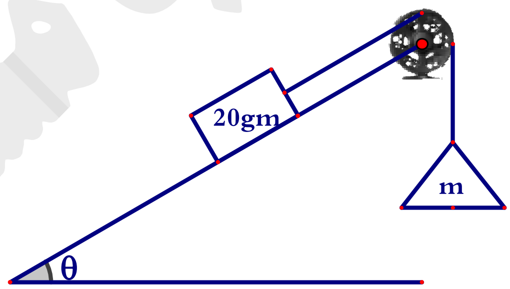
---

(2) If θ is the measure of the angle between the final limiting force and the resultant reaction, then the coefficient of the static friction is equal to.........

ⓐ $\tan\theta$ ⓑ $\sin\theta$ ⓒ $\cos\theta$ ⓓ $\cot\theta$

---

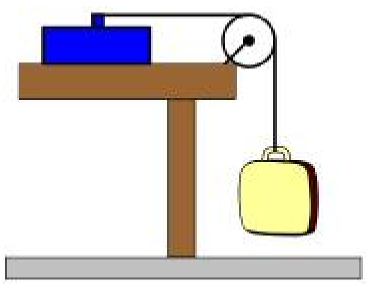
(3) In the opposite figure:
A body of mass 20 gm is placed on a rough plane inclines to the horizontal with an angle of $\tan\theta = \frac{4}{3}$ and is connected by a light string passing over a smooth pulley at the top of the plane such that a pan of mass 7 gm holds a mass of magnitude m gm, is suspended from the other end. If the coefficient of static friction between the body and the plane is equal to $\frac{1}{6}$ the value of m at which the friction force vanishes is ......gm.



ⓐ **9** ⓑ **10** ⓒ **11** ⓓ **12**

---

(4) One end of a light inextensible string is attached to a tool box of mass 2.8 kg which is lying on a rough horizontal table. The string passes over a smooth pulley and is tied at the other end to a bag of mass 1.4 kg. if the tool box is just on the point of sliding, then the coefficient of friction equals ....



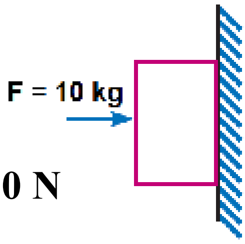
ⓐ **0.5** ⓑ **0.6** ⓒ **2** ⓓ **1**

---

(5) The coefficient of friction is based upon.........

ⓐ the area of the contact surface between two bodies.
ⓑ Shape of the two bodies.
ⓒ Nature of the two bodies.
ⓓ All mentioned.

(6) A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. then the weight of the block is ……



ⓐ 2 N ⓑ 20 N ⓒ 50 N ⓓ 100 N

----

(7) If $\| \vec{F} \| = 2\sqrt{5}$ newton acting along $\overrightarrow{AB}$ where $A(3, 4)$ and $B(4, 6)$ then the moment vector of $\vec{F}$ about the origin point is ……

ⓐ $4\hat{k}$ ⓑ $-4\hat{k}$ ⓒ $6\sqrt{2}\hat{k}$ ⓓ $-6\sqrt{2}\hat{k}$

----

(8) If B is the midpoint of $\overline{AC}$, $\vec{M}_B = \vec{O}$, $\vec{M}_A = 12\hat{k}$ then $\vec{M}_C =$ …..

ⓐ 12 ⓑ $12\hat{k}$ ⓒ -12 ⓓ $-12\hat{k}$

----

(9) If the moment of a system of coplanar forces about three colinear points A , B and C are $\vec{M}_A = 20\hat{k}$, $\vec{M}_B = \vec{O}$ and $\vec{M}_C = -10\hat{k}$ then ……

ⓐ the system of coplanar forces is in equilibrium.

ⓑ the resultant of the system of forces bisects $\overline{AC}$

ⓒ the resultant of the system of forces parallel to $\overline{AC}$.

ⓓ the line of action of resultant of the system of frces diveds $\overline{AC}$ internaly with ratio 2 : 1

----

(10) If the moment of $\vec{F} = 3\hat{i} + 4\hat{j}$ about the Origen point is $12\hat{k}$ then the equation of the line of action of $\vec{F}$ is …..

ⓐ $4x + 3y = 12$ ⓑ $4x - 3y = 12$ ⓒ $4x - 3y = 6$ ⓓ $4x - 3y = 0$

----

(11) If the force $\vec{F} = 3\hat{i} + \alpha\hat{j} + 4\hat{k}$ acting at the point $A(1, 0, -1)$ and the moment vector of $\vec{F}$ about the point $B(2, -1, 3)$ is $-4\hat{i} - 8\hat{j} - \hat{k}$ then $\alpha =$ …..

ⓐ 2 ⓑ -2 ⓒ 0 ⓓ -8

----

(12) If the force $\vec{F} = \hat{i} + 2\hat{j} - 3\hat{k}$ acting at the point $A(2, -1, 3)$ then the perpendicular distance from the Origen point to the line of action of $\vec{F}$ is …..

ⓐ $\frac{14}{115}$ ⓑ $\sqrt{\frac{115}{14}}$ ⓒ $\sqrt{\frac{14}{115}}$ ⓓ $\frac{115}{14}$

----

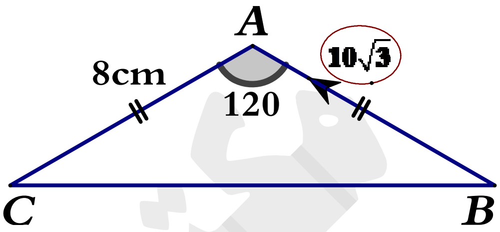
(13) If the maximum force, which can be applied to an object without sliding occurring, is 60 N, and the coefficient of static friction is 0.3. then the normal force between the two surfaces is ……. Newton.

ⓐ **200** ⓑ **18** ⓒ **60.3** ⓓ **59.7**

----

(14) In the opposite figure:

ABC is a triangle in which $AB = AC = 8cm$ and $m(\widehat{A}) = 120°$ If a force of magnitude $10\sqrt{3}$ newton acts along $\overrightarrow{BA}$ then the algebraic measure of the moment of this force about the point C is ……

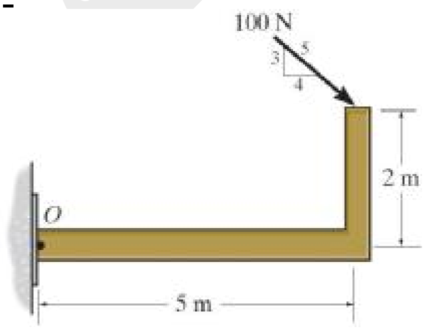


ⓐ $-80\sqrt{3}$ ⓑ $80\sqrt{3}$ ⓒ 120 ⓓ -120

----

(15) In the opposite figure:

the moment of the force $F = 100$ newton about the point O is ……..N.m



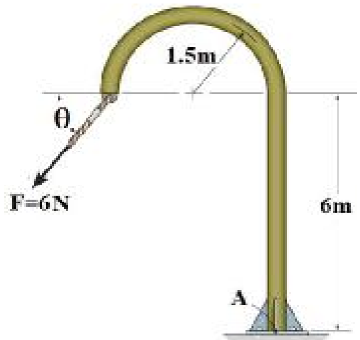
ⓐ **460** ⓑ **−460**

ⓒ **140** ⓓ **−140**

----

(16) In the opposite figure:

If $\theta \in \left[0 , \frac{\pi}{2}\right]$ then the maximum value of the magnitude of the moment of the force F about the point A is ……..N.m



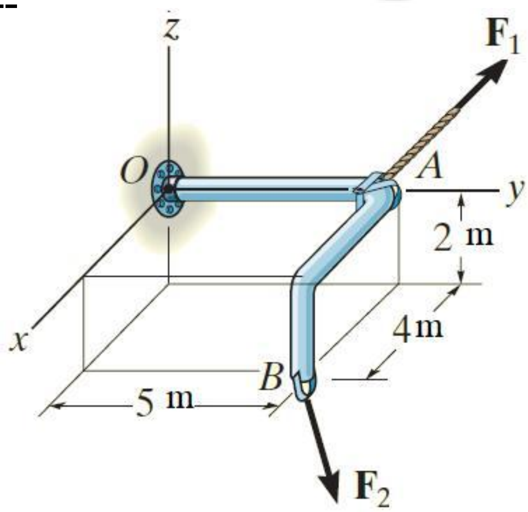
ⓐ $18\sqrt{5}$ ⓑ 36

ⓒ 18 ⓓ $36\sqrt{5}$

----

(17) In the opposite figure:

if $\overrightarrow{F_1} = -3\hat{i} + 2\hat{j} + \hat{k}$ and $\overrightarrow{F_2} = 4\hat{i} + 2\hat{j} - \hat{k}$ then the moment vector of the resultant of the two forces about the point O is ……..

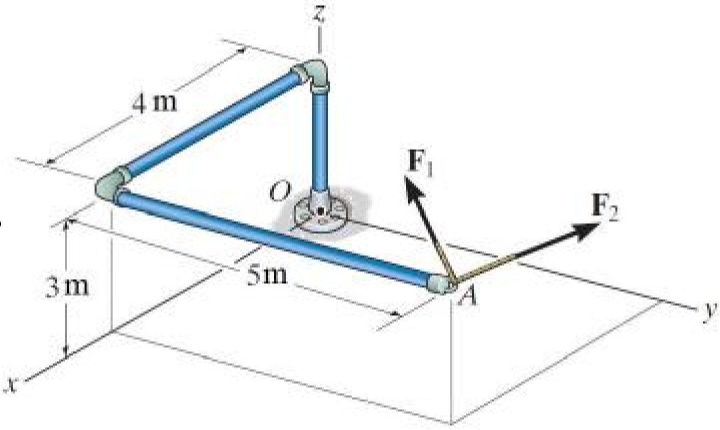


ⓐ $4\hat{i} - 2\hat{j} - 3\hat{k}$ ⓑ $3\hat{i} - 40\hat{j} + 6\hat{k}$

ⓒ $-4\hat{i} - 2\hat{j} + 3\hat{k}$ ⓓ $4\hat{i} - 4\hat{j} + 3\hat{k}$

(18) In the opposite figure:

if $\overrightarrow{F_1} = 4\hat{i} - 5\hat{j} + 3\hat{k}$ and $\overrightarrow{F_2} = -4\hat{i} + 5\hat{j} + 2\hat{k}$ then the moment vector of the resultant of the two forces about the point O is ……..



ⓐ $-25\hat{i} + 20\hat{j}$ ⓑ $25\hat{i} - 20\hat{j}$

ⓒ $25\hat{i} + 20\hat{j}$ ⓓ $-25\hat{i} - 20\hat{j}$

----

(19) $\overrightarrow{F_1}$, $\overrightarrow{F_2}$ are two horizontal forces acting at the two points $A(1 , 3)$, $B(0 , 5)$ respectively if the two forces form a cuple with moment $20\hat{k}$ then $\overrightarrow{F_1}$ = ...

ⓐ (10 , 0) ⓑ (11 , 0) ⓒ (20 , 0) ⓓ (0 , -10)

----

(20) If $\overrightarrow{F_1} = 3\hat{i} + m\hat{j}$, $\overrightarrow{F_2} = -6\hat{i} - 8\hat{j}$ are two parallel forces acting at $A(1 , 3)$, $B(0 , 5)$ respectively then the point of action of their resultant is ……

ⓐ (5 , 13) ⓑ (−1 , 7) ⓒ (−5 , -13) ⓓ (1 , -7)

----

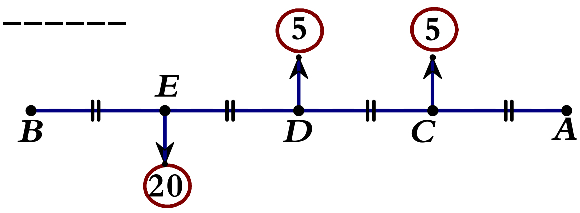
(21) If the resultant of the two parallel forces $7\,\hat{c}$ and $5\,\hat{c}$ newtons act at point $2\frac{1}{3}$ meters distant from the line of action of the smaller force, then the distance between the two lines of action of the two forces is ……m

ⓐ $\frac{49}{15}$ ⓑ $\frac{28}{5}$ ⓒ $\frac{5}{3}$ ⓓ 4

----

(22) In the opposite figure:

the point of action of the resultant of the three forces divides $\overline{AB}$ ……..



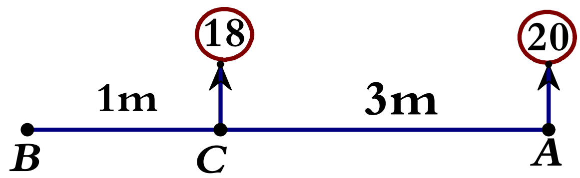
ⓐ internaly with ratio 9 : 1 ⓑ externaly with ratio 9 : 1

ⓒ internaly with ratio 9 : 8 ⓓ externaly with ratio 9 : 8

----

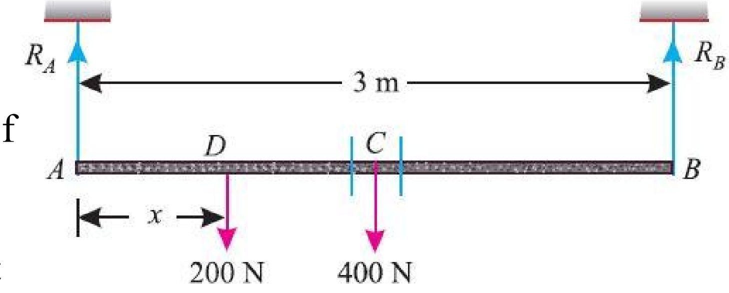
(23) In the opposite figure:

If the resultant of three forces act on the rod AB of negligible weight in the figure is **13** kg.wt and acting upwards distant 3 meters on the right of B.then the point of action of the third force is at a distance ….. m from the point A.



ⓐ 1.64 ⓑ 3.92 ⓒ 2.36 ⓓ 0.08

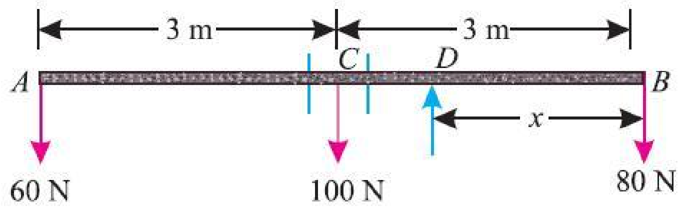
(24) A beam 3m long of weighing 400 newton is suspended in a horizontal position by two vertical strings, each of which can withstand a maximum tension of 350 newton. Abody of weight 200 newton is attached at point D on the beam where $AD = x$ cm. then $x =$……… so that one of the two strings may just break.



ⓐ 75 ⓑ 0.75 ⓒ 2 ⓓ 4

----

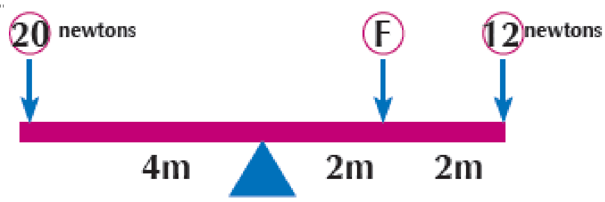
(25) A uniform beam AB of weight 100 newton and 6m long had two bodies of weights 60 and 80 newton suspended from its ends as shown in the figure. The point at which the beam should be supported so that it rests horizontlly is at a distance ….cm from the end A.



ⓐ 2.75 ⓑ 3.25 ⓒ 2 ⓓ 4

----

(26) The opposite figure represents a uniform rod in equilibrium, then F =….. newton.



ⓐ 16 ⓑ 14 ⓒ 18 ⓓ 32

----

(27) Two forces form a couple the magnitude of one of them is 70 newtons and the moment of the couple is 350 newtons.m, then the perpendicular distance between them is equal to …….. cm

ⓐ 50 ⓑ 5 ⓒ 500 ⓓ 24500

----

(28) If a system of coplanar forces is in equilibrium, then the algebraic measure of the sum of their moments about any point in the plane is equal to……

ⓐ a non-zero constant ⓑ zero
ⓒ resultant of these force ⓓ the unity

----

(29) The center of gravity of two physical bodies of masses 3 newtons and 6 newtons and the distance between them is 15 cm is at distance .... cm from the first body

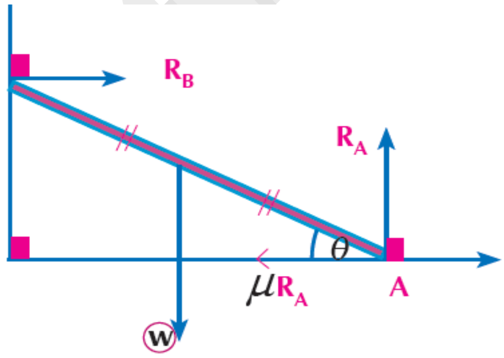
ⓐ 5 ⓑ 7.5 ⓒ 10 ⓓ 9

(30) Two couples act on a body the magnitude of one of the two forces of the first couple is 20 kg.wt, the moment arm is 2 m and the direction of its rotation is in anti clockwise direction while the magnitude of one of the two forces of the second couple is 30 kg.wt, moment arm is 1 m and the direction of its rotation is in the clockwise direction, then the resultant couple is equal to……..

ⓐ 20 kg.wt.m and in the clockwise direction.
ⓑ 20 kg.wt.m and in the anti-clockwise direction.
ⓒ 10 kg.wt.m and in the clockwise direction.
ⓓ 10 kg.wt.m and in the anti-clockwise direction.

----

(31) In the opposite figure:
If λ is the angle of friction between the ground and the rod, then $\tan\lambda \cdot \tan\theta = \dots$



ⓐ 2 ⓑ $\frac{1}{2}$
ⓒ 1 ⓓ 3

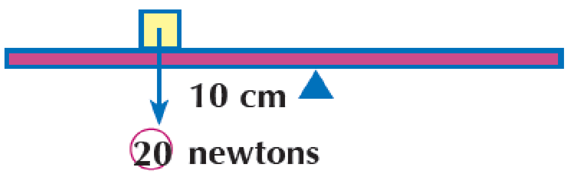
----

(32) A mass of 5 kg acts at point (2 , -1) and a mass of 7 kg acts at point (1 , 2) then the center of gravity of the two masses acts at point

ⓐ (17 , 9) ⓑ $(\frac{17}{12}, \frac{3}{4})$ ⓒ (19 , 13) ⓓ $(\frac{19}{12}, 14)$

----

(33) The opposite figure represents a uniform rod leaning on a support at its midpoint. A body is placed on the rod as shown in the figure which of the following forces makes the rod be in equilibrium is ……



ⓐ A force of magnitude 10 newtons upwards act on a distance 20 cm on right of the rod midpoint.
ⓑ A force of magnitude 10 newtons downwards acts on a distance 20 cm on the right of the rod midpoint.
ⓒ A force of magnitude 30 newtons upwards acts on a distance 5 cm on the left of the rod midpoints.
ⓓ A force of magnitude 30 newtons downwards acts on a distance 5 cm on the left of the rod midpoint.

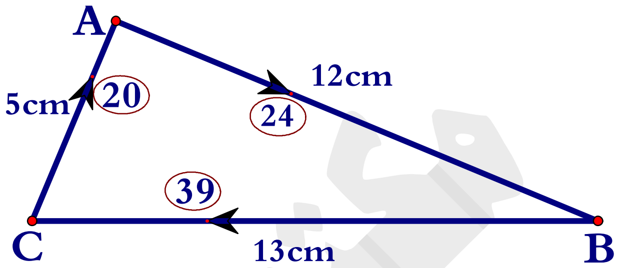
----

(34) If the two forces $\overrightarrow{F_1} = 5\hat{i} + a\hat{j} + 3\hat{k}$ and $\overrightarrow{F_2} = b\hat{i} - 9\hat{j} + c\hat{k}$ form a couple then $a + b + c = \ldots\ldots.$

ⓐ -1 ⓑ 0 ⓒ 1 ⓓ 17

---

(35) In the opposite figure :
the sum of the algebric measure of moments of the forces acting on the sides of triangle ABC about the point A equals ………



ⓐ 180 ⓑ -180 ⓒ -120 ⓓ -240

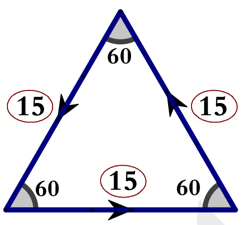
---

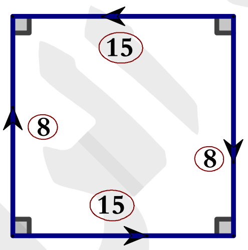
(36) If a system of coplanar forces form couple A , B and C are three points in its plane where $\overrightarrow{M}_A + \overrightarrow{M}_B = 22\hat{k}$ then $\overrightarrow{M}_C = \ldots\ldots$

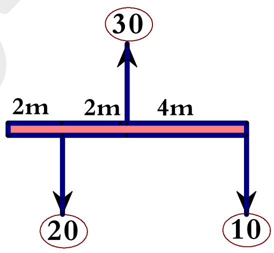
ⓐ $22\hat{k}$ ⓑ $-22\hat{k}$ ⓒ $11\hat{k}$ ⓓ $-11\hat{k}$

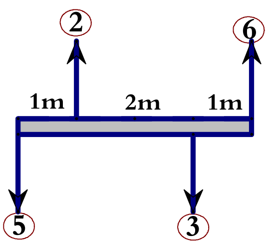
---

(37) The system of forces which is not equivalent to a couple is ……….

ⓐ


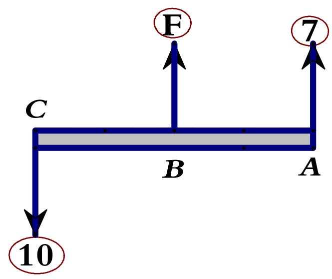
ⓑ


ⓒ


ⓓ


---

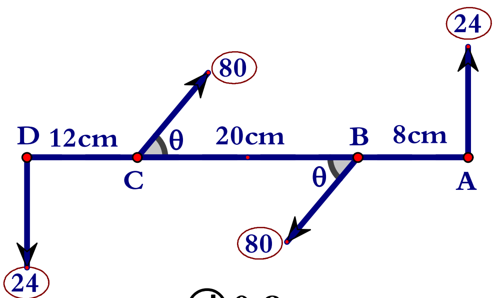
(38) The opposite figure:
if the shown force in the figure are measuered in newton and is equivalent to a couple then $F = \ldots..$ newton.



ⓐ 3 ⓑ 7 ⓒ 10 ⓓ 17

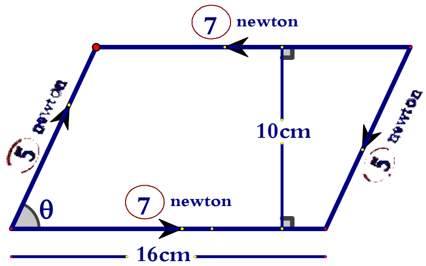
---

(39) The opposite figure represents an equilibrium rod under the action of four forces. then the value of $\sin\theta = \ldots\ldots$



ⓐ 0.4 ⓑ 0.5 ⓒ 0.6 ⓓ 0.8

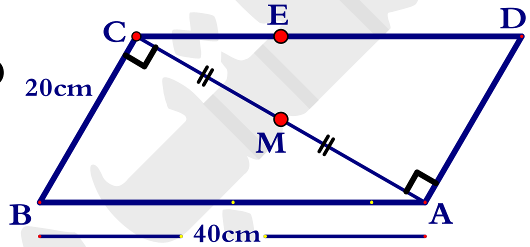
(40) The opposite figure shows a lamina in the form of a parallelogram acted on by two couples if the algebraic measure of the moment of the resultant couple is equal to 40 newtons.cm. then $\theta =$.....



ⓐ 30° ⓑ 45° ⓒ 60° ⓓ 90°

---

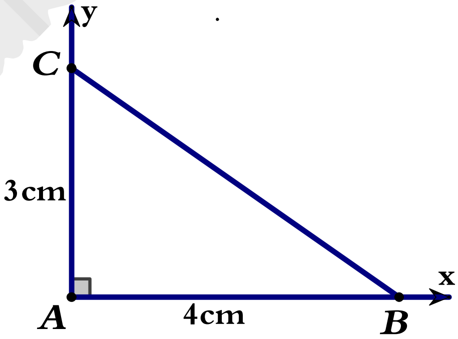
(41) The opposite figure shows a uniform fine lamina in the form of a parallel gram **ABCD** If the lamina is suspended at point $E \in \overline{CD}$ to be in equilibrium when $\overline{CD}$ is horizontal, then the length of **CE** = ... cm



ⓐ $10\sqrt{3}$ ⓑ 20 ⓒ 15 ⓓ $5\sqrt{3}$

---

(42) The center of gravity of three equal masses each of 2 kg placed at the vertices of a right-angled triangle whose length of the two legs of the right angle are 3 cm and 4 cm is ....



ⓐ $(1 , \frac{4}{3})$ ⓑ $(2 , \frac{3}{2})$ ⓒ $(\frac{4}{3} , 1)$ ⓓ $(\frac{3}{2} , 2)$

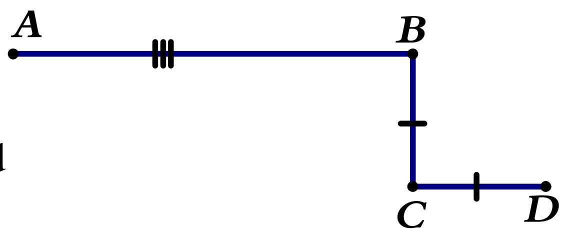
---

(43) The center of gravity of a uniform fine lamina in the form of an equilateral triangle of side length $12\sqrt{3}$ cm is distant .... from one of the vertices of the triangle ....

ⓐ 12 ⓑ 6 ⓒ 18 ⓓ 15

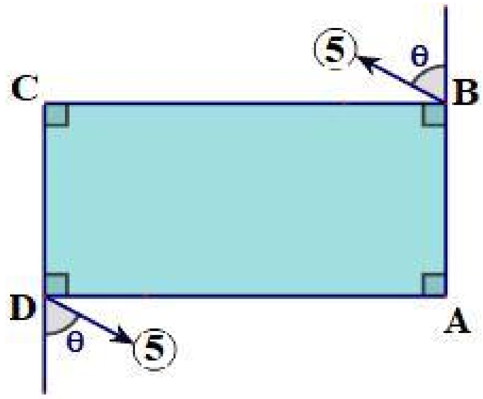
---

(44) In the opposite figure:
ABCD is a uniform wire of length100 cm in which **AB = 3 BC = 3 CD** then the distance between the center of gravity of the wire and both $\overline{BC}$ and $\overline{BA}$ respectively is ....



ⓐ (−16 , −6) ⓑ (16 , 6) ⓒ (6 , 16) ⓓ $(2 , \frac{3}{2})$

(45) In the opposite figure:
ABCD is a uniform a lamina in the form of a rectangle in which $AD = 12$ cm , $AB = 5$ cm.
If the algebraic measure of the moment of the couple of the two forces 5 , 5 newton quales 65 newton.cm then $\tan\theta = ...$



ⓐ undefined. ⓑ zero
ⓒ $\frac{5}{12}$ ⓓ $\frac{4}{3}$

Producing answers questions

(1) A particle of weight 76 newton is placed on a horizontal rough plane, if the static friction coefficient between the particle and the plane is $\frac{1}{4}$ then find:

ⓐ The required horizontal force which enough to make the particle is about to move.

ⓑ The inclined force which makes an angle of measure $\theta = \tan^{-1}\frac{3}{4}$ to the plane and makes the particle is about to move.

---

(2) A particle of weight 6 newton is placed on a horizontal rough plane and two forces in the same plane of magnitudes 2 and 4 newton include an angle of measure $120°$ act on it, the particle kept at rest prove that the measure of the angle of friction λ between the body and the plane must not less than $30°$. And if $\lambda = 45°$ and the directions of the two forces unchanged, and the force of magnitude 4 newton without change. Determine the magnitude of the other force for the particle to be about to move.

---

(3) A body of weight $10\sqrt{3}$ newton's is placed on a rough inclined plane, it is notice that the body is about to move. If the plane inclined to the horizontal by an angle of measure $30°$, If the inclination of the plane to horizontal is increased to $60°$, then find:

ⓐ The least force which acts on the body parallel to the line of the greatest slope and prevent the body from slipping.

ⓑ The force which acts on the body parallel to the line of the greatest slope and make it about to move up the plane.

---

(4) A body of weight 10 kg.wt is placed on a rough inclined plane. A force P acts on it in the direction of the line of the greatest slope up. If it's known that the body is about to move upwards the plane when P = 6 kg.wt and about to move downwards the plane when P = 4 kg.wt. Find:

ⓐ The angle of inclination of the plane to the horizontal.

ⓑ The static friction coefficient .

ⓒ The value of P at which the friction force vanished.

---

(5) 3 and 5 are two masses connected by a light string are placed on a rough inclined plane , the coefficient friction between the plane and the two bodies $\frac{2}{3}$, $\frac{4}{5}$ respectively. Show which of the bodies is placed bottom the other so that the two bodies move together, then prove that the tangent of the angle of inclination of the plane to the horizontal when the two bodies are about to move is $\frac{3}{4}$.

----

(6) If $\hat{i}$, $\hat{j}$ and $\hat{k}$ are a right system of the unit vectors and the force $\vec{F} = \hat{i} - 2\hat{j}$ acts at the point $A(2 , 3)$ find:

ⓐ The moment of the force $\vec{F}$ about point $B(2 , 1)$

ⓑ The length of the perpendicular segment from point A on the line of action of the force .

----

(7) A B C D is a square of side length is 6 cm and $E \in \overline{BC}$ where BE = 1 cm, forces of magnitudes 1, 2, 3, 4, and F newtons act along $\overrightarrow{AB}, \overrightarrow{BC}, \overrightarrow{CD}, \overrightarrow{DA}$ and $\overrightarrow{AC}$ respectively.If the line of action of the resultant passes through point E, find the value of F.

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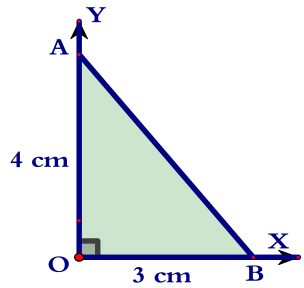
(8) A force F at the xy-plane acts on the triangle A O B. If the algebraic measure of the moment of F about point O is equal to 84 newton.m, the algebraic measure of its moment about point A is equal to - 100 newton.m , and the algebraic measure of its moment at point B is equal to zero, determine F



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(9) A force $\vec{F}$ acts at point $A(-3 , 2)$. If the moment of F about each of the two points $B(3 , 1)$ and $C(-1 , 4)$ equals $28\hat{k}$ find $\vec{F}$.

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(10) If the moment force $\vec{F} = 2\hat{i} + 3\hat{j} - \hat{k}$ about the origin point O is equal to $\overline{M_o} = -5\hat{i} + 3\hat{j} - \hat{k}$ and if this force passes through a point whose y-coordinate is equal to 2. Find the coordinates x and z for the point, hence find the length of the perpendicular segment drawn from the origin point to the line of action of the force.

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(11) If the force $\vec{F} = n\hat{i} + m\hat{j} - 2\hat{k}$ acts at point A whose position vector with respect to the origin point is $\vec{r} = 3\hat{i} + \hat{j} + \hat{k}$ if the two components of the moment of F about x and y-axes are - 1 and - 8 respectively, find the value for each of n and m.

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(12) If C, D and $E \in \overline{AB}$ such that AC : CD : DE : EB = 1 : 3 : 5 : 7. Parallel forces in the same directions and equal in the magnitudes act at points A, C, D, E and B. Prove that the resultant divides $\overline{AB}$ by a ratio 3 : 5

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(13) Two like forces of magnitudes F and 2F act at the two points A and B. If the force 2 F moves parallel to itself in the direction of $\overrightarrow{AB}$ a distance x cm, prove that the resultant of the two forces moves in the same direction a distance $\frac{2}{3}x$

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(14) $\overline{AB}$ is a rod of length 90 cm and weight 50 newton's acting at its midpoint rests horizontally on two supports. One of them at end A and the other is distant 30 cm from B carries a 20-newton weight at a point distant 15 cm from B. Find the value of pressure exerted on each support and find the magnitude of the weight which should be suspended from end B such that the rod is about to rotate. What is the value of the pressure exerted on C hence?

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(15) $\overline{AB}$ is a light ruler measured by cm rests horizontally on two supports at C, D where $C \in \overline{AD}$, 2AC = 2BD = CD, a weight of magnitude (w) newton is suspended from the point (m) on the ruler , it is about to rotate if a weight of magnitude 10 newton is suspended from A Or a weight of magnitude 6 newton is suspended from B . Find the magnitude (w) and prove that AM : MB = 9:7

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(16) Two men A and B carry a body of mass 90 kg suspended from a strong light iron rod. If the distance between the two men is 60 cm and the suspension point of the body is distant 20 cm from A. What is the magnitude that each man can carry of this weight? If man B cannot carry more than 50 kg.wt, identify the maximum distance from A the weight can be suspended at until man B can keep carrying the rod.

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(17) A uniform rod $\overline{AB}$ of length 60 cm and weight 8 newtons is hinged at its end A to a hinge fixed at a vertical wall. A weight of 6 newtons is suspended at a point in the rod distant 40 cm from the end A. The rod is being kept in a horizontal position by a light string attached at one of its two ends with the end B of the rod while the other end of the string is fixed at a point on the wall distant 80 cm vertically upwards from A. Find the tension in the string and the reaction of the hinge.

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(18) A uniform ladder AB of weight 30 kg.wt and length 4 meters rests with its end A on a smooth horizontal plane and its other end B against a smooth vertical wall.The ladder is being kept in a vertical plane and inclined at 45^o by a horizontal rope joining the end A with a point of the horizontal plane lying vertically under B exactly. If a man of weight 80 kg.wt ascends the ladder, prove that the tension of the rope increases whenever the man ascends. If the rope does not stand tension more than 67 kg.wt, find the length of the maximum distance the man can ascend without cutting the rope.

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(19) A uniform rod AB of weight 40 newtons rests with its end A on a vertical wall such the coefficient of friction between the wall and the rod is equal to $\frac{1}{2}$ and with its end B on a horizontal ground such that the coefficient of friction between the ground and the rod is equal to $\frac{1}{3}$. If the minimum horizontal force making the end B of the rod about to move towards the wall is equal to 60 newtons. Find, in the position of the equilibrium, the measure of the angle of inclination of the rod to the horizontal known that the rod is being kept in a horizontal plane.

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(20) A uniform rod $\overline{AB}$ of weight 20 newtons and length 60 cm rests with its end A at a rough horizontal plane and at one of its points C at a smooth wedge which is 25 cm upon the horizontal plane. If the rod is about to slip as it is inclined at 30^o to the horizontal, find the reaction of the wedge and the coefficient of friction between the rod and the plane known that the rod lies in a vertical plane.

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(21) A uniform ladder of length 10 meters and weight 20 kg.wt rests on rough horizontal ground with its end A.The coefficient of friction between the ground and the ladder is $\frac{1}{4}$. The ladder also rests in a smooth vertical wall with its end B. Prove that the ladder cannot be in equilibrium when the end B is distant 8 meters from the ground surface.

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(22) ABCDEF is a regular hexagon, The forces 3 , 9 , F_1 , 3 , 9 , F_2 gm.wt act along the directions $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{DC}$, $\overrightarrow{DE}$, $\overrightarrow{EF}$ and $\overrightarrow{AF}$ respectively. Find the value for each of F_1 and F_2 so that the system is in equilibrium.

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(23) ABCD is a trapezium in which $\overline{AD} \mathbin{//} \overline{BC}$, AB ⊥ BC , AB = 6 cm, BC = 9 cm and AD = 3 cm. The forces F_1 , F_2 , F_3 and F_4 completely represented by the directed straight segments act at $\overrightarrow{DA}$, $\overrightarrow{CD}$, $\overrightarrow{BC}$ and $\overrightarrow{AB}$ respectively. If the system is equivalent to a couple the magnitude of its moment is 360 newtons.cm in the direction of ABCD. Find the magnitude for each of F_1 , F_2 , F_3 and F_4 .

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(24) ABCD is a square of side length 10 cm, $E \in \overrightarrow{CB}$, $F \in \overrightarrow{CD}$, such that CE=CF=30 cm. Forces of magnitudes 40, 10, 20, 30 and $20\sqrt{2}$ kg.wt act at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, $\overrightarrow{DA}$ and $\overrightarrow{EF}$ respectively. Prove that the system is equivalent to a couple and find its moment.

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(25) ABCD is a rectangle in which AB = 60 cm , BC = 160 cm , X and Y midpoints of $\overline{BC}$ and $\overline{AD}$ respectively. The forces of magnitudes 200 , 200 , 400 , 400 , F and F newtons act in the direction $\overrightarrow{AB}$, $\overrightarrow{CD}$, $\overrightarrow{CB}$, $\overrightarrow{AD}$, $\overrightarrow{XA}$ and $\overrightarrow{YC}$, respectively. If the algebraic measure of the moment of the resultant couple is equal to 6400 newton.cm, in the direction ***ADCB*** then find the value of F.

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(26) ABCD is a rhombus of side length10cm, m(∠BAC)=120°.Forces of magnitudes 20, 15, 20 and 15 kg.wt act at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$ and $\overrightarrow{DA}$ respectively. Prove that the system is equivalent to a couple and find the magnitude of its moment. Find the two forces acting at B and D perpendicular to $\overline{BD}$ such that the system is in equilibrium.

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(27) ABCD is an isosceles trapezium in which $\overline{AD} \mathbin{//} \overline{BC}$, AD= 9 cm ,AB=DC=15 cm and BC=33 cm. The forces of magnitudes 45, 99 , 45 and 27act in the directions of $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, $\overline{DA}$ respectively. Prove that the system is equivalent to a couple and find the magnitude of its moment.

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(28) ABCDE is a regular pentagon of side length 15 cm. Forces the magnitude of each is 10 kg.wt act at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, $\overrightarrow{DE}$ and $\overrightarrow{EA}$ respectively.
Prove that the system is equivalent to a couple and find the magnitude of its moment.

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(29) ABC is a triangle in which AB = BC = 6cm, m(∠ABC) = 120°. Forces of magnitudes 18, 18 and 18 $\sqrt{3}$ act at $\overrightarrow{AB}$, $\overrightarrow{BC}$ and $\overrightarrow{CA}$ respectively prove that the system is equivalent to a couple. find the magnitude of its moment. And the two forces acting at A and B parallel to $\overleftrightarrow{AB}$ such that the system is in equilibrium.

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(30) ABCD is a fine lamina in the form of a square whose side length is50 cm and of weight **300**gm.wt acts at the point at which the diagonals meet. The lamina is suspended by a pin from a small hole near the vertex A such that its plane is vertical find the reaction of the pin. And if a couple of a magnitude 7500 gm.wt acts on the lamina perpenducular to its plane. Find, in the position of equilibrium, the measure of the angle of inclination of $\overline{AC}$ to the vertical

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(31) A thin wire of uniform thickness and density in the form of a trapezium ABCD in which AB=15cm , BC=12cm , CD=10cm , m(∠ABC)= m(∠BCD)=90°. Find the distance between the center of gravity of the wire and the two sides $\overline{AB}$ and $\overline{BC}$.

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(32) A uniform squared lamina of weight (w) is suspended freely from the vertex A and a weight of $\frac{1}{4}W$ is fixed at vertex B. Prove that the tangent of the angle of inclination of the diagonal $\overline{AC}$ to the vertical in the equilibrium position is equal to $\frac{1}{5}$

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(33) A fine lamina of mass 300 gm in the form of an equilateral triangle ABC of side length 12 cm, A mass of 100 gm is stuck to the lamina at the trisection point $\overline{AB}$ from A. Determine the distance between the center of gravity of the system and the point A

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(34) A fine lamina of a uniform density in the from of a rectangle ABCD in which AB = 6 cm, BC = 10cm and E∈$\overline{AD}$ such that AE = 6cm , if the triangle ABE is bent about the side $\overline{BE}$ until $\overline{AB}$ is coincident with $\overline{BC}$ completely, find the position of the center of gravity of the lamina after bending it with respect to $\overline{CB}$, $\overline{CD}$.

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(35) ABCD is a lamina of a uniform thickness and density in the form of a rectangle in which AB = 12 cm , B C = 16 cm and point E is the intersection point of its diagonals $\overline{AC}$ and $\overline{BD}$, the triangle A E D is separated and fixed above the triangle B E C. Find the center of gravity of the lamina in this case. If the lamina is freely suspended from point C, find the tangent of the angle of $\overline{CB}$ to the vertical.

(36) A fine lamina of a uniform thickness and density in the form of a circular disc whose center is the origin point and the radius length is 6 unit length. Two circular discs , the center of one of them is (-1 , -3) and radius length is a unit length and the center of the other disc is (1 , 2) and radius length is 3 unit length are cut off. Find the center of gravity of the remaining part of the origin disc.

Final answers

(1)	a	**(2)**	d	**(3)**	a	**(4)**	a	**(5)**	c
(6)	a	**(7)**	a	**(8)**	d	**(9)**	d	**(10)**	b
(11)	b	**(12)**	b	**(13)**	a	**(14)**	c	**(15)**	b
(16)	a	**(17)**	d	**(18)**	b	**(19)**	a	**(20)**	b
(21)	d	**(22)**	b	**(23)**	a	**(24)**	a	**(25)**	b
(26)	a	**(27)**	c	**(28)**	b	**(29)**	c	**(30)**	d
(31)	b	**(32)**	b	**(33)**	b	**(34)**	c	**(35)**	b
(36)	c	**(37)**	c	**(38)**	a	**(39)**	c	**(40)**	a
(41)	c	**(42)**	c	**(43)**	a	**(44)**	b	**(45)**	c

Producing answers questions

(1) 19 N , 20 N

(2) $2+2\sqrt{6}$ N

(3) 10 N , 20 N

(4) 30° , $\frac{\sqrt{3}}{15}$, 5 kg.wt.

(5) prove.

(6) $-2\hat{k}$, $\frac{5\sqrt{2}}{2}$ kg.wt.

(7) $8\sqrt{2}$ N.

(8) $\vec{F}=-46\hat{i}+24\hat{j}$

(9) $\vec{F}=8\hat{i}-6\hat{j}$

(10) $x=z=1$, length of ⊥ $\simeq 1.58$

(11) n =2 , m = -1

(12) prove.

(13) prove

(14)7.5 , 62.5 15 85 N

(15) 8 N

(16)30 , 60 , $33\frac{1}{3}$

(17) 10 , $6\sqrt{2}$, its direction $\frac{\pi}{4}$

(18) 2.6 m

(19) 45°

(20) $6\sqrt{3}$ N , $\frac{3\sqrt{3}}{11}$

(21) prove

(22)12 N , 12 N

(23) 15 , $30\sqrt{2}$, 45 , 30 N

(24) 100 kg.wt.

(25) 300N

(26) $175\sqrt{3}$ kg.wt.cm , 17.5 , 17.5 kg.wt.

(27) 1134 N.cm

(28) 516.14 kg.wt.cm

(29) $54\sqrt{3}$ kg.wt.cm.

(30) 45° , 135°

(31) 635

(32) 5.4

(33)

(34) 2.4 , 4.4

(35) (4 , 8) $\tan\theta=\frac{1}{2}$

(36) $\left(\frac{-4}{13} , \frac{-15}{26}\right)$