UNIVERSITY OF BARISHAL

ASSIGNMENT

COURSE TITLE : Basic Mechanical Engineering

COURSE CODE : EEE-1207

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SEMESTER : 2nd

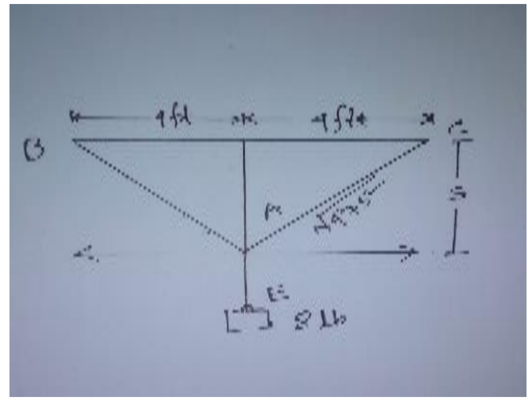
YEAR : 1st

DATE OF SUBMISSION : 11/18/2024

*Lecture Note 1&2:

Problem No : 3.13

Answer:



The weight of block E is 8 lb.

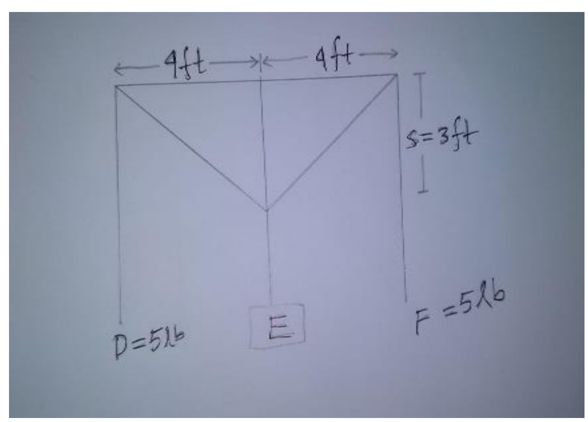
$\sum F_y=0;$

- $F_E\left(\frac{s}{\sqrt{s^2+4^2}}\right)+F_E\left(\frac{s}{\sqrt{s^2+4^2}}\right) - 8=0$
- $5 \text{ X } \left(\frac{s}{\sqrt{s^2+4^2}}\right) + 5 \text{ X } \left(\frac{s}{\sqrt{s^2+4^2}}\right) - 8=0$
- $\frac{5s}{\sqrt{s^2+4^2}} + \frac{5s}{\sqrt{s^2+4^2}} =0$
- $\frac{10s}{\sqrt{s^2+16}} =8$
- $10s =8 \sqrt{s^2+16}$
- $100s^2 = 64s^2 + 1024$
- $s^2=28.44$

$\therefore S = 5.33$(Ans)

Problem No : 3.14

Answer:



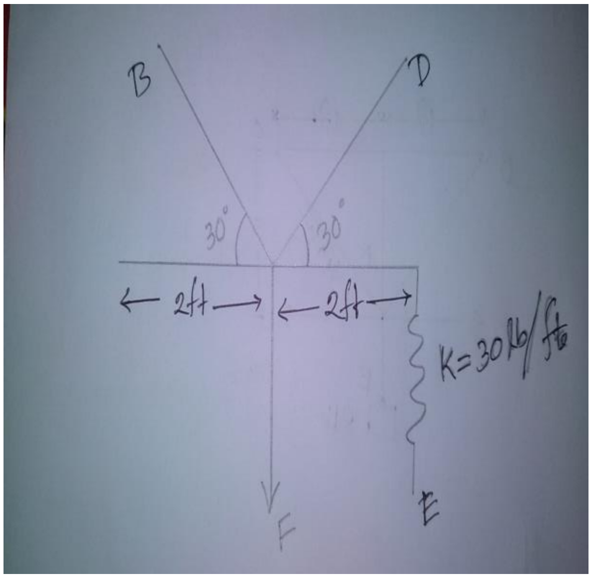
The weight of D and F blocks are 5 lb .

- $\sum F_y=0;$
- $F_E\left(\frac{3}{\sqrt{3^2+4^2}}\right) + F_E\left(\frac{3}{\sqrt{3^2+4^2}}\right)-F_E=0$
- $F_E=5.\frac{3}{5} + 5.\frac{3}{5}$
- $F_E=3+3$

$\therefore F_E=6$ lb. (Ans)

Problem No : 3.25

Answer:



Here,

F=?

K=30 lb

X=stress

Initial stretching x_0=1ft

- $\text{Cos}30=\frac{2}{D}$
- $d=\frac{2}{\cos 30}$

$\therefore$ d=2.309

For the stretching of the string after θ=30

X=1+(2.309-2)

=1.309

$\therefore$ F = kx = (30 X 1.309) =39.27 lb .(Ans)

*Lecture Note 3

Problem No : 3.44

Answer:

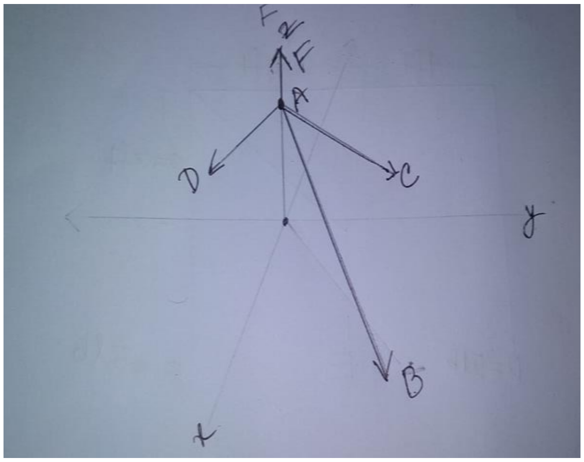
Here, cable AB is subjected to a tension of 700N.

$$F_{AB}=700\left(\frac{2i+3j-6k}{\sqrt{(2)^2+(3)^2+(-6)^2}}\right)$$

$=\{200i + 300j - 600k\}$N

$F_{AC}=F_{AC}\left(\frac{-1.5i+2J-6k}{\sqrt{(-1.5)^2+(2)^2+(-6)^2}}\right)$

$=-0.23F_{AC}i+0.30F_{AC}j-0.92F_{AC}k$



$F_{AD}=F_{AD}\left(\frac{-3i-6j-6k}{\sqrt{(-3)^2+(-6)^2+(-6)^2}}\right)$

$= -0.33F_{AD}i - 0.66F_{AD}j-0.66F_{AD}k$

$F=F_K$

The coefficient of i , j and k

$\sum x=0;$

- $200-0.23F_{AC}-0.33F_{AD}=0$ --------------------(1)

$\sum y=0;$

- $300+0.3F_{AC}-0.66F_{AD}=0$ --------------------(2)

$\sum Z=0;$

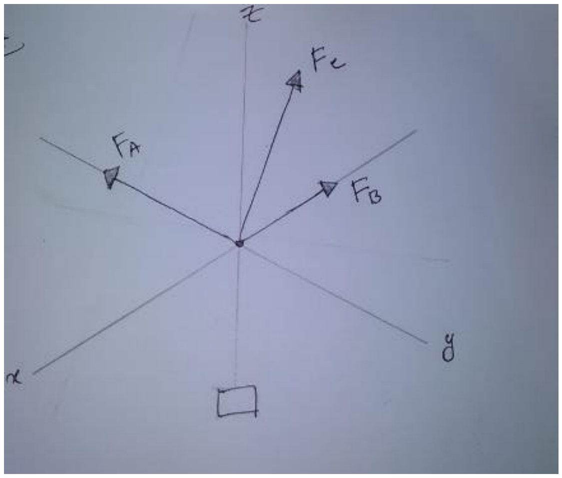
- $-600-0.92F_{AC}-0.66F_{AD}+F=0$ --------------------(3)

To solve the three equation we get the value of F_{AC}=130N, F_{AD}=510N, F=1060N .

Problem No : 3.47

Answer:

The co-ordinate position of C(6,4,12).



$F_C=F_C\left\{\frac{6i+4j+2k}{\sqrt{(6)^2+(4)^2+(12)^2}}\right\}$

$=\frac{Fc}{14}(6i + 4j + 2k)$

$F_A=-F_Aj$

$F_B = -F_B i$

$W = -20 \text{ X } 9.81 \text{ k}$

$= -196.2 \text{ k}$

$\sum F = 0;$

$\sum F_x = 0;$

- $\frac{6Fc}{14} - F_B = 0$
- $FB = \frac{6Fc}{14}$ ---------------------------(1)

$\sum F_y = 0;$

- $F_A = \frac{4Fc}{14}$ ---------------------------(2)

$\sum F_z = 0;$

- $F_C = \frac{196.2 \; X \; 14}{12} = 228.9\text{N}$---------------------------(3)

Now,

$F_B = \frac{6 \text{ X } 228.9}{14} \text{ N} = 98.1\text{N}$

$F_A = \frac{4Fc}{14}$

$\therefore \; F_A = 65.4\text{N}$

According to the formula,

$F_A = kx_A$

- $X_A = \frac{FA}{K}$

$X_A = \frac{65.4}{30} = 0.218$ m.

$F_B = kx_B$

- $X_B = \frac{FB}{K}$

$X_A = \frac{98.1}{300} = 0.327$ m.

Problem No : 3.54

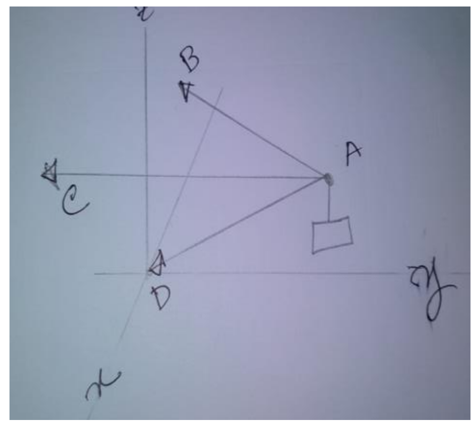
<u>Answer:</u>

The co-ordinate position of A(0,6,2.5).

The co-ordinate position of B(-2,0,4).

The co-ordinate position of C(2,0,5.5).

The co-ordinate position of D(0,0,0).



r_{AD}=0i+6j+2.5k

r_{AB}=-2i-6j+1.5k

r_{AC}=2i-6j+3k

$$F = F \text{ X } \left\{\frac{0i+6j+2.5k}{\sqrt{(6)^2+(2.5)^2}}\right\}$$

= 0.923F j +0.384F k

W=-400k

$$F_B = F_B \text{ X } \left\{\frac{-2i-6j+1.5k}{\sqrt{(-2)^2+(-6)^2+(1.5)^2}}\right\}$$

$=-0.307F_B i-0.923F_B j+0.23F_B k$

$$F_C = F_C \text{ X } \left\{\frac{2i-6j+3k}{\sqrt{(2)^2+(-6)^2+(3)^2}}\right\}$$

$\sum F_x=0;$

- $0.307F_B+0.285F_C=0$-----------------------------------(1)

$\sum F_y=0;$

- $-0.923F_B-0.857F_C+0.923F=0$-------------------------(2)

$\sum F_z=0;$

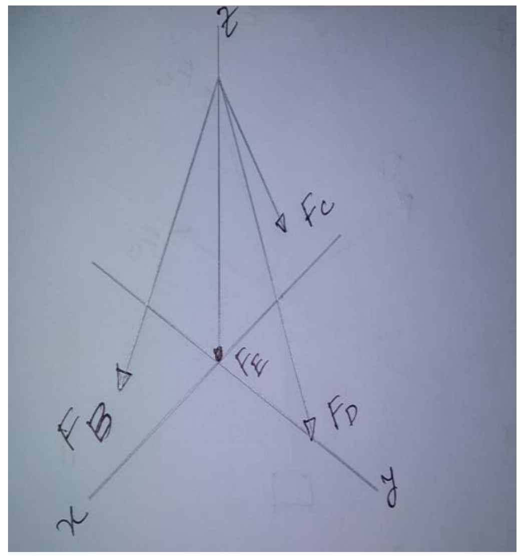
- $0.230F_B+0.428F_C+0.384F-400=0$------------------(3)

Calculate the three equation we get the value of F=548.32 lb.

F_B=274.14 lb , F_C=295.30 lb.

Problem No : 3.62

Answer:



$F_B=F_B\{\frac{10i-15j-30k}{\sqrt{(10)^2+(15)^2+(-30)^2}}\}$

$=0.28F_Bi-0.42F_Bj-0.85F_Bk$

$F_C=F_C\{\frac{-15i-10j-30k}{\sqrt{(-15)^2+(-10)^2+(-30)^2}}\}$

$=-0.42F_Ci-0.285F_Cj-0.85F_Ck$

$F_D=F_D\{\frac{0i+12.5j-30k}{\sqrt{(0)^2+(12.5)^2+(-30)^2}}\}$

$=0.384F_Dj-0.923F_Dk$

$F_E=F_Ek$

$\sum F_x=0;$

- $0.28F_B-0.42F_C=0$-----------------------------------(1)

$\sum F_y=0;$

- $-0.42F_B-0.285F_C+0.384F_D=0$-------------------------(2)

$\sum F_z=0;$

- $-0.85F_B-0.85F_C-0.923F_D+F_E=0$------------------(3)

Let us assume that cable AB achieve maximum tension first . So, F_B=1000 lb.

Now, solving these equation ,we get

F_C=666.67 lb.

F_E=2914 lb.

F_D=1610 lb.

*Lecture Note 4

Problem No : 4.4

Answer:

The moment point of A,

$\circlearrowleft + (M_{F1})_A = -375(8)$

=-3000 lb. ft = 3.00 kip.ft (***clockwise***)

$\circlearrowleft + (M_{F2})_A = -500\left(\frac{4}{5}\right)(14)$

=-5600 lb. ft = 5.60 kip.ft (***clockwise***)

$\circlearrowleft + (M_{F3})_A = -160(\cos 30^o)(19) + 160\sin 30^o(0.5)$

=-2593 lb.ft =2.59 kip.ft (***clockwise***)

The moment point of B,

$\circlearrowleft + (M_{F1})_{\mathbf{B}} = 375(11)$

=4125 lb. ft = 4.125 kip.ft (***Counterclockwise***)

$\circlearrowleft + (M_{F2})_B = 500\left(\frac{4}{5}\right)(5)$

=2000 lb. ft = 2.00 kip.ft (***Counterclockwise***)

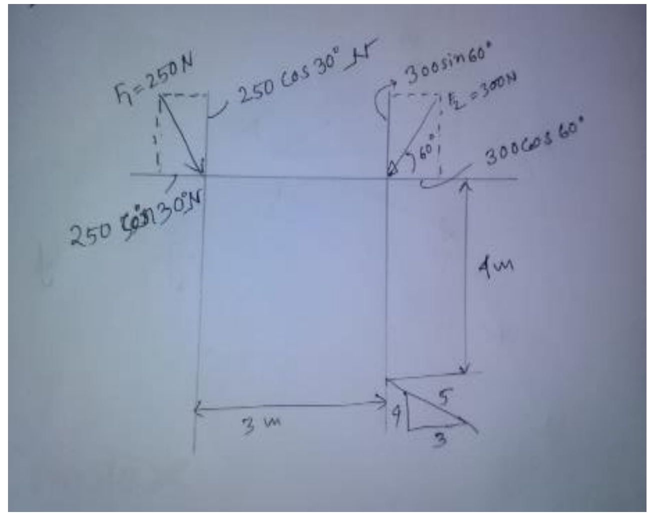
$\circlearrowleft + (M_{F3})_B = 160(\sin 30^o)(0.5) - 160\cos 30^o(0)$

=40.0 lb.ft (***Counterclockwise***)

Problem No : 4.7

Answer:

The moment arm measured perpendicular to each force from point A is



d_1=2sin60º=1.732 m

d_2=5sin60º=4.330 m

d_3=2sin53.13º= 1.60m

Using each force where M_A =Fd , we have

↺ + $(M_{F1})_A$= -250(1.732)

= -433 N.m =433 N.m(***clockwise***)

↺ + $(M_{F2})_A$= -300 (4.330)= -1299 N.m =1.30 kN.m (***clockwise***)

↺ + $(M_{F3})_A$= -500(1.60)

=-800 N.m =800 N.m (***clockwise***)

The forces are resolved into horizontal and vertical component as shown, For F_1,

↺ + M_B= 250 cos30º (3) – 250 sin30º (4)

= 149.51 N.m =150 N.m ↻

For F_2,

↺ + M_B= 300 sin60º (0) + 300 cos60º (4)

=600 N.m ↻

Since the line of action of F_3 passes through B , its moment arm about point B is zero. Thus M_B=0.

Problem No : 4.27

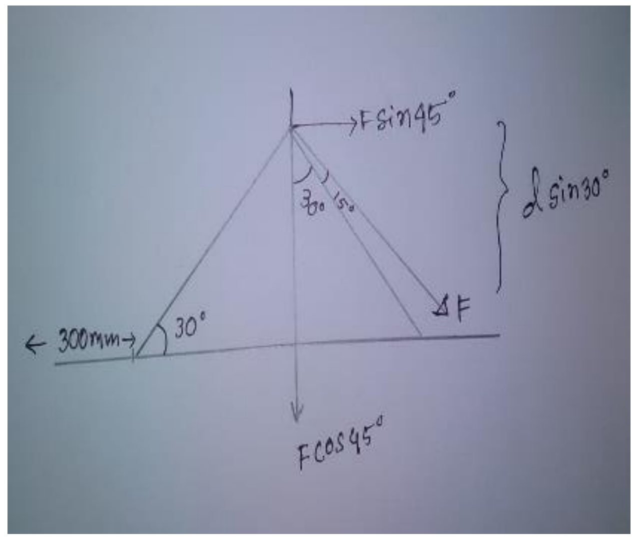
<u>Answer:</u>

The applied force F=200N.

And d=300mm = 0.3m

↺ + M_A= -(d sin30º) X (Fsin45º) – (0.3 + d cos30º) X (Fcos 45º)

= -(0.3 sin30º) X (200 X sin45º) – (0.3 + 0.3 cos30º) X (200 X cos45º)



= -21.21 – 79.16

= -100.37 Nm

=100.37 Nm ↻

Problem No : 4.28

<u>Answer:</u>

The clockwise moment = 120Nm

↺ +M_A=-120Nm

Force F= 200N

The extension d=?

↺ +M_A= - (dsin30º) F sin45º – (0.3 + dcos30º) X Fcos45º

- -120 = - (dsin30º)200sin45º –(0.3 + dcos30º) X 200 cos45º
- -120 = - 193.18 d - 42.42
- -193.18 d = -77.57

$\therefore$ d = 0.401 m

Problem No : 4.29

<u>Answer:</u>

The clockwise moment = 120Nm

↺ $+M_A$=-120Nm

Force F= ?

The extension d=300mm = 0.3 m

We know that,

↺ $+M_A = -(0.3 + 0.3\cos 30^o)(F\cos 45^o) - (0.3\sin 30^o)(F\sin 45^o)$

- $-120 = -(0.56)(0.7F) - (0.15)(0.7F)$
- $-120 = (0.7F)(-0.56-0.15)$
- $0.7F=119.29$

$\therefore F=239.02$ N

*Lecture Note 5

Problem No : 4.8

Answer:

A vector analysis using $M_{AB} = u_B \cdot (r \times F)$ will be considered for the solution rather than trying to find the moment arm or perpendicular distance from the line of action of **F** to the AB axis. Each of the terms in the equation will now be identified.

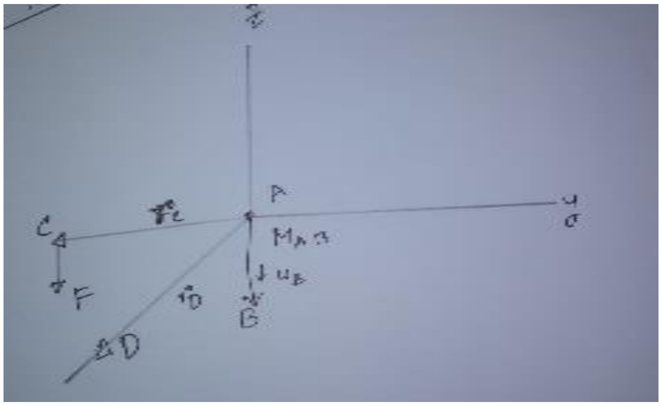
Unit vector u_B defines the direction of the AB axis of the rod,

$$u_B=\frac{\boldsymbol{r}B}{rB} = \frac{\{0.4i+0.2j\}m}{\sqrt{(0.4m)^2+(0.2m)^2}}$$

= 0.8944i + 0.4472j

Vector r is directed from any point on the AB axis to any point on the line of action of the force. For example, position vectors r_C and r_D are suitableFor simplicity, we choose r_D, where

$$r_D = \{0.6i\}\ m$$



The force is

$$F = \{ -300k\} \text{ N}$$

$M_{AB} = u_B \cdot (r_D \times F)$

$$= \begin{vmatrix} 0.8944 & 0.4472 & 0 \\ 0.6 & 0 & 0 \\ 0 & 0 & -300 \end{vmatrix}$$

$= 0.8944\,[0(-300) - 0\,(0)\,] - 0.4472\,[0.6(-300) - 0\,(0)] + 0[0.6(0) - 0(0)]$

$= 80.50$ N . m

This positive result indicates that the sense of M_{AB} is in the same direction as u_B.

$M_{AB} = M_{AB}\mathbf{u}_B = (80.50 \text{ N.m})(0.8944i + 0.4472j)$

= {72.0i + 36.0j} N.m (***Ans***)

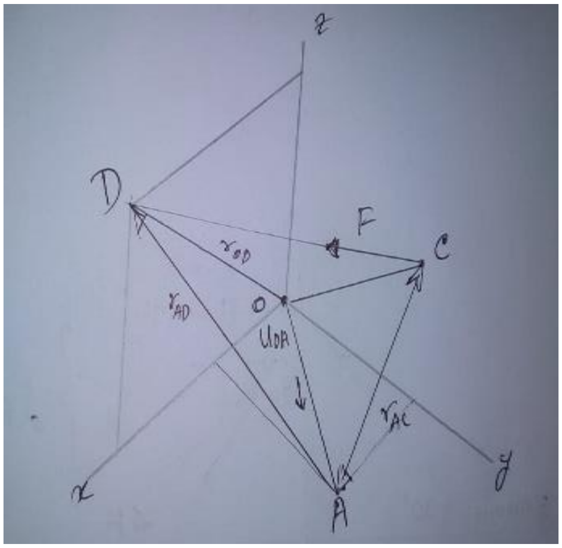
Problem No : 4.9

<u>Answer:</u>

The moment of F about the OA axis is determined from $M_{OA} = u_{OA} \cdot (r \times F)$, where r is a position vector extending from any point on the OA axis to any point on the line of action of F. As indicated in either r_{OD}, r_{OC}, r_{AD}, or r_{AC} can be used; however, r_{OD} will be considered since it will simplify the calculation. The unit vector u_{OA}, which specifies the direction of the OA axis, is

$$\mathbf{u}_{OA} = \frac{rOA}{rOA} = \frac{(0.3i+0.4j)m}{\sqrt{(0.3m)^2+(0.4\,m)^2}}$$

$= 0.6i + 0.8j$



And the position vector $\mathbf{r}_{OD}$ is

$\mathbf{r}_{OD} = \{0.5i + 0.5k\}$

The force F expressed as a Cartesian vector is

$$F = F\left(\frac{rCD}{rCD}\right)$$

$= (300N)\left[\frac{\{0.4i-0.4j+0.2k\}}{\sqrt{(0.4)^2+(-0.4)^2+(0.2)^2}}\right]$

$=\{200i - 200j + 100k\}N$

Therefore ,

$M_{OA} = \mathbf{u}_{OD} .(\mathbf{r}_{OD} \times F)$

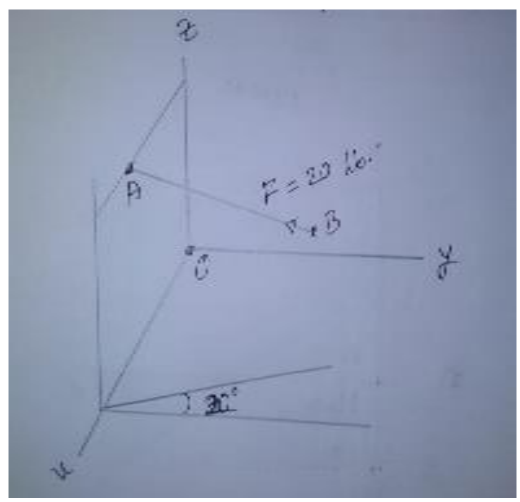
$$=\begin{vmatrix} 0.6 & 0.8 & 0 \\ 0.5 & 0 & 0.5 \\ 200 & -200 & 100 \end{vmatrix}$$

= 0.6[0(100)-(0.5)(-200)]-0.8[0.5(100)-(0.5)(200)]+0

=100 N.m (***Ans***)

Problem No : 4.50

<u>Answer :</u>



$|M_x| = u_x . (r \times F)$

Here, $u_x = \frac{\mathbf{u}x}{ux} = \frac{5i}{5} = i$

r = 4k

For calculation we have to consider r_{OA}

So, $r_{OA} = \{3i + 0j + 4k\}$ft

Now,

$F = 20\left\{\frac{3i-3cos20^0 j+(4-3\sin 20^0)k}{\sqrt{3^2+(-3cos20^0)^2+(4-3sin20^0)^2}}\right\}$

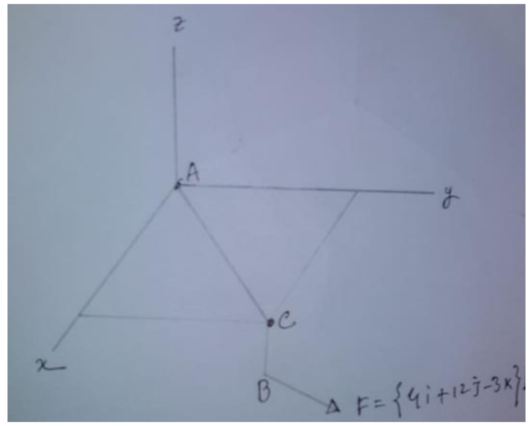
$=\{11.8i - 11.1j + 11.7k\}$lb

Now, $M_x = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 0 & 4 \\ 11.8 & -11.1 & 11.7 \end{vmatrix}$

=44.4 lb.ft (***Ans***)

Problem No : 4.53

<u>Answer:</u>



r_{CB} ={-2k}ft

r_{AB}={(4-0)I +(3-0)j + (-2-0)k} ft

={4i + 3j -2k}ft

Unit vector along AC Axis:

$u_{AC} = \frac{(4-0)i+(3-0)j}{\sqrt{(4-0)^2+(3-0)^2}}$

=0.8i+0.6j

Moment of force F about AC axis : with F = {4i+12j-3k}lb

We have

$M_{AC} = u_{AC} \cdot (r_{CB} \times F)$

$$= \begin{vmatrix} 0.8 & 0.6 & 0 \\ 0 & 0 & -2 \\ 4 & 12 & -3 \end{vmatrix}$$

= 0.8 [(0) (-3) -12 (-2)] -0.6[0(-3) – 4 (-2)]+0

=14.4 lb.ft

Expressing M_{AC} as a Cartesian vector yields

$M_{AC} = M_{AC}\, u_{AC}$

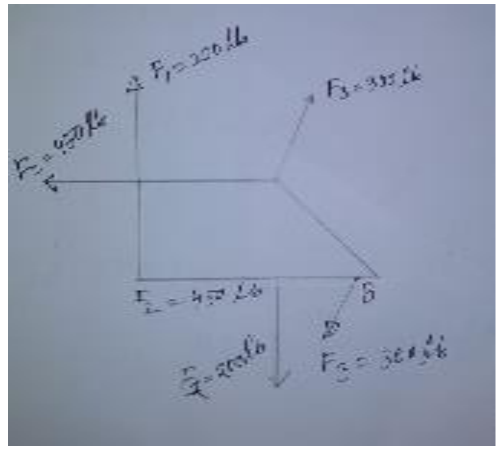
= 14.4 (0.8 i+ 0.6j)

={11.5i+8.64j} lb.ft (***Ans***)

Problem No : 4.10

<u>Answer:</u>

As shown the perpendicular distances between each pair of couple forces are d_1 = 4 ft, d_2 = 3 ft, and d_3 = 5 ft. Considering counterclockwise couple moments as positive, we have



$\circlearrowleft + M_R = \sum M$;

$M_R = - F_1d_1 + F_2d_2 - F_3d_3$

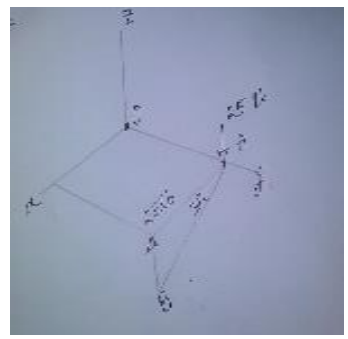
=-(200 lb)(4ft) +(450 lb) (3ft)-(300 lb) (5 ft)

= -950 lb.ft = 950 lb.ft $\circlearrowright$ (***Ans***)

Problem No : 4.12

Answer:

The moment of the two couple forces can be found about any point. If point O is considered,



$M = r_A \times (-25k) + r_B \times (25k)$

$= (8j) \times (-25k) + (6 \cos 30^0 i + 8j - 6\sin 30^0 k) \times (25k)$

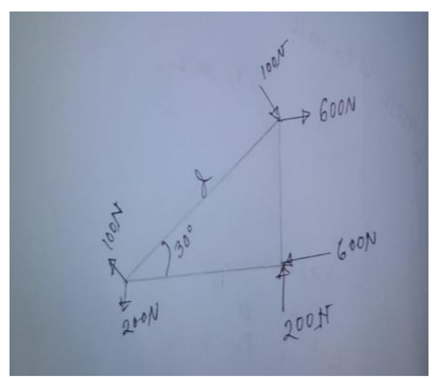
=-200i -129.9j + 200k

={-130j} lb.in.(***Ans***)

Problem No : 4.68

Answer:

The resultant couple is 350 N.m clockwise.



We have,

- $0+350 = -200\, d\cos 30^0 + 600 \sin 30^0 + 100d$
- $350 = -173d + 300d + 100d$
- $227d = 350$

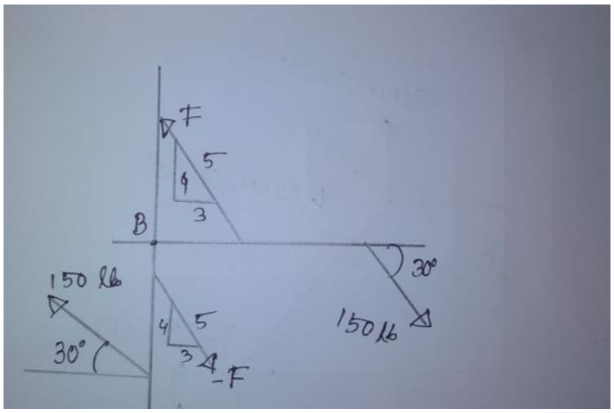
$\therefore d = 1.54$ mm. (***Ans***)

Problem No : 4.80

Answer:

The resultant couple moment on the frame is 200 lb.ft, clockwise.

Force F=?



$\sum M_A = 150\cos 30\,(2) - F\left(\frac{3}{5}\right) \times 4 + F \times \left(\frac{3}{5}\right) \times 6 + F \times \left(\frac{4}{5}\right) \times 2 - 150\cos 30^0\,(6) - 150\sin 30^0\,(4)$

- ➢ -200= 259.8 – 2.4F +3.6F +1.6F – 779 -300
- ➢ 2.8F = 619.62

  ∴ F = 221.29 lb (***Ans***)

Problem No : 4.89

Answer:

Position vector

$r_{AB} = (0.35 - 0.35)i + (-0.4\cos 30^0 - 0)j + (0.4\sin 30^0 - 0)k$

= -0.346j +0.20k

Couple moment $F_1 = (35k)N, F_2 = (50i)N$

$M_{C1} = r_{AB} + F_1$

$$= \begin{vmatrix} i & j & k \\ 0 & -0.346 & 0.2 \\ 0 & 0 & 35 \end{vmatrix}$$

= -12 .12i N.m

$M_{C2}=r_{AB} +F_2$

$$= \begin{vmatrix} i & j & k \\ 0 & -0.346 & 0.2 \\ 50 & 0 & 0 \end{vmatrix}$$

= -100j -17.32k N.m

Resultant couple moment , $M_R=\sum M$

=-12.12i +(-100j-17.32k)

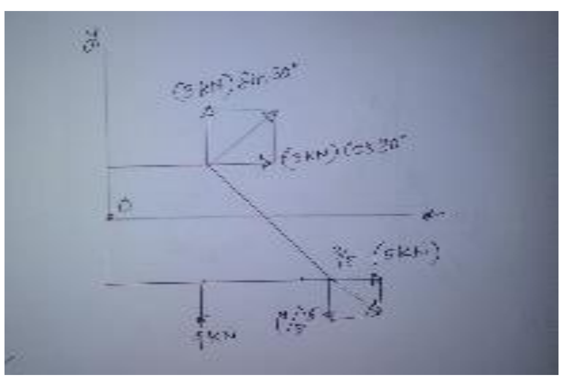
= -12.12i -100j-17.32k (***Ans***)

*Lecture Note 6 & 7

Problem No : 4.14

<u>Answer:</u>

Force Summation. The 3 kN and 5 kN forces are resolved into their x and y component . we have,



$\sum F_x$;

$(F_R)_x = (3kN)\cos 30^0 + \left(\frac{3}{5}\right)(5kN) = 5.598kN \rightarrow$

$\sum F_y$;

$(F_R)_y = (3kN)\sin 30^0 + \left(\frac{4}{5}\right)(5kN) - 4kN = -6.5kN = 6.5kN\downarrow$

Using the pythagoream theorem, the magnitude of F_R is

$F_R = \sqrt{(FR)x^2 + (FR)y^2}$

$= \sqrt{(5.598kN)^2 + (6.50kN)^2}$

=8.58 kN.

Its direction θ is

$\theta = \tan^{-1}\left(\frac{(FR)y}{(FR)x}\right)$

$= \tan^{-1}\left(\frac{6.50kN}{5.598kN}\right) = 49.3^0$

Moment summation: The moments of 3 kN and 5 kN about point O will be determined using their x and y components. we have

$\circlearrowleft + (M_R)_O = \sum M_O$;

$(M_R)_O = (3kN)\sin 30^0 (0.2) - (3kN)\cos 30^0 (0.1m) + \left(\frac{3}{5}\right)(5kN)(0.1m) - \left(\frac{4}{5}\right)(5kN)(0.5m) - (4kN)(0.2m)$

$= -2.46kN.m = 2.46kN.m \circlearrowright$ (***Ans***)

Problem No : 4.15

<u>Answer:</u>

Force summation : Since the couple forces of 200 N are equal but opposite, they produce a zero resultant force, and so it is not necessary to consider them in the force summation. The 500-N force is resolved into its x and y components, thus

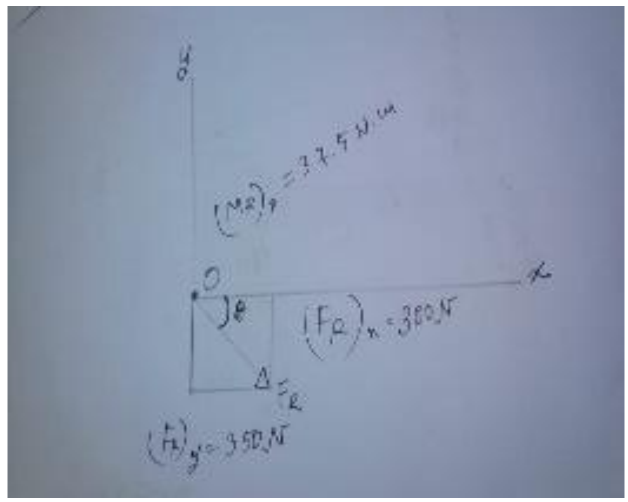
$\sum F_x$;

$(F_R)_x = \left(\frac{3}{5}\right)(500N) = 300N \rightarrow$

$\sum F_y$;

$(F_R)_y = (500N)\left(\frac{4}{5}\right) - 700N = -350N = 350N\downarrow$

the magnitude of F_R is



$F_R = \sqrt{(FR)x^2 + (FR)y^2}$

$= \sqrt{(300N)^2 + (350N)^2}$

$= 461$ N.

Its direction θ is

$\theta = \tan^{-1}\left(\frac{(FR)y}{(FR)x}\right)$

$= \tan^{-1}\left(\frac{350N}{300N}\right) = 49.4^0$

Moment summation: Since the couple moment is a free vector, it can act at any point on the member. we have

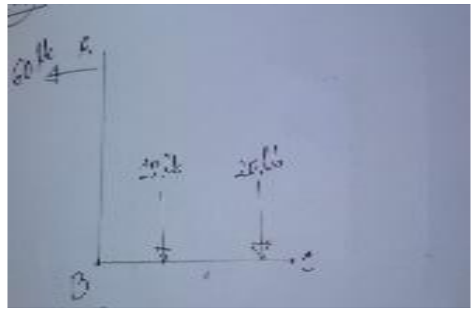
$\circlearrowleft + (M_R)_O = \sum M_O + \sum M$;

$(M_R)_O = (500N)\left(\frac{4}{5}\right)(2.5m) - (500N)\left(\frac{3}{5}\right)(1m) - (750N)(1.25m) + 200N.m$

$= -37.5N.m = 37.5N.m \circlearrowright$ (***Ans***)

Problem No : 4.104

<u>Answer:</u>



$\overset{+}{\rightarrow}$ $\sum(F_{RX}) = \sum F_x$

F_{Rx}=-60 lb = 60 lb ←

+↑ $\sum(F_{Ry}) = \sum F_y$

F_{Ry}=-10 -20 =-30 lb

= 30 lb ↓

$F_R = \sqrt{60^2 + 30^2} = 67.1$ lb

The direction of angle θ,

$\theta = \tan^{-1}\left(\frac{30}{60}\right) = 20.57^0$

Moment summation :-

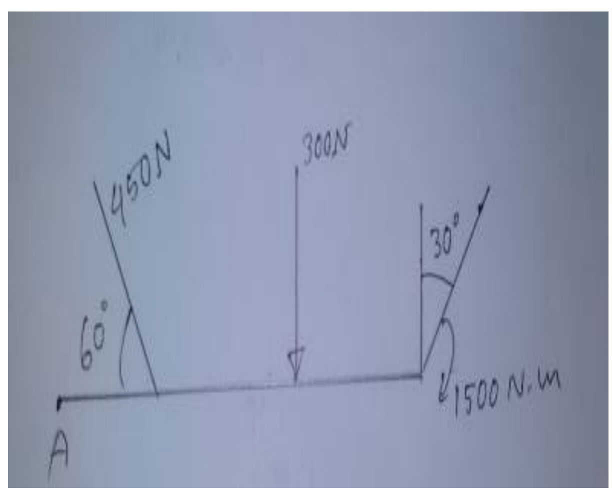
↺ + $(M_R)_B = \sum M_B$

- $60d = 60 \times 12 - 10 \times 4.5 - 20 \times 9$

∴ d = 8.25 (***Ans***)

Problem No : 4.117 & 4.118

<u>Answer:</u>



For the point A,

$\overset{+}{\rightarrow}$ $F_{Rx} = \sum F_x$;

$F_{Rx} = 450\cos60^0 - 700\sin30^0$

= -125N =125N←

+↑ $F_{Ry} = -450\sin60^0 - 700\cos30^0 - 300$

$=-1296N = 1296N\downarrow$

$F = \sqrt{(-125)^2 + (-1296)^2} = 1302N$

$\theta = \tan^{-1}\left(\frac{1296}{125}\right) = 84.5$

$\circlearrowleft + M_{RA} = \sum M_A;$

$1296(x) = 450 \sin 60^0 (2) + 300(6) + 700\cos30^0 (9) + 1500$

$\therefore X = 7.36m$

For the point B,

$\xrightarrow{+} F_{Rx} = \sum F_x;$

$F_{Rx} = 450\cos60^0 - 700\sin30^0$

$= -125N = 125N\leftarrow$

$+\uparrow F_{Ry} = -450\sin60^0 - 700\cos30^0 - 300$

$=-1296N = 1296N\downarrow$

$F = \sqrt{(-125)^2 + (-1296)^2} = 1302N$

$\theta = \tan^{-1}\left(\frac{1296}{125}\right) = 84.5^0$

$\circlearrowleft + M_{RB} = \sum M_B;$

$1296(x) = -450 \sin 60^0 (4) + 700\cos30^0 (3) + 1500$

$\therefore X = 1.36m$

Problem No : 4.120

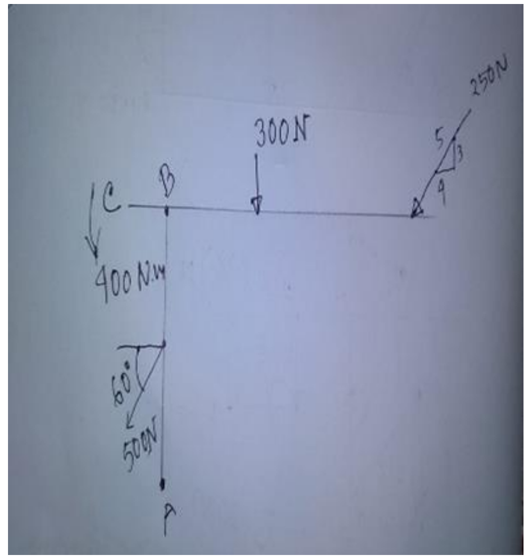
Answer:

Force summation

$\xrightarrow{+} F_{Rx} = \sum F_x;$

F_{Rx}= -500cos60^0 -250 $\left(\frac{4}{5}\right)$

= -450N



=450N←

+↑ F_{Ry} == $\sum F_y$;

$(F_R)_y$= -500sin60^0 -300- 250 $\left(\frac{3}{5}\right)$

= -883.01 N

=883.01N↓

∴ $\mathbf{F}_R$ = $\sqrt{(450)^2 + (883.01)^2}$

= 991.06N

The angle θ is,

θ = $\tan^{-1}\left(\frac{883.01}{450}\right)$

=63

↻ +MA = 500cos60^0 (3) +400-300 x 2 -250 $\left(\frac{3}{5}\right)$(5) + 250$\left(\frac{4}{5}\right)$ (5)

=300 N.m

F_{Rx} d = $\sum M_A$

- d= $\frac{800}{450}$

∴d =1.78 m (***Ans***)

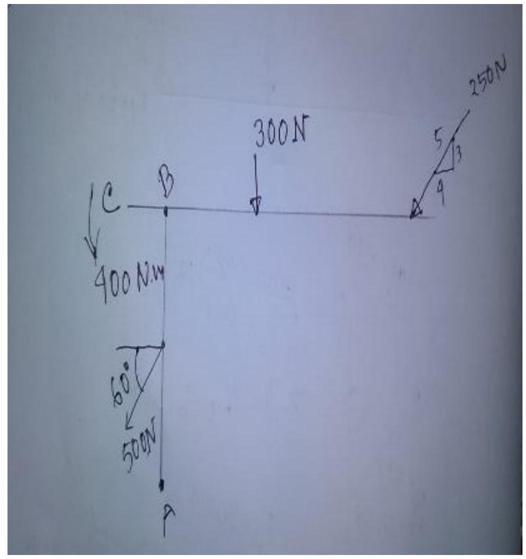
Problem No : 4.121

<u>Answer:</u>

Force summation

$\overset{+}{\rightarrow}$ F_{Rx} = $\sum F_x$;

F_{Rx}= -500cos60^0 -250 $\left(\frac{4}{5}\right)$



= -450N

=450N←

+↑ F_{Ry} == ∑F_y ;

$(F_R)_y$= -500sin60^0 -300- 250 $\left(\frac{3}{5}\right)$

= -883.01 N

=883.01N↓

∴ $\mathbf{F}_R = \sqrt{(450)^2 + (883.01)^2}$

= 991.06N

The angle θ is,

θ = $\tan^{-1}\left(\frac{883.01}{450}\right)$

=63

↻+ ∑M_C = 400 -500cos60(2)-500sin60(1) -300 (3) -250 (6)$\left(\frac{3}{5}\right)$

= -2333.01 N.m

F_{Ry} d =∑M_C

- ➢ d= $\frac{2333.01}{833.01}$

∴d =2.64 m (***Ans***)

Problem No : 4.124

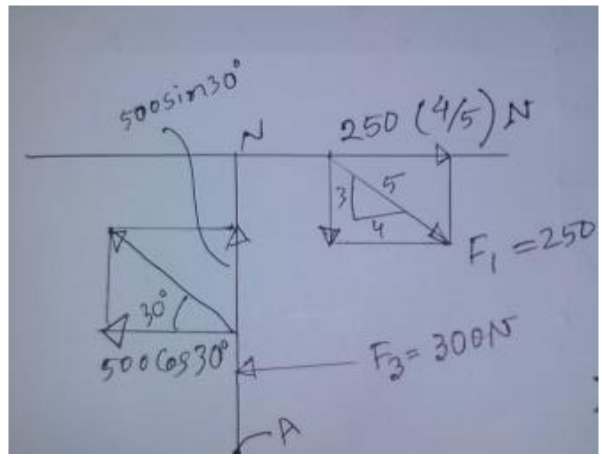
<u>Answer:</u>

Equivalent Resultant Force: Forces F_1 and F_2 are resolved into their x and y components. Summing these force components algebraically along the x and y axes,

$\xrightarrow{+}$ $F_{Rx} = \sum F_x$;

$F_{Rx}=250\left(\frac{4}{5}\right)-500\cos 30^0 -300 = -533.01N = 533.01\leftarrow$

$+\uparrow F_{Ry} == \sum F_y$; $(F_R)_y=500\sin 30^0 -250\left(\frac{3}{5}\right) = 100N\downarrow$



The magnitude of the resultant force F_R is given by

$F_R = \sqrt{(533.01)^2 + (100)^2} = 542N$

The angle θ of F_R is

$\theta = \tan^{-1}\left[\frac{(FR)y}{(FR)y}\right] = \tan^{-1}\left[\frac{100}{533.01}\right]$

= 10.63

Location of the Resultant Force: Applying the principle of moments and summing the moments of the force components algebraically about point A,

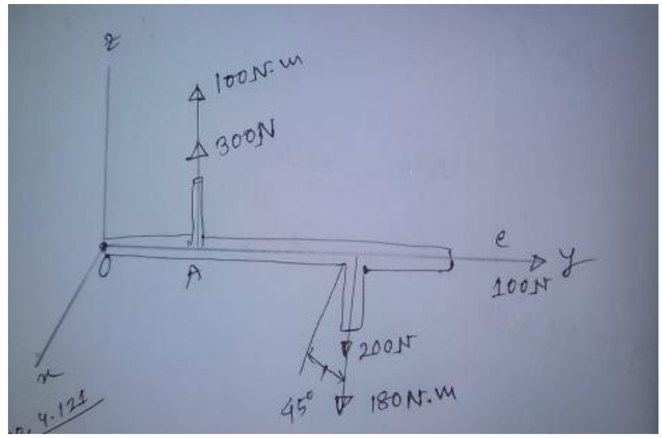
$\curvearrowleft + M_{RA} = \sum M_A$;

- 533.01(d) = $500\cos 30^0$ (2)- $500\sin 30^0$ (0.2)-$250\left(\frac{3}{5}\right)$(0.5)-$250\left(\frac{4}{3}\right)$(3)
  + 300(1)
- d= 0.8274m=827mm.(***Ans***)

Problem No : 4.134

<u>Answer:</u>

Force and moment vectors:



$\mathbf{F_1}$ = {300k}N

$\mathbf{F_3}$ = {100j}N

F_2 = 200{cos45^{0}i –sin45^{0}k}N

={141.42i – 141.42k}N

M_1 = {100k}N.m

M_2= 180 {cos45^{0}i – sin45^{0}k}N.m

={ 127.28i -127.28k}N.m

Equivalent force and couplt moment at point O :

$F_R = \sum F$;

$F_R = F_1+F_2+F_3$

=141.42i+100.0j+(300-141.42)k

={141i + 100j +159k}N

The position vectors are r1 = {0.5j}m and r2 = {1.1j}m.

$M_{Ro} = \sum M_o$;

$M_{Ro} = r_1 \times F_1 + r_2 \times F_2 + M_1 + M_2$

$$= \begin{vmatrix} i & j & k \\ 0 & 0.5 & 0 \\ 0 & 0 & 300 \end{vmatrix} + \begin{vmatrix} i & j & k \\ 0 & 1.1 & 0 \\ 141.42 & 0 & -141.42 \end{vmatrix}$$

= {122i -183k} N.m (***Ans***)

-------------------------------------The End-------------------------------------