M R
Ahmed Mahdy

فيزياء	استاتيكا
دوائر كهربية	الكـــترونيات
ميكانيكا الانشائات	هيدروليكا

مدرس خصوصي

اونلاين حضوري

يحصل الطالب علي

- مقاطع فيديوهات لشرح المقرر بشكل وافي
- ملخص للمادة Pdf للمذكرة والمراجعة
- محاضرات مباشرة علي برنامج زووم
- لمناقشة الأجزاء الغير مفهومة
- تواصل مستمر مع معلم المادة

للتواصل

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Questions : (5 Marks)

1-

a- Convert a torque value of 31.86 N.m in to US units.

$M = 31.86\ N.m = 31.86 * \left(\frac{lb}{4.448}\right) * \left(\frac{ft}{0.3048}\right)$

$= 23.5\ lb\text{-}ft$

b- Evaluate and express with SI units having an appropriate prefix the $45MN^3/900Gg$

$45MN^3/900Gg$

$45 * 10^{18} N^3 / 900 * 10^9 g$

$= 50 * 10^6 N^3/g = 50 * 10^6 \frac{N^3}{g}$

$= 50 * 10^6 \frac{N^3}{10^{-3} kg} = 50 * 10^9 \frac{N^3}{kg} = 50\ kN^3/kg$

$kN \rightarrow 10^3 N$

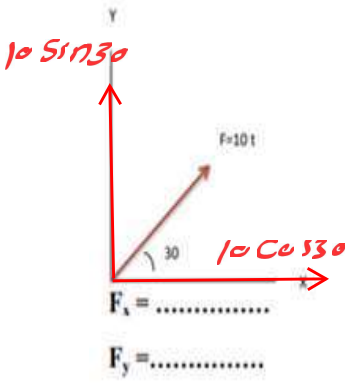
$kN^3 = 10^9 N^3$

c- By definition show the difference between the Vector and Scalar.

* vector quantaty has a direction and magnitude

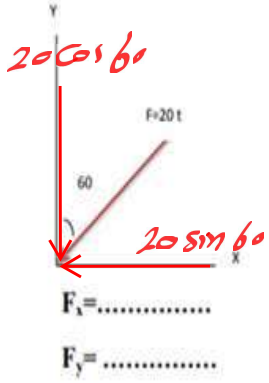
* scalar quantaty has magnitude only

d- Resolve the force given in the following figures along the line X and Y?



$f_x = 10\cos 30 = 8.66\ t$

$f_y = 10\sin 30 = 5\ t$

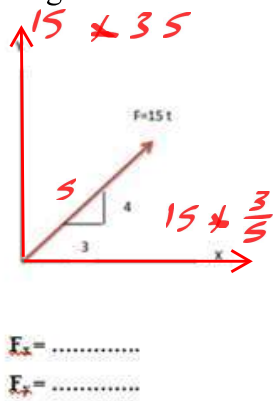


$f_x = -20\sin 60$

$= -17.32\ t$

$f_y = -20\cos 60$

$= -10\ t$

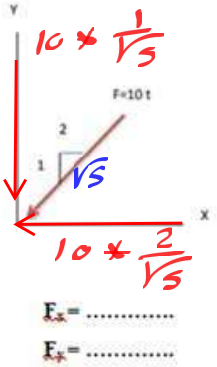


$f_x = 15 * \frac{3}{5}$

$= 9\ t$

$f_y = 15 * \frac{4}{5}$

$= 12\ t$



$f_x = -10 * \frac{2}{\sqrt{5}}$

$= -4\sqrt{5}$

$f_y = -10 * \frac{1}{\sqrt{5}}$

$= -2\sqrt{5}$

2- Four forces act on bolt A as shown. Determine the resultant of the forces on the bolt.

$\Sigma F_x = 150\cos30 + 100\cos15 - 80\sin20$

$= 199.13\ N$

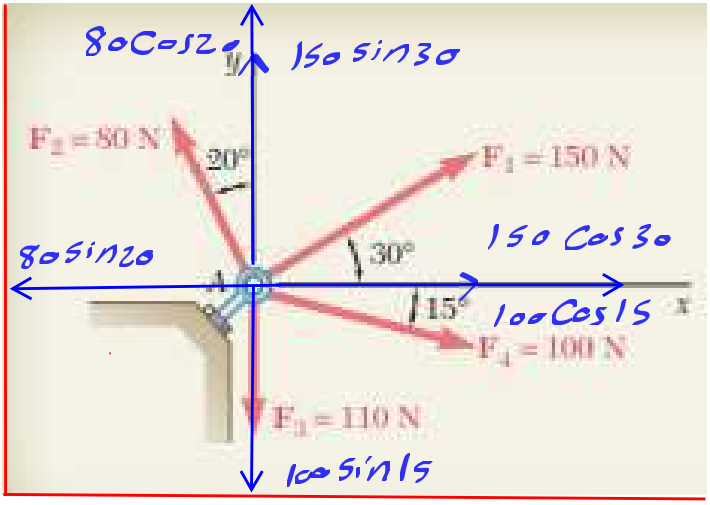
$\Sigma F_y = 150\sin30 + 80\cos20 - 100\sin15 - 110$

$= 14.29\ N$

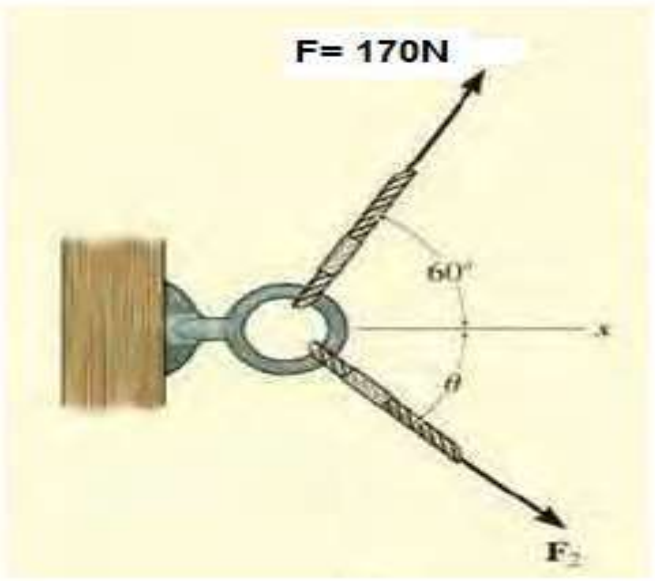
$R = \sqrt{x^2 + y^2} = \sqrt{(199.13)^2 + (14.92)^2}$

$R = 199.688\ N$

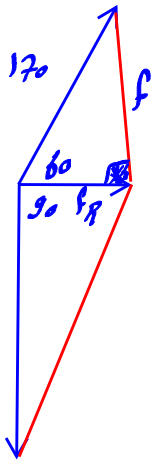
$\theta = \tan^{-1}\left(\frac{y}{x}\right) = 4.1°$



3- It is required that the resultant force acting on the eyebolt in figure below be directed along the positive x axis and that F_2 have a minimum magnitude. Determine this magnitude, the angle θ and the corresponding resultant force.



for minimum value of $f_2 \Rightarrow \theta = 90°$



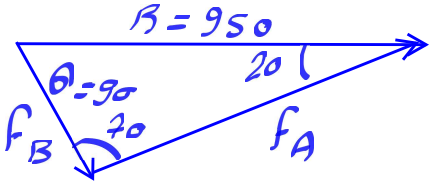
$\frac{170}{\sin90} = \frac{f}{\sin60} = \frac{f_R}{\sin30}$

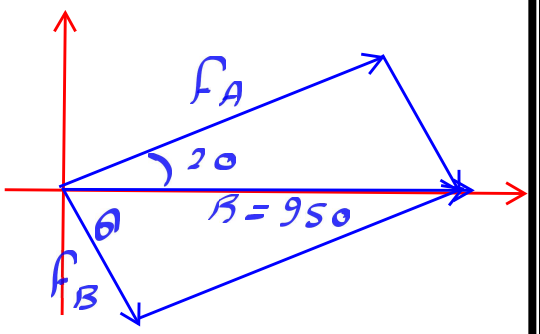
$f = 170\sin60 = 147.23\ N$

$f_R = 170\cos60 = 85\ N$

4- A truck is to be towed using two ropes. If the resultant force is to be 950 N, directed along the positive x axis, determine the magnitudes of forces F_A and F_B acting on each rope and the angle θ of F_B so that the magnitude of F_B is a minimum , F_A acts at 20 from the x axis.

for minimum value $f_B \Rightarrow \theta = 90$





$$\frac{950}{\sin 70} = \frac{f_A}{\sin 90} = \frac{f_B}{\sin 20}$$

$$f_A = 950 * \frac{\sin 90}{\sin 70} = 1010.97\,N \qquad f_B = 950 * \frac{\sin 20}{\sin 70} = 345.77\,N$$

5- Determine the moment of each of the three forces about point B.

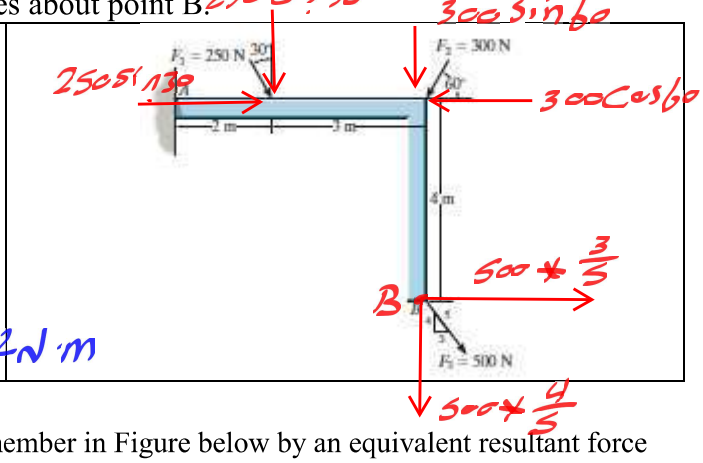
$M_1 = -250\sin 30 * 4 + 250\cos 30 * 3$

$M_1 = 149.52$

$M_2 = 300\cos 60 * 4 = 600\,N.m$

$M_3 = 0$

$\Sigma M = +149.52 + 600 = 749.52\,N.m$



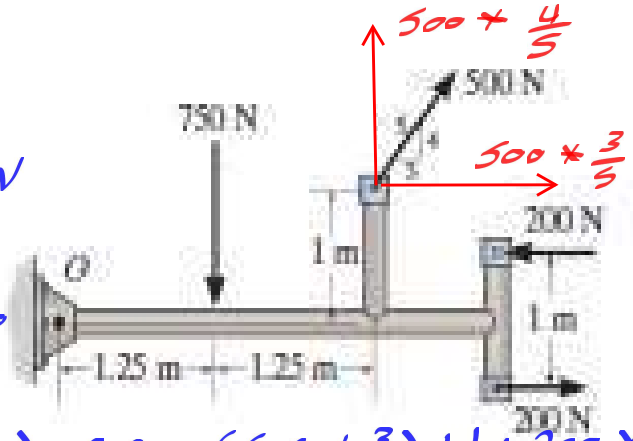
6- Replace the force and couple system acting on the member in Figure below by an equivalent resultant force and couple moment acting at point *O*.

$\Sigma f_x = 500 * \frac{3}{5} = 300\,N$

$\Sigma f_y = -750 + 500 * \frac{4}{5} = -350\,N$

$R = \sqrt{300^2 + (-350)^2} = 461\,N$

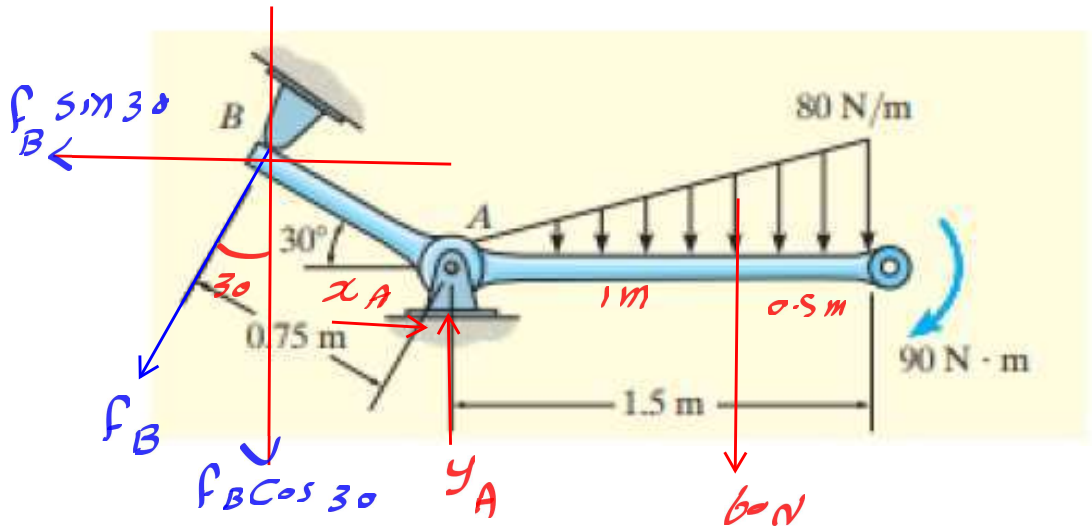
$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{-350}{300}\right) = -49.4°$



$\Sigma M_o = -750 * 1.25 + (500 * \frac{4}{5}) * 2.5 - (500 * \frac{3}{5}) * 1 + 200 * 1$

$= -37.5\,m.t \circlearrowleft = +37.5\,m.t \circlearrowright$

7- The member shown in Fig below is pin connected at A and rests against a smooth support at B. Determine the horizontal and vertical components of reaction at the pin A.

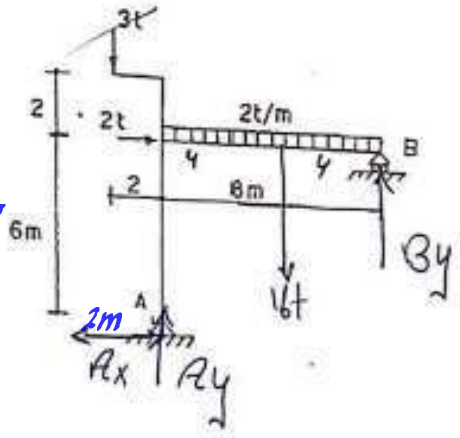


$$\Sigma M_A = f_B * 0.75 - 60 * 1 - 90 = 0 \Rightarrow f_B = 200\ N$$

$$\Sigma f_x = -f_B \sin 30 + x_A = 0 \Rightarrow x_A = 200 \sin 30 = 100\ N$$

$$\Sigma f_y = -f_B \cos 30 + y_A - 60 = 0 \Rightarrow y_A = 233.21\ N$$

8- Determine the reaction for the frame as shown, draw the (FBD)



$$\Sigma f_x = -x_A + 2 = 0$$

$$x_A = 2\ t \leftarrow$$

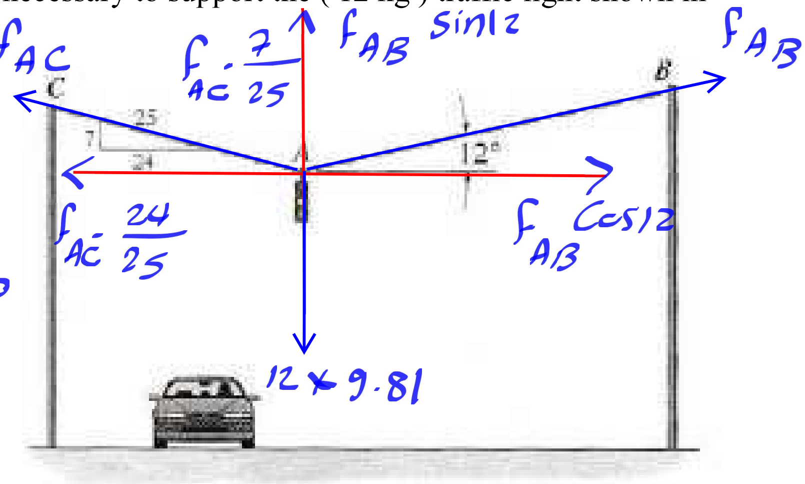
$$\Sigma M_A = 3 * 2 - 2 * 6 - 16 * 4 + B_y * 8 = 0$$

$$B_y = 8.75\ t \uparrow$$

$$\Sigma f_y = -3 + A_y - 16 + 8.75 = 0$$

$$A_y = 10.25\ t \uparrow$$

9- Determine the force in cables AB and AC necessary to support the (12 kg) traffic light shown in figure.



$\Sigma F_x = F_{AB} \cos 12 - F_{AC} \cdot \frac{24}{25} = 0 \rightarrow (1)$

$\Sigma F_y = F_{AB} \sin 12 + F_{AC} \frac{7}{25} - 12 * 9.81 = 0$

$F_{AB} \sin 12 + F_{AC} \frac{7}{25} = 12 * 9.81$

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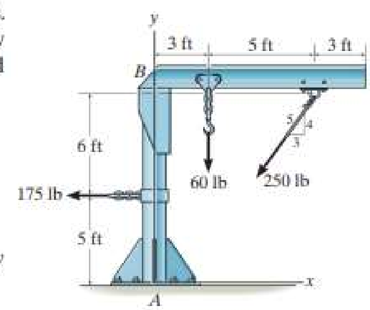
$F_{AB} = 238.7\ N$, $F_{AC} = 243.2\ N$

10- The jib crane shown in Figure is subjected to three coplanar forces. Replace this loading by an equivalent resultant force and specify where the resultant's line of action intersects the column *AB* and boom *BC*.

EXAMPLE 4.18

The jib crane shown in Fig. 4–45a is subjected to three coplanar forces. Replace this loading by an equivalent resultant force and specify where the resultant's line of action intersects the column *AB* and boom *BC*.



(a)

SOLUTION

Force Summation. Resolving the 250-lb force into x and y components and summing the force components yields

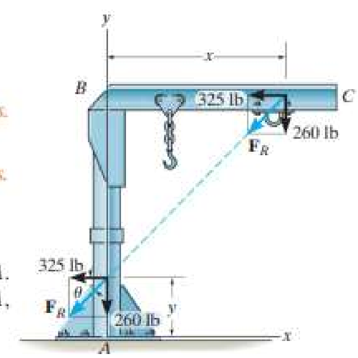
$$\xrightarrow{+} (F_R)_x = \Sigma F_x; \quad (F_R)_x = -250\text{ lb}\left(\tfrac{3}{5}\right) - 175\text{ lb} = -325\text{ lb} = 325\text{ lb} \leftarrow$$

$$+\uparrow (F_R)_y = \Sigma F_y; \quad (F_R)_y = -250\text{ lb}\left(\tfrac{4}{5}\right) - 60\text{ lb} = -260\text{ lb} = 260\text{ lb}\downarrow$$

As shown by the vector addition in Fig. 4–45b,

$$F_R = \sqrt{(325\text{ lb})^2 + (260\text{ lb})^2} = 416\text{ lb} \qquad \text{Ans.}$$

$$\theta = \tan^{-1}\left(\frac{260\text{ lb}}{325\text{ lb}}\right) = 38.7° \qquad \text{Ans.}$$



(b)

Fig. 4–45

Moment Summation. Moments will be summed about point A. Assuming the line of action of $\mathbf{F}_R$ *intersects AB* at a distance y from A, Fig. 4–45b, we have

$$\circlearrowleft + (M_R)_A = \Sigma M_A; \qquad 325\text{ lb}\,(y) + 260\text{ lb}\,(0)$$

$$= 175\text{ lb}\,(5\text{ ft}) - 60\text{ lb}\,(3\text{ ft}) + 250\text{ lb}\left(\tfrac{3}{5}\right)(11\text{ ft}) - 250\text{ lb}\left(\tfrac{4}{5}\right)(8\text{ ft})$$

$$y = 2.29\text{ ft} \qquad \text{Ans.}$$

By the principle of transmissibility, $\mathbf{F}_R$ can be placed at a distance x where it intersects BC, Fig. 4–45b. In this case we have

$$\circlearrowleft + (M_R)_A = \Sigma M_A; \qquad 325\text{ lb}\,(11\text{ ft}) - 260\text{ lb}\,(x)$$

$$= 175\text{ lb}\,(5\text{ ft}) - 60\text{ lb}\,(3\text{ ft}) + 250\text{ lb}\left(\tfrac{3}{5}\right)(11\text{ ft}) - 250\text{ lb}\left(\tfrac{4}{5}\right)(8\text{ ft})$$

$$x = 10.9\text{ ft} \qquad \text{Ans.}$$