

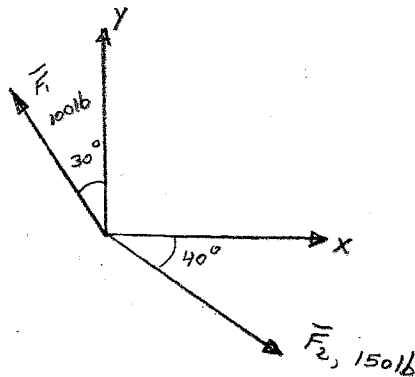
## ENGR 2050

Fall 2009

Test #1

Two forces,  $F_1$  and  $F_2$ , are acting as shown below.

- Determine the  $i$  and  $j$  components of the force  $F_1$ .
- Determine the  $i$  and  $j$  components of the force  $F_2$ .
- Determine the  $i$  and  $j$  components of the Resultant force for these two forces.



$$\vec{F}_1 = 100 \text{ lb} \sin 30^\circ (-\vec{i}) + 100 \text{ lb} \cos 30^\circ (\vec{j})$$

$$\vec{F}_1 = 50 \text{ lb} (-\vec{i}) + 86.6 \text{ lb} (\vec{j})$$

$$\vec{F}_2 = 150 \text{ lb} \cos 40^\circ (\vec{i}) + 150 \text{ lb} \sin 40^\circ (-\vec{j})$$

$$\vec{F}_2 = 115 (\vec{i}) + 96.4 (-\vec{j}) \quad (1b)$$

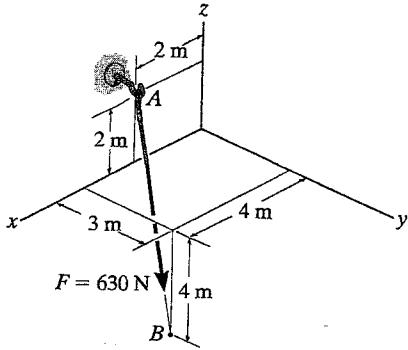
$$\vec{R} = \vec{F}_1 + \vec{F}_2$$

$$\vec{R} = (-50 + 115) \vec{i} + (86.6 - 96.4) \vec{j} \quad (1b)$$

$$\vec{R} = 65 (\vec{i}) + 9.8 (-\vec{j}) \quad (1b)$$

2. The 630-N force,  $F$ , is acting along the line AB.

- Determine the unit vector,  $\mathbf{u}_{AB}$ , that runs along the line AB in the direction of the force. Write this unit vector in Cartesian form.
- Determine the Cartesian form of the force,  $F$



coordinates pt A

$$\begin{aligned}x &= 2 \text{ m} \\y &= 0 \text{ m} \\z &= 2 \text{ m}\end{aligned}$$

coordinates of B

$$\begin{aligned}x &= 4 \text{ m} \\y &= 3 \text{ m} \\z &= -4 \text{ m}\end{aligned}$$

$$\overline{AB} = (4-2)\overline{i} + (3-0)\overline{j} + (-4-2)\overline{k} \text{ (m)}$$

$$\overline{AB} = 2\overline{i} + 3\overline{j} - 6\overline{k} \text{ (m)}$$

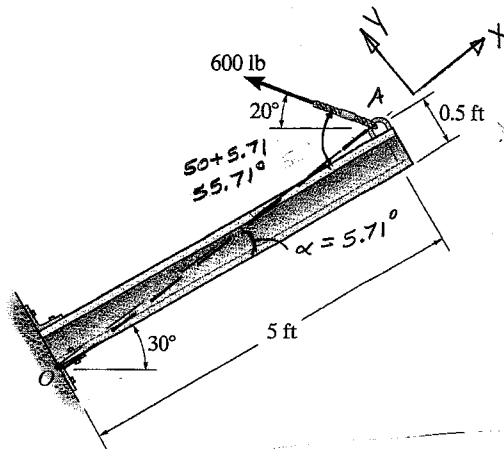
$$AB = \sqrt{(2)^2 + (3)^2 + (6)^2} = 7 \text{ m}$$

$$\overline{u}_{AB} = .286\overline{i} + .429\overline{j} - .857\overline{k}$$

$$\overline{F} = F\overline{u}_{AB} = 630 \text{ N } \overline{u}_{AB}$$

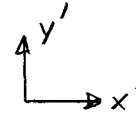
$$\overline{F} = 180\overline{i} + 270\overline{j} + 540(-\overline{k}) \text{ (N)}$$

3. Determine the moment of the force shown below about the point O. Express this moment vector in Cartesian form.



$$\tan \alpha = \frac{.5}{5} \Rightarrow \alpha = 5.71^\circ$$

$$OA = \sqrt{(5)^2 + (.5)^2} = 5.0249$$



Using the x-y coordinate system

$$\vec{M}_O = 600 \text{ lb} \sin(55.71^\circ) (5.02 \text{ ft}) (\vec{k})$$

$$\vec{M}_O = 2488 (\vec{k}) \text{ (lb ft)}$$

Using the x'-y' coordinate system

$$\vec{F}_{x'} = 600 \text{ lb} \cos 20^\circ (-\vec{i}) = 564 \text{ lb} (-\vec{i})$$

$$\vec{F}_{y'} = 600 \text{ lb} \sin 20^\circ (\vec{j}) = 205 \text{ lb} (\vec{j})$$

$$\begin{matrix} 386 \\ 4160 \end{matrix}$$

$$\vec{M}_O^{F_{x'}} = F_{x'} (5.02 \text{ ft} \sin(35.71^\circ))$$

$$= 564 \text{ lb} (2.93 \text{ ft}) (\vec{k})$$

$$\vec{M}_O^{F_{x'}} = 1652 \text{ lb ft} (\vec{k})$$

$$1410 \text{ lb ft}$$

$$\vec{M}_O^{F_{y'}} = F_{y'} (5.02 \cos 35.71^\circ)$$

$$= 205 \text{ lb} (4.08 \text{ ft})$$

$$\vec{M}_O^{F_{y'}} = 836 \text{ lb ft} (\vec{k})$$

$$888 \text{ lb ft}$$

$$\vec{M}_O = \vec{M}_O^{F_{x'}} + \vec{M}_O^{F_{y'}}$$

$$\vec{M}_O = 2488 \text{ lb ft} (\vec{k})$$

$$2298 \text{ lb ft}$$