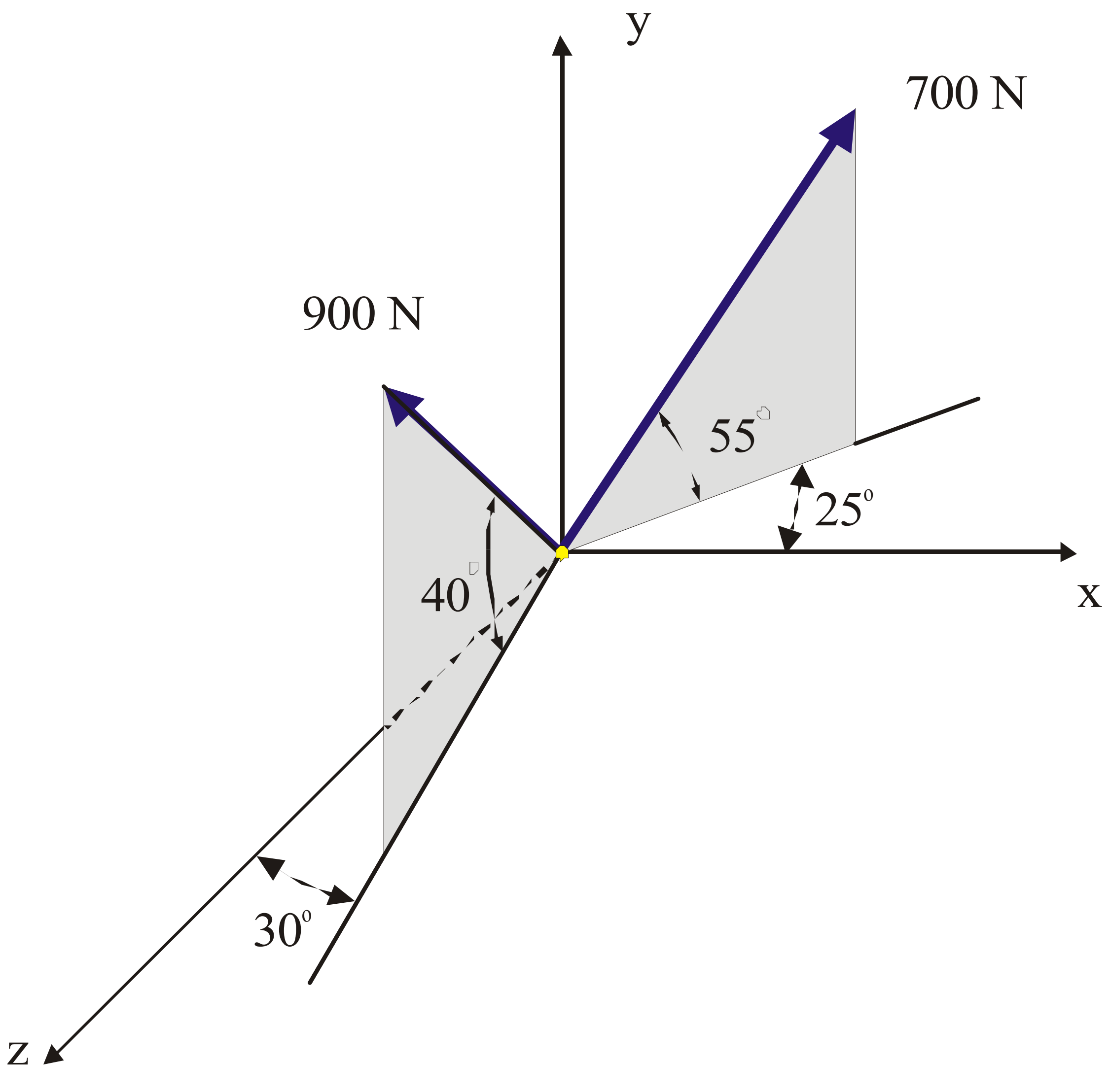
Example 5.1

J. Frye

Example 5.1:

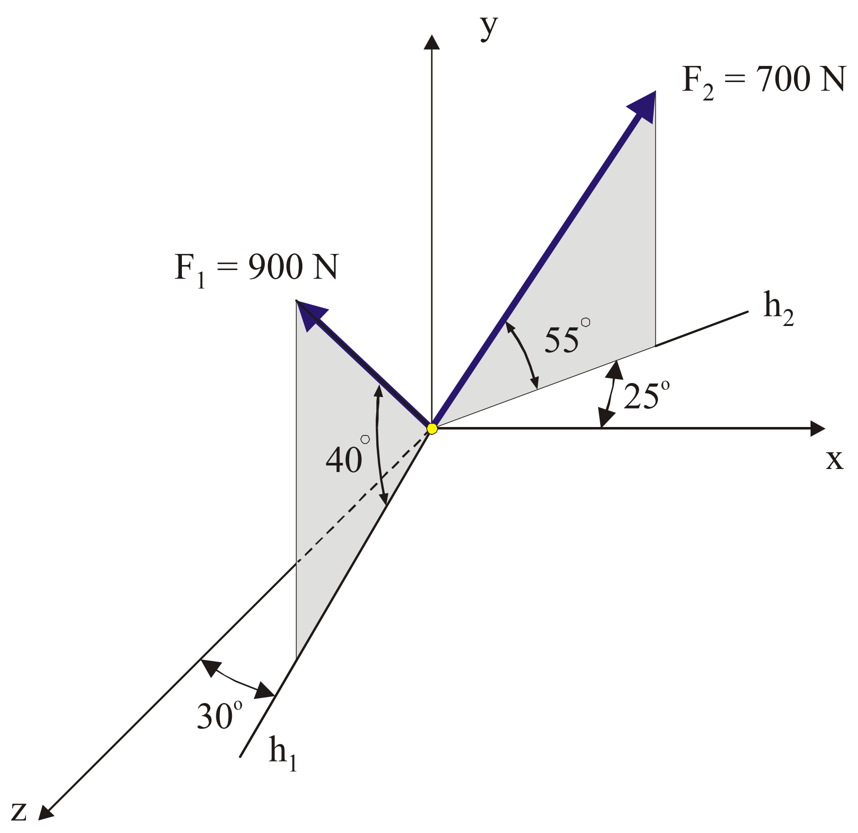
Determine the resultant of the two forces shown.



We label the 900 N force as F_1 and the 700 N force as F_2. We also label two new axes as h_1 and h_2 respectively. These new axes lie in the x-z plane.

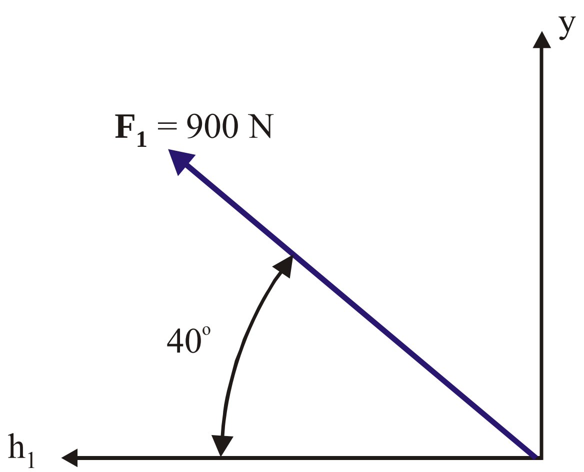
$\mathbf{R} = \mathbf{F_1} + \mathbf{F_2}$

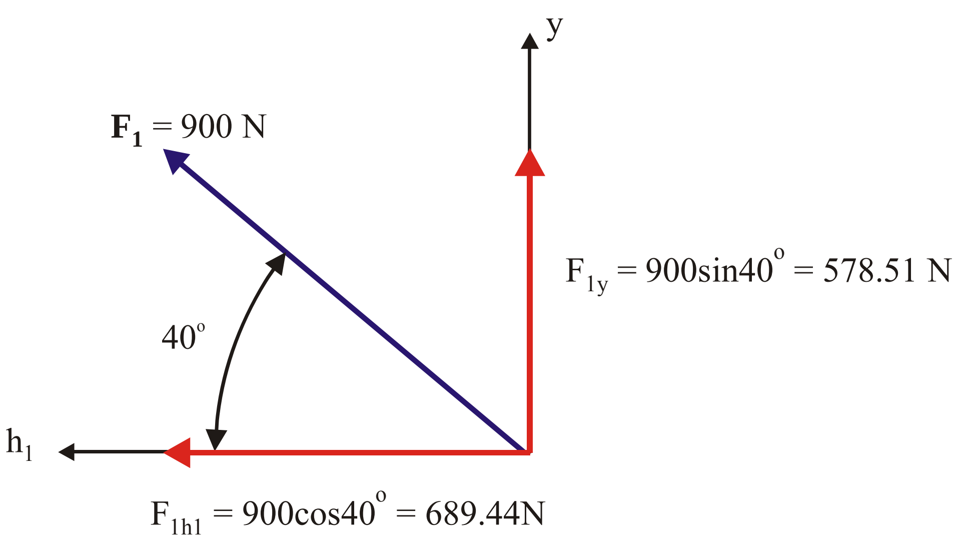
To determine R we must resolve each of the forces into its rectangular components.



F1 – Rectangular Components:

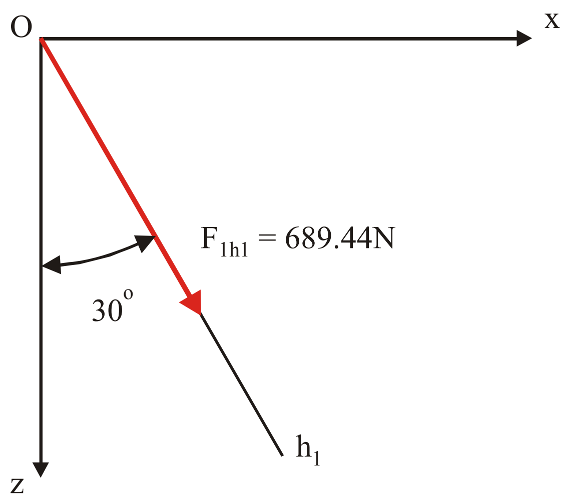
$\mathbf{F_1}$ lies in the h_1-y plane and makes an angle of 40° with the h_1 axis (50° with the y-axis). We resolve $\mathbf{F_1}$ into a component along the h_1-axis and a component along the y-axis as shown below.

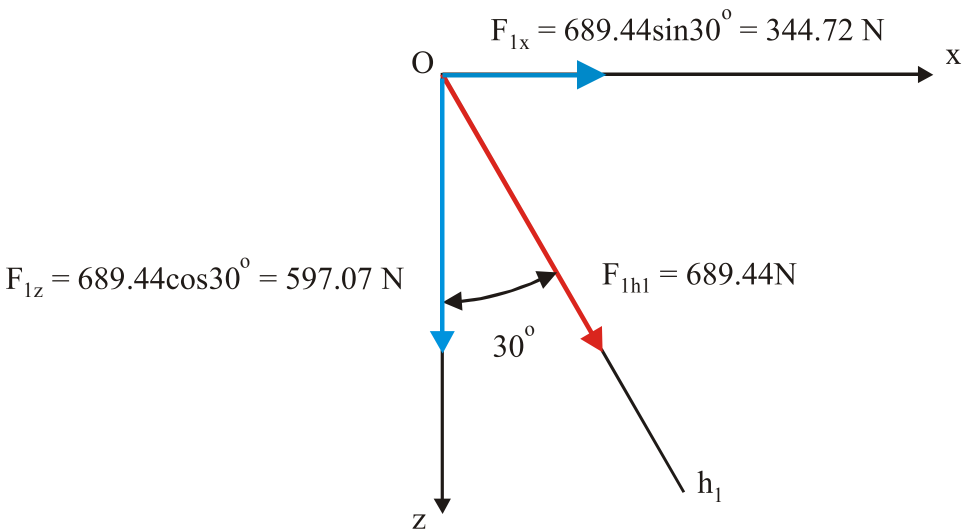




We note that the $\mathbf{F_{1h1}}$ component along the h_1-axis makes an angle of 30º to the z-axis. We now resolve $\mathbf{F_{1h1}}$ into a component along the x-axis and a component along the z-axis.

We express $\mathbf{F_1}$ in vector notation. The correct algebraic sign for each component is determined by INSPECTION.



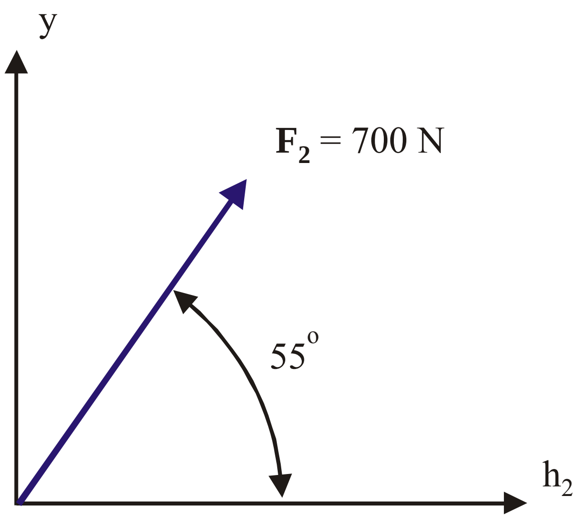


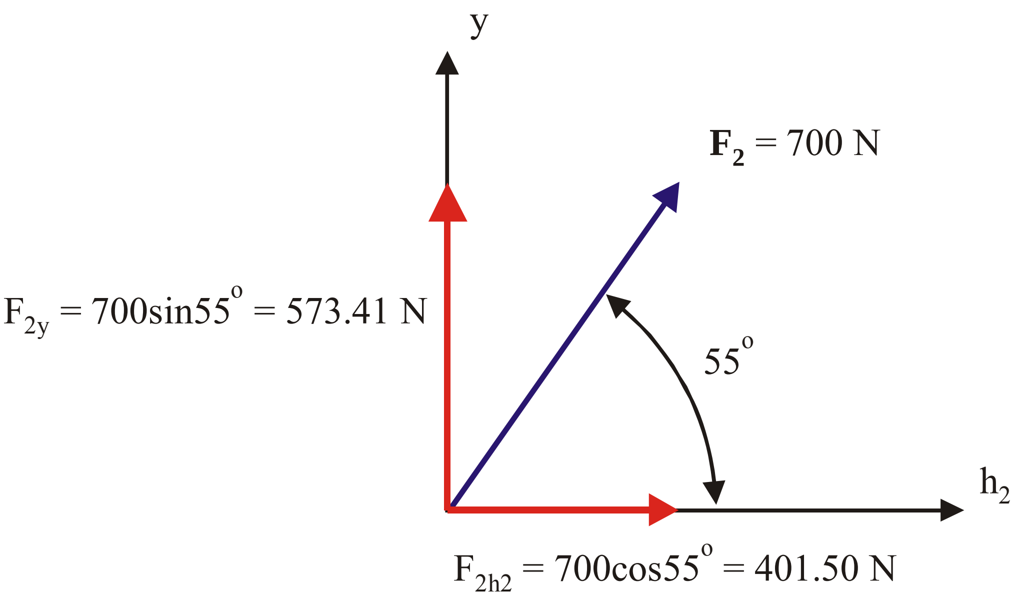
$$\mathbf{F_1} = F_{1x}\mathbf{i} + F_{1y}\mathbf{j} + F_{1z}\mathbf{k}$$

$$\mathbf{F_1} = 344.72\mathbf{i} + 578.51\mathbf{j} + 597.07\mathbf{k}$$

F2 – Rectangular Components: (We repeat the procedure for F_2)

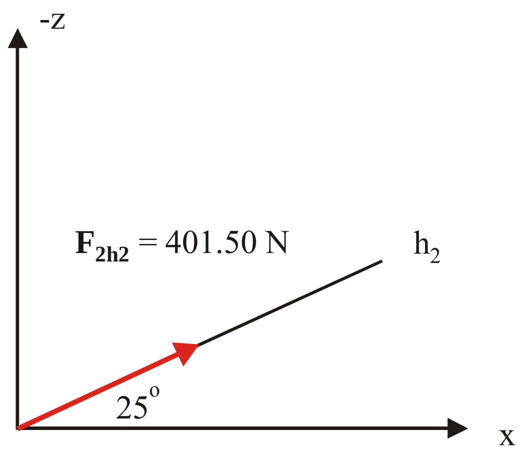
F_2 lies in the h_2-y plane and makes an angle of 55º with the h_2 axis (35º with the y-axis). We resolve **F_2** into a component along the h_2-axis and a component along the y-axis as shown below.

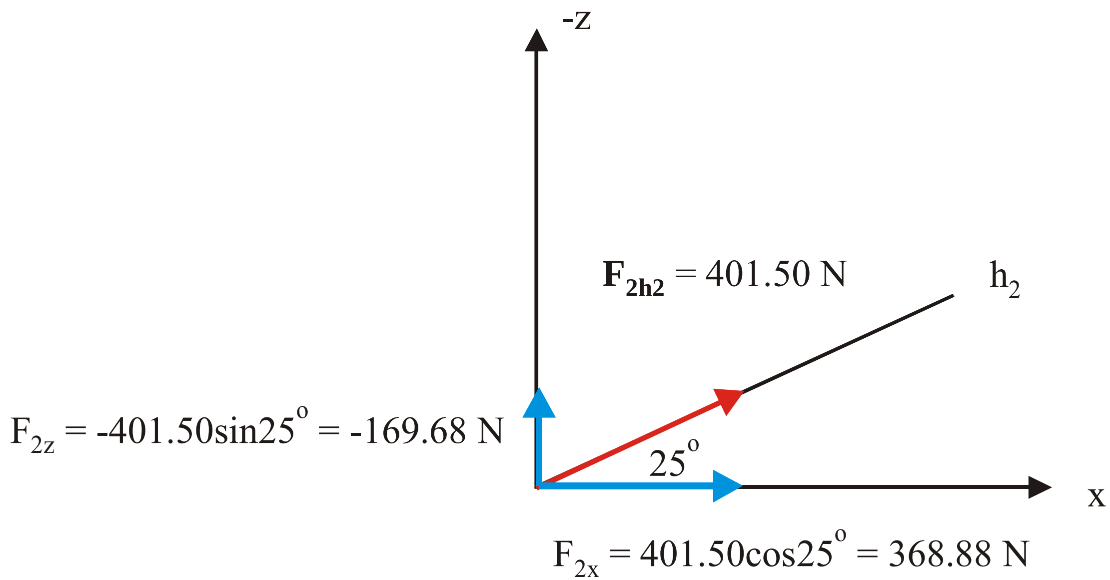




We note that the $\mathbf{F_{2h2}}$ component along the h_2-axis makes an angle of 25° to the x-axis. We now resolve $\mathbf{F_{2h2}}$ into a component along the x-axis and a component along the z-axis.

We express $\mathbf{F_2}$ in vector notation. The correct algebraic sign for each component is determined by INSPECTION. We see by inspection that the z-component will be negative.





$$\mathbf{F_2} = F_{2x}\mathbf{i} + F_{2y}\mathbf{j} + F_{2z}\mathbf{k}$$

$$\mathbf{F_2} = 363.88\mathbf{i} + 573.41\mathbf{j} - 169.68\mathbf{k}$$

Resultant, **R**:

$$\mathbf{R} = \mathbf{F_1} + \mathbf{F_2}$$

$$\mathbf{F_1} = \left(344.72\mathbf{i} + 578.51\mathbf{j} + 597.07\mathbf{k}\right)\mathrm{N}$$

$$\mathbf{F_2} = \left(363.88\mathbf{i} + 573.41\mathbf{j} - 169.68\mathbf{k}\right)\mathrm{N}$$

$$\mathbf{R} = \left(344.72\mathbf{i} + 578.51\mathbf{j} + 597.07\mathbf{k}\right) + \left(363.88\mathbf{i} + 573.41\mathbf{j} - 169.68\mathbf{k}\right)$$

$$\mathbf{R} = \left(708.6\mathbf{i} + 1151.92\mathbf{j} + 427.39\mathbf{k}\right)\mathrm{N}$$

$$\mathrm{R} = \sqrt{\left(708.6\right)^2 + \left(1151.92\right)^2 + \left(427.39\right)^2} = 1418.34\mathrm{N}$$

$$\cos\theta_x = \frac{708.6}{1418.34} \Rightarrow \theta_x = 60.03^{\circ}$$

$$\cos\theta_y = \frac{1151.92}{1418.34} \Rightarrow \theta_y = 35.69^{\circ}$$

$$\cos\theta_z = \frac{427.39}{1418.34} \Rightarrow \theta_z = 72.46^{\circ}$$