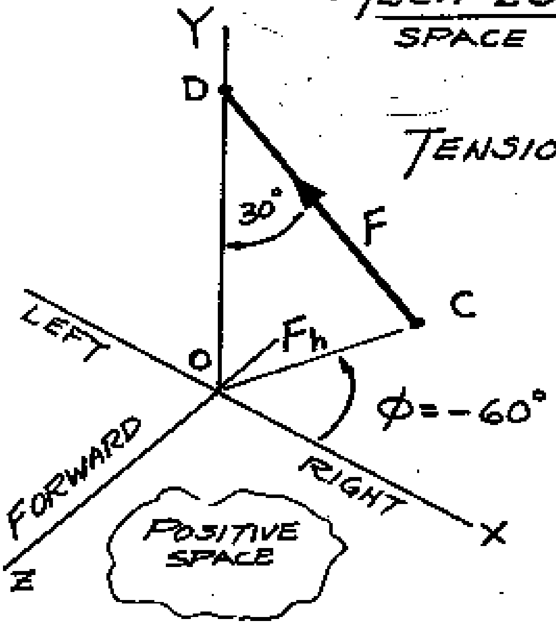
MECH 234 + 235

SPACE VECTORS

PROB. 2.78
p. 54



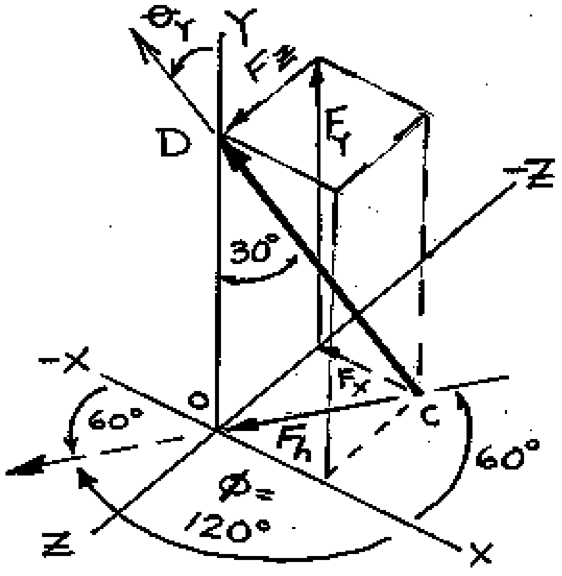
TENSION IN WIRE $\overline{CD}$

DETERMINE THE FORCE EXERTED ON C

NOTE THE DIRECTIONS OF THIS VECTOR, begin at C.

along X-axis, LEFT, $-\hat{i}$
along Y-axis, UP, $+\hat{j}$
along Z-axis, FORWARD, $+\hat{k}$

SKETCH THE BOX TO SEE THE COMPONENTS.



EXTEND THE VECTORS OF $\vec{F}$ + $\vec{F_h}$ ALONG THEIR LINE OF ACTION TO SEE ANGLES θ_Y + ϕ

OC $\perp$ OD $\therefore F_h \perp$ Y-AXIS

$F_h = F \sin\theta_Y = F \sin 30°$

$F_X = F_h \cos 60° \, (-\hat{i})$ LEFT

$F_Z = F_h \sin 60° \, (+\hat{k})$ FORWARD

GIVEN $F_X = -20\hat{i}$

$$F_X = -20 = F_h \cos 60° \quad \therefore F_h = \frac{-20}{\cos 60°} = -40 \;?$$

If you used $\phi = 120°$, then $F_h = \dfrac{-20}{\cos 120°} = \boxed{40^{lb.} = F_h}$

So $F_Z = F_h \sin\phi = 40^{lb.} \sin 120° = 34.64^{lb.}$

Since $F_h = F \sin\theta_Y$, $F = \dfrac{F_h}{\sin\theta_Y} = \dfrac{40^{lb.}}{\sin 30°} = \boxed{80^{lb.} = F}$

Then $F_Y = F\cos\theta_Y = 80 \cos 30° = 69.28^{lb.}$

$F_X = -20\hat{i}$ $\qquad \theta_X = \cos^{-1}\left[{-20}/{80}\right] = 104.5°$

$F_Y = 69.3\hat{j}$ $\qquad \theta_Y = \cos^{-1}\left[{69.3}/{80}\right] = 29.97° \approx 30°$

$F_Z = 34.6\hat{k}$ $\qquad \theta_Z = \cos^{-1}\left[{34.6}/{80}\right] = 64.4°$