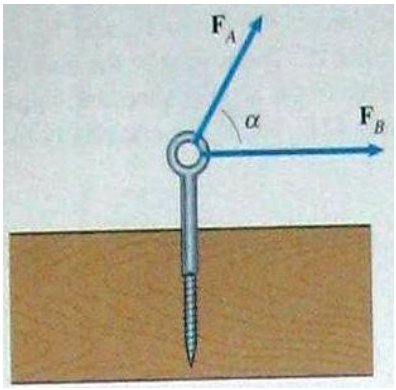
Week 1 Problem Set: Vectors

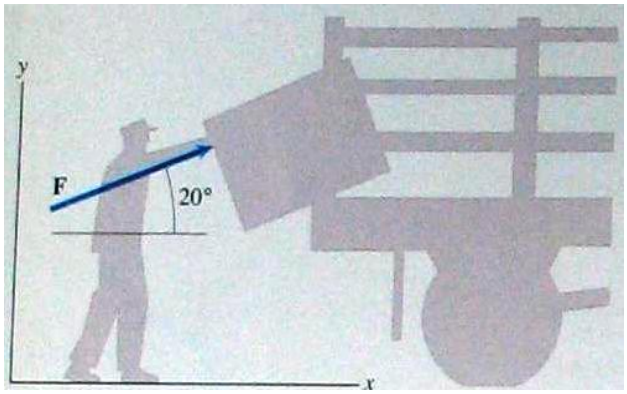
2.4. The magnitudes |FA| = 60 N and |FB| = 80 N. The angle α = 45°. Determine the magnitude of the force $\underline{F} = 2\underline{F}_A - 3\underline{F}_B$ and the angle between $\underline{F}_B$ and $\underline{F}$.

Answers: |F| = 176.8N, α = 151.3°



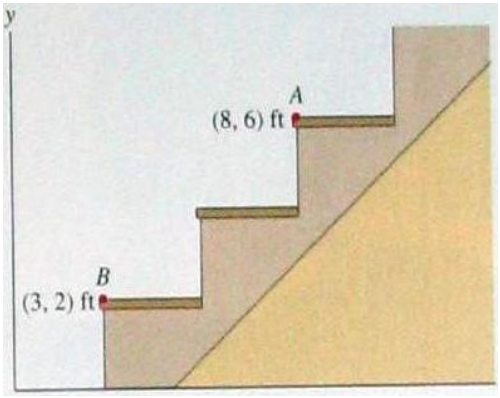
2.28. A person exerts a 60 N force $\underline{F}$ to push a crate onto a truck. Express $\underline{F}$ in terms of scalar components.

Answer: $\underline{F}$ = 56.4î + 20.5ĵ N



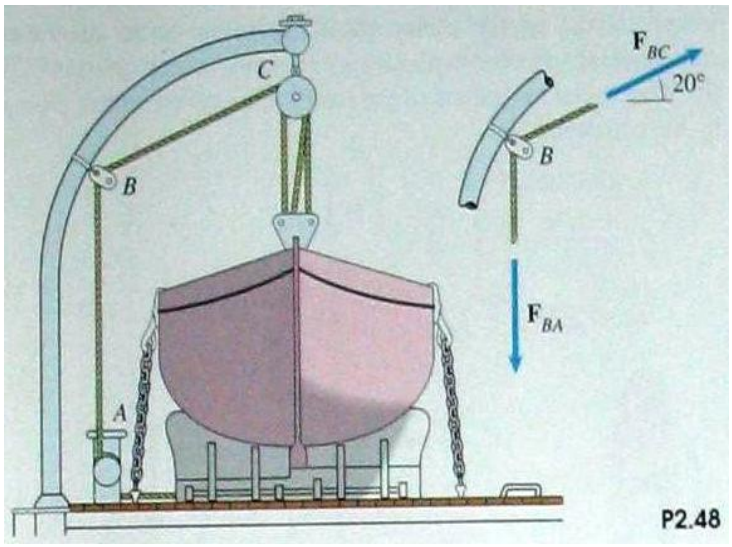
2.40. The coordinates of two points *A* and *B* are shown. Determine a unit vector ê that points from *A* to point *B*.

Answer: ê = -0.781 î – 0.625 ĵ



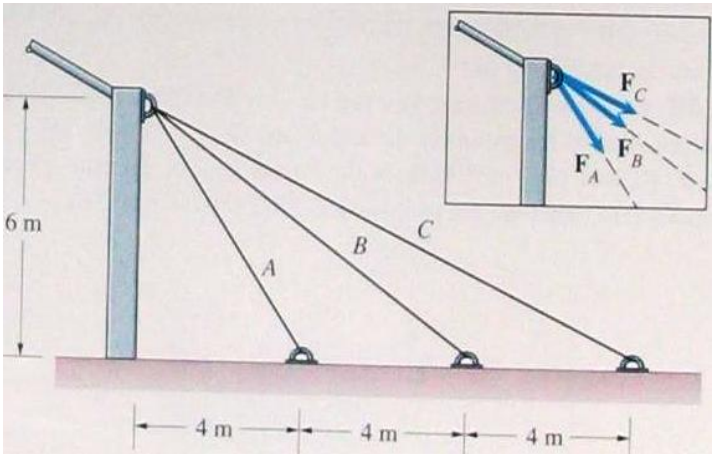
2.48. The rope *ABC* exerts forces $\underline{F}_{BA}$ and $\underline{F}_{BC}$ on the block at *B*. Their magnitudes are $|\underline{F}_{BA}| = |\underline{F}_{BC}| = 800$ N. Determine the magnitude of the vector sum of the forces by resolving the forces into components.

Answer: $|\underline{F}_{BA} + \underline{F}_{BC}| = 918$ *N.*



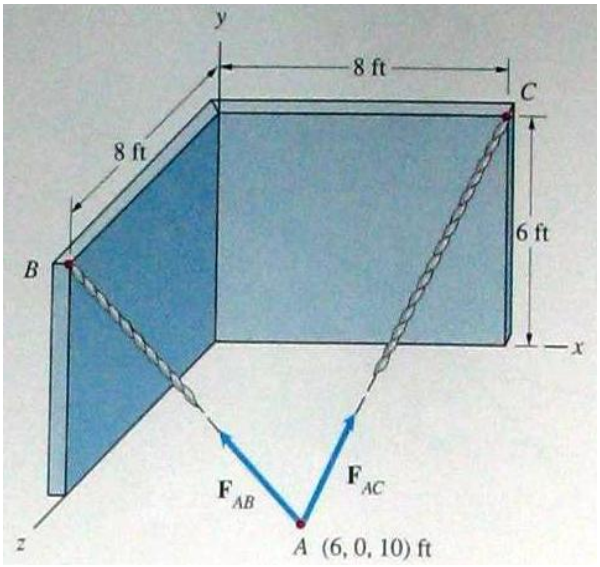
2.58. The cables A, B, and C help support a pillar that forms part of the supports of a structure. The magnitudes of the forces exerted by the cables are equal: $|\underline{F}_A| = |\underline{F}_B| = |\underline{F}_C|$. The magnitude of the vector some of the three forces is 200 kN. What is $|\underline{F}_A|$?

Answer: $|\underline{F}_A| = 68.2$ *kN.*



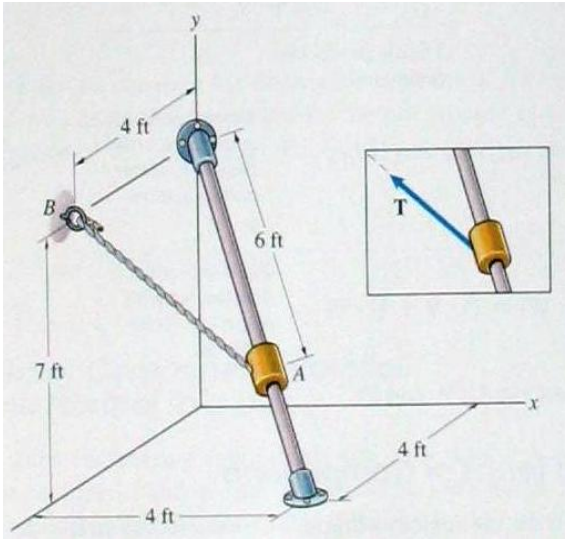
2.96. Cable *AB* exerts a 200-N force $\underline{F}_{AB}$ at point A that is directed along the line from *A* to *B*. The cable *AC* exerts a 100-N force F_{AC} at point A that is directed along the line from *A* to *C*. Determine the magnitude of the total force exerted at point *A* by the two cables.

Answer: 259 N.



2.100. Cable *AB* exerts a 32-N force T on the collar at *A*. Express T in terms of scalar components.

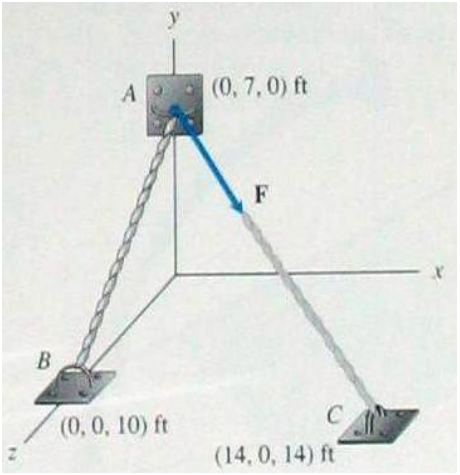
Answer: $\underline{T} = -15.4\,\hat{\imath} + 27.0\,\hat{\jmath} + 7.7\,\hat{k}$ *N.*



2.118. Cables extend from *A* to *B* and from *A* to *C*. The cable *AC* exerts a 1000 N force F at *A*.

a) What is the angle between the cables AB and AC?
b) Determine the vector component of F parallel to the cable *AB*.

Answers: a) 42.5°; b) $-423\hat{\jmath} + 604\,\hat{k}$ *N*



2.130. What is the cross product of the position vector $\underline{r} = 2\hat{\imath} + 2\hat{\jmath} + 2\hat{k}$ (m) and the force $\underline{r} = 20\hat{\imath} - 40\hat{k}$ (N)?

Answer: $\underline{r} \times \underline{F} = -80\hat{\imath} + 120\,\hat{\jmath} - 40\hat{k}$ *(Nm)*

2.132. Consider the vectors $\underline{U} = 6\hat{\imath} - 2\,\hat{\jmath} - 3\hat{k}$ and $\underline{V} = -12\hat{\imath} + 4\,\hat{\jmath} + 6\hat{k}$.

a) Determine the cross product U x V.
b) What can you conclude about U and V from the result of a)?
Answer: $\underline{U}$ x $\underline{V}$ *= 0.*

2.146. Consider vectors $\underline{U} = 6\hat{\imath} + 2\,\hat{\jmath} - 4\hat{k}$, $\underline{V} = 2\hat{\imath} + 7\,\hat{\jmath}$, $\underline{W} = 2\hat{\imath} + 6\,\hat{\jmath} - 4\hat{k}$.

a) Determine the value of the mixed triple product $\underline{U} \cdot (\underline{V} \times \underline{W})$ by first evaluating the cross product $\underline{V} \times \underline{W}$ and then taking the dot product of the result with the vector $\underline{U}$.
b) Determine the value of the mixed triple product $\underline{U} \cdot (\underline{V} \times \underline{W})$ by using the determinant equation.
Answer: $\underline{U} \cdot (\underline{V} \times \underline{W})$ *= -4*