King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

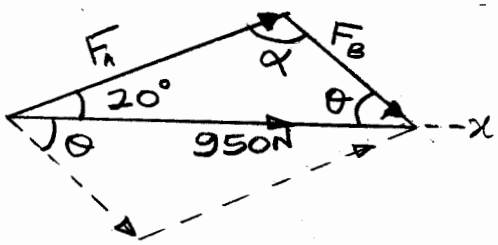
CE 201 STATICS (Sections 1 & 2)

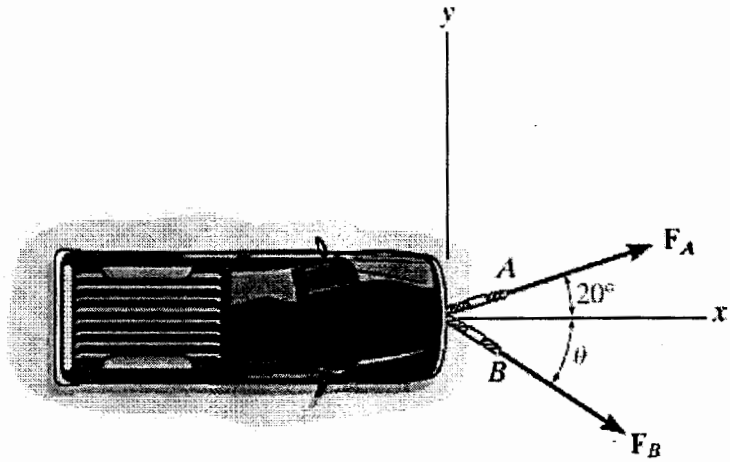
Second Semester 1432 / 2011 (102)

Name: Key #1	Quiz # 1	Score ___ / 10
ID #: ___		

The 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 $\mathbf{F}_A$ and $\mathbf{F}_B$ acting on each rope and the angle θ of $\mathbf{F}_B$ so that the magnitude of $\mathbf{F}_B$ is a *minimum*. $\mathbf{F}_A$ acts at 20° from the x axis as shown.

Solution





From the figure, using sine rule

$$\frac{F_A}{\sin\theta} = \frac{950}{\sin\alpha} = \frac{F_B}{\sin 20} \quad \text{---------- (1)}$$

$$F_B = \frac{950 \sin 20}{\sin\alpha} \quad \text{---------- (2)}$$

(2) means that for $F_B = \min$, $\sin\alpha = \max = 1$

$\Rightarrow \alpha = 90, 270, \ldots$ But $\alpha < 160°$, so $\alpha = 90°$

$\alpha = 160 - \theta = 90° \Rightarrow \underline{\theta = 70°}$

From (2), $F_B = \dfrac{950 \sin 20°}{\sin 90°} = \underline{324.92\,N}$

From (1), $F_A = \dfrac{950 \sin 70°}{\sin 90°} = \underline{892.71\,N}$

Hence for minimum F_B, $F_A = 892.71N$, $F_B = 324.92N$ and $\theta = 70°$

King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

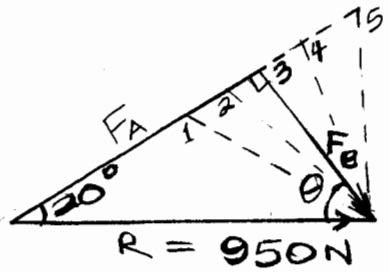
CE 201 STATICS (Sections 1 & 2)

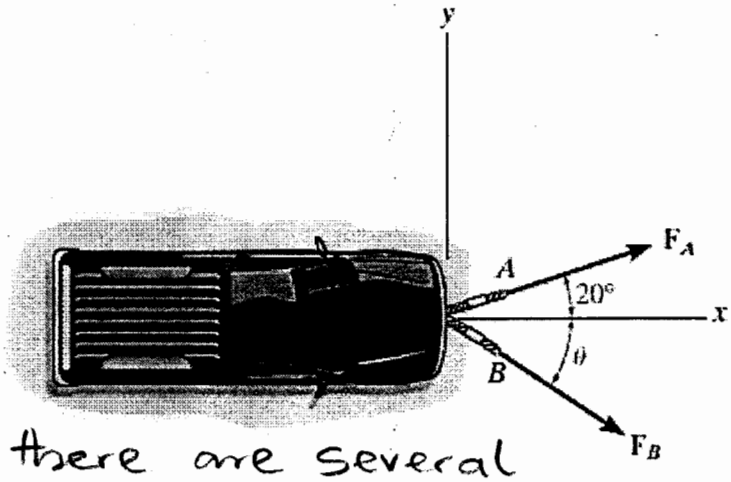
Second Semester 1432 / 2011 (102)

Name: Key #2	Quiz # 1	Score ___ / 10
ID #: ___		

The 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 $\mathbf{F}_A$ and $\mathbf{F}_B$ acting on each rope and the angle θ of $\mathbf{F}_B$ so that the magnitude of $\mathbf{F}_B$ is a *minimum*. $\mathbf{F}_A$ acts at 20° from the x axis as shown.

Alternative Solution





From the figure above, there are several possible directions of F_B such as 1, 2, 3, 4, 5 and so on.

For minimum F_B, the smallest magnitude of vector F_B occurs when $F_A \perp F_B$. Hence

$$\theta = 180^\circ - 90^\circ - 20^\circ = 70^\circ$$

Using sine rule,

$$\frac{F_A}{\sin 70^\circ} = \frac{F_B}{\sin 20^\circ} = \frac{950}{\sin 90^\circ} = 950$$

or we can use cos/sin directly in the ◺ triangle.

Thus

$$F_A = 950 \sin 70^\circ = 892.71\,N$$

$$F_B = 950 \sin 20^\circ = 324.92\,N$$