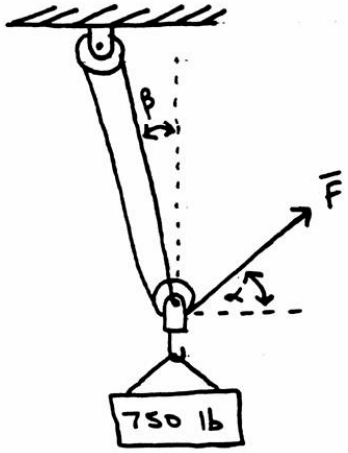
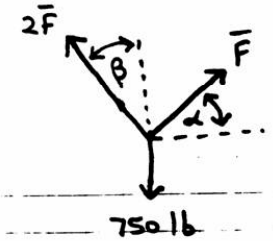
SAMPLE Computer Solution

Problem 2.C2 A 750-lb crate is supported by the rope-and-pulley arrangement shown. Write a computer program which can be used to determine, for a given value of β, the magnitude and direction of the force $\bar{F}$ which should be exerted on the free end of the rope. Use this program to calculate F and α for values of β from 0 to 30° at 5° intervals.



Solution:

Free Body Diagram: (lower pulley)



$$\Sigma F_x = 0 = F\cos\alpha - 2F\sin\beta$$

$$\cos\alpha = 2\sin\beta$$

$$\boxed{\alpha = \cos^{-1}(2\sin\beta)}$$

$$\Sigma F_y = 0 = F\sin\alpha + 2F\cos\beta - 750$$

$$F(\sin\alpha + 2\cos\beta) = 750$$

$$\boxed{F = \frac{750}{\sin\alpha + 2\cos\beta}}$$

Now write a computer program to solve the 2 boxed equations above for $\beta = 0$ to 30° in 5° increments.

Sample Computer Solution Using MATHCAD

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Problem 2.C2

A 750-lb crate is supported by the rope-and-pulley arrangement shown. Write a computer program which can be used to determine, for a given value of β, the magnitude and direction of the force F which should be exerted on the free end of the rope. Use this program to calculate F and α for values of β from 0 to 30 degrees in 5 degree intervals.

Solution: See additional sheet for Free Body Diagram and development of equations.

$\beta := 0,5..30$ degrees

$\alpha(\beta) := \text{acos}\left(2\cdot\sin\left(\beta\cdot\frac{\pi}{180}\right)\right)$ radians (Note: β was converted to radians)

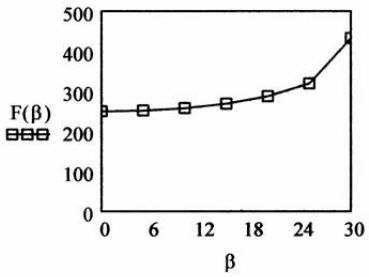
$$F(\beta) := \frac{750}{2\cdot\cos\left(\beta\cdot\frac{\pi}{180}\right) + \sin(\alpha(\beta))}$$

$\alpha\text{deg}(\beta) := \alpha(\beta)\cdot\frac{180}{\pi}$ degrees

β = es	αdeg(β) =degrees	F(β) =
0	90.0	250.0
5	80.0	251.9
10	69.7	258.0
15	58.8	269.1
20	46.8	287.5
25	32.3	319.6
30	0.0	433.0

Produce graphs to illustrate how F and α vary with β:

Force F versus angle β



Angle α versus angle β