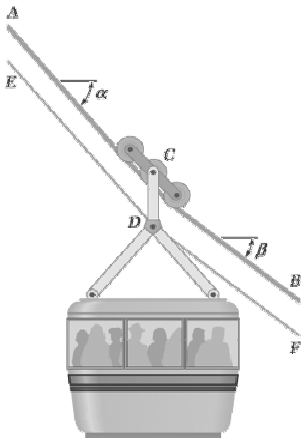
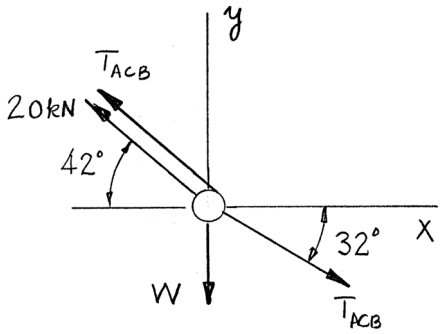


PROBLEM 2.56

The cabin of an aerial tramway is suspended from a set of wheels that can roll freely on the support cable *ACB* and is being pulled at a constant speed by cable *DE*. Knowing that $\alpha = 42°$ and $\beta = 32°$, that the tension in cable *DE* is 20 kN, and assuming the tension in cable *DF* to be negligible, determine (*a*) the combined weight of the cabin, its support system, and its passengers, (*b*) the tension in the support cable *ACB*.

SOLUTION

Free-Body Diagram



First, consider the sum of forces in the *x*-direction because there is only one unknown force:

$$\xrightarrow{+} \Sigma F_x = 0: \quad T_{ACB}(\cos 32° - \cos 42°) - (20\text{ kN})\cos 42° = 0$$

or

$$0.1049T_{ACB} = 14.863\text{ kN}$$

$$(b) \quad T_{ACB} = 141.7\text{ kN} \blacktriangleleft$$

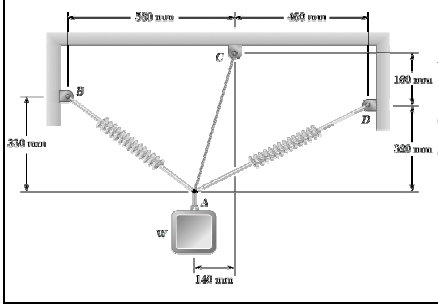
Now

$$+\uparrow \Sigma F_y = 0: \quad T_{ACB}(\sin 42° - \sin 32°) + (20\text{ kN})\sin 42° - W = 0$$

or

$$(141.7\text{ kN})(0.1392) + (20\text{ kN})(0.6691) - W = 0$$

$$(a) \quad W = 33.1\text{ kN} \blacktriangleleft$$

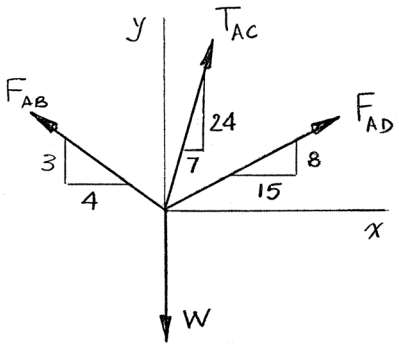


PROBLEM 2.57

A block of weight W is suspended from a 500-mm long cord and two springs of which the unstretched lengths are 450 mm. Knowing that the constants of the springs are $k_{AB} = 1500$ N/m and $k_{AD} = 500$ N/m, determine (*a*) the tension in the cord, (*b*) the weight of the block.

SOLUTION

Free-Body Diagram At A



First note from geometry:

The sides of the triangle with hypotenuse AD are in the ratio 8:15:17.

The sides of the triangle with hypotenuse AB are in the ratio 3:4:5.

The sides of the triangle with hypotenuse AC are in the ratio 7:24:25.

Then:

$$F_{AB} = k_{AB}\left(L_{AB} - L_o\right)$$

and

$$L_{AB} = \sqrt{(0.44\text{ m})^2 + (0.33\text{ m})^2} = 0.55\text{ m}$$

So:

$$F_{AB} = 1500\text{ N/m}\left(0.55\text{ m} - 0.45\text{ m}\right)$$

$$= 150\text{ N}$$

Similarly,

$$F_{AD} = k_{AD}\left(L_{AD} - L_o\right)$$

Then:

$$L_{AD} = \sqrt{(0.66\text{ m})^2 + (0.32\text{ m})^2} = 0.68\text{ m}$$

$$F_{AD} = 1500\text{ N/m}\left(0.68\text{ m} - 0.45\text{ m}\right)$$

$$= 115\text{ N}$$

(*a*)

$$\xrightarrow{+} \Sigma F_x = 0: \quad -\frac{4}{5}(150\text{ N}) + \frac{7}{25}T_{AC} - \frac{15}{17}(115\text{ N}) = 0$$

or

$$T_{AC} = 66.18\text{ N} \qquad T_{AC} = 66.2\text{ N} \blacktriangleleft$$

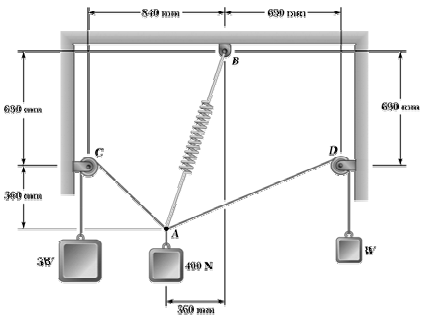
PROBLEM 2.57 CONTINUED

(*b*) and

$$+\uparrow \Sigma F_y = 0: \quad \frac{3}{5}(150\text{ N}) + \frac{24}{25}(66.18\text{ N}) + \frac{8}{17}(115\text{ N}) - W = 0$$

or $W = 208\text{ N}$ ◀

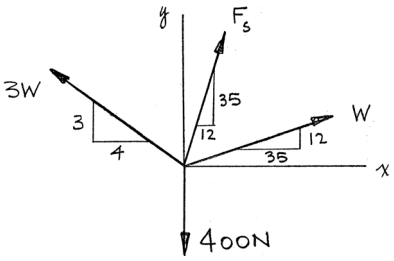
PROBLEM 2.58



A load of weight 400 N is suspended from a spring and two cords which are attached to blocks of weights $3W$ and W as shown. Knowing that the constant of the spring is 800 N/m, determine (*a*) the value of W, (*b*) the unstretched length of the spring.

SOLUTION

Free-Body Diagram At A



First note from geometry:

The sides of the triangle with hypotenuse AD are in the ratio 12:35:37.

The sides of the triangle with hypotenuse AC are in the ratio 3:4:5.

The sides of the triangle with hypotenuse AB are also in the ratio 12:35:37.

Then:

$$\xrightarrow{+} \Sigma F_x = 0: \quad -\frac{4}{5}(3W) + \frac{35}{37}(W) + \frac{12}{37}F_s = 0$$

or

$$F_s = 4.4833W$$

and

$$+\uparrow \Sigma F_y = 0: \quad \frac{3}{5}(3W) + \frac{12}{37}(W) + \frac{35}{37}F_s - 400\text{ N} = 0$$

Then:

$$\frac{3}{5}(3W) + \frac{12}{37}(W) + \frac{35}{37}(4.4833W) - 400\text{ N} = 0$$

or

$$W = 62.841\text{ N}$$

and

$$F_s = 281.74\text{ N}$$

or

(*a*) $W = 62.8\text{ N}$ ◀

PROBLEM 2.58 CONTINUED

(*b*) Have spring force

$$F_s = k\left(L_{AB} - L_o\right)$$

Where

$$F_{AB} = k_{AB}\left(L_{AB} - L_o\right)$$

and

$$L_{AB} = \sqrt{(0.360\text{ m})^2 + (1.050\text{ m})^2} = 1.110\text{ m}$$

So:

$$281.74\text{ N} = 800\text{ N/m}\left(1.110 - L_0\right)\text{m}$$

or $L_0 = 758\text{ mm}$ ◀