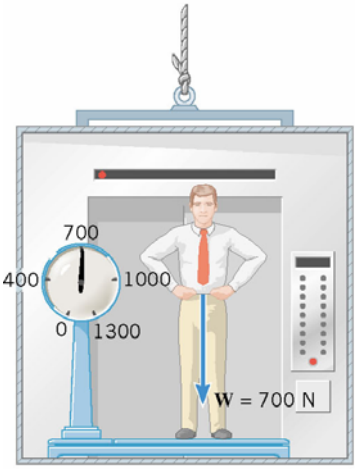
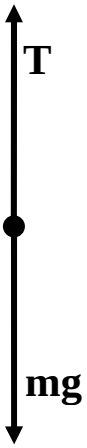
Physics 151 Class Exercise: Net Force

In the sequence of images that follow, Bob Costas is shown riding on an elevator while standing on a scale that illustrates his apparent weight. In the image to the immediate right, Bob is shown standing in the elevator stopped at the 6th floor. Determine the acceleration of the elevator in each of the four images. (Hint: You should begin by drawing a FBD and specifying your coordinate system.)



$a_1 = 0\ m/s^2$

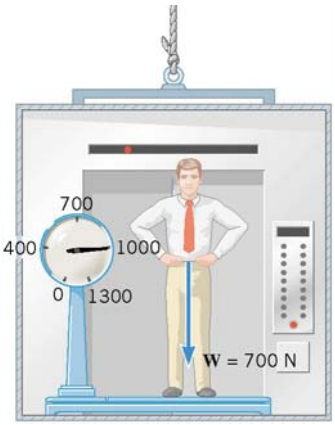


$$W = mg$$

$$g = \frac{W}{g} = \frac{700N}{\left(9.81\frac{m}{s^2}\right)} = 71.4\,kg$$

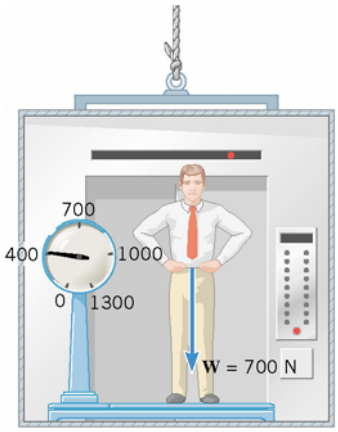
$$\Sigma F_y = N - mg = ma$$

$$a_2 = \frac{N - mg}{m} = \frac{(1000N) - (700N)}{(71.4kg)} = 4.2\frac{m}{s^2}$$



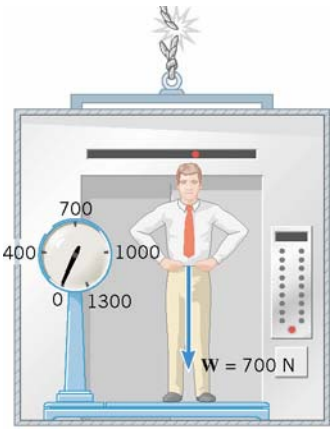
$$\Sigma F_y = N - mg = ma$$

$$a_3 = \frac{N - mg}{m} = \frac{(400N) - (700N)}{(71.4kg)} = -4.2\frac{m}{s^2}$$

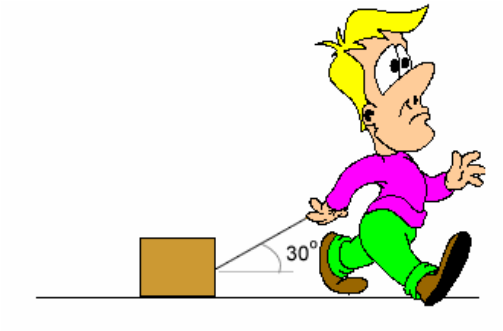


$$\Sigma F_y = N - mg = ma$$

$$a_4 = \frac{N - mg}{m} = \frac{(0N) - (700N)}{(71.4kg)} = -9.8\frac{m}{s^2}$$



2. Wally is dragging a 300 N crate across a smooth floor by pulling with a 65 N force on a roped at a 30º above the horizontal. (Hint: You should begin by drawing a FBD and specifying your coordinate system.)



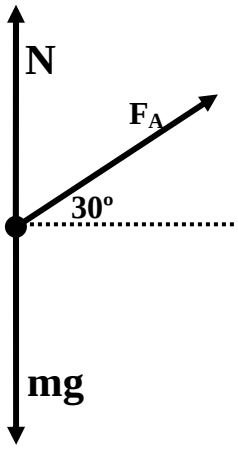
(a) Calculate the acceleration of the crate.

$$W = mg$$

$$m = \frac{W}{g} = \frac{(300N)}{\left(9.81\frac{m}{s^2}\right)} = 30.6\,kg$$

$$\Sigma F_x = F_A \cos 30° = ma_x$$

$$a_x = \frac{F_A \cos 30°}{m} = \frac{(65N)\cos 30°}{(30.6\,kg)}$$



(b) Calculate the value of the normal force exerted by the floor on the crate.

$$N = mg - F_A \sin 30°$$
$$= (300N) - (65N)\sin 30°$$
$$= 268N$$

(c) Calculate the value of the force Wally must apply to have the crate accelerate at 0.75 m/s^2.

$$\Sigma F_x = F_A \cos 30° = ma_x$$

$$F_A = \frac{ma_x}{\cos 30°} = \frac{(30.6kg)\left(0.75\frac{m}{s^2}\right)}{\cos 30°} = 26.5N$$