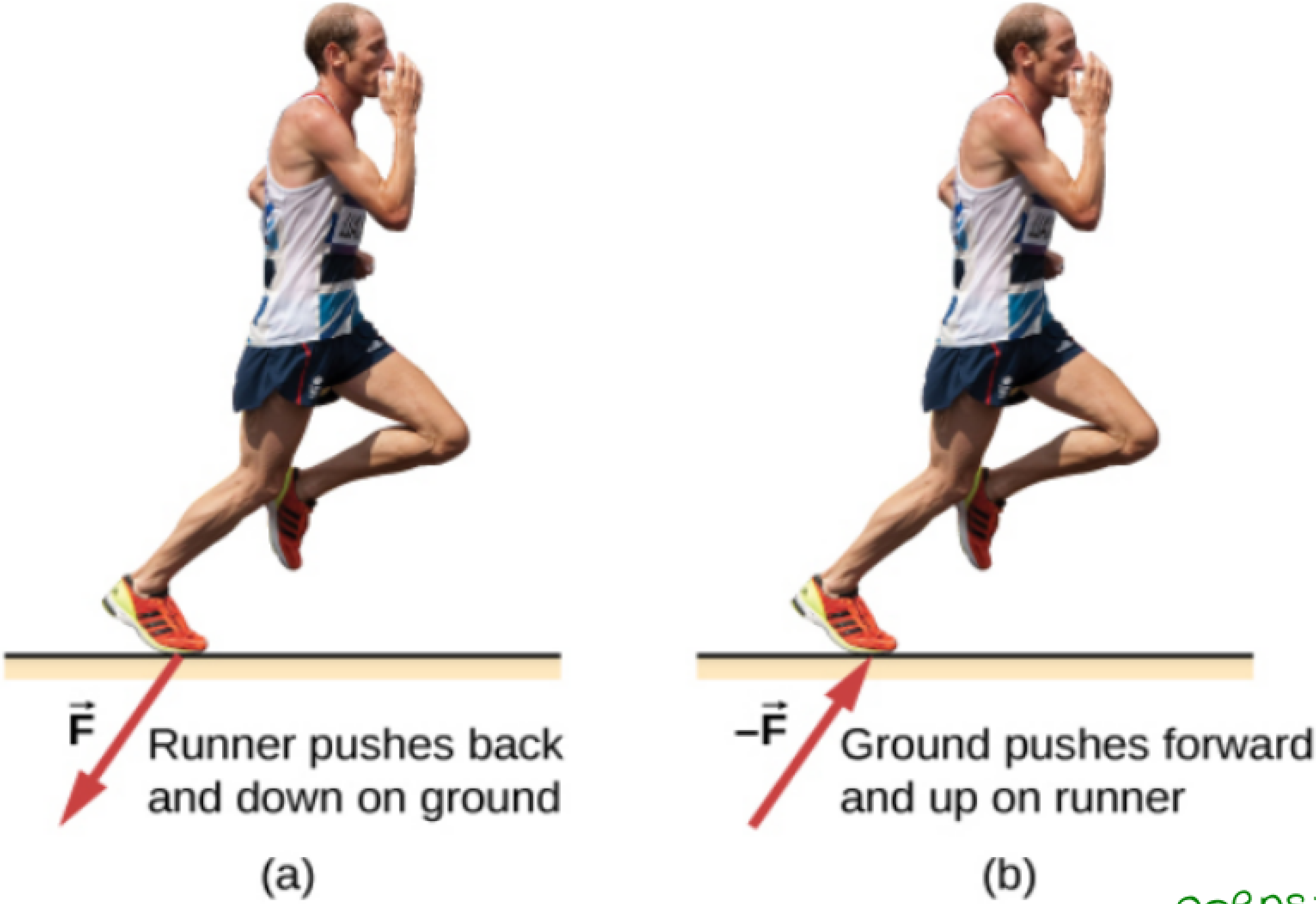
Using the Newtons laws

Defining the "system" in Newtons third law



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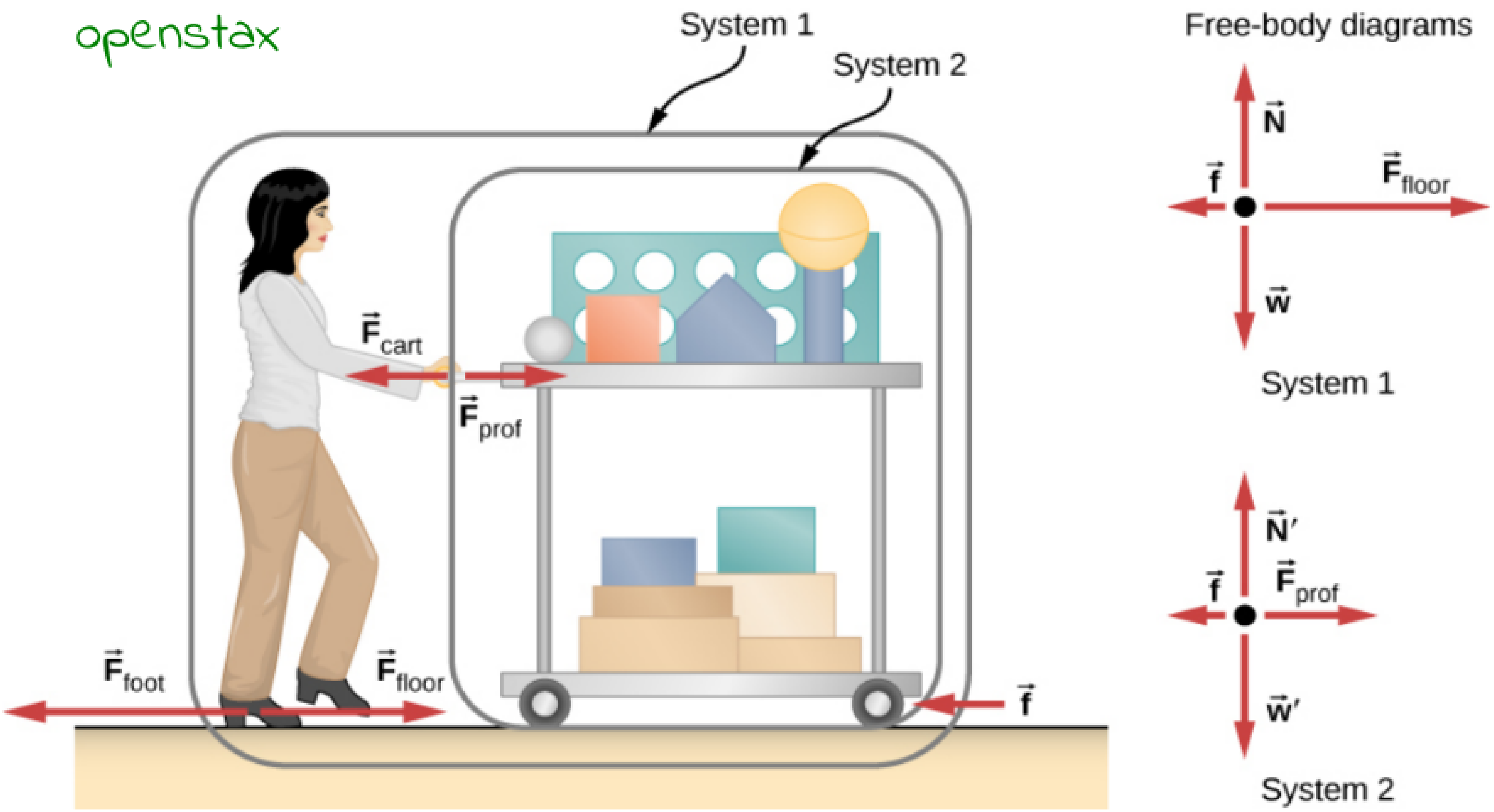


Figure 5.20 A professor pushes the cart with her demonstration equipment. The lengths of the arrows are proportional to the magnitudes of the forces (except for $\vec{\mathbf{f}}$, because it is too small to drawn to scale). System 1 is appropriate for this example, because it asks for the acceleration of the entire group of objects. Only $\vec{\mathbf{F}}_{floor}$ and $\vec{\mathbf{f}}$ are external forces acting on System 1 along the line of motion. All other forces either cancel or act on the outside world. System 2 is chosen for the next example so that $\vec{\mathbf{F}}_{prof}$ is an external force and enters into Newton's second law. The free-body diagrams, which serve as the basis for Newton's second law, vary with the system chosen.

Mass of professor $M_p = 65\ \text{Kg}$

Mass of chart $M_c = 12\ \text{Kg}$

Mass of equipment $M_e = 7\ \text{Kg}$

Friction force $f = 24\ \text{N}$

Force of her foot on the floor $F_{Foot} = 150\ \text{N}$

what is the acceleration of "system 1", (P + C + E)?

The only external force: $\bar{F}_{net} = \bar{F}_{Floor} - \bar{f}$

$$\rightarrow \quad \bar{a} = \frac{\bar{F}_{net}}{M_T} = \frac{\bar{F}_{Floor} - \bar{f}}{M_p + M_c + M_e} = \frac{(150-24)\,\text{N}}{84\ \text{Kg}}$$

$$\simeq 1{,}5\ \text{m/s}^2$$

The force on the chart (Ex. 5.11)

Now the relevant system is "system 2"

$$F_{net} = F_p - f \qquad \bar{a} \quad \text{"2"}$$

known

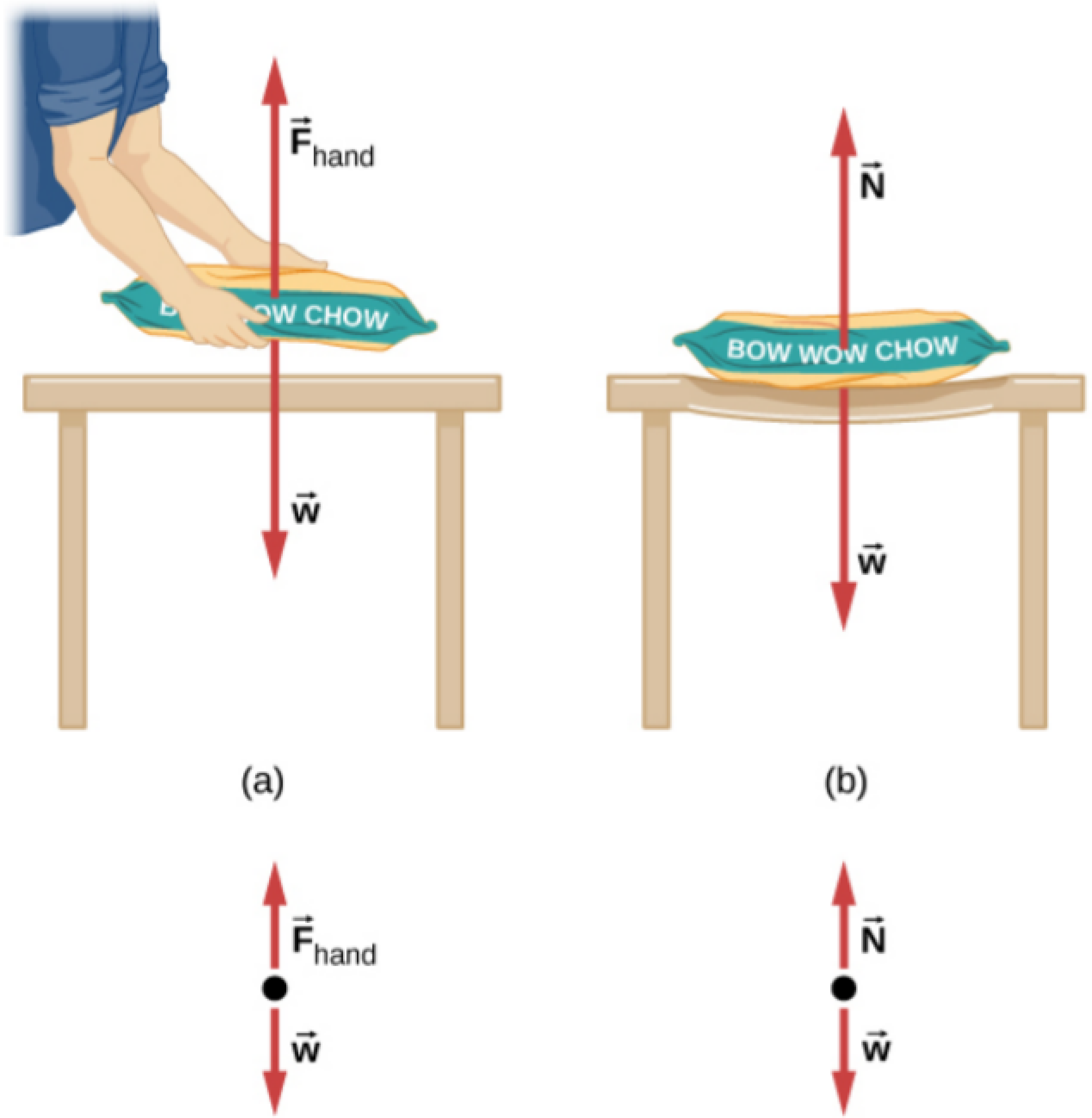
$$\rightarrow F_p = F_{net} + f \,, \qquad F_{net} = (M_c + M_e)\,a$$

$$\rightarrow F_p = (M_c + M_e)\,a + f$$

$$\approx 29\,N + 24\,N \quad = \underline{53\,N}$$

She pushes with much larger force on the floor, than the chart, the difference goes into her own acceleration!

weight and normal force (þyngd og normalkraftur)



Free-body diagrams

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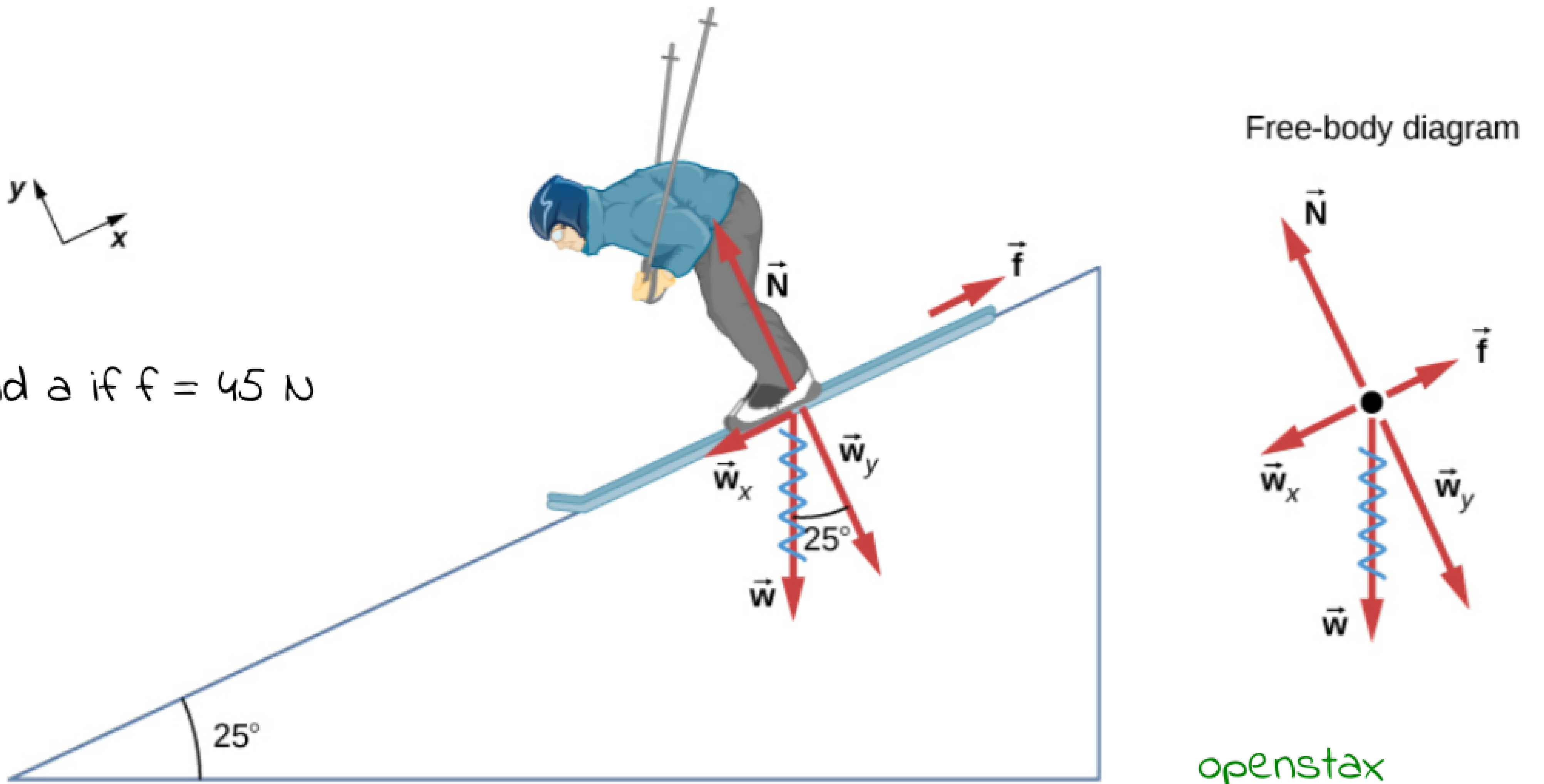
weight on an incline, (Ex. 5.12)



Find a if f = 45 N

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Figure 5.22 Since the acceleration is parallel to the slope and acting down the slope, it is most convenient to project all forces onto a coordinate system where one axis is parallel to the slope and the other is perpendicular to it (axes shown to the left of the skier). $\vec{\mathbf{N}}$ is perpendicular to the slope and $\vec{\mathbf{f}}$ is parallel to the slope, but $\vec{\mathbf{w}}$ has components along both axes, namely, w_y and w_x. Here, $\vec{\mathbf{w}}$ has a squiggly line to show that it has been replaced by these components. The force $\vec{\mathbf{N}}$ is equal in magnitude to w_y, so there is no acceleration perpendicular to the slope, but *f* is less than w_x, so there is a downslope acceleration (along the axis parallel to the slope).

we find the components of w along the axes of the coordinate system

$$W_x = -W \sin\theta$$

$$W_y = -W \cos\theta$$

$\theta = 25^\circ$

$m = 60 \text{ kg}$

x : $(F_{net})_x = W_x + f$

y : $(F_{net})_y = W_y + N = 0$, no acc. along y

$$(F_{net})_x = -W \sin\theta + f = m a_x$$

$$a_x = \frac{-W \sin\theta + f}{m} \approx -3,39 \ m/s^2$$

Tension - togkraftur

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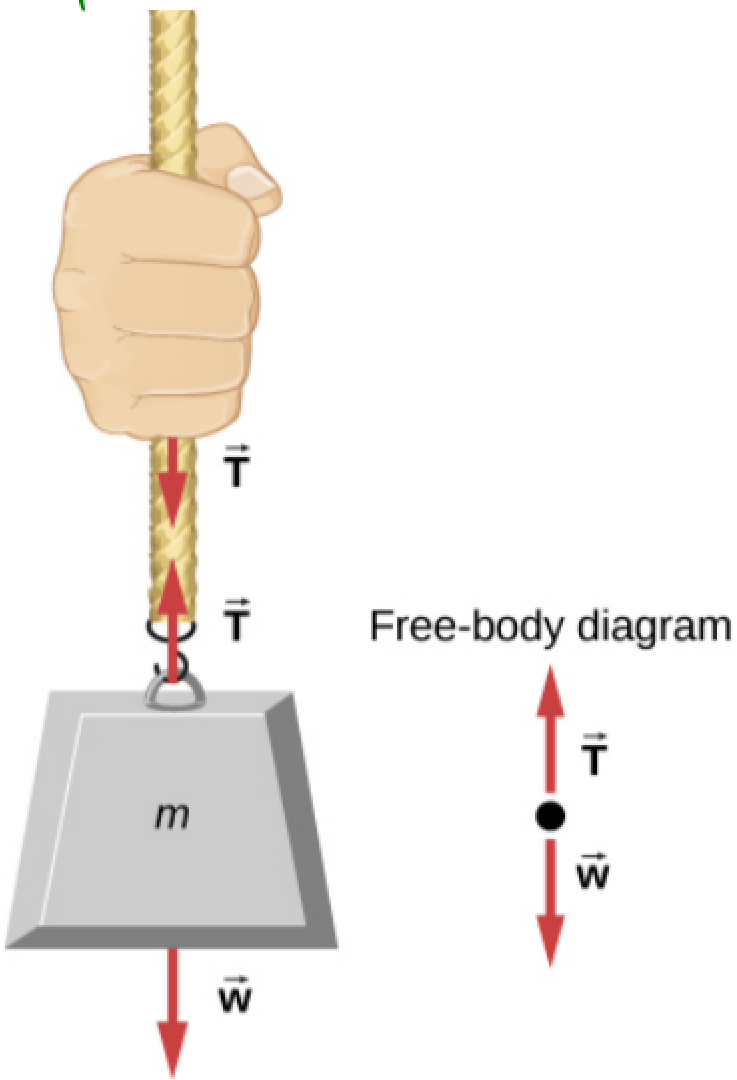


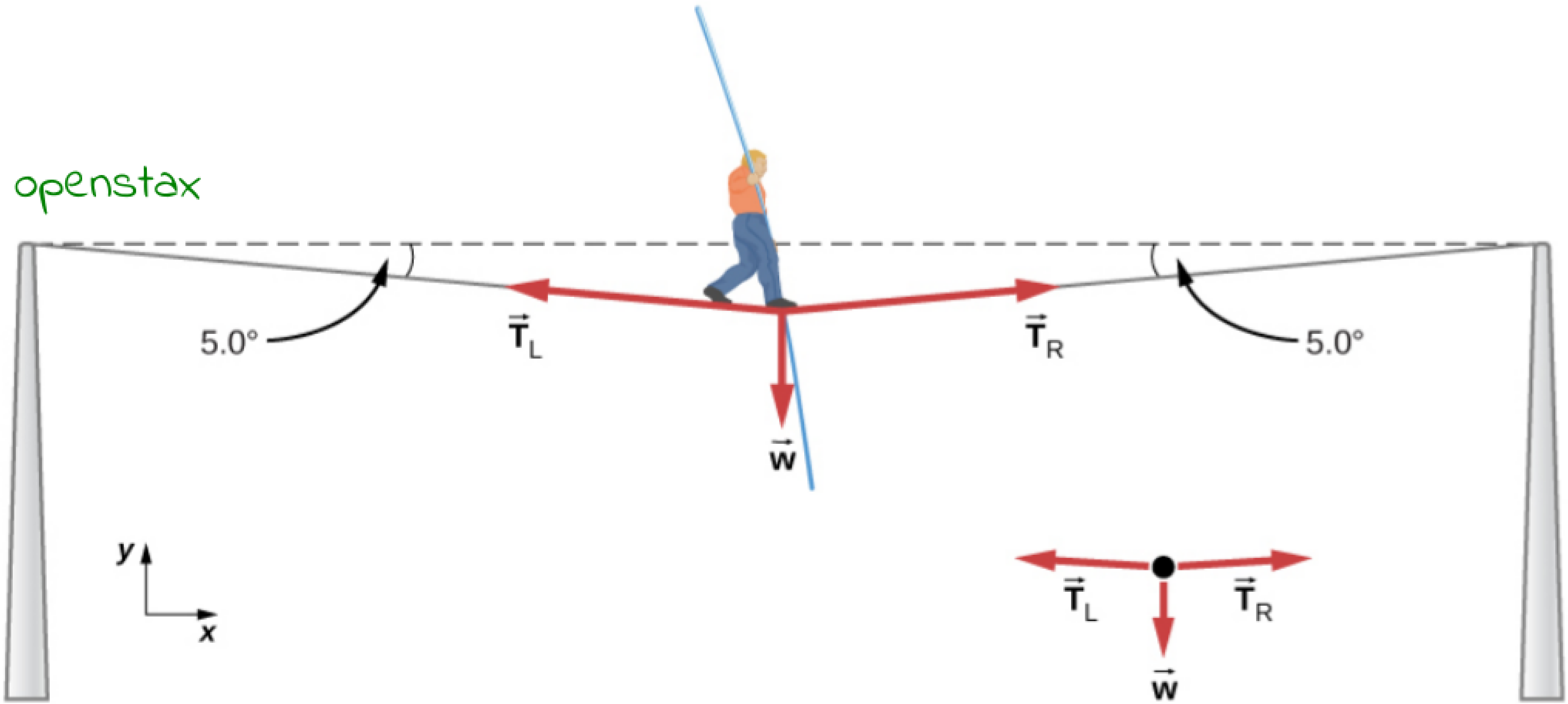
If the mass m is not accelerated we have the condition

$$\boxed{F_{net} = T - W = 0}$$

T is the tension in the rope, and here we have

$$T = mg \, , \text{ as } T = W$$

Tension in a tightrope, (Ex. 5.13)



we need to find the components of the forces along the x- and y-axes

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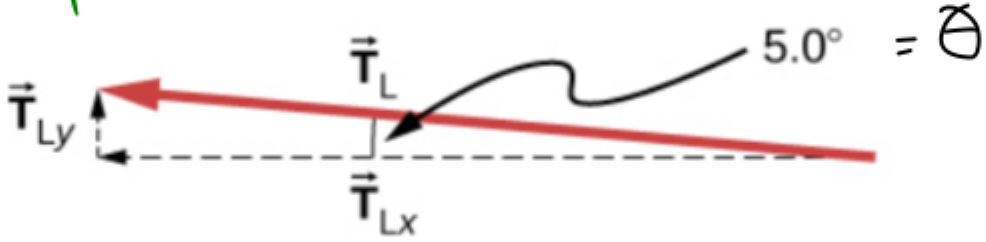
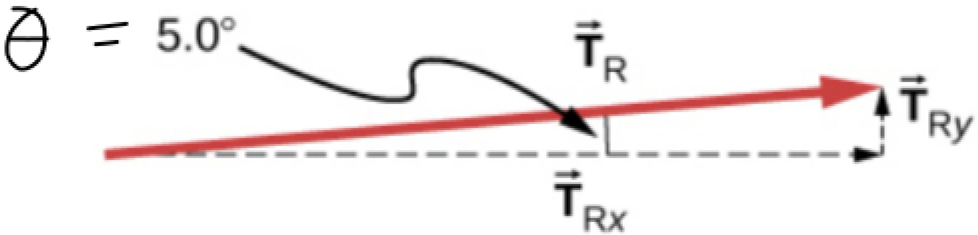
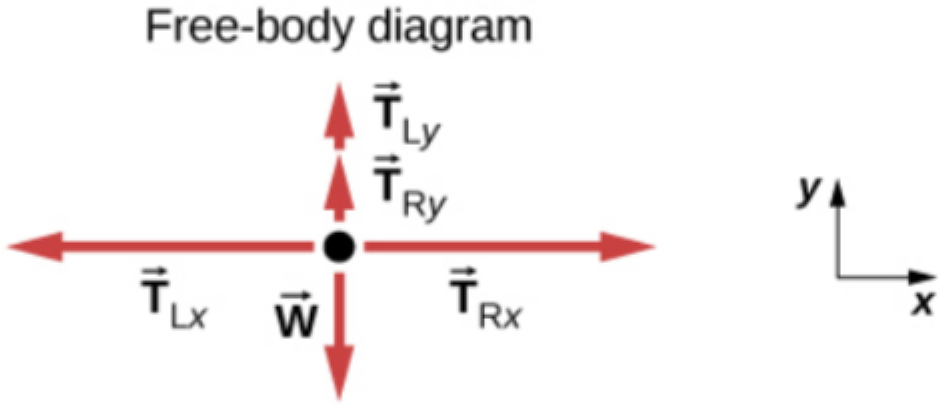






$$\vec{F}_{\text{net } x} = 0 \ ; \ \vec{F}_{\text{net } y} = 0$$

X:

$$(F_{net})_x = (T_R)_x - (T_L)_x = 0$$

$$\rightarrow \quad (T_L)_x = (T_R)_x \rightarrow T_L \cos\theta = T_R \cos\theta$$

$$\rightarrow \quad T_L = T_R$$

y:

$$(F_{net})_y = (T_L)_y + (T_R)_y - W = 0$$

$$\rightarrow \quad 0 = T\sin\theta + T\sin\theta - W$$

$$0 = 2T\sin\theta - W$$

$$\rightarrow \quad T = \frac{W}{2\sin\theta} = \frac{mg}{2\sin\theta}$$

If $m = 70\ kg$

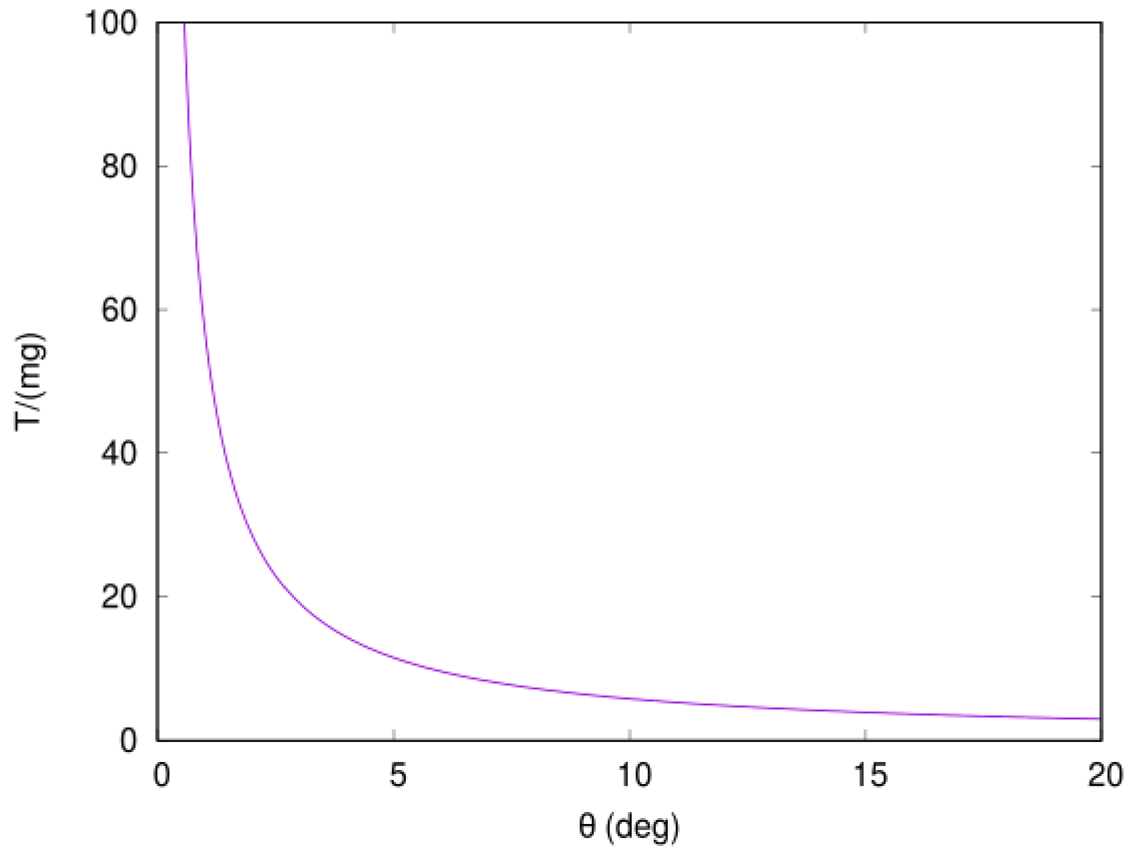
$g = 9.81\ m/s^2$

$\theta = 5^\circ$

$$\rightarrow \quad T = 3930\ N$$

but $W \simeq 687\ N$

view in a graph,
singularity
(properties of a rope)



Possible usage, (think about T, the rope, savety)

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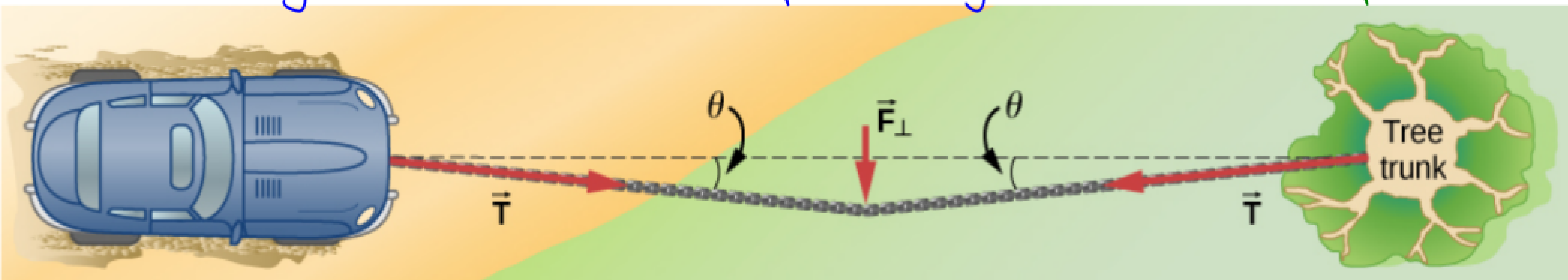
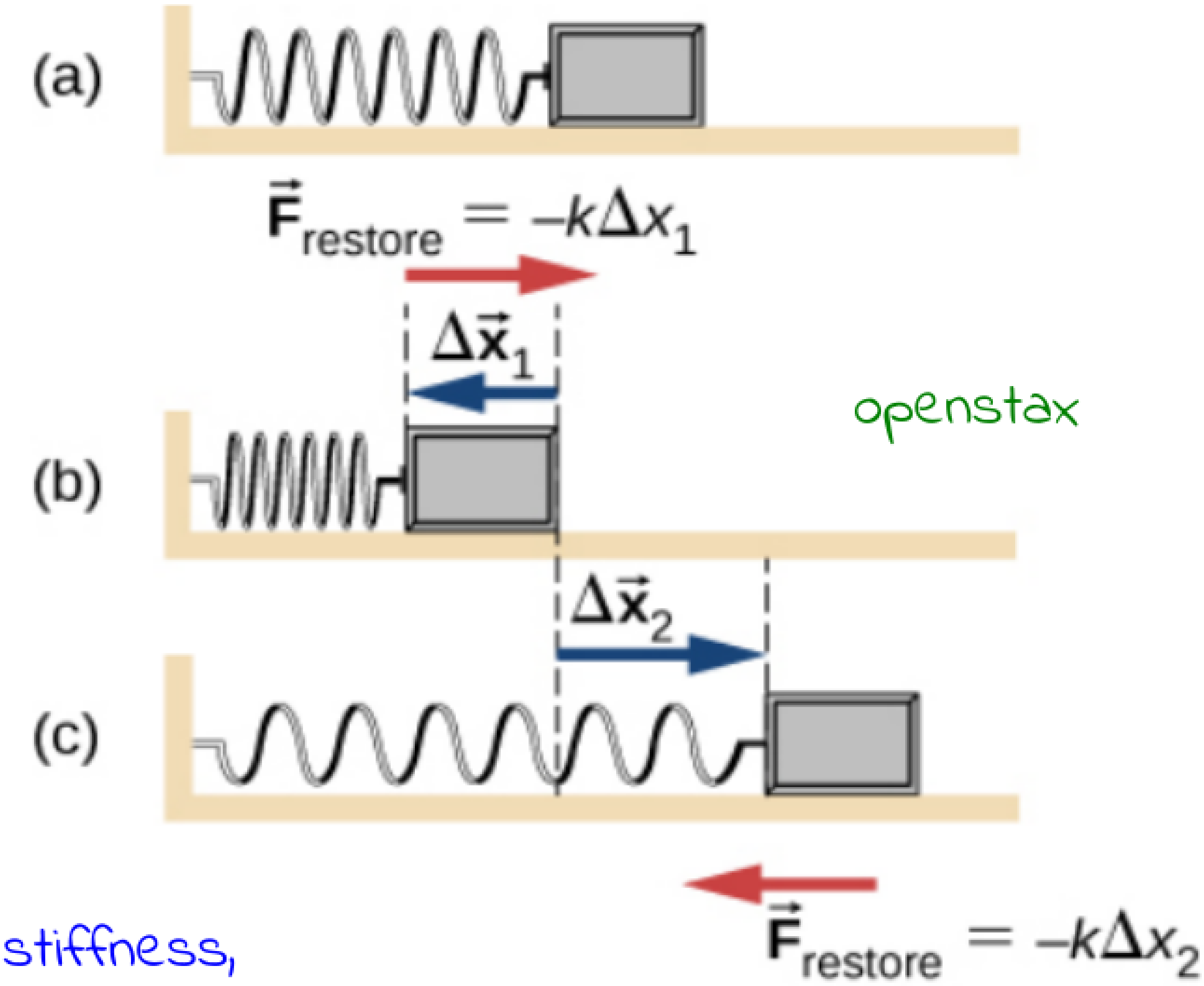


Figure 5.28 We can create a large tension in the chain—and potentially a big mess—by pushing on it perpendicular to its length, as shown.

Spring force, (Hookes law)



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$$\boxed{\bar{F} = -k\,\overline{\Delta x}}$$

spring constant, measure of stiffness,
fjaðurfasti, gormfasti
experimental observation

Pseudo forces in noninertial frames

Gerfikraftar í ekki-tregðukerfum

Coriolis forces -- centrifugal forces ...

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