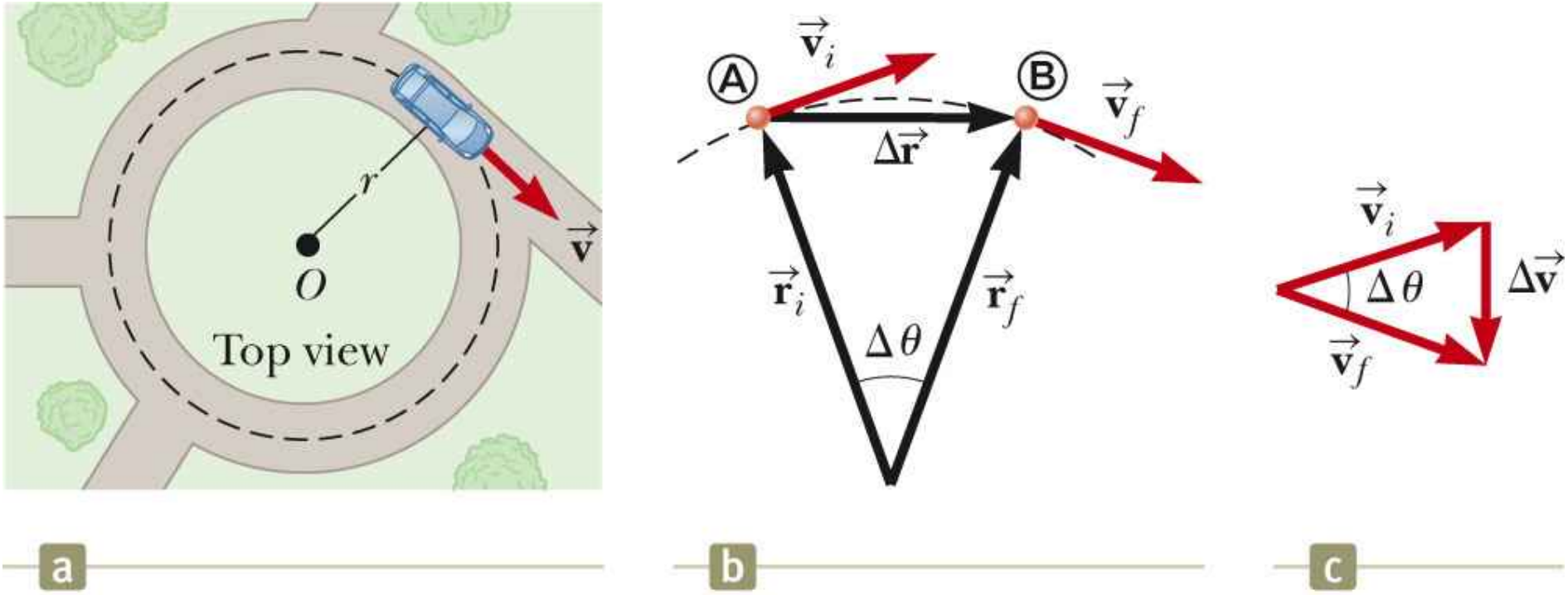
Week 4 outline

Chapter 4. Review circular motion
Chapter 5. The Laws of Motion

Uniform circular motion = object moves at constant speed in a circular path.



Time to make one cycle = period = T = circumf/speed

Fig. 4.15, p. 86

Total acceleration – sum of tangential and centripetal components

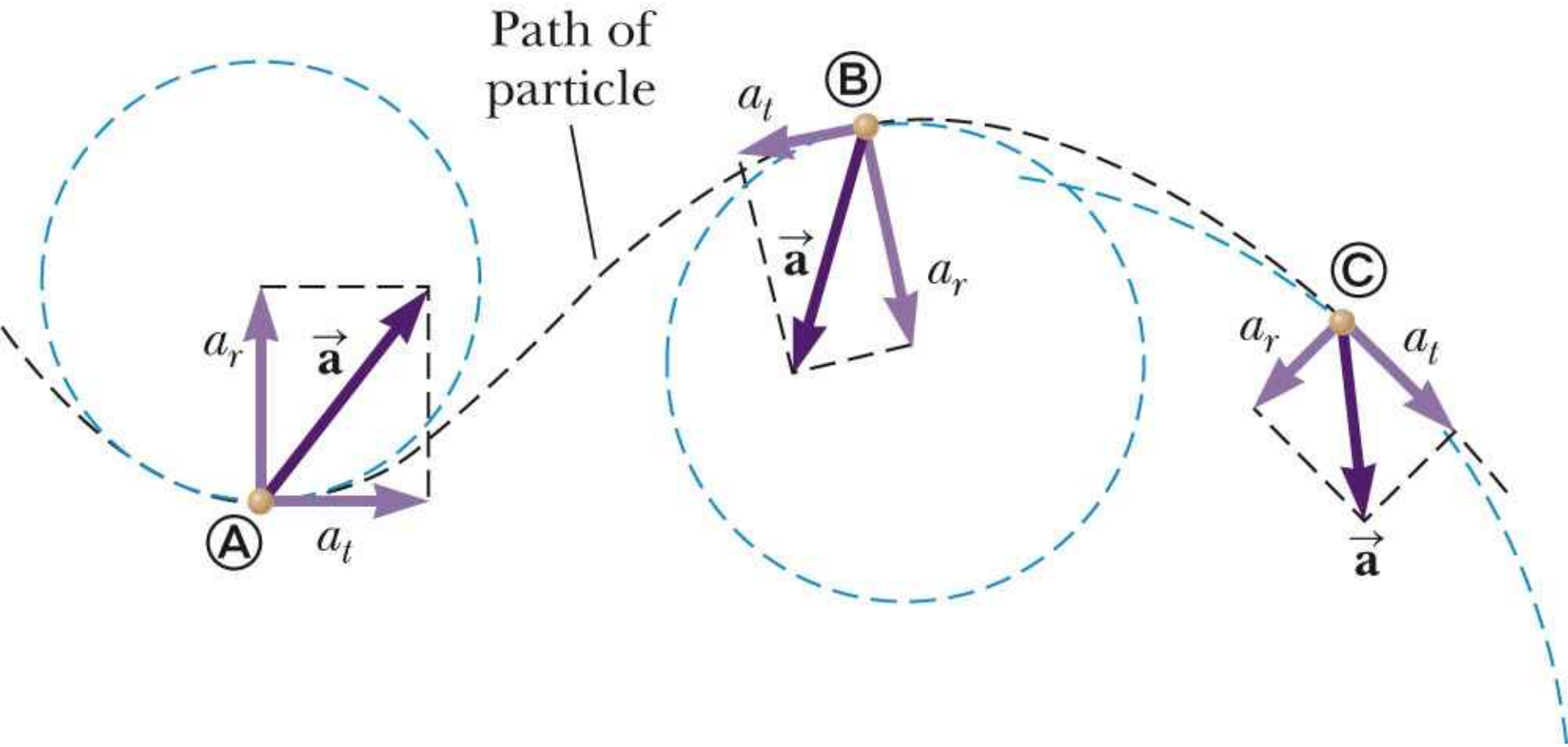


Fig. 4.16, p. 88

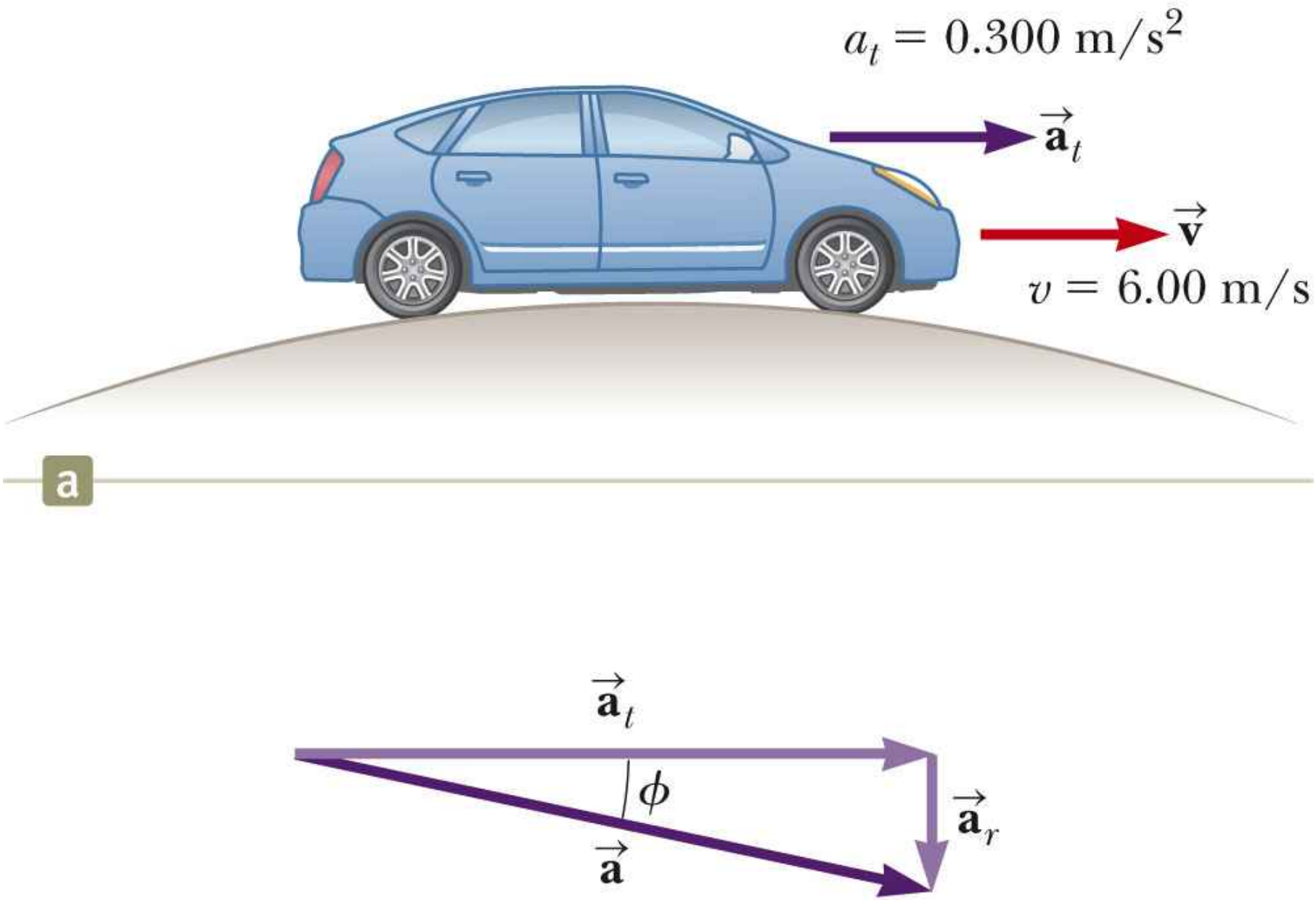

$a_t = 0.300\ \text{m/s}^2$
$\vec{\mathbf{a}}_t$
$\vec{\mathbf{v}}$
$v = 6.00\ \text{m/s}$
a
$\vec{\mathbf{a}}_t$
ϕ
$\vec{\mathbf{a}}_r$
$\vec{\mathbf{a}}$
b

Fig. 4.17, p. 89

The woman standing on the beltway sees the man moving with a slower speed than does the woman observing the man from the stationary floor.

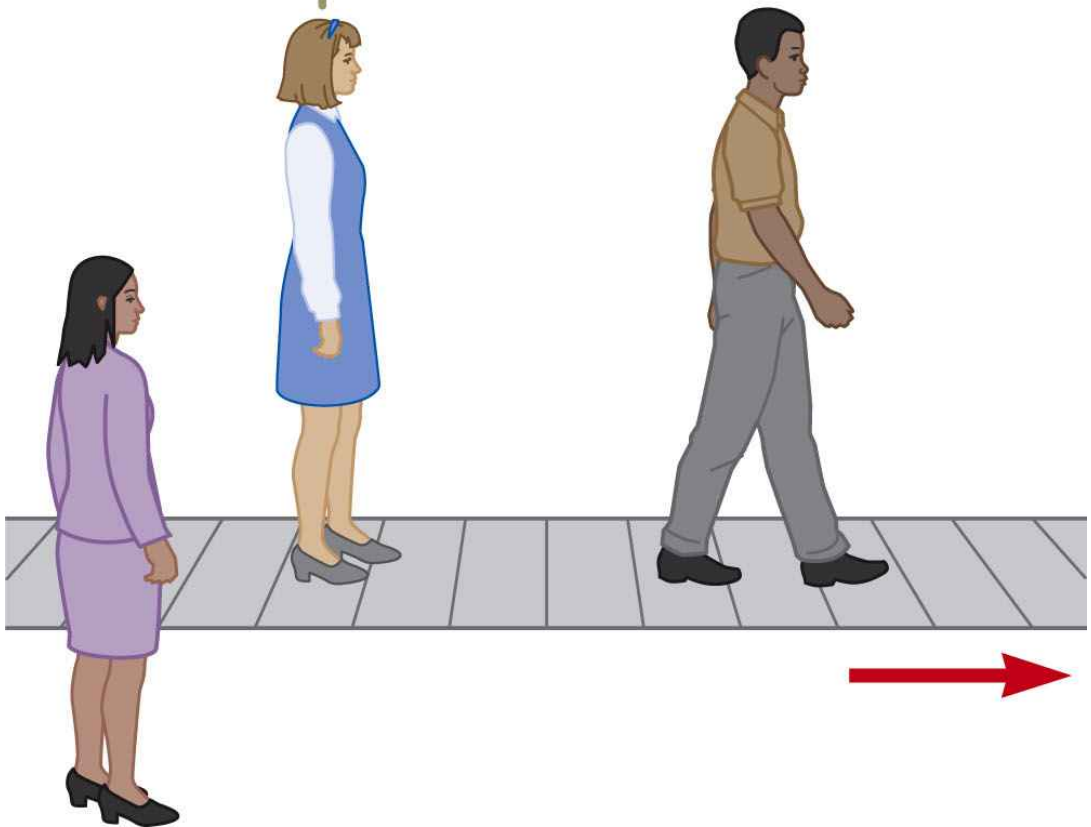


Fig. 4.19, p. 90

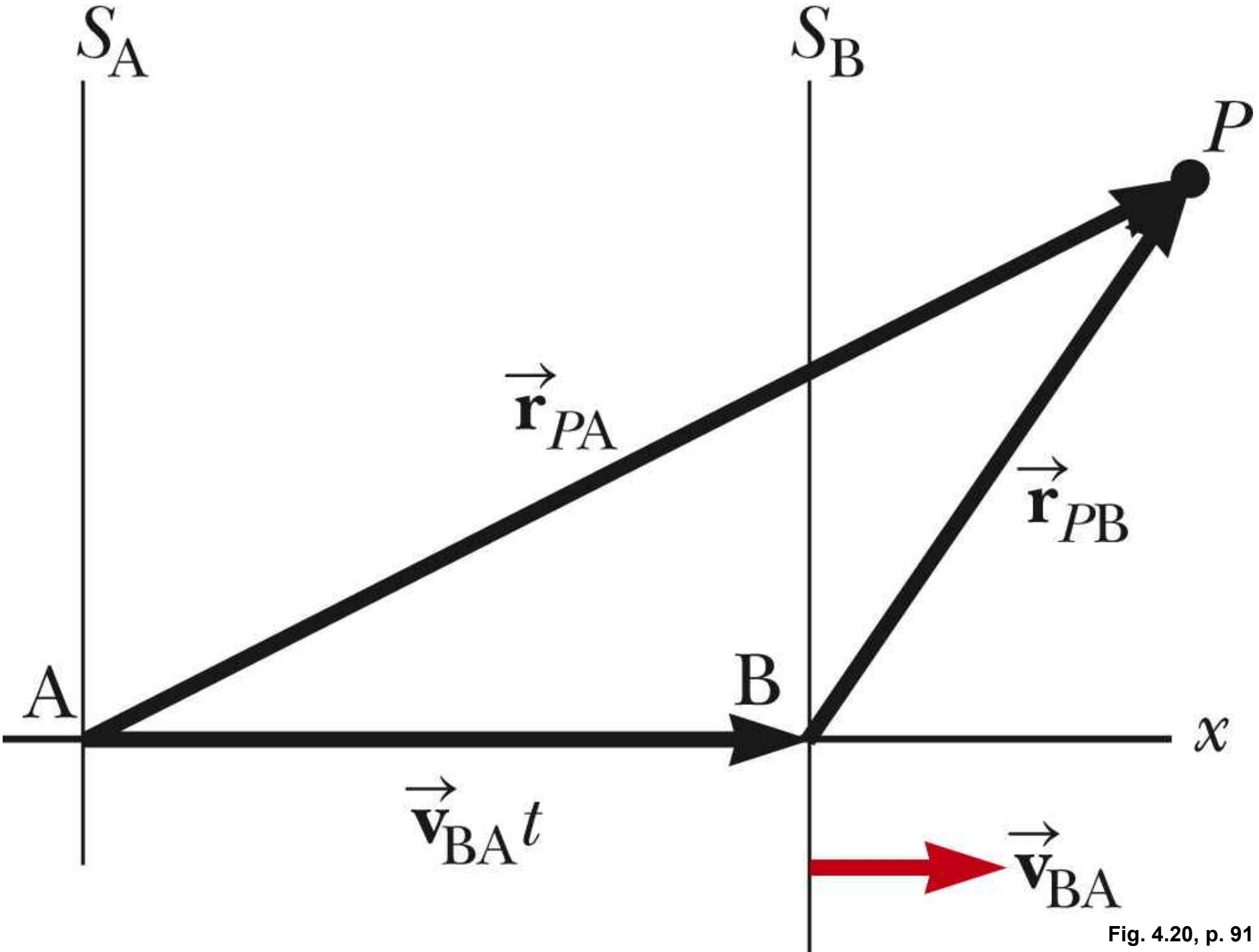

S_A
S_B
P
$\vec{\mathbf{r}}_{PA}$
$\vec{\mathbf{r}}_{PB}$
A
B
x
$\vec{\mathbf{v}}_{BA}t$
$\vec{\mathbf{v}}_{BA}$

Fig. 4.20, p. 91

Forces

Forces are vectors

Forces act between systems (the dashed boxes)

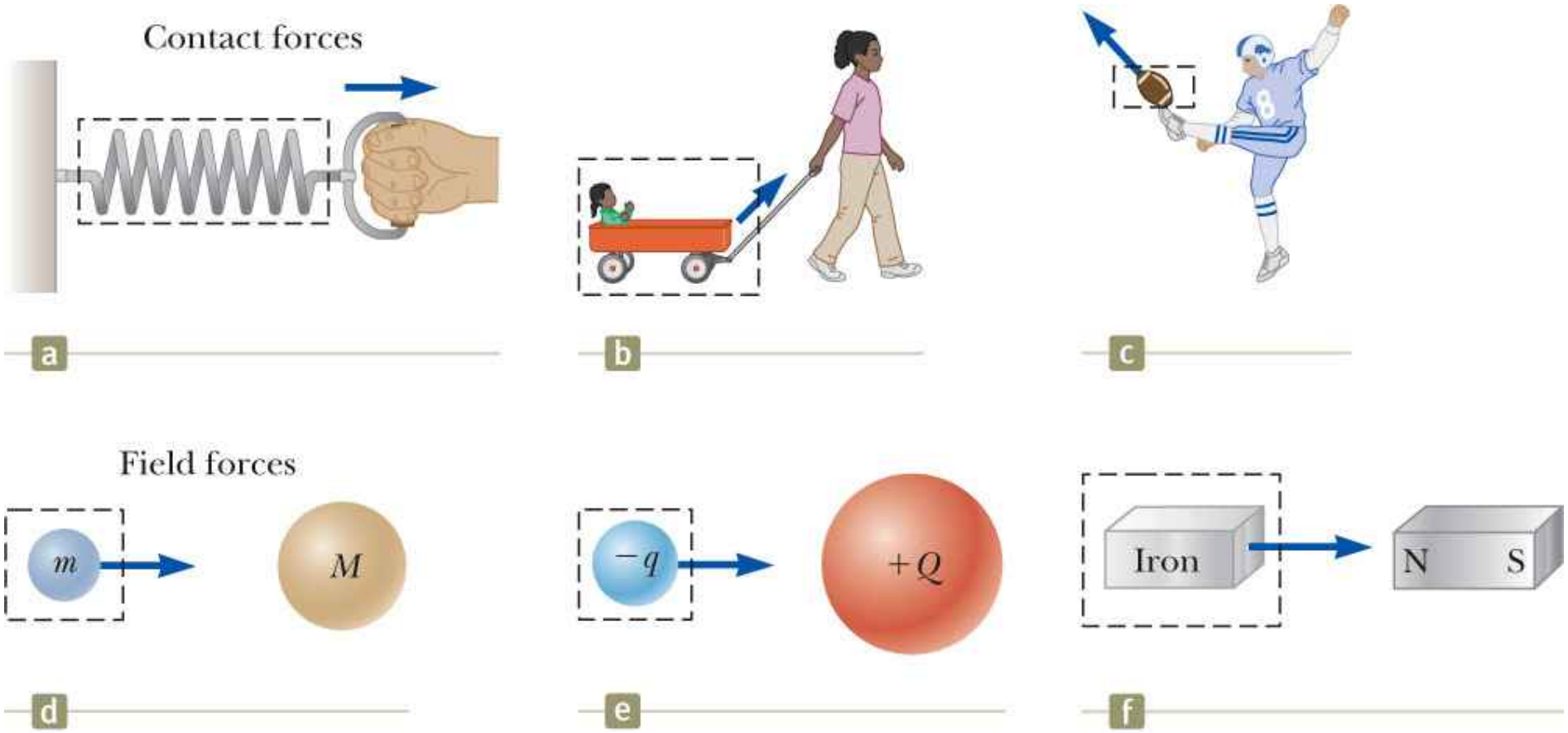
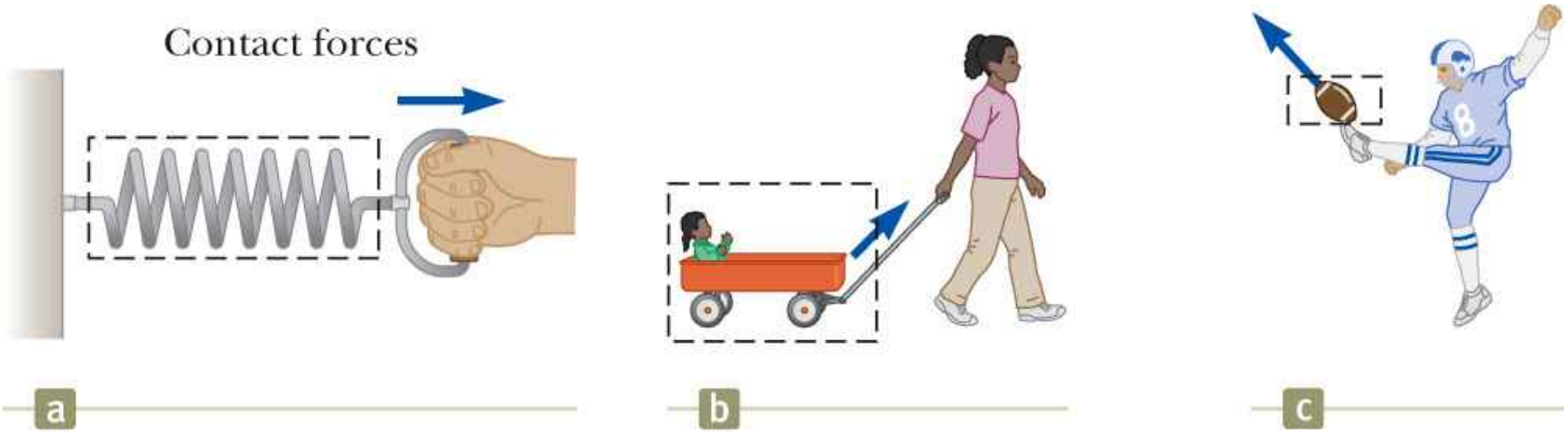


Fig. 5.1, p. 104

Types of forces

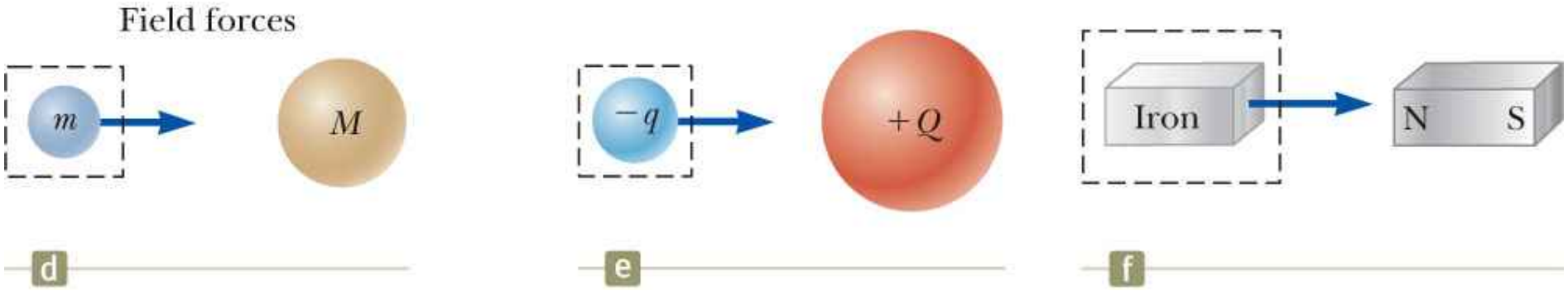


contact forces

- tension – pulling apart
- compression – pushing together
- shear – pushing tangentially
- torsion - twisting

Fig. 5.1, p. 104

Types of forces



Field forces

gravitational electric magnetic

Fig. 5.1, p. 104

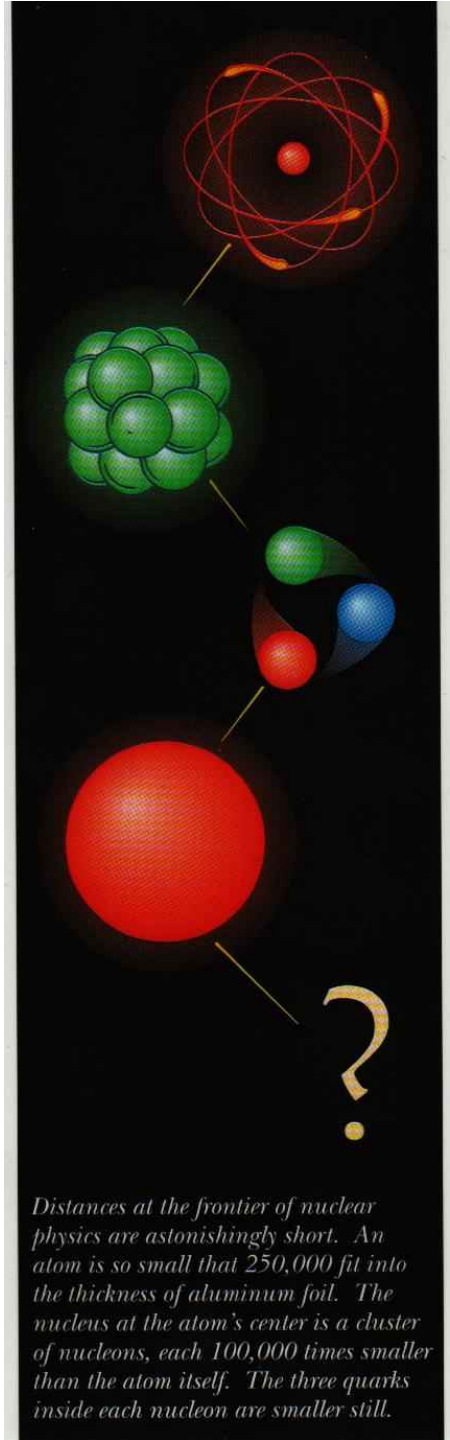
The 4 Fundamental forces

Gravity

Electromagnetic Force

Nuclear Strong Force – holds nuclei together

Nuclear Weak force – decay of n and p

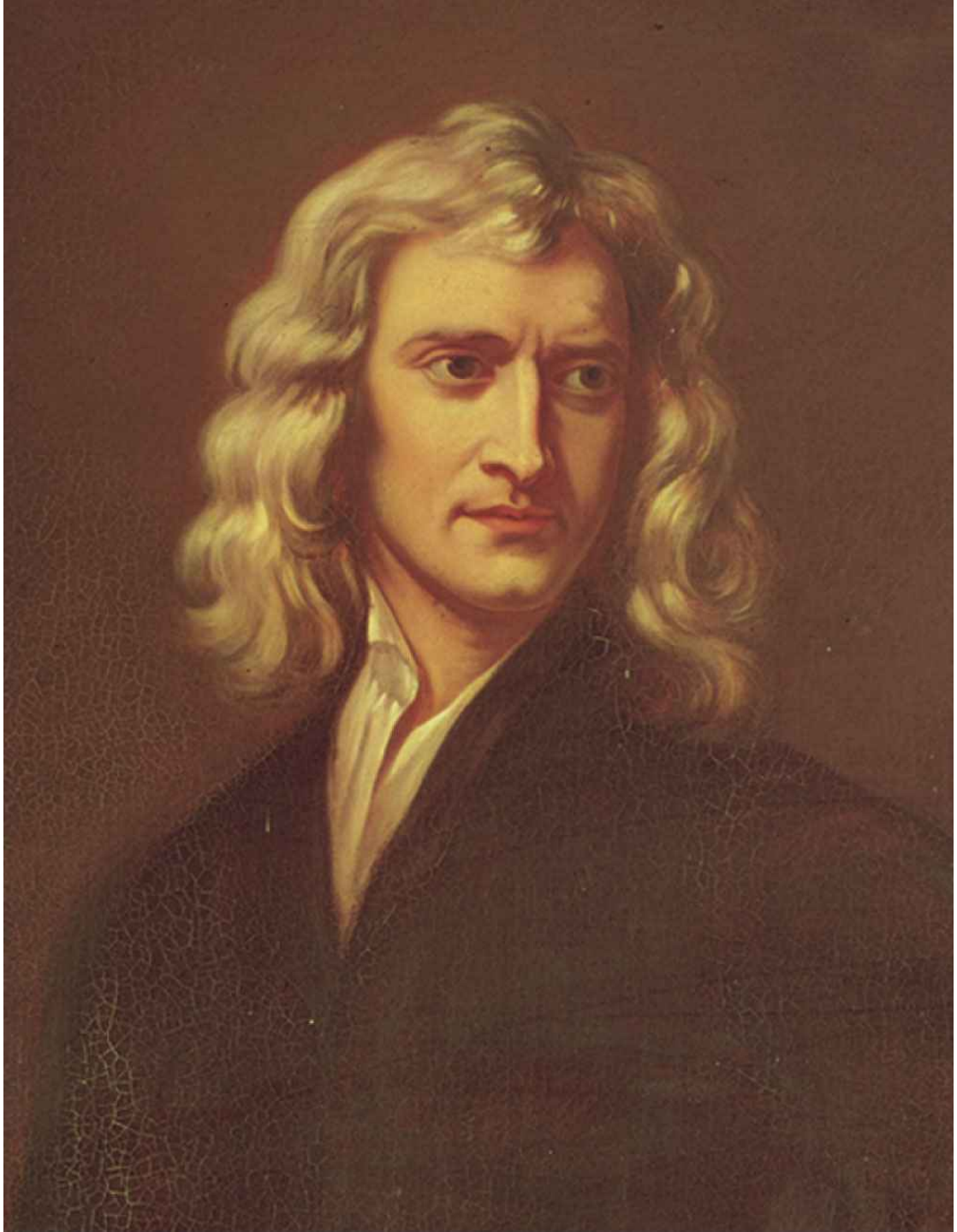


Distances at the frontier of nuclear physics are astonishingly short. An atom is so small that 250,000 fit into the thickness of aluminum foil. The nucleus at the atom's center is a cluster of nucleons, each 100,000 times smaller than the atom itself. The three quarks inside each nucleon are smaller still.

Isaac Newton
(1642 - 1727)

3 laws of motion

1 law of Universal Gravitation

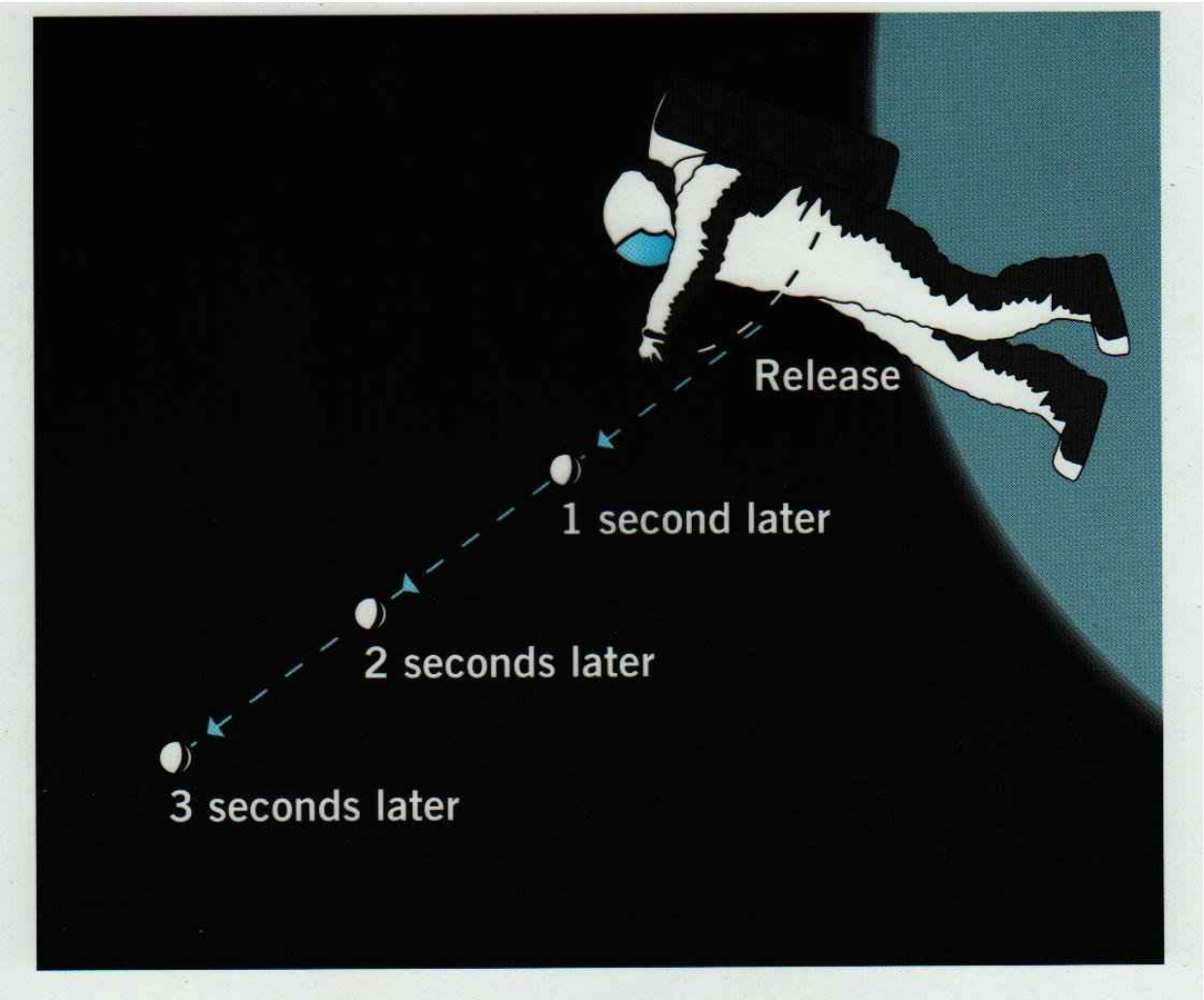


Newton's 1st law = inertial frames of reference exist such that an object will move with a constant velocity if no forces act upon it.

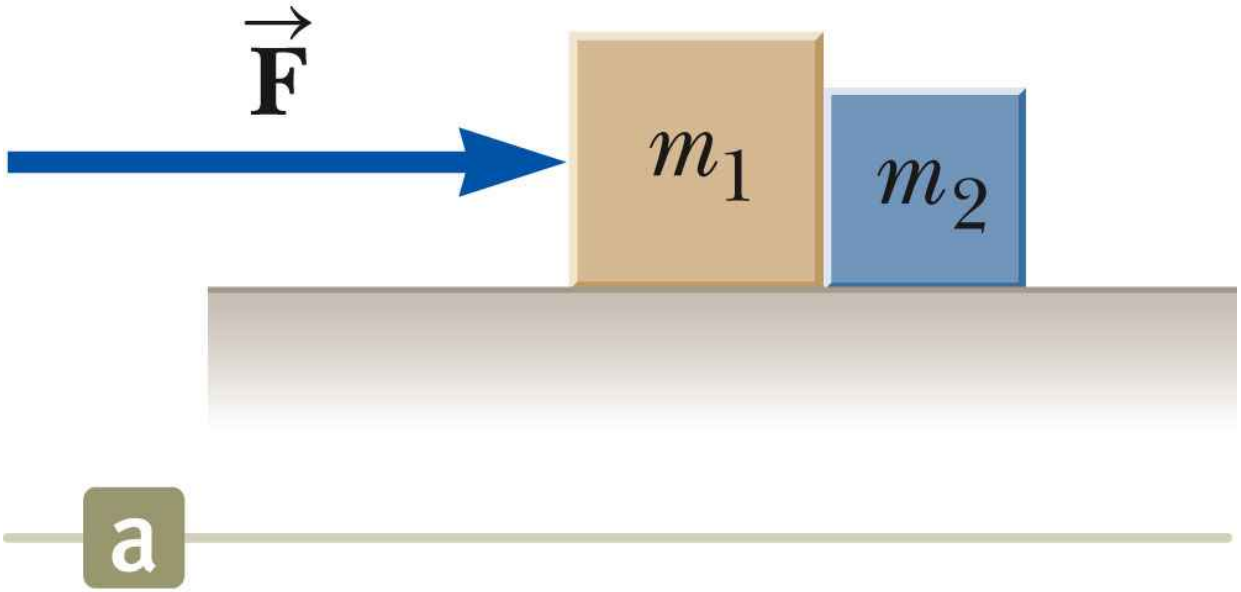
Overthrows Aristotle and medieval thought:

"natural state" is at rest

"impetus" pushes an arrow along



Newton's 2nd law = the acceleration of an object is proportional to the net force and inversely proportional to the mass.

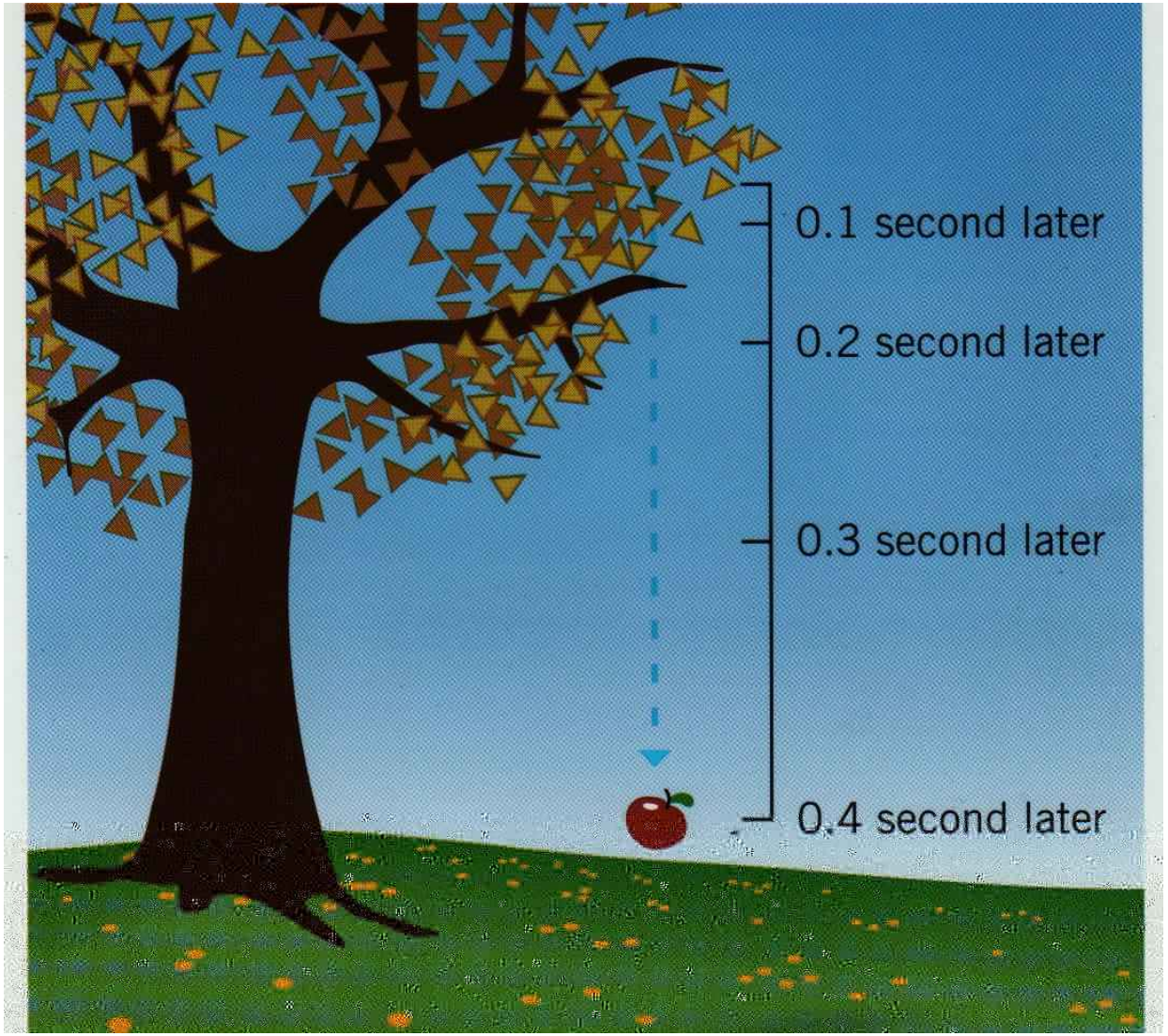


$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

If same force acts on m1, m2, and m1+m2, the accelerations are different.

Newton's 2nd law (cont.)

Example: gravity



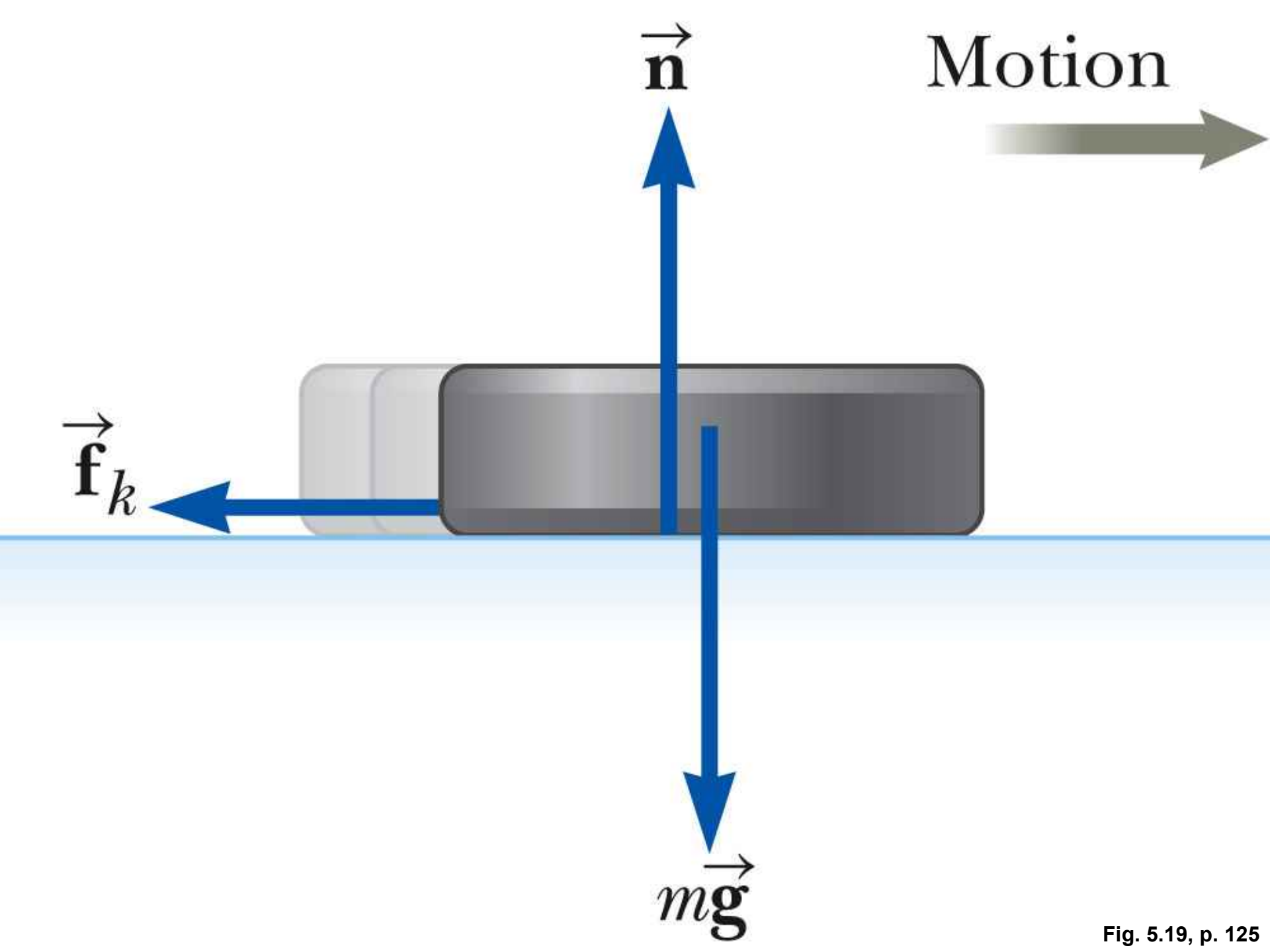


Fig. 5.19, p. 125

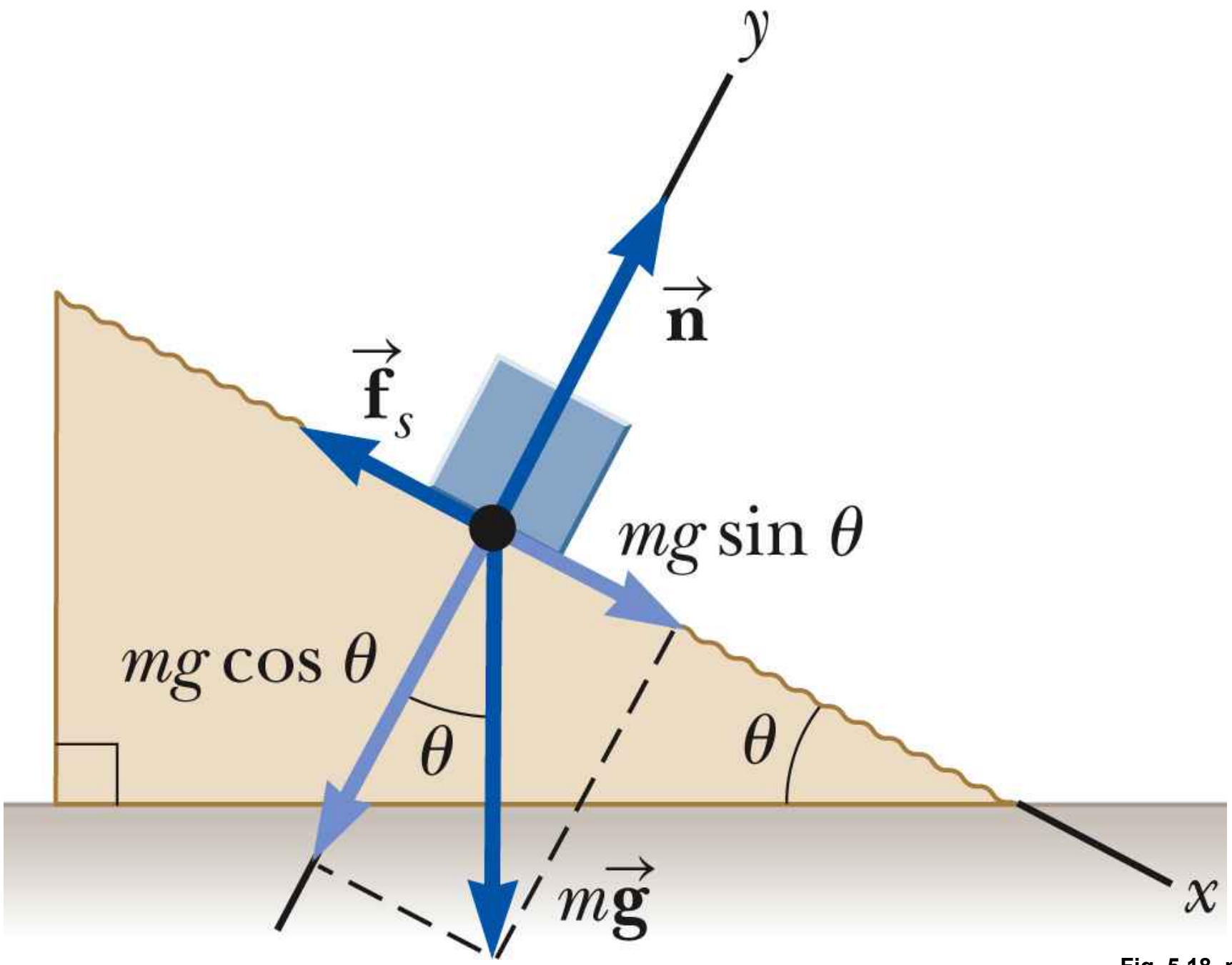

y
$\vec{\mathbf{n}}$
$\vec{\mathbf{f}}_s$
$mg \sin \theta$
$mg \cos \theta$
θ
θ
$m\vec{\mathbf{g}}$
x

Fig. 5.18, p. 124

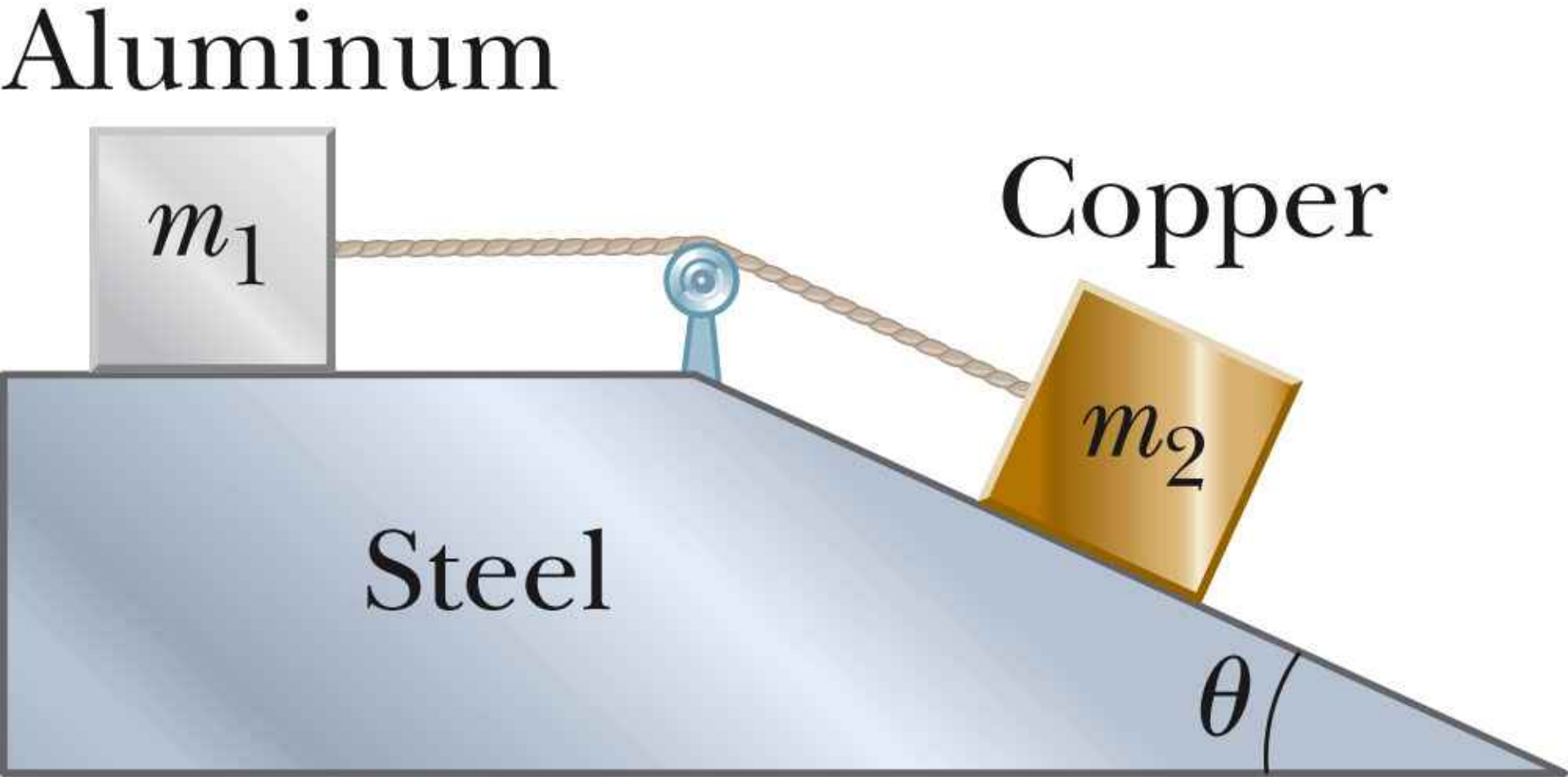


Fig. P5.62, p. 136

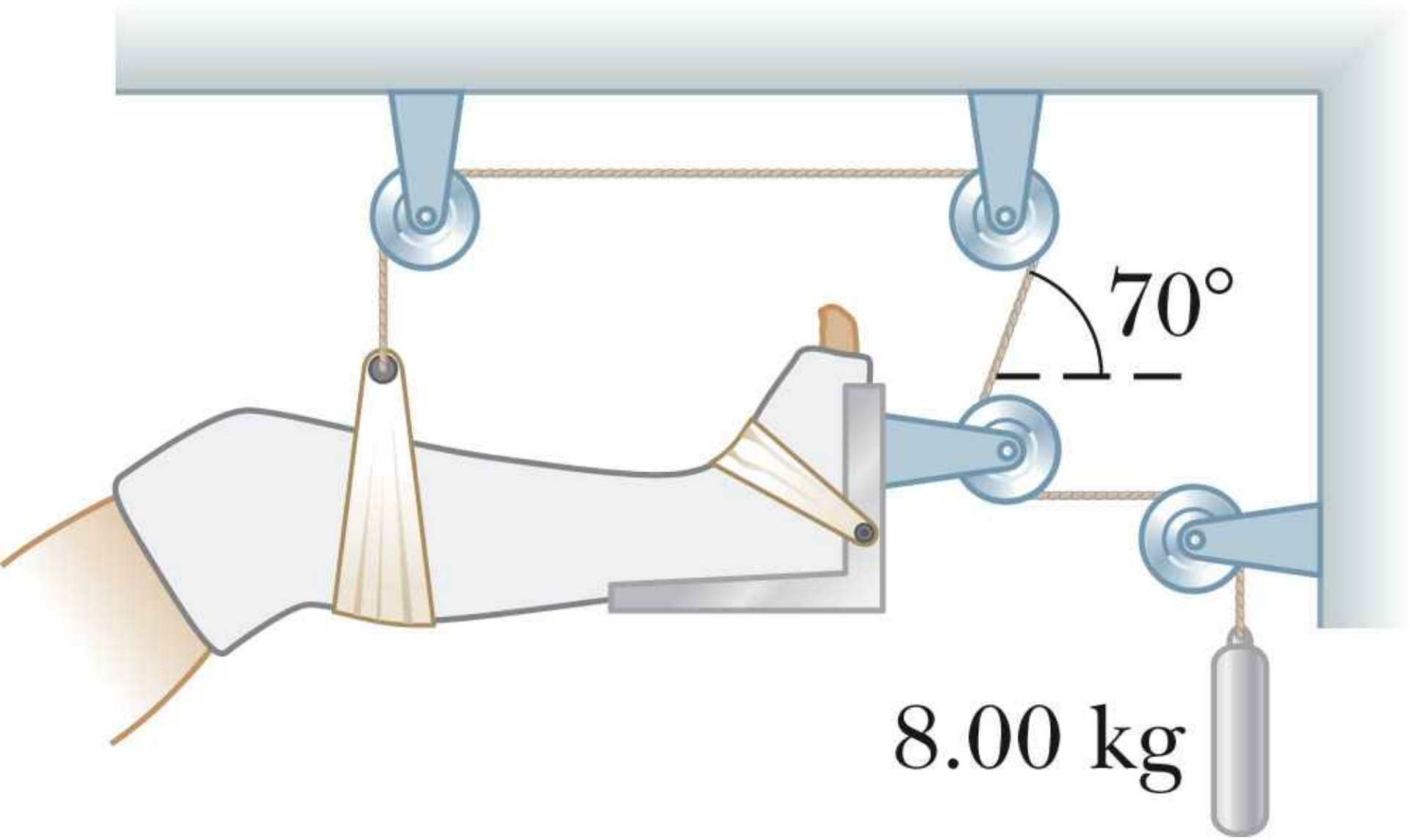


Fig. P5.26, p. 133