3.Newton's Third Law

If you press against a corner of this textbook with your fingertip, the book pushes back and makes a small dent in your skin. If you push harder, the book does the same and the dent in your skin is a little larger. This simple activity illustrates that forces are interactions between two objects: when your finger pushes on the book, the book pushes back on your finger. This important principle is known as Newton's third law

Newton's third law

If two objects interact, the force $\vec{F}_{12}$ exerted by object 1 on object 2 is equal in magnitude and opposite in direction to the force $\vec{F}_{21}$ exerted by object 2 on object 1:

$$\vec{F}_{12} = -\vec{F}_{21} \qquad (5.7)$$

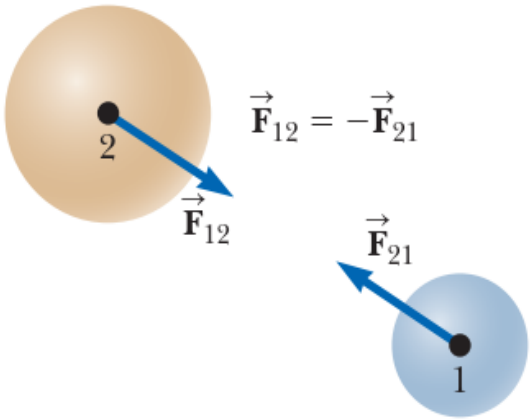

Figure 5.6 Newton's third law. The force $\vec{F}_{12}$ exerted by object 1 on object 2 is equal in magnitude and opposite in direction to the force $\vec{F}_{21}$ exerted by object 2 on object 1.

Ex ch 3

23. | The position of a particle as a function of time is given by $\vec{r} = (5.0\hat{i} + 4.0\hat{j})t^2$ m, where t is in seconds.
   a. What is the particle's distance from the origin at $t = 0$, 2, and 5 s?
   b. Find an expression for the particle's velocity $\vec{v}$ as a function of time.
   c. What is the particle's speed at $t = 0$, 2, and 5 s?

23. a. 0 m, 25.6 m, 160 m b. $(10\hat{i} + 8\hat{j})t$ m/s c. 0 64.0 m/s
25. a. $-6\hat{i} + 2\hat{j}$ b. 6.3, 18° above the $-x$-axis
27. $-1.1\hat{i} - 3.0\hat{j}$
29. $0.707\hat{i} + 0.707\hat{j}$
31. a. 100 m lower b. 5.03 km

Ex . page 148

13. | FIGURE EX5.13 shows an acceleration-versus-force graph for a 500 g object. What acceleration values go in the blanks on the vertical scale?

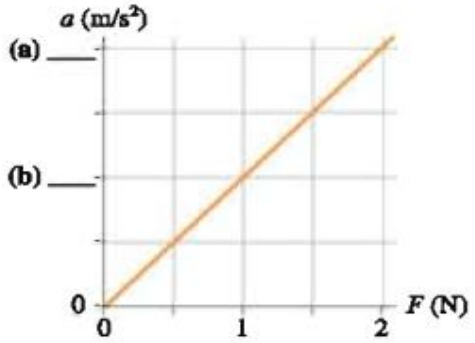

FIGURE EX5.13

Kinetic friction $\vec{f}_k$

7. 3
9. $\frac{9}{25}$
11. 3.7 s
13. a. 4 m/s² b. 2 m/s²
15. 0.25 kg
17. a. ≈0.05 N b. ≈100 N
19.

15. | FIGURE EX5.15 shows an object's acceleration-versus-force graph. What is the object's mass?

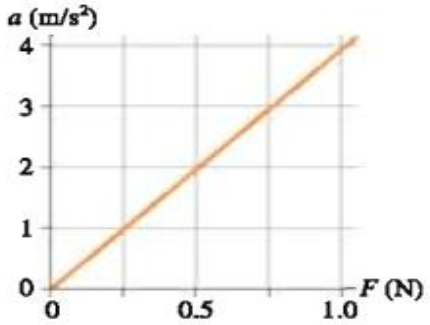

FIGURE EX5.15

Ex

30. | A single force with x-component F_x acts on a 2.0 kg object as it moves along the x-axis. The object's acceleration graph (a_x versus t) is shown in FIGURE P5.30. Draw a graph of F_x versus t.

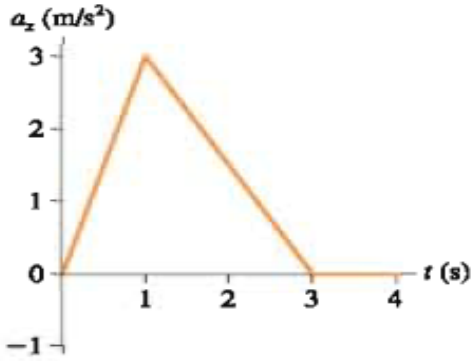

FIGURE P5.30