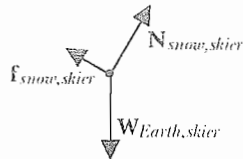




9. Rear-end collisions
11. The inertia of the anvil keeps it from moving.
13. No, inertia refers to how hard it is to speed up or slow down.
15. No, the net force will not normally point in the direction of any of the individual forces.
17. 2 N
19. The wagon now accelerates (speeds up indefinitely) because the net force is not zero.
21. East; still east
23. The net force is up.
25. It doubles.
27.  $4 \text{ m/s}^2$
29. Her mass doesn't change.
31. The weight triples.
33. For a skier moving down and to the right:
35. If there is no air resistance
37. Upward force of resistance balances downward force of gravity, so acceleration is zero.
39. The acceleration of each is zero, so the net force on each must be zero.
41. Newton's first law is always valid. There must be other forces opposing the friction so that the net force is zero.
43. The frictional force is equal to 400 N because the net force is zero.
45. 250 N
47. They are equal and opposite by Newton's third law.
49. They are equal and opposite by Newton's third law.
51. Zero
53. According to Newton's third law, there is a reaction force on the cannon.
55. The frictional force of the floor on your feet
57. 40 N
59. The forces act on different objects. The frictional force of the ground on the horse's hooves allows the horse to move the cart.
61. By Newton's second law because the net force is zero





### Exercises

1. 14 N; 2 N; 10 N
3. 250 N backward
5.  $3 \text{ m/s}^2$
7.  $900,000 \text{ m/s}^2$
9. 120 N
11.  $1.67 \text{ m/s}^2$
13. 75 kg
15. 5 N down
17.  $5 \text{ m/s}^2$
19. 162 N
21. 10 N
23.  $3 \text{ m/s}^2$

## CHAPTER 4

### Questions

1. At each point the instantaneous velocity is in the direction of motion (tangent to the circle), and the net force is toward the center of the circle.
3. Gravity provides the required centripetal force.
5. The velocity is tangent to the path; all the others point radially inward.
7. (a)  (b) 
9. (a) Speeding up in a straight line (b) Speeding up and turning left
11. (a) Any example that is moving up and speeding up would work, such as a rocket taking off. (b) Any example that is moving down and slowing down would work, such as a diver slowing down as she enters the water.
13. The tension force must be greater than the monkey's weight.
15. At the bottom
17. Doubling speed would quadruple acceleration; reducing radius to half would only double acceleration.
19. Only the force of gravity
21. The ball's velocity is horizontal toward home plate; the net force and acceleration are vertically downward.
23. The accelerations would be the same. Acceleration is independent of horizontal velocity.
25. They hit at the same time. They start with the same vertical velocity.
27. She should not modify anything.
29. Kicks the ball at a larger angle.
31. 5 N, by Newton's third law
33. The diagram contains only the gravitational force exerted by the Sun.
35. Point C is most likely nearest the object's center of mass.

### Exercises

1. (a) 5 m/s west (b) 5 m/s east (c) 15 m/s east
3. 5 m/s at  $37^\circ$  north of west
5.  $5 \text{ m/s}^2$  ( $53^\circ$  north of east)
7. (a)  $8 \text{ m/s}^2$  (b) 960 N
9. (a)  $3.15 \times 10^7 \text{ s}$  (b)  $9.42 \times 10^{11} \text{ m}$  (c)  $5.96 \times 10^{-3} \text{ m/s}^2$  (d)  $3.56 \times 10^{22} \text{ N}$
11. 22 m/s; 4 m/s
13. 60 m; 80 m
15. 2 s; 60 m
17.  $9.83 \text{ m/s}^2$

## CHAPTER 5

### Questions

1. None
3. Same, by Newton's third law
5. Same