Chapter 6 Answers

6.1 Section Review

1. Answers are: a. wind; b. the foot kicking the ball; c. gravity; d. gravitational pull of the Moon and the Sun on Earth.
2. A shopping cart full of groceries has more inertia.
3. The answer is A.
4. Answers are: (a) the normal force; (b) gravity; (c) friction
5. The answer is (D). The ball would follow a straight line of motion once the string broke.

Technology

Mass transportation

1. Cars: Currently, researchers are exploring ways to reduce the mass of a car by changing the material of its body from steel to lighter metals such as aluminum, magnesium, and their alloys, and plastic. Some studies have also been done on the use of titanium, zinc, and nonmetallic materials (like carbon fiber) for car design. The frame and chassis are integrated together reducing the number of parts.

Cars with less mass would use less fuel. But if cars use materials that are too light, they are more dangerous to ride in should a collision occur.

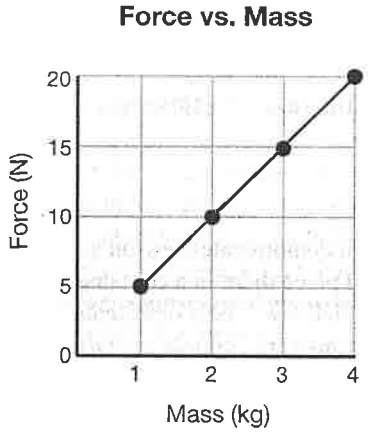
Planes: Aviation designers rely on aluminum and aluminum alloys to keep planes light-weight. Aluminum is very useful because it can be dented and still have structural integrity. However, designers are also using composite materials to reduce the weight of planes. Composites are a combination of different materials chosen for their structural properties. Composites are embedded in a matrix structure, which makes them stronger. Designers are always on the look out for new materials that are light-weight and strong. They jokingly refer to such materials that haven't been developed yet as "unobtainium."

2. Cars: Lighter weight materials have to be tested to ensure they are able to handle the forces produced by the car. The ideas of the designers are fabricated and tested to ensure they are safe alternatives to the heavier steel parts before they are used in an actual car. Also, reducing the total mass of a car can, for some parts, reduce the total force needed to be supported by the part. For example, reducing the total mass of the car reduces the forces exerted on parts of the suspension system. These parts could then be replaced by lighter materials, further reducing the total mass of the car.

Planes: Planes (and cars) may be partially composed of fiberglass, a composite material. When making parts of fiberglass (or other fibrous materials such as boron fiber), the fibers can be wound tightly or layered to increase strength but mass.

6.2 Section Review

1. Three main ideas related to the second law are: that unbalanced forces res in acceleration, that force and acceleration are proportional, and that mass a acceleration are inversely proportional.
2. For acceleration to occur there must be unbalanced forces acting on an obj to cause it to change its speed or direction.
3. 1 kg-m/s^2 = 1 N
4. $F = a \times m$; $F = 20$ m/s$^2 \times 20$ kg $= 400$ kg-m/s$^2 = 400$ N
5. Acceleration is 5 m/s^2 or 5 N/kg. Graph:



6. a = change in $v \div$ change in $t = (6$ m/s$) \div (3$ s$) = 2$ m/s^2
   $F = a \times m$; F $= 2$ m/s$^2 \times 2$ kg $= 4$ kg-m/s$^2 = 4$ N
   The ground would need to exert 4 N of force on the rabbit.
7. Acceleration is directly proportional to force and inversely proportional to mass. For example, an empty pickup truck will accelerate faster than a full pickup truck. The increasing mass decreases the acceleration of the truck.
8. $a = F \div m = (4{,}000$ N$) \div (1{,}500$ kg$) = 2.67$ m/s^2
9. The potato with the least mass will have the acceleration. The answer is the 100-gram potato.
10. The acceleration of the motorcycle is 2.5 m/s^2. The mass is 250 kg.
    $F = a \times m$; F $= 2.5$ m/s$^2 \times 250$ kg $= 625$ kg-m/s$^2 = 625$ N

Solve It!

1. Acceleration tr
2. Mass increased

Science Fact

Newton vs. Einste

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Technology

Race car design

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6.3 Section R

1. The action f that pushes equal in stre effect of the landed on th
2. The ground skateboard skateboard. your foot ha unbalanced
3. Action-reac different ob
4. Momentum
5. The exhaus push back

Solve It!

1. Acceleration triples.

2. Mass increased.

Science Fact

Newton vs. Einstein

Students are asked to take a poll to find out whether Newton or Einstein was the bigger contributor to science and humankind. You may want to have students submit a plan for how they will conduct their poll. How many people should they ask? Should the poll be anonymous? In the Royal Society poll 1,363 members of the public responded on-line and 345 scientists responded by email.

Technology

Race car design

As the mass of the car is reduced while the force produced by the motor remains the same or increases, the acceleration of the race car increases. A fast rate of acceleration makes a race car good for winning races. According to Newton's second law of motion: Acceleration is inversely proportional to mass, and directly proportional to force.

6.3 Section Review

1. The action force of Emilio pushing against the canoe creates a reaction force that pushes the canoe away from Emilio. The action and reaction forces are equal in strength and opposite in direction. Emilio clearly misjudged the effect of the action/reaction forces. If the canoe had held still, he might have landed on the dock!
2. The ground is pushing forward against your feet. At the same time, the skateboard is pushing on the ground and the ground is pushing on the skateboard. The skateboard moves forward because the ground is pushing your foot harder than the ground is pushing back on the skateboard. The unbalanced forces cause the skateboard to move forward.
3. Action-reaction forces do not cancel each other out because they work on different objects.
4. Momentum depends on the mass of an object and its velocity.
5. The exhaust gases and the plane are an action-reaction pair. The exhaust gases push back on the plane and cause it to move forward.
6. Answers:
   a. Due to Newton's third law which states that forces come in action-reaction pairs and the forces are equal and opposite in direction, the balls will experience the same amount of force.
   b. Due to the law of conservation of momentum, the total momentum of the two balls before the collision equals the total momentum after the collision (as long as we do not consider any outside forces).
   c. Let the velocity of the basketball after the collision be v_1.
   $[600 \text{ kg} \times (0 \text{ m/s})] + [(100 \text{ kg}) \times +5 \text{ m/s}] =$
   $[600 \text{ kg} \times (v_1)] + [(100 \text{ kg}) \times -4 \text{ m/s}]$
   $500 \text{ kg-m/s} = 600\text{kg } (v_1) + -400 \text{ kg-m/s}$
   $900 \text{ kg-m/s} = 600 \text{ kg } (v_1)$
   $900 \text{ kg-m/s} \div 600 \text{ kg} = 1.5 \text{ m/s} = v_1$
   The velocity of the basketball after the collision is 1.5 m/s.

Journal

Student answers will vary. Examples: (1) Action force: my hand pulling a door knob; reaction force: the door knob pulling back on me. (2) Action force: my teeth applying force to an apple; reaction force: the apple applying force to my teeth. (3) Action force: my feet applying force to a step in a stairwell; reaction force: the step applying force to my foot.

Solve It!

Sample diagram: The diagram below shows the action-reaction pair for a hand pulling on a doorknob.