

107 Answer Key - Chapter 4 assignments

Conceptual: 2, 30, 36, 40

Problems: 4, 6, 16

September 22, 2005

1 Conceptual Exercises

2) “Is any force exerted on you while you move in a circle at unchanging speed? How do you know?”

Remember our definition $acceleration = \frac{change\ in\ velocity}{time\ elapsed}$. Velocity is speed and direction; the speed is not changing, but the direction is. Since there must be a force if there is an acceleration (either by the Law of Inertia, or $F = m * a$), there is a force when going in a circle because the direction of the velocity is changing.

30) “An astronaut on the moon kicks (horizontally) a large rock. What if she kicked the same rock on Earth? Neglecting frictional effects, would it hurt her foot more, or less, or just as much?”

Why is the astronaut’s foot going to hurt? There are two ways to view this:

1) Her foot will hurt because the rock resists motion due to inertia.

Since the resistance of an object to motion (i.e. inertia) depends only on its mass, then her foot should hurt the same on the moon; its mass doesn’t change, but its weight will.

2) Her foot will hurt because of the force from the rock on her foot.

Because of the law of force pairs, the force on her foot from the rock should be the same as the force on the rock from her foot. As long as she kicks the rock the same on Earth, the force on her foot should be the same, so it should hurt the same.

36) “When a rifle fires, it accelerates a bullet along the barrel. Explain why the rifle must recoil.”

There is an acceleration of the bullet due to the rifle, therefore the rifle must be exerting a force on the bullet. By the law of force pairs, there is an equal but opposite force from the bullet on the rifle. Since the force on the bullet is forward, the opposite force on the rifle is backwards - this is the recoil.

40) “A pitcher exerts a force on a baseball while throwing it. Describe the other member of the force pair.”

The other member of the force pair must be a force on the pitcher from
the ball, away from the direction the pitcher is throwing.

2 Problems

4) “A 747 jumbo jet of mass 30,000 kg accelerates down the runway at 4 m/s^2 . What must be the thrust of each of its four engines?”

The force causing the jet to accelerate is given by $\text{Force} = (\text{mass}) * (\text{acceleration}) = 30,000 \text{ kg} * 4 \text{ m/s}^2 = 120,000 \text{ kg} * \text{m/s}^2 = 120,000 \text{ N}$. Assuming the force on the jet is evenly distributed among all four engines, each engine provides one-fourth the total force: $F_{\text{engine}} = \frac{120,000 \text{ N}}{4} = 30,000 \text{ N}$.

6) “How much force must a pitcher exert on a 0.5 kg baseball in order to accelerate it at 50 m/s^2 ?”

Once again, use $\text{Force} = (\text{mass}) * (\text{acceleration}) =$ $0.5 \text{ kg} * 50 \text{ m/s}^2 = 25 \text{ N}$.

16) “A small car having a mass of 1000 kg runs into an initially stationary 60,000 kg 18-wheeled truck from behind, exerting a force of 30,000 N on the truck. How big, and in what direction, is the force that the truck exerts on the car?”

By the law of force pairs, the force the truck exerts on the car is equal and opposite to the force the car exerts on the truck; namely, 30,000 N backwards.