

Exercises for Unit 2: Motion

Lesson 1: Velocity Exercises

1. What is velocity?
2. What's the difference between speed and velocity?
3. What is terminal velocity?
4. Why do feathers have a low terminal velocity?
5. Why do bowling balls have a high terminal velocity?
6. Gravity pulls equally on a man with a closed parachute as on the same man with his parachute open. Why does the man fall more slowly with an open parachute?

Lesson 2: Acceleration Exercises

1. What is acceleration?
2. If a car is going 35 mph and comes to a stop at a stop sign, did it accelerate?
3. Is the moon accelerating?
4. What is force?
5. Does something with a lot of inertia need a lot or a little force to get it going?
6. What makes an object change its motion?
7. What happens if something is moving downhill and the force of gravity is 4 Newtons but the force of friction is 3 Newtons?
8. If you are riding your bike and stop pedaling, why do you slow down?
9. If you are riding your bike and air friction, as well as the friction from the bike is 10 Newtons, how much force do you need to exert to keep moving forward at a constant speed?
10. What's Newton's Third Law?

11. You are floating in space and your Super 3000 Space Jets short out on you. You are holding a wrench. How do you get back to the space ship?

14. I'm riding on my bike and I accidentally hit the front brakes instead of the back brakes. The bike stops and flips me right over the handle bars. As I'm falling, I realize that I am quite a comical example of which of Newton's Laws?

12. I'm hammering a nail into a hard piece of wood. I'm using one of my son's light hammers and getting nowhere fast. Finally, I grab a hammer with a heavier head and it goes much easier. Which one of Newton's Laws did I finally remember?

15. What two things on Earth cause Newton's First Law to appear to not be true?

13. A long time ago, David Letterman had a race down a hallway with a fire extinguisher and a rolling office chair. As he shot the fire extinguisher one way, the chair zipped down the hallway. (Don't try this at home!!) Which of Newton's Laws was Dave delicately demonstrating?

Answers to Velocity Exercises

1. Velocity is the speed and direction of an object.
2. Speed is just a number. Velocity is a number and a direction.
3. Terminal velocity is when something falling cannot gain any more speed because the air resistance pushing up against that something is equal to the force of gravity pulling down on that something.
4. Gravity pulls on them very lightly and they have a lot of air resistance.
5. Gravity pulls pretty hard and they have little air resistance.
6. Gravity pulls the same on both (they weigh the same) but air resistance is much greater with an open parachute. The force of air resistance equals the force of gravity much more quickly with an open parachute so the fall is slower.

Answers to Acceleration Exercises

1. Acceleration is the rate at which velocity is changing. In other words, it is the rate at which speed and/or direction is changing.
2. Yes, it changed speed and you could say it accelerated negatively since it lost speed. (Remember, there's no such thing as deceleration in physics.)
3. Yup, did I get you with that one? I get most folks. The moon is not changing speed but it is constantly changing direction.
4. A force is a push or a pull on something.
5. A lot of force is needed to get an object with a lot of inertia moving.
6. Force causes acceleration, which is a change in motion (slowing down, speeding up, or changing directions).

7. It speeds up. That something is accelerating because there is a net positive force of 1 Newton. The force of gravity is greater than the force of friction.
8. The force of friction is acting on your bike, slowing you down.
9. 10 Newtons. Any less and you slow down, any more and you speed up. If the net forces equal zero, acceleration is zero, so there is no change in speed.
10. Every action has an equal and opposite reaction.
11. You can throw the wrench so that it goes in the opposite direction of the ship. The force of the throw will have an opposite force on you and you will zip to the ship. See how handy physics is?!?!?
12. Newton's Second Law. The heavier head of the hammer has a larger mass. The larger mass with the same acceleration will hit with a greater force on the nail than the lighter hammer will ($F = ma$).
13. Newton's Third Law. Every action has an equal and opposite reaction. The action of the fire extinguisher firing will have an equal and opposite reaction, which zips Dave backwards down the hall.
14. Newton's First Law. An object in motion tends to stay in motion. An object at rest tends to stay at rest. Since I was moving, I continued moving even though the bike stopped. Luckily, my face broke my fall! (Helmets are a good idea!)
15. Gravity and friction are two ever present forces on this planet that cause things to stop moving. If these forces did not exist, there would be nothing to stop objects from moving all over the place.