

Fall 2015 Physics 100: Homework 1 solutions

To be counted for credit, these problems must be turned in by the due date. Solutions will be posted after the due date.

- You are also encouraged to look at the exercises and problems in your book

Chapters 2 and 3: due Sep 4

1) Asteroids have been moving through (mostly empty) space for billions of years. What keeps them moving?

Nothing keeps asteroids moving. The Sun's force deflects their paths but is not needed to keep them moving. From Newton's 1st Law, an object that is moving tends to stay moving at constant speed in the same direction, unless a force acts on it. So, once set in motion, an asteroid in outer space just keeps moving.

2) As you stand on a floor, does the floor exert an upward force against your feet? How much force does it exert? Why are you not moved upward by this force?

Yes, the floor exerts an upward-directed normal force, or support force, against my feet. Because I am at rest, and not accelerating in the vertical direction, this force exactly counters the downward force on me, which is due to the gravitational force on me, i.e. my weight. That is, the floor exerts a force exactly equal to my weight, in the upward direction. I am not moved upward by this force because the net force on me is zero – the upward force from the floor and the downward gravitational force exactly cancel.

3) For a free-falling object dropped from rest, what is its speed at the end of the 5th second of fall? What about its acceleration at that time?

A free-falling object gains about 10m/s every second. So 1s after being dropped from rest, it is at 10m/s, after 2s it is 20m/s....after 5s, it is at 50 m/s. (More accurately, it gains 9.8m/s each second, which would have it at 49m/s after 5 seconds). The acceleration at that time is $g = 10 \text{ m/s}^2$ (or more accurately, 9.8 m/s^2), as it is at any time for free-falling objects.

4) If it were not for air resistance, why would it be dangerous to go outdoors on rainy days?

If there was no air resistance, the only force acting on raindrops as they fell would be Earth's gravitational force, leading them to gain in speed about 10 m/s each second. Since raindrops fall for a huge distance then they would accumulate a tremendous speed by the time they reach our level. If it were not for the slowing effect of air resistance, raindrops would strike the ground with the speed of high-speed bullets!

5) Your own clicker qn!