

## Fall 2015 Physics 100: Homework Problems

- *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?
- 2) As you sit in your chair, the chair exerts an upward force against you. How much force does it exert? Why are you not moved upward by this force, i.e. what other forces are acting on you?
- 3) For a free-falling object dropped from rest, what is its speed at the end of the 5<sup>th</sup> second of fall? What about its acceleration at that time?
- 4) If there was no air resistance, why would it be dangerous to go outdoors on rainy days?
- 5) Devise your own clicker question for Ch 2 or 3

### Chapters 4 and 5: due Sep 18

- 1) Consider if, when Galileo dropped two balls from the top of the Leaning Tower of Pisa, air resistance was not really negligible. Assuming both balls were the same size, one made of wood and one of metal, which ball struck the ground first? Explain your answer.
- 2) A firefighter of mass 80kg slides down a vertical pole with an acceleration of  $4 \text{ m/s}^2$ . What is the friction force that acts on the firefighter?
- 3) You push a heavy car by hand. The car, in turn, pushes back with an opposite but equal force. Doesn't this mean the forces cancel one another, making acceleration impossible? Why or why not?
- 4) Suppose two carts, one twice as massive as the other, are held together and joined by a compressed spring. They will fly apart when the compressed spring that joins them is released. How fast does the heavier cart roll compared to the lighter cart?
- 5) Devise your own clicker question for Ch 4 or 5.

### Chapters 6 and 7: due Sep 29

- 1) When an apple falls from a tree and strikes the ground without bouncing, what happens to its momentum?
- 2) You are at the front of a floating canoe near a dock. You jump, expecting easily to land on the dock. Instead you land in the water. Explain.
- 3) Someone wanting to sell you a "Superball" claims that it will bounce to a height greater than the height from which it was dropped. Can this be? (note that the ball is dropped from rest, not thrown)
- 4) In the absence of air resistance, a ball thrown vertically upward with a certain initial kinetic energy will return to its original level with the same kinetic energy. When air resistance is a factor affecting the ball, will it return to its original

level with the same, less, or more kinetic energy? Does your answer contradict the law of conservation of energy? Explain.

5) Devise your own clicker question for Ch 6 or Ch 7. (Remember to include multiple-choice answer options! Otherwise it is not a clicker question)

### Chapter 8: Due Oct 6

1) A bowling ball, a hula-hoop, and a frisbee, initially at rest, roll down a hill. In which order do they reach the bottom? Explain the reasoning behind your answer.

2) Why do you tend to bend forward when carrying a heavy load on your back? (hint: consider stability)

3) If the polar ice caps of the Earth were to melt, the oceans would be deeper by about 30 m. What effect would this have on the Earth's rotation?

4) Devise your own clicker question for Ch 8.

### Chapter 9 and 11: due Oct 20

1) Somewhere between the Earth and the moon, the gravitational force on a space shuttle would cancel. Is this location closer to the moon or to the Earth? Explain your answer.

2) Which is greater, the gravitational pull of the moon on the Earth or that of the sun on the Earth? Which has a greater effect on our ocean tides, the sun or the moon? Explain your answers.

3) a) A particular atom contains 47 electrons, 61 neutrons, and 47 protons. What is the atomic number of this element, and what is its name?

b) If one proton is somehow added to the atom in (a), when what would its atomic number and name be? How about if an electron was instead added? And what about if instead a neutron was added?

4) Which contributes more to an atom's mass: electrons or protons? Which contributes more to an atom's size?

5) Devise your own clicker question for Ch 9 or Ch 11.

### Chapter 13 and 14: due Oct 30

1) If liquid pressure were the same at all depths, would there be a buoyant force on an object submerged in liquid?

2) Why is it inaccurate to say that heavy objects sink and that light objects float? Give exaggerated examples to support your answer.

3) The relative densities of water, ice, and alcohol are 1.0, 0.9, and 0.8, respectively. Do ice cubes float higher or lower in a mixed alcoholic drink compared to a drink of water? Explain your answer.

4) Your uncle says that the buoyant force of the atmosphere on an elephant is much greater than the buoyant force of the atmosphere on a small helium-filled balloon. Explain whether you agree, and if so, why doesn't this mean the elephant floats.

5) Devise your own clicker question for either Ch. 13 or 14.

Chapter 15 and 19: due Nov 6

- 1) Desert sand is very hot during the day and very cool at night, varying much more than the ocean temperature. What does this mean about the specific heat of sand and that of water?
- 2) It would be much safer if we could use water in thermometers rather than mercury. Explain why this wouldn't work by considering the behavior of such a water-thermometer at 4°C if the temperature increased compared to if it decreased.
- 3) Galaxies are observed to have a "red-shift". What can we deduce about their motion, and give the name of the phenomena you are using to make this deduction?
- 4) A weight suspended from a spring is seen to bob up and down over a distance of 20 cm every three seconds. What is its frequency? Its period? Its amplitude?
- 5) Devise your own clicker question for either Ch. 15 or Ch. 19.

Chapter 20 and 22: due Nov 13

- 1) What two physics mistakes occur in a science fiction movie that shows a distant explosion in outer space where you see and hear the explosion at the same time?
- 2) Explain why if you pluck the A-string on a one-eighth-size child's violin equally hard as you pluck the A-string on a regularly-sized violin, why the sound is softer in the first case.
- 3) Consider two charged particles somehow held a certain distance apart, e.g. two electrons.
  - a) What is likely to be larger, the gravitational or the electrical force between them?
  - b) How would the electric force between them change if they are brought to twice their original distance of separation? What about the gravitational force?
- 4) In a thunderstorm, why should you not stand under a tall tree? Also, why should you not stand with your feet apart? Nor lie down?  
(Note that charges flow when there is an electric potential difference between two points, as we briefly discussed in class, more in Chapter 23; so think of the electric potential difference at different points on the ground if there was a lightning strike localized at one spot on the ground).
- 5) Your own clicker question for either Chapter 20 or Chapter 22.

Chapter 23 and 24: due Dec 1

- 1) In class, we said that electrons flow very slowly through a circuit. Why then when you flip the switch on, a distant lamp lights up almost immediately?
- 2) Consider a flashlight connected to a battery. In the following, note that the brightness of a bulb measures power.
  - a) If you add a second identical flashlight in series, how does the brightness of each bulb compare to if only one was connected?
  - b) If instead you added a second identical flashlight in parallel, then how does the brightness of each bulb compare if only one was connected?
  - c) Will the battery run down faster if the two bulbs are connected in series or in parallel?
- 3) Can an electron placed at rest in a magnetic field be set in motion by the magnetic field? What if were placed at rest in an electric field?
- 4) Several paperclips dangle from the north pole of a magnet, forming a dangling chain. What is the induced pole in the bottom of the lowest paperclip: is it a north pole or south pole? Explain your answer.
- 5) Your own clicker question.

Chapter 25, 26 and 27: due Dec 11

- 1) A magician places an aluminum ring on a table, under which is hidden an electromagnet (i.e. a coil of wire that may carry a current). When the magician says “abracadabra” (and discreetly pushes a switch that turns on the current in the coil), the ring jumps in the air. Explain his magic trick.
- 2) Can an efficient transformer step up energy? What about power? Explain your answer.
- 3) What is the same about radio waves and light? What is different about them?
- 4) Is glass transparent to light of frequencies that match its own natural frequencies?
- 5) How could you use the colored spotlights at a play to make the yellow clothes of a performer suddenly appear black?
- 6) If the sky on a certain planet in the solar system were normally orange, what color would sunsets be?
- 7) Your own clicker question