

Physics 261: Random Questions 2

These are questions from the end of chapters in Halliday and Resnick's book (used for the 130 series) and from Jearl Walker's *Flying Circus of Physics*.

- (1) You shoot an arrow into the air and you keep your eye on it as it follows a parabolic flight path to the ground. You notice that the arrow turns in flight so that it is always tangent to its flight path. What makes it do that?
- (2) In November 1984, astronauts Joe Allen and Dale Gardner salvaged a Westar-6 communications satellite from a faulty orbit and placed it into the cargo bay of the space shuttle *Discovery*. Describing the experience, Joe Allen said of the satellite, "It's not heavy; it's massive." What did he mean?
- (3) A massless rope is strung over a frictionless pulley. A monkey holds onto one end of the rope and a mirror, having the same weight as the monkey, is attached to the other end of the rope at the monkey's level. Can the monkey get away from its image seen in the mirror (a) by climbing up the rope, (b) by climbing down the rope, or (c) by releasing the rope?
- (4) A woman stands on a spring scale in an elevator. In which of the following cases will the scale record the minimum reading ...the maximum reading: (a) elevator stationary; (b) elevator cable breaks, free fall; (c) elevator accelerating upward; (d) elevator accelerating downward; (e) elevator moving at constant velocity?
- (5) A crate, heavier than you are, rests on a rough floor. The coefficient of static friction between the crate and the floor is the same as that between the soles of your shoes and the floor. Can you push the crate across the floor?
- (6) A log is floating downstream. How would you calculate the drag force acting on it?
- (7) A body's center of mass moves only if an external force is applied, but you can get to the other side of the room in a chair without letting your feet touch the floor. If all your twisting and contortions are internal forces, what provides the external force?
- (8) Suppose you suddenly find yourself driving toward a brick wall on the far side of a T-intersection. What should you do? Use your brakes *fully*, without skidding, while steering straight ahead? Turn at full speed? Or turn while applying your brakes as well as you can?

- (9) Does the weight of an hourglass depend on whether the sand is flowing? If some of the sand is in free fall, won't the weight of the hourglass be less?
- (10) Hold a yardstick horizontally on your index fingers and slide your fingers together smoothly. Does the stick slide smoothly over your fingers? No, it slides first on one finger and then on the other, and so on. Why does the sliding change back and forth?
- (11) Artificial satellites don't orbit the earth forever. Eventually the earth's atmosphere, thin as it may be up there, will bring them down. But did you know the linear speed of a satellite in a near circular orbit will increase because of the air drag? The satellite will experience an acceleration forward along its path, and the accelerations's magnitude will be the same as if the air drag were turned around and were pushing the satellite along. How can that be?