

1. (4 points) In a crash test, a 1000 kg automobile moving at 10 m/s crashes into a brick wall. How much energy goes into demolishing and heating the wall and the auto?

**Answer:** All the kinetic energy of the car will be converted into the energy going into heating and demolishing the wall and car (plus sound, which we ignore). So  $\frac{1}{2}mv^2 = \frac{1}{2}(1000 \text{ kg})(10 \text{ m/s})^2 = 50\,000 \text{ J}$ .

2. (3 points) For an object freely falling to Earth, which of the following is true, ignoring air resistance?

- (a) Its kinetic, gravitational, and total energies all increase.
- (b) Kinetic energy increases, gravitational decreases, the total remains constant.**
- (c) Kinetic energy decreases, gravitational increases, the total remains constant.
- (d) None of its energies change: they all remain constant.
- (e) Kinetic, gravitational, and total energy all decrease.

3. (3 points) Since matter is made of electrically charged particles, why don't we and the objects around us feel electric forces all the time?

- (a) Constituents of objects have opposite charges, adding up to electric neutrality overall.**
- (b) The charges need to be activated before we see any effect; normal matter is inert.
- (c) The electric forces are cancelled out by the magnetic forces.
- (d) We *do* feel these forces: that is where gravity comes from.
- (e) Since these forces act in all directions, they push as often as pull, cancelling out.

4. (3 points) Which of the following is *not* an example of electromagnetic waves?

- (a) Radio waves
- (b) Microwaves
- (c) Visible light
- (d) Sound waves**
- (e) X-rays

5. (3 points) Why would a reptilian, cold-blooded monster hiding under the bed in the dark remain undetected even if you were able to see into the infrared part of the spectrum?

- (a) Reptilian scales give off no infrared radiation
- (b) Objects at the same temperature are equally bright in the infrared**
- (c) Neutrinos interact so rarely that they routinely pass through the whole Earth
- (d) Because of the cosmic microwave background radiation
- (e) Gravitational waves would interfere with your detector

6. (4 points) According to Neil DeGrasse Tyson, in what way does science extend our senses? Give an example of an instrument allowing us to detect something we can't ordinarily sense.

**Answer:** There is a lot going on that our ordinary senses cannot detect. We extend our senses by using technology—we build instruments that can detect what our biological senses cannot. For example, we cannot see most of the electromagnetic spectrum. But we can make a radio telescope to allow us to “see” into the radio part of the spectrum. Or we can build a magnetometer (or even an ordinary compass) to detect magnetic fields. Et.c etc. Your examples will vary.