

Astronomy 301 – Fall 2019

Homework 6

Due Date: Wednesday, October 16, 2019, 9:00 AM

You must turn in your homework answers electronically via Canvas. A .pdf or .docx file would be best, but if you can get a good image of your hand-written homework, a .jpg or .png file would okay also. Make sure your name and eid appear at the beginning of your homework.

We encourage you to work together on the homework but you are not allowed to copy from each other. You must write out the answers in your own words.

1. Here are four kinds of variable stars:

- (a) Cepheid variables.
- (b) Supernovae.
- (c) RR Lyrae stars.
- (d) Eclipsing binaries.

For each type, draw a typical light curve and give a one-sentence description of the cause of the variability.

2. Compare the strong nuclear force to gravity and the electromagnetic force. Specifically, what kind of material or particle does each force act on? Are they short range or long range? Do they attract or repel? Are they strong or weak forces? If, as claimed, gravity is much weaker than the strong nuclear force, why do we notice gravity but not the nuclear force in our everyday lives?
3. Austin Energy, the electric utility for the city of Austin, can produce about 3000 MegaWatts of power (as of 2019). Since one Watt is 10^7 ergs/sec, and a MegaWatt is 10^6 Watts, Austin Energy can produce

$$3000 \times 10^6 \times 10^7 = 2.5 \times 10^{16} \text{ erg/sec.}$$

Suppose you could convert mass to electrical energy with 100% efficiency. How much mass would you have to convert to energy every year to satisfy the needs of Austin Energy?

4. Describe hydrostatic (pressure) equilibrium in stars. Hydrostatic equilibrium means that stars must have higher pressure at their centers than at their surfaces. Why? What kinds of behavior can a star have if it is not in hydrostatic equilibrium? Give examples of stars not in hydrostatic equilibrium.
5. Stars radiate energy into space at their surfaces and this energy comes from the cores of the stars. Describe the three main ways that energy can be transported from the cores of stars to their surfaces. The cores of stars must be hotter than their surfaces. Why? The Earth is hot (it surface temperature is about 300 K) and, therefore, it emits black body radiation. Why, then, does energy flow from the sun to the Earth and not from the Earth to the sun?