

Homework 08

Physics II

Due Friday, May 20, 2022

College of the Atlantic. Spring 2022

There are two parts to this assignment.

Part 1: WeBWorK. Do Homework 05 which you will find on your WeBWorK page. I recommend doing the WeBWorK part of the homework first. This will enable you to benefit from WeBWorK's instant, if not necessarily friendly, feedback before you do part two.

Part 2: Not WeBWorK. Below are some non-WeBWorK problems.

- If you want, you can do these problems in pairs and hand in only one write-up.
 - “Hand in” the problem on google classroom. You can take a picture of your work, or type up your work, or scan your work.
1. Consider the version of the EPR experiment that we considered in class on Monday, May 9. Suppose the left-moving atom has the instruction set **GRG**. The left analyzer can have orientation A, B, or C, as can the right analyzer. There are thus nine possible orientations for the left and right analyzers taken together.
 - (a) For each of the nine possible analyzer orientations, state whether the two lights flash opposite or different colors.
 - (b) What is the probability that, regardless of orientation, the lights flash different colors?
 2. Repeat the above question, but for a left-moving atom that has the instruction get **RRR**.
 3. The temperature of the sun is around 5800 Kelvin.
 - (a) What is the frequency at which the intensity of the radiation from the sun is the largest?
 - (b) How does this frequency compare to the visible spectrum? Why do you think this is the case?
 4. Suppose the temperature of a woodstove increased from 350 to 450 Fahrenheit. By what factor does the total energy radiated by the woodstove increase. (Note: You will need to convert the temperatures to Kelvin. You do not need to use the value of σ nor do you need to know the surface area of the woodstove to answer this question.)
 5. In this problem we'll use the Stefan's Law to estimate a value for the metabolic rate of humans. Assume that the surface area of a person is 2 m^2 and that the surface temperature of a person is 30 C. Why 30? Because clothes trap some body heat, so the average temperature of a person's clothes might be around 30.
 - (a) At what rate is energy lost via radiation given the assumptions above. Your answer should have units of Watts.

- (b) You should have found a worryingly large number for your answer to the previous question. We are indeed losing energy at the rate you found, but we are also gaining energy from the radiation of the surroundings. Let's say that the ambient temperature is 20 C. In this case, how much radiative energy is being absorbed by an average human. (The formula for energy absorption is the same as for energy emission.)
- (c) Find the difference between your answers to the above two questions. This is an estimate of the human metabolic rate. It's the net rate at which energy is lost, so that's how much energy your body needs to generate from food so that it can maintain a constant body temperature.
- (d) Your answer to the previous question should be in units of Watts. Convert this answer to Joules per day, using the fact that one Watt is one Joule/s.
- (e) Then convert your answer to dietary calories per day. One dietary calorie is approximately 4184 Joules. You should get an answer that is roughly the number of calories in a daily human diet.