

Physics and Mathematics of Sustainable Energy

Homework One

Due April 4, 2014

1. A 0.8 kg bird flies at 2 m/s. What is its kinetic energy?
2. Water flows into a reservoir at the rate of 20 gallons/sec. How much water flows into the tank in three hours?
3. An appliance draws 20 Watts. How much energy does the appliance use in three hours? Express your answer in both kWh and J.
4. The lights in an office draw 120 W. Suppose I have the lights on for three hours a day for a month.
 - (a) How much energy does this use? Express your answer in both kWh and J.
 - (b) How much does this amount of electrical energy cost in Maine?
5. What wattage light bulb uses 1 kWh in one day?
6. In a typical day a typical person typically eats around 2500 calories of food.¹ These are dietary calories. Confusingly, 1 dietary calorie equals 1000 “real” calories.
 - (a) How many Joules does a typical person consume in a day?
 - (b) What power is this? Express your answer in kW.
 - (c) Most of the food energy you consume ultimately gets converted to heat. Thus, we can view people as heaters—they convert chemical food energy into thermal energy. How many people would you need to have in a room to have a heating power roughly equivalent to one 1500 W space heater?

¹I believe this is the average for men in the U.S. I’m sure it’s different in other countries and different for women and children.