

PHYS/ENVS 3070

Homework Assignment #2:

Problem #1:

Below is the nutritional information about a Snicker's Candy Bar. What is the energy content of this product in the following units?

- a) Joules; b) British Thermal Units; c) Calories; d) kiloWatt-hours; e) foot-pounds

Nutrition Facts

Serving Size: (100 grams)

Amount Per Serving

Calories: 467

% Daily Value*

Total Fat 19g	29%
Saturated Fat 7g	36%
Cholesterol 14mg	4%
Sodium 228mg	9%
Total Carbohydrates 65g	21%
Dietary Fiber 3g	~
Sugars 50g	~
Protein 9g	18%

Vitamin A 2%	Vitamin C 0%
Iron 6%	Calcium 10%

*Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs

Problem #2:

It has been estimated that a person can perform continuous manual labor at a power of 60 Watts for an 8 hour working day.

- a) How many gallons of crude oil contain the energy equivalent of the useful physical labor a person can perform in a 5 day work week?
- b) How many pounds of coal contain the energy equivalent of the useful physical labor a person can perform in a 5 day work week?
- c) How many cubic feet of natural gas contains the energy equivalent of the useful physical labor a person can perform in a 5 day work week?

Problem #3:

A bacterial colony starts growing in a jar at 11:00 am. The size of the colony doubles every minute, and the jar is just full at 12:00 noon. How many minutes past 11:00 am was the jar 1/16 full?

Problem #4:

Identify each of the following units as being either a unit of Energy or a unit of Power or Neither.

- a) BTU / hour
- b) horsepower
- c) kiloWatt - hour
- d) Joule / second
- e) horsepower / second
- f) BTU / Watt

Problem #5:

Later this semester we will learn that we could meet all of the energy needs in the United States if we covered 0.16% of the entire country (including all states) with very efficient solar panels.

- a) Calculate how large an area in square miles is the equivalent of this 0.16%.

- b) Relate this area to the size of the state of Colorado?
- c) Convert the area in square miles into square meters.
- d) Ignoring certain practical issues, what is a reasonable estimate for the required cost of solar panels (per square meter) to consider such an option? Give a basis for your estimate.

Problem #6:

I decide to connect my stationary bicycle to my water heater. Assume that I generate 100 Watts of power, and that my device is 50% efficiency at converting this energy to heat in the water. Assuming there is no cooling of the water due to poor insulation, how many hours must I cycle to increase the temperature of my 50 gallon water tank by 30 degrees Fahrenheit?