

**Homework 1***Due in class April 22, 2009*

Your Name \_\_\_\_\_

**Part 1: Practice Problems on Numbers****Express all your answers in scientific notation, for example  $3 \times 10^8$ . One digit of accuracy is adequate.**

1. Work out how many meters there are in a light year.

(a) What is the speed of light, in meters per second? \_\_\_\_\_

(b) How many seconds are there in a year? \_\_\_\_\_

(c) Multiply to get the answer: \_\_\_\_\_ meters

(d) Convert your answer above to miles, using  $1.61 \text{ km} = 1 \text{ mile}$ .

$$\text{_____ meters} \times 10^{-3} \frac{\text{km}}{\text{meter}} \times \frac{\text{mile}}{1.61 \text{ km}} = \text{_____ miles}$$

2. Ratios of big numbers. To find out how much bigger the cosmic horizon ( $10^{29} \text{ cm}$ ) is than the earth ( $10^7 \text{ cm}$ ), divide:  $10^{29} \text{ cm} / 10^7 \text{ cm} = 10^{29-7} = 10^{22}$  times bigger.(a) How much bigger is a galaxy ( $10^{23} \text{ cm}$ ) than a person (1 m)? \_\_\_\_\_(b) How much bigger is a person than an atom ( $10^{-8} \text{ cm}$ )? \_\_\_\_\_3. (a) Multiply  $5 \times 10^{28}$  times  $2 \times 10^7$  \_\_\_\_\_(b) Divide  $6 \times 10^8$  by  $10^7$  \_\_\_\_\_4. The amount of energy E in a kilogram of matter is given by Einstein's famous formula  $E = mc^2$ , where m is the mass in kilograms and  $c = 3 \times 10^8 \text{ m/s}$  is the speed of light (in meters per second) and E is the energy in Joules.  $1 \text{ Joule} = 1 \text{ kg (m/s)}^2 = 1 \text{ watt-second}$ , so  $1 \text{ kilowatt-hour} = 10^3 \text{ watts} \times (60 \text{ seconds/minute}) \times (60 \text{ minutes}) = 3.6 \times 10^6 \text{ watt-seconds} = 3.6 \times 10^6 \text{ Joules}$ .

(a) How much energy in Joules is in a kilogram of matter?

- (b) You are billed for electric power at around 10 cents per kilowatt-hour (kwh), and (as we just saw)  $1 \text{ kwh} = 3.6 \times 10^6 \text{ Joules}$ . How much is the energy in a kilogram of matter worth at that rate?

## **Part 2: Term Project Thoughts**

What is your current favorite topic for your term project?

Which other classmates do you plan to work on this with?

## **Part 3: One-Paragraph Essay**

(Please type it on a separate page and attach to this page. Be sure to proofread it to avoid spelling and grammatical errors.)

In Bertold Brecht's play *Galileo*, Galileo's students are disappointed that Galileo capitulated to the Inquisition and recanted his support for the Copernican system. Do you agree?