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PHY 115—Spring 2014

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Assignment 1

**1. Alpha Centauri is approximately 4.2 light-years\* from the Earth. Using two significant figures, express this distance in:**

**a. miles**

1 light year = 5.9 x 1012 miles

1 light year = 4.2 x (5.9 x 1012 miles)

1 light year = 2.5 x 1013 miles

**b. kilometers**

1 light year = 9.5 x 1012 kilometers

1 light year = 4.2 x (9.5 x 1012 kilometers)

1 light year = 4.0 x1013 kilometers

*\*One light-year (ly) is the distance that light travels in one year in a vacuum. The speed of light in vacuum is approximately 3.0 x 108 m/s.*

**2. Your friend Dee, a Digipen junior, wants to communicate with you about time periods using unconventional units.**

**a. Dee wishes to express one year in terms of seconds. How many seconds does a year have? Please use 3 significant figures for all of the quantities you use in your calculation.**

1 year = (365.25 days / 1 year) x (24 hours / 1 day) x (60 minutes / 1 hour) x (60 seconds / 1 minute)

1 year = 31557600 seconds

1 year = 3.16 x 107 seconds

**b. How many nanoseconds are in 1.00 year?**

1 year = (365.25 days / 1 year) x (24 hours / 1 day) x (60 minutes / 1 hour) x (60 seconds / 1 minute) x

1 year = 31557600 seconds

1 year = 3.16 x 107 seconds

If 1 second = 0.000000001 nanoseconds  
then 3.16 x 107 seconds = 31600000000000000 nanoseconds

1 year = 3.16 x 1016 nanoseconds

**c. Dee wants to express one second in terms of years. How many years are there in 1.00 second?**

1 year = (365.25 days / 1 year) x (24 hours / 1 day) x (60 minutes / 1 hour) x (60 seconds / 1 minute) x

1 year = 31557600 seconds

1 year = 3.16 x 107 seconds

To get seconds in a year: second / year

1 second / 3.16 x 107 seconds

3.16 x 10-8 seconds

**3. Why is it incorrect to think that the more digits your answer contains, the more accurate it (the answer) is? Explain.**

It is incorrect to think that the more digits your answer contains, the more accurate it is due to the limitation of precise measurements and the significant figures being used in the calculation. For example, an answer involving pi, or 3.14, will only be significant to the 3 significant figures of pi being used. When multiplying or dividing the number of significant figures in the result is no greater than in the factor with the fewest significant figures. When adding and subtracting, the result cannot have more decimal places than the term with the fewest decimal places.

**4.**

**a. Estimate how long it would take (in hours) you to walk along the equator, around the surface of the Earth, if you moved at a constant pace. The mean radius of the Earth is 6.37 x 103km.**

Assumption: average walking speed of a human is 5.0 kilometers per hour

2πr = circumference of the earth

2π(6.37 x 103 km)

4.00 x 104 km / 5.0 kilometers per hour

8.00 x 103 hours

**b. Briefly state 3 assumptions you made in part a.**

Firstly I assumed that the average walking speed of a human is 5 kilometers per hour. Secondly, this equation assumed that a human can maintain a constant walking pace. Thirdly, this equation assumes that walking the varying terrain of the equator of the earth would be possible for a human to do at all.

**c. Estimate how many planets with the radius equal to the radius of the earth would fit inside the Sun. The mean radius of the Sun is equal to 6.96 x 105 km. Hint: you will need to remember the equation for the volume of a sphere.**

The volume of a sphere = (4/3) x pi x r3

The volume of the Earth = (4/3) x (3.14) x (63703) = 1.08 x 1012

The volume of the sun = (4/3) x (3.14) x (6960003) = 1.41 x 1018

Sun / Earth = 1.41 x 1018 / 1.08 x 1012

1.30 x 106 planets with the radius equal to that the of Earth would fit inside the Sun

**5. Dee has a new temporary job. The contract is for 30 business days. The employer let the employee decide between two methods of payment. The choices are:**

**(A) a thousand-dollars ($1000) a day**

**(B) one cent on the first day, two cents on the second day, four cents on the third day, and continue to double the daily pay up to day 30.**

**Dee asks for your advice. Being a good friend, you make sure Dee chooses the best option. What is the best option, (A) or (B)? Justify your answer.**

Option A: $1000 per day for 30 days = $1000 x 30 = $30,000

Option B: Geometric Sequence = first term x factor(n-1) = 0.01 X 2(30-1) = $5,368,709.12

I would tell Dee to choose option B

**6. EXTRA\_CREDIT: A theory cannot be absolutely verified. Explain the previous statement, and provide an example of a scientific theory that was accepted for many years, and then refuted or modified later. Provide references for the refuted/modified theory. Please do not write more than 200 words, or less than 50 words.**

A theory is meant to be a well-thought out explanation of some particular aspect of the world based upon repeatable observations and experimentations. A theory cannot be absolutely verified because it would, by definition, no longer be a theory. This is important because it allows for theories to be refuted and steadily updated over time. For example, Geocentricity was once an accepted theory that the Earth is the center of the universe and that all heavenly bodies move around it. This theory was supported by how it appeared that the sun, stars, and planets revolved around the stable and unmoving Earth. This theory was accepted for quite a long time until the work of Copernicus, Galileo, and Kepler in the 16th century finally disproved it.