

Created on 5/12/2010 4:12:00 PM;

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This homework is due once we have discussed uncertainty calculations in a lecture or lab.

1. The proton has a mass of $1.673\text{E-}27$ kg, and a radius of $1.0\text{E-}15$ m. Calculate its volume and density with the correct number of significant figures.

Answer: $V=4.2\text{E-}45\text{m}^3$; $\rho=4.0\text{E}17\text{kg/m}^3$. (**Note: E17 is the same as 10^{17}**)

2. Newton's law of universal gravitational attraction has the form $F = \frac{Gm_1m_2}{r^2}$ where the masses are given in kg, the distance r in m, and the force itself in newtons N. Express the units of the universal gravitational constant G in terms of the given units. We put unit calculations in square brackets.

Answer: $[G]=\text{N}\cdot\text{m}^2/\text{kg}^2$

3. There are nearly $\pi\cdot 10^7$ seconds in one year. Calculate the percent error in this approximation, where we define percent error as

$$\frac{|\text{assumed or measured value} - \text{correct or accepted value}|}{\text{correct or accepted value}} \cdot 100\%$$

Answer: 0.45%

If we use $1\text{year} = 365.25 \text{ days} = 3.15576\text{E}7$ seconds we get: The absolute error in 1 year corresponds to at most $0.005\text{days} = 432$ seconds. The relative error is $1\text{E-}5 = 0.001\%$.

4. The density of a solid cylinder has been measured as follows: radius = 1.956cm, height = 10.4 cm, mass = 865.45 grams. Calculate the density of this cylinder, its relative and its absolute uncertainty. Pay attention to the correct number of significant figures in your answers. (Consult the paper on uncertainty! [ch 0 uncertainty calculations.pdf](#)) posted on website: answer $\rho=6.92\text{g/cm}^3$; $\Delta\rho=0.04 \text{ g/cm}^3$; $\Delta\rho/\rho = 0.5\%$
www.heisingart.com/dvc

5. Unit conversions: How many meters are in 12.3 miles: $1.98\text{E}4$ m
 6. If the radius of the earth is $6.37\text{E}3\text{km}$ and the distance to the Sun is $1.5\text{E}11\text{m}$, how many meters do you travel with respect to the Sun, in 1.0 year?:
 $9.4\text{E}11\text{m}$
 7. What is 25.00 mph in m/s: 11.18m/s
 8. How many seconds are in 1 year (365.25 days): $3.1558\text{E}7\text{s}$.
 9. If the speed of light $c=3.00\text{E}8\text{m/s}$ find the distance corresponding to 1 lightyear, the distance light travels in 1 year. $9.47\text{E}15\text{m}$