Common Astronomy Calculations on the TI-30XA

Matter-Energy Equivalence

Suppose you wish to compute the energy liberated when 1 kg of matter is converted to pure energy. To do this you use Einstein's' equation $E = mc^2$ where $c = 3 \times 10^8 m/s$ - the speed of light in free space

$$(1kg) \times (3 \times 10^8 m/s)^2 = 9 \times 10^{16} \text{ joules}$$

On your TI-30XA (data entry is in normal font, computation keys are <u>underlined</u>, result is **bold**)

1 <u>×</u> 3 <u>EE</u> 8 <u>x²</u> <u>=</u> **9. ¹⁶**

Note: **9. 16** is how the TI-30XA represents 9.0×10^{16} in it's normal mode. Notice that we are not concerned about carrying the units (*kg, m/s*, etc.) through the calculation and there is no provision for keeping track of units on the TI-30 even if we wanted to. It is the number that matters most. You should know, however, that the result of this calculation is in *joules* since it is energy.

Let's try doing the same calculation with 1 gram of matter instead of 1 kilogram. Recall that a gram is 1/1000th of a kilogram or 10^{-3} kg.

$$(1 \times 10^{-3} kg) \times (3 \times 10^8 m/s)^2 = 9 \times 10^{13} \text{ joules}$$

1 <u>EE</u> 3 <u>+/-</u> <u>×</u> 3 <u>EE</u> 8 <u>x^2</u> <u>=</u> **9. 13**

Suppose you wish to compute a mass deficit. The example given in class was from the proton-proton cycle.

$4 \times$ 1 hydrogen	$= 4 \times 1.673 \times 10^{-27}$ kg	$= 6.692 \times 10^{-27}$ kg
- 1 helium	$= 1 \times 6.645 \times 10^{-27}$ kg	$= 6.645 \times 10^{-27}$ kg
		$= 0.047 \times 10^{-27}$ kg

On your TI-30XA:

6.693 <u>EE</u> 27 <u>+/-</u> <u>-</u> 6.645 <u>EE</u> 27<u>+/-</u> <u>=</u> **4.7 –29**

Which is the same as 0.047×10^{-27} kg.

Distance

Suppose you wish to compute the distance to a star with a measured parallax half angle of p = .75 arc seconds: $d_{parsecs} = \frac{1}{0.75} = 1.3$ parsecs (~ 4.3 LY)

On your TI-30XA:

.75 1/x **1.3333333**

Wien's Law

Suppose you wish to compute the temperature of our sun from the color of the photosphere. Our sun radiates most strongly at λ_{max} = 500nm. Wien's Law yields**:**

$$T_K = \frac{3\times10^6}{500nm} = 6000K$$

On your TI-30XA:

3 EE 6 ÷ 500 = **6000**

The Stefan-Boltzman Law

Suppose you wish to compute the luminosity of an object given its temperature and surface area. Recall that this may be accomplished with the Stefan-Boltzman law: $E = \sigma T^4$, where $E = L/A$, $\sigma = 5.67 \times 10^{-8}$ W/m^2 K^4 (Stefan-Boltzman constant). More conveniently written: $L = \sigma T^4 4\pi R^2$ for an isotropic radiator (spherical). Our sun has a radius of 7×10^8 km and a surface temperature of about 6000 K.

$$L = (5.67\times10^{-8})(6000)^4(4\pi)(7\times10^8)^2 \approx 4\times10^{26}$$

5.67 EE 8 +/- × 6000 y^x 4 × 4 × π × 7 EE 8 x^2 = **4.5247** $^{\mathbf{26}}$

Dénouement

These examples should be sufficient to get you through the calculations you need for astronomy class. Some practice with your calculators will insure success. As always, feel free to ask for help if you need it.