

## The Greenhouse Effect

### Instructions:

Use the text in the attached "lab" to step you through the following calculations, but use an Excel spreadsheet to make it easier for you. You can download a template spreadsheet from the course web page (click on the "Homework" link).

In addition to calculating the Earth's temperature without an atmosphere, we will repeat the calculation for Venus and Mars. This is very easy to do on a spreadsheet. Work your way down the middle column, carefully typing in the right formulae. When you get it right (you should get a T of 251 or so for the Earth), then all you have to do is copy your formulae to the cells for Venus and Mars. Voila!

After you complete this table, answer the discussion questions. Read "The Atmosphere's Influence: The Greenhouse Effect" section and complete the discussion question, but OMIT the calculation of epsilon. Do NOT calculate the "subsolar" temperature for Venus and Mars. Use the results from your table instead. Answer the discussion questions about Venus and Mars.

Constants:	$\pi$	3.14159	(units)	
	Sun's radius	6.96E+10	cm	
	Sun's temperature	5800	K	
	$\sigma$	5.67E-05	erg cm <sup>-2</sup> K <sup>-4</sup> s <sup>-1</sup>	
planet data:	<b>VENUS</b>	<b>EARTH</b>	<b>MARS</b>	(units)
distance from Sun	1.08E+13	1.50E+13	2.28E+13	cm
radius	6.05E+08	6.38E+08	3.40E+08	cm
albedo	0.35	0.35	0.35	
<b>Solar Luminosity</b>				
A =				cm <sup>2</sup>
L =				erg s <sup>-1</sup>
<b>The Solar Energy Absorbed by Planet</b>				
F =				erg cm <sup>-2</sup> s <sup>-1</sup>
E =				erg s <sup>-1</sup>
L <sub>e</sub> =				erg s <sup>-1</sup>
<b>The Planet as a Black Body</b>				
T <sub>e</sub> <sup>4</sup> =				K <sup>4</sup>
T <sub>e</sub> =		<b>251</b>		K
T <sub>e</sub> =				°C