Homework: Ch. 13

1. What happens to a liquid or gas when it reaches the critical point?

2. Describe why the laws of thermodynamics start numbering at zero and not with one. In other words, why is the Zeroth law of Thermodynamics not simply called the First law of Thermodynamics?

3. What is thermal stress? Give an example when thermal stress is useful and when it is unwanted.

4. At what temperature do the Fahrenheit and Celsius scales have the same numeric value?

5. Below is a table of temperatures. Fill in the missing values by using the appropriate conversion factor.

Celsius (°C)	Fahrenheit (°F)	Kelvin (K)	Rankine (R)
-40			
		335	
			123
	65		

6. A bubble has a volume of 1.0 cm^3 at the bottom of the ocean where the pressure is 12 atm and the temperature is 7.0 °C. What is the volume of the bubble when it rises to the surface where the pressure is 1.0 atm and the temperature is 27 °C? Assume that the air trapped inside the bubble is ideal.

7. Much of the gas near the Sun is atomic hydrogen. Its temperature would have to be 1.50×10^7 K for the average velocity, v_{rms}, to equal the escape velocity from the Sun. What is that velocity?

8. Calculate the effective (root mean square) speed of 4.00 g/mol of helium at 27.0 °C. Note that Avogadro's number is 6.02×10^{23}.

9. A brass gear is to be fitted on a metal shaft. At a temperature of 20.0 °C, the diameter of the shaft is 1.0020 cm while the hole in the gear has a diameter of 1.0000 cm. To what final temperature must the gear be raised so it will fit on the shaft? Note that $\alpha_{brass} = 1.00 \times 10^{-5}$ °C^{-1}

10. In the deep space between galaxies, the density of atoms is as low as 1.00×10^6 atoms/m^3 and the temperature is a frigid 2.70 K. What is the pressure?

11. How much taller does the Eiffel Tower become at the end of a day when the temperature has increased by 15 °C? Its original height is 321 m and you can assume that $\alpha = 6.00 \times 10^{-5} \, °C^{-1}$

12. A hot air balloon can fly when the air inside has a temperature of 77 °C and occupies a volume of 1000.0 m^3 at 1.0 atm. How many moles of air are inside the balloon?

13. Using the same balloon from the previous problem, what is the effective (root mean square) speed of the molecules of air in the balloon?

14. What is the density of water vapor in g/m^3 on a hot day in the desert when the temperature is 40.0 °C and the relative humidity is 6.00%?