PY2P30 Homework Assignment #5 (SM #2)

DUE MONDAY 26th NOVEMBER AT START OF **11 AM** LECTURE

Question 1

An ideal gas expands at a constant pressure of 3.0 atm from 0.4 L to 0.66 L while heat enters the system. Heat then flows out of the system at constant volume, and the pressure and temperature are allowed to drop until the original temperature is reached.

a. Draw the PV diagram for the overall process.
b. Calculate the total work done by the gas in the process and the total heat flow into the gas.

Question 2

a. On a day when the temperature is 20 °C and the relative humidity is 50%, calculate the mass of water per cubic meter in the air (assume saturated vapour pressure of water at 20 °C is 2.34×10^3 Nm^{-2}).
b. During the day the relative humidity is measured to be 70 % when the temperature is 25 ^{0}C. Do you expect dew to form when the temperature falls to 10 ^{0}C the following night? (Saturated vapour pressure of water:

   1.23×10^3 N m^{-2} at 10 ^{0}C,
   1.71×10^3 N m^{-2} at 15 ^{0}C,
   2.33×10^3 N m^{-2} at 20 ^{0}C,
   3.17×10^3 N m^{-2} at 25 ^{0}C)

Question 3

a. The electron density in the dayside ionosphere increased rapidly due to the arrival of a solar flare at Earth. Calculate the plasma frequency if the peak density measured was 6.7×10^{12} m^3. What wavelength does this correspond to assuming the speed of light is 3×10^8 m s^{-1}?
b. The solar flare was associated with a coronal mass ejection directed towards Earth. If it launched at 02:00 UT, and travelled with a speed of 2000 ms^{-1}, what time did it reach Earth?

Question 4

A burning log can be considered be a blackbody with an emissivity of 1.0.

a. If the log has a temperature of 800 ^{0}C and an area of 0.25 m^2, what is the power of the emitted thermal radiation?
b. What is the wavelength where the emitted spectral irradiance is maximum?

Question 5

a. What fraction of the radiant flux emitted by the Sun does the Earth intercept (assume the radius of Earth is 6,371km and 1 astronomical unit is 1.5×10^{11} m)?
b. Assuming that the Earth is in radiative equilibrium, the solar irradiance incident on the Earth is 1368 W m^{-2}, and the Earth albedo is 0.3, calculate the equivalent blackbody temperature of the Earth.