HW3, PHYS 3113

P1 (2.34) Show that during the quasistatic isothermal expansion of a monatomic ideal gas, the change in entropy is related to the heat input Q by the simple formula

$$\Delta S = \frac{Q}{T}$$

P2 (2.35) According to the Sackur-Tetrode equation, the entropy of a monatomic ideal gas can become negative when its temperature (and hence its energy) is sufficiently low. (This implies that the Sackur-Tetrode equation must be invalid at very low temperatures). Consider a sample of helium at room temperature and atmospheric pressure, then lower the temperature holding the density fixed. Pretend that the helium remains a gas and does not liquefy. Below what temperature would the Sackur-Tetrode equation predict that S is negative?

P3 (2.42) Calculate the entropy of a one-solar mass black hole, using the formula

$$S = k\frac{8\pi^2 GM^2}{hc}$$