# PHY121 Summer 2018
Problem Set #9
Due Tuesday 6/19

1. Convert from the given units of temperature to the other two (K, °C, °F).

   (a) 157 °F

   (b) -87 °C

   (c) 5 K

2. Thermal Processes:

   (a) An 0.15 mol of an ideal gas is enclosed in a cylinder with a movable piston on top. The piston has a mass of 8 kg and an area of 5 cm^2 and is free to slide up and down (so that the pressure of the gas is constant). How much work is done on the gas as the temperature of the gas is raised from 20 °C to 310 °C (assume the system is isolated)?

   (b) One mole of an ideal gas is warmed slowly so that it goes from a state (P_i, V_i) to a state $(3P_i, 3V_i)$ in such a way that the pressure of the gas is directly proportional to the volume. How much work is done on the gas in the process?

   (c) Determine the work done on a gas that expands from i to f as shown. How much work is done on the gas as it is instead compressed from f to i along the same path?
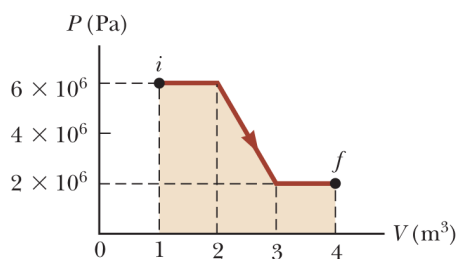
3. The First Law (no, not "A robot may not injure a human being or, through inaction, allow a human being to come to harm." – the less fun one):

   (a) A 2 mol sample of helium (initially at 298 K and 0.4 atm) is compressed isothermally to 1.15 atm. Helium is well-approximated as an ideal gas. Find the final volume of the gas, the work done on the gas, and the heat.

   (b) An ideal gas initialy at 298 K undergoes an isobaric expansion at 2.5 kPa. If the volume increases from 1.15 m^3 to 2.85 m^3 and 12.4 kJ is added to the gas by heat, what are the change in its internal energy and its final temperature?

4. High-frequency sound can be used to produce standing-wave vibrations in a wine glass. A standing-wave vibration in a wine glass is observed to have four nodes and four antinodes equally spaced around the 20.0-cm circumference of the rim of the glass. If transverse waves move around the glass at 900 m/s, an opera singer would have to produce a high harmonic with what frequency to shatter the glass with a resonant vibration?

5. You're standing in a tiled box at room temperature, pressure, and humidity. The box has dimensions 1 m x 2 m x 3 m. At integer multiples of what frequency or frequencies (i.e. in what key) should you sing to convince yourself to audition for a talent show?