Thermodynamics

You will need to build on your knowledge of the three gas laws, the concept of an ideal gas and the ideal gas equation. You will need to be confident in using the Kelvin temperature scale and to remember the concept of absolute zero. You need to understand the principles of the kinetic theory model.

Task 1: List below the assumptions of an ideal gas.

Task 2: For these questions either work directly into the document or upload a photo of your work (using the laptop camera, not your phone!)

1. A fixed mass of an ideal gas is contained in a cylinder closed with a frictionless piston. The volume of the gas is 2.5×10^{-3} m^3 when the temperature of the gas is 37 °C and the pressure of the gas is 4.0×10^5 Pa.

(a) Calculate the number of gas particles in the cylinder.

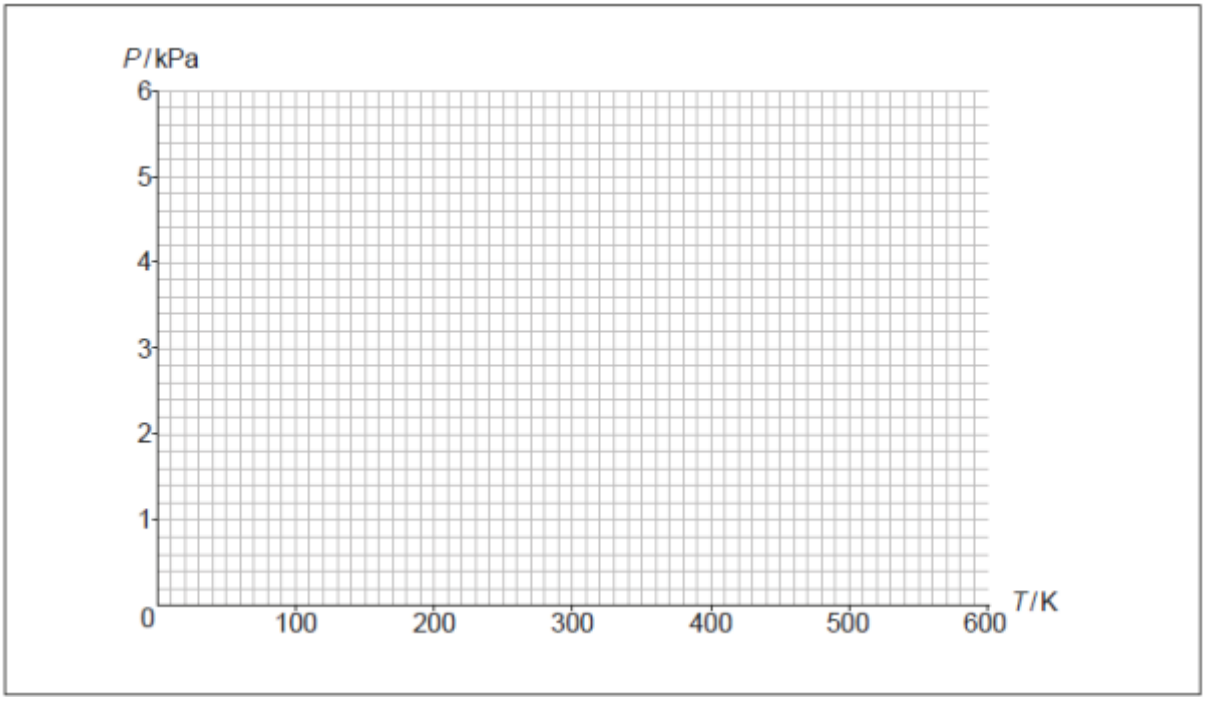
Energy is now supplied to the gas and the piston moves to allow the gas to expand. The temperature is held constant. Discuss, for this process, the changes that occur in the density of the gas.

How does the internal energy of the gas change?

2. What is the internal energy of an ideal gas?

A quantity of 0.24 mol of an ideal gas of constant volume 0.20 m^3 is kept at a temperature of 300 K. Calculate the pressure of the gas.

The temperature of the gas is increased to 500 K. Sketch, on the axes, a graph to show the variation with temperature *T* of the pressure *P* of the gas during this change. (it is a google drawing so double click to edit)



A container is filled with 1 mole of helium (molar mass 4 g mol^{-1}) and 1 mole of neon (molar mass 20 g mol^{-1}). Compare the average kinetic energy of helium atoms to that of neon atoms.

3. The air in a kitchen has pressure 1.0×10^5 Pa and temperature 22°C. A refrigerator of internal volume 0.36 m^3 is installed in the kitchen. With the door open the air in the refrigerator is initially at the same temperature and pressure as the air in the kitchen. Calculate the number of molecules of air in the refrigerator.

The refrigerator door is closed. The air in the refrigerator is cooled to 5.0°C and the number of air molecules in the refrigerator stays the same.Determine the pressure of the air inside the refrigerator.

The door of the refrigerator has an area of 0.72 m^2. Show that the minimum force needed to open the refrigerator door is about 4 kN.

Task 3: Find and copy here the Laws of Robotics as defined by Isaac Asimov

Task 4: Find and copy here the Laws of Thermodynamics

Which have you seen/heard before?

Task 5: Explain the difference between an open, closed, and isolated system.