Department of Physics and Astronomy

University of Canterbury

PHYS101-21S1

Tutorial 6

$m = 0.786\,kg$

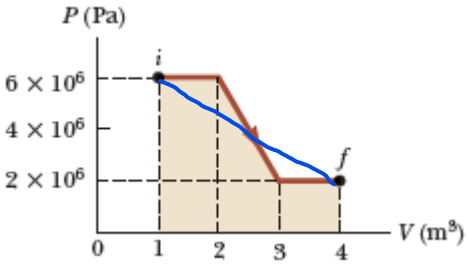
1. A 2.00-kg block of copper at 20.0°C is dropped into a large vessel of liquid nitrogen at its boiling point, 77.3 K. How many kilograms of nitrogen boil away by the time the copper reaches 77.3 K? (The specific heat of copper is 0.368 J/g·°C, and the latent heat of vaporization of nitrogen is 202.0 J/g.)

$293.15\,K$

$Q = mc\Delta t = ML$

$2 \times 0.368 \times 215.85 = M \times 202$

2. (a) Determine the work done on a gas that expands from *i* to *f*.



$3 \times 2 \times 10^6$

$+1 \times 4 \times 10^6$

$+\frac{1}{2} \times 4 \times 10^6$

$= -12\,000\,000$

(b) How much work is done on the gas if it is compressed from *f* to *i* along the same path?

PTO

$= +12\,000\,000$

3. Consider the cycle shown in the figure below. By considering the work done **in each process**, find the net heat energy transferred to the system during one cycle.

$\Delta E = Q$

$C \to A = 0$

$\Delta E_{int} = Q$

$\Delta E_{int} = Q - 350$

$B \to C = +200$

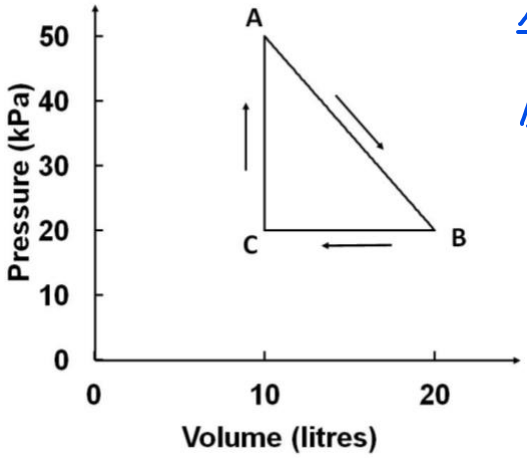
$\Delta E_{int} = Q + 200$

$\Delta E_{int} \uparrow$

$Q > 0$

$A \to C = -350$

$\Delta E_{int} \downarrow$



4. A truck with total mass 21 200 kg is travelling at 95 km/h. The truck's aluminium brakes have a combined mass of 75.0 kg. If the brakes are initially at room temperature (18.0°C) and all the truck's kinetic energy is transferred to the brakes:

   (a) What temperature do the brakes reach when the truck comes to a stop?

   $Q = mc\Delta t$

   (b) How many times can the truck be stopped from this speed before the brakes start to melt? [T_{melt} for Al is 630 °C]

   (c) State clearly the assumptions you have made in answering this problem.