2 A fixed mass of an ideal gas has a volume V and a pressure p.

The gas undergoes a cycle of changes, X to Y to Z to X, as shown in Fig. 2.1.

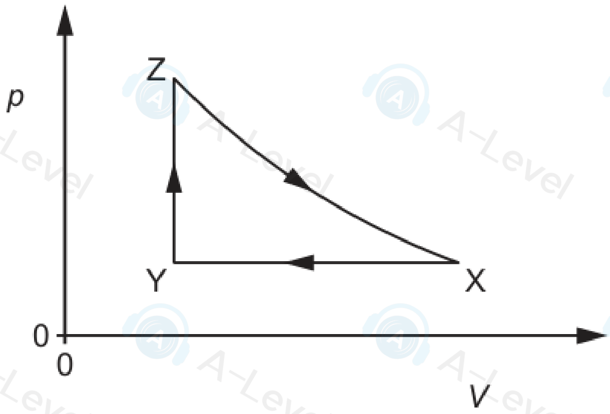

Fig. 2.1

Table 2.1 shows data for p, V and temperature T for the gas at points X, Y and Z.

Table 2.1

	$p / 10^5$ Pa	$V / 10^{-3}$ m^3	T / K
X	1.5	4.2	540
Y			230
Z	5.1		782

(a) State the change in internal energy ΔU for one complete cycle, XYZX.

ΔU = ... J [1]

(b) Calculate the amount n of gas.

n = ... mol [2]

(c) Complete Table 2.1.
Use the space below for any working.

10 In an X-ray tube, electrons are accelerated through a potential difference of 75 kV. The electrons then strike a tungsten target of effective mass 15 g.

The electron energy is converted into the energy of X-ray photons with an efficiency of 5.0%. The rest of the energy is converted into thermal energy.

(a) The X-ray tube produces an image using a current of 0.40 A for a time of 20 ms.

The specific heat capacity of tungsten is $130\,\mathrm{J\,kg^{-1}\,K^{-1}}$.

Determine the temperature rise ΔT of the tungsten target.

ΔT = ... K [3]

(b) The linear attenuation coefficient of the X-ray photons in muscle is $0.22\,\mathrm{cm^{-1}}$.

Calculate the thickness t of muscle that will absorb 80% of the incident X-ray intensity.

t = ... cm [2]

(c) Table 10.1 shows the linear attenuation coefficient μ for the X-ray photons in different tissues.

Table 10.1