PHYS102.10
Quiz # 4

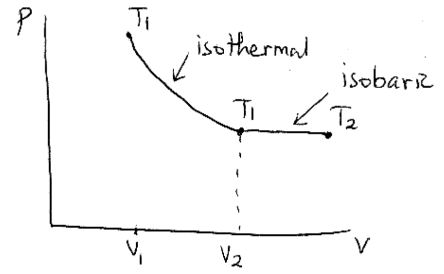
Name: Key Id#:

Two moles of an ideal monatomic gas, initially at 20 °C, are taken through an isothermal process in which the volume doubles, then through an isobaric process in which the temperature doubles.

(a) Draw roughly the two processes on a PV diagram

(b) Calculate the total change in internal energy of the gas.

a)



b) ΔE_{int} for isothermal process is zero

because $\Delta E_{int} = n C_V \Delta T$ and $\Delta T = 0$

$\Rightarrow \boxed{\Delta E_{int} = 0}$

For isobaric process

$\Delta E_{int} = n C_V \Delta T = n C_V (T_2 - T_1)$

$T_1 = 20°C = 293K$

$T_2 = 2 \times 20°C = 40°C = 313K$

$C_V = \frac{3}{2} R = 12.5$

$n = 2$ moles

$\Delta E_{int} = 2 \times 12.5 \times (313 - 293) = \boxed{500J}$

$\boxed{\Delta E_{int, total} = 500J}$

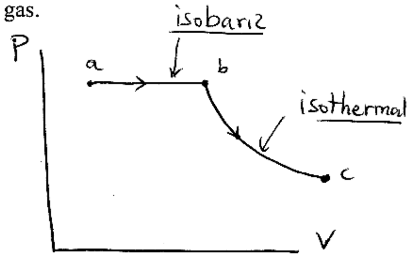
PHYS102.11
Quiz # 4

Name: Key Id#:

Five moles of helium (monatomic gas) are initially at a temperature of 27 °C and occupy a volume of 20 L. The helium gas expands isobarically until its volume doubles, then isothermally until its volume triples.

(a) Draw roughly the PV diagram of the two processes.
(b) Calculate the total change in thermal energy of the gas.

a)



b)

$$\Delta E_{int} = \Delta E_{int,ab} + \cancelto{0}{\Delta E_{int,bc}}$$

$$= n\, C_v\, \Delta T$$

$$= 5 \times \frac{3}{2} R \times (T_b - T_a)$$

$$T_a = 27\,°C = \frac{P_a V_a}{nR}$$

$$T_b = \frac{P_a V_b}{nR} = \frac{P_a\, 2V_a}{nR} = 2T_a = 54\,°C$$

$$\Delta E_{int} = 5 \times \frac{3}{2} \times 8.31 \times (54 - 27) = \boxed{1683\,J}$$

or

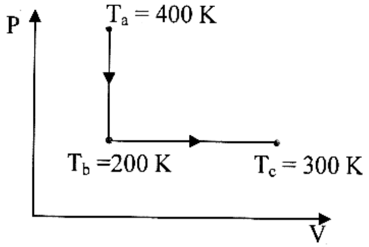
PHYS102.12
Quiz # 4

Name: Key Id#:

Two moles of helium (monatomic gas) are taken through the two processes as shown in the PV diagram.

(a) Calculate the heat gained/lost during the process a-b.

(b) Calculate the change in thermal energy during the process b-c.



a) $Q_{ab} = n C_V \Delta T = \cancel{2} \times \frac{3}{\cancel{2}} \times 8.31 \times (200 - 400)$

$= -4986$ J

b) $\Delta E_{int,bc} = n C_V \Delta T = \cancel{2} \times \frac{3}{\cancel{2}} \times 8.31 \times (300 - 200)$

$= 2493$ J