Name: __Key__

Physics 4C Spring 2020 Test 2 (Thermo)

1. One mole of an ideal gas is contained in a cylinder with a movable piston. The initial pressure is P_i and the initial volume is V_i. The gas undergoes an isothermal compression in which the final pressure is three times the initial pressure. Give your answers in terms of P_i, V_i, and any universal constant needed.

   (a) What is the initial temperature?

   (b) In terms of V_i only, what is the final volume of the gas?

   (c) Sketch this process on a PV diagram, labeling the axes and the initial and final values and showing the direction of the process.

   (d) Find the work done on the gas in this process.

   (e) Find the amount of heat transferred to the gas.

c)
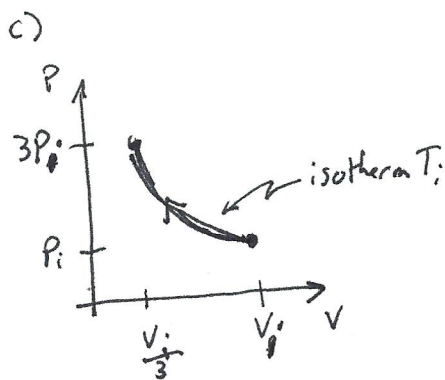
a) $PV = nRT$

$P_i V_i = nRT_i$

$T_i = \dfrac{P_i V_i}{nR}$ $n=1$

$\boxed{T_i = \dfrac{P_i V_i}{R}}$

b) Isothermal $\Rightarrow$ T const. $\Rightarrow$ $\dfrac{PV}{R}$ const

or $PV = $ const

$\dfrac{P_f V_f}{R} = \dfrac{P_i V_i}{R}$

$3P_i V_f = P_i V_i$

$\boxed{V_f = \dfrac{V_i}{3}}$

d) $W = -\displaystyle\int_{V_i}^{V_f} P \, dV$ $PV = nRT_i$

$P = \dfrac{nRT_i}{V}$

$= -\displaystyle\int_{V_i}^{\frac{V_i}{3}} \dfrac{nRT_i}{V} \, dV$

$= -nRT_i \displaystyle\int_{V_i}^{\frac{V_i}{3}} \dfrac{1}{V} \, dV$

$= -nRT_i \ln\left(\dfrac{V_i/3}{V_i}\right)$ $n=1$,

$T_i = \dfrac{P_i V_i}{R}$

$\boxed{W = P_i V_i \ln 3}$

e) · isothermal process

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

$Q = -W$

$Q = -P_i V_i \ln 3$

$\boxed{Q = -P_i V_i \ln 3}$