④

HW4 p 455 MC 4
p 456 Problems 3, 5, 6
Online - understand PV + calc W

(10)

p455 - Multiple Choice

4) Possible ways to do work on system?

(1)

ⓐ Do work on system
ⓑ Heat system
c) transfer energy w/o work or heat

P456 - Problems

3) Helium balloon & placed in container, popped (← vacuum)

balloon $V = .010\ m^3$
container $V = .020\ m^3$
$T = 20°C = 293K$

a) $W =$ ~~PΔV~~ Fd $= 0J$ b/c in vacuum → no F from atm

b) What values not changed?

(3) @1 of #3

- density
- ✓ avg K
- gas pressure
- ✓ T of helium
- ✓ Thermal E of helium

(1) here

thermally insulated

→

c) Calc final pressure

$$P_f = \frac{nRT}{V_0} = \frac{(1)(1)(1)}{2} = \frac{1}{2} P_0$$

double V, half P

(2) here)

d) gas = ?

d) $\rho = \frac{m}{V}$

$V = \frac{m}{\rho}$

$PV = nRT$

$P \frac{m}{\rho} = nRT$

text uses 1.1 atm

$m = 4u$ for He

so $m = 4 g/mol$

$m = 4 \times 10^{-3} kg$

$$\rho = \frac{Pm}{nRT} = \frac{(1.1 \times 10^5 Pa)(4 \times 10^{-3} kg)}{1 mol (8.31 \frac{J}{mol K})(293 K)}$$

$= .18 \ kg/m^3$

e) $\rho = \frac{Pm}{nRT}$ half P, half ρ

$.09 \ kg/m^3$

5) $T_0 = 20°C = 293K$ expand at constant P

a) $V_0 = .030 m^3$
$V_f = .043 m^3$

a) $W = ?$ $W = -P\Delta V$

$W = -(1\times10^5 Pa)(.043m^3 - .030m^3)$

$= -1300J$

b) $n = ?$ $n = \frac{PV}{RT} = \frac{(1\times10^5 Pa)(.030m^3)}{(8.31 J/molK)(293K)}$

$n = 1.23$ mol

(13)

c) no heating, ΔU occurs

$T_f = ?$ $\Delta U = \cancel{Q}^0 + W$

① $\frac{3}{2} nR\Delta T = W$

$\Delta T = \frac{2W}{3nR} = \frac{2(-1300J)}{3(1.23mol)(8.31 J/molK)}$

$= -84.8 K$

② $\Delta T = T_f - T_i$

$T_f = \Delta T + T_i = -84.8K + 293K$

$T_f = 208 K$

6) · empty rubber raft $\quad$ P constant
· large air pump

$V = 1.0L \ (1 \times 10^{-3} m^3)$
$F = 20N$
$d = .02m$
$T_1 = 293K$

a) $W = Fd$
$= (20N)(.02m)$
$= .40J$

b) all work convert to therma energy
$\Delta T = ?$

(1)

$\Delta U = \cancel{Q} + W$

$P_1V_1 = nRT_1$

$nR = \frac{P_1V_1}{T_1}$

$\frac{3}{2} nR \Delta T = W$

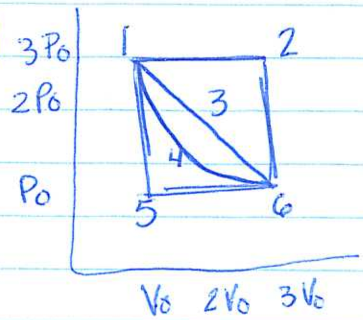
$\frac{3}{2}\left(\frac{P_1V_1}{T_1}\right)\Delta T = W$

$\Delta T = \frac{2T_1W}{3P_1V_1} = \frac{2(293K)(.40J)}{3(1\times10^5 Pa)(1\times10^{-3}m^3)}$

$\Delta T = .78K$

- Online - Understand PV diagram + calc W

a)



a) W done 1 → 2

$W = -P\Delta V$

$W = -(3P_o)(3V_o - V_o)$ Won is −

$= -3P_o(2V_o) = -6P_oV_o$

online Wby gas is +

b) Wdone 2 → 1

Wby is − online

$W = +6P_oV_o$

Won is +

(2)

c) Wdone by 5 → 6

$W = -P\Delta V = -P_o(2V_o) = -2P_oV_o$

online says +

d) Wby 1 → 3 → 6

$W_{by} = \text{Area} = \frac{1}{2}(2V_o)(2P_o) + 2V_oP_o$

$= 2V_oP_o + 2V_oP_o$

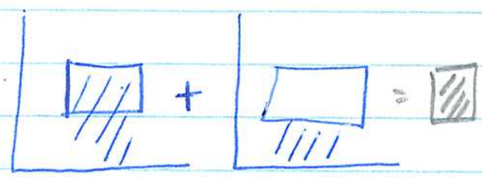
online by is +

$= -4V_oP_o$

continued

e) W_{by} $2 \to 6$ $W = 0J$ b/c no ΔV

f) W_{by} $1 \to 2 \to 6 \to 5 \to 1$



$W = P\Delta V$

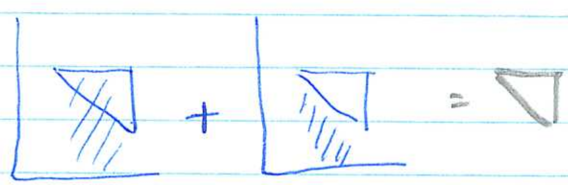
$= (2P_0)(2V_0)$

by is + → +

$= 4 P_0 V_0$

(1)

g) W_{by} $1 \to 2 \to 6 \to 3 \to 1$



$\frac{1}{2}(2V_0)(2P_0)$

$= 2 V_0 P_0$