CHM 222

QUIZ I, 16 Jan 2018

KEY

1) $W=P_{ex}\, dV$
   For reversible work, $P_{in}= P_{ex}$
   $W_{rev} = P_{in}\, dV$ & $W_{irrev} = P_{ex}\, dV$
   for expansion, $P_{in} > P_{ex}$,
   $W_{rev} > W_{irrev}$ (4 x 1 = 4)

2) $C_V = (dQ/dT)_V$
   $dE = dQ - P_{ex}dV$
   at Constant volume
   $dE_V = dQ_V$
   So, $C_V = (dQ/dT)_V = (dE/dT)_V$ (4 x 1 = 4)

3) (a) two bulbs A and B connected by a stop cock, immersed in water
   (b) B is evacuated.
   (c) stop cock opened to allow ideal gas to expand against zero pressure, $P_{ex} = 0$
   (a-c= 2)
   (d) No temp change, dT=0 and dQ=0
   (e) $dE = (dE/dT)_V\, dT + (dE/dT)_V\, dV$
   (f) $dE = dQ - P_{ex}dV$
   Or $(dE/dT)_V\, dT + (dE/dT)_V\, dV = dQ - P_{ex}dV$
   Since dT=0 and dQ=0 and $P_{ex} = 0$
   $(dE/dT)_V\, dV = 0$
   since dV is not zero, $(dE/dT)_V = 0$. (d-f = 4)

4) In Joule-Thompson Experiment dQ=0
   So $dE= P_{ex}\, dV$
   Since irreversible, $W_{irrev} = P_{ex}\, dV = P_{ex} (V_{final} - V_{initial})$
   For left piston $P_{ex}\, dV = P_1 (0-V_1) = - P_1V_1$
   For right piston $P_{ex}\, dV = P_2 (V_2 -0) = P_2V_2$
   $dE = E_2 - E_1 = - (- P_1V_1 + P_2V_2)$
   $E_2 + P_2V_2 = E_1 + P_1V_1$ (6 x1 = 6

5) H vs T curve for Carnot Cycle.
   For ideal Gas, H=E+PV= E + RT
   Further for ideal gas, $dE = C_VdT$

So $dH = C_v\, dT + RdT = C_P\, dT$
For isothermal process $dT = 0$ and hence, $dH = 0$.
Thus two isothermals become a point.
For adiabatic process $dH = C_p\, dT$
Integrating $H = C_p\, T$ + constant
Thus for adiabatic process H varies linearly with T i.e. a straight line. (6x 1)

6) work done for electrolysis of 36 gm water at 27 C. (use R = 8 J $M^{-1}K^{-1}$)
$H_2O = H_2 + ½\ O_2$
1 mole or18 gm water = 1 mole H_2 + ½ mole O_2 = 3/2 mole
36 gm or 2 moles water = 3 mole
$W = P_{ex}\ (V_{gas} - V_{water}) = P_{ex}\ V_{gas} = P_{ex}\ x\ (nRT/P_{ex}) = nRT = 3 \times 8 \times 300$ J=7200 J