Chemical Thermodynamics-II

JEE Previous year questions:

JEE mains:

1. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208 J of heat. The values of q and w for the process will be:
   (R = 8.314 J/mol K) (ln 7.5 = 2.01) (JEE,2013)

   a) q= -208 J, w=-208 J
   b) q=-208 J, w= +208 J
   c) q=+208 J, w= +208 J
   d) q=+208 J, w= - 208 J
2. If 100 moles of H_2O_2 decompose at 1 bar and 300 K, the work done (kJ) by one mole of $O_2(g)$ as it expands against 1 bar pressure is:
   (R = 8.3 J/mol K)
   a) 62.25 b) 124.5 c)249 d)498 (JEE,2016)
3. ΔU is equal to:
   a) Isobaric work; b) Adiabatic work; c) Isothermal work; d) Isochoric work (JEE ,2017)
4. An ideal gas is allowed to expand form 1 L to 10 L against a constant external pressure of I bar. The work done in kJ is:
   a) +10.0 b) -0.9 c)-2.0 d)-9.0 (JEE,2019)

Solutions:

1. By 1st law of thermodynamics, $q = \Delta U - W$
   At constant T, $\Delta U = 0$
   $q = -W$
   Heat absorbed = 208 J
   $\therefore q = +208$ J
   $W = -208$ J
2. $2H_2O_2 \leftrightarrow 2H_2O + O_2$
   $W=-P_{ext}\Delta V$
   100 moles H_2O_2 produces 50 moles O_2
   Work done by O_2= -50*8.3*300=- 124.5 KJ
3. Adiabatic work as q=0 for adiabatic process so $\Delta U=W_{ad}$
4. This is an irreversible process as gas is expanding against a constant external process.
   Work done in irreversible process
   $W = - P_{ext}\Delta V$
   $= -$ 1 bar ×× 9 L
   $= - 10^5$ Pa ×× 9 ×× 10^{-3} m^3
   $= - 9 \times\times 10^2$ N-m
   = - 900 J
   = - 0.9 kJ