

A foam cup is filled with hot water and allowed to cool. While being stirred by a paddlewheel. Initially the water has an internal energy of 200 KJ and while cooling it loses

150 KJ of heat . The paddlewheel does 25 KJ of work on the water. Calculate the change in internal energy of the water and the final internal energy.

$$U_i = 200 \text{ KJ}, Q = -150 \text{ KJ}, W = +25 \text{ KJ}$$

Q is given –ve sign because heat is given out from the system

$$\Delta U = Q + W$$

$$\Delta U = ?$$

$$= -150 + 25$$

$$= -125 \text{ KJ}$$

$$U_f = U_i + \Delta U$$

$$= 200 - 125 = 75 \text{ KJ}$$

2 A pump full of compressed gas is allowed to expand and 80 KJ work is done by the gas on an object in the lab. At the same time, the gas is warmed by the radiation of 100 KJ of heat energy . The initial internal energy of the gas is 500 KJ . Calculate the final internal energy.

$$\text{Ans..} \Delta U = 20 \text{ KJ}, \text{ Final internal} = 520 \text{ KJ}$$

3.0.5 mole of an ideal gas at a temperature of 300 K expands isothermally from an initial volume of 2L to 6 L . a) what is the work done by the gas ? b) estimate the heat added to the gas C) what is the final pressure of the gas ?

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$\text{Workdone } w = nRT \ln \left(\frac{V_f}{V_i} \right)$$

$$= 0.5 \times 8.314 \times 300 \times \ln \left(\frac{6}{2} \right) = 1369 \text{ KJ}$$

From I law of thermodynamics for iso thermal expansion $\Delta U = q - w = 0$

So $q = w$, heat added to the system is equal to work done , so $q = 1369 \text{ KJ}$, Heat flows into the system

$$P_i V_i = P_f V_f = nRT$$

$$P_f = nRT / V_f$$

$$= 0.5 \times 8.314 \times 300 / 6 \times 10^{-3}$$

$$= 207.75 \text{ KPa}$$

$$V_f = 6 \text{ lit} = 6 \times 10^{-3}$$

-3

m

3

Conversion factor

4. One mole of an ideal gas is heated at constant pressure from 0 deg Centigrade to 200 deg Centigrade . Calculate the work done

T

1

$$= 0 \text{ Deg C} = 273 \text{ K}, T$$

2

$$= 200 \text{ Deg C} = 473 \text{ K}$$

$$W = -P \Delta V = -P \{V$$

2

$$- V$$

1

$$) = -P (nRT$$

2

$$/ P - nRT$$

1

$$/P)$$

Ans 397.4 Cal 1662.8 j

5. 0.5 mole of an ideal gas expands isothermally and reversibly from 10 lit to 20 lit at a temperature of 30 deg C. Determine q, w, ΔU for the process. Express in Joules

Since it is isothermal expansion, $\Delta U = 0$, $q = -w$

$$W = -nRT \ln \left(\frac{V_f}{V_i} \right)$$

f

/ V

i

$$) = -0.5 \times 8.314 \times 303.2 \times \ln \left(\frac{20}{10} \right) = -873.6 \text{ J}$$

$$q = -w = 873.6 \text{ J}$$

6. Calculate the work done during isothermal reversible expansion of one mole of an ideal gas from 10 atm to 1 atm at 300 K

Ans 1388.8 cal