

Quiz #4

Name Key

1. Matching (Use a letter only once)

The expression for isothermal, reversible work is

a.When changing the temperature of a substance like liquid water at constant P, the heat, q, is j.If the only work is P,V work and V is constant, q equals f. ΔH is negative for d.The enthalpy, H, is defined as g.

a. $-nRT \ln(V_2/V_1)$

b. $3RT/2$

c. $(\partial H/\partial T)_P$

d. condensation

e. $q + w$

f. ΔU

g. $U + PV$

h. $-nRT \ln V$

i. evaporation

j. $\int C_p dT$

2. One mole of an ideal gas initially at a volume of 1.0 L and 300 K is allowed to expand reversibly and isothermally until its final volume is 15.0 L. What are ΔU , ΔH , q, and w.

$R = 8.314 \text{ J/mol}\cdot\text{K}$

$(1/2) \Delta U = C_V \Delta T = 0$

$(1/2) \Delta H = C_P \Delta T = 0$

$H = U + PV$

$\Delta H = \Delta U + \Delta(PV)$

$\Delta H = \Delta U + nR\Delta T$

$\Delta H = \Delta U = 0$

$(1/2) q = -w = +6.754 \text{ kJ}$

$$(1/2) w = -nRT \ln \frac{V_2}{V_1} = -8.314 \times 300 \times \ln(15/1)$$

$$= -6.754 \text{ J} = -6.754 \text{ kJ}$$

3. It takes 330 joules of heat to raise the temperature of 24.6 g of benzene, C_6H_6 , from 21.0 to 28.7° at constant pressure. What is the molar heat capacity of benzene at constant pressure?

Atomic weights are H = 1.008 and C = 12.01.

$330 \text{ J} = C_p(24.6 \text{ g}) \times 7.7$

$$M [C_6H_6] = 6.048 + 72.06$$

$$= 78.11 \text{ g}$$

$C_p(24.6 \text{ g}) = \frac{42.86 \text{ J}}{\text{K}}$

$\bar{C}_p = \frac{42.86 \text{ J}}{\text{K} \times 24.6 \text{ g}} \times \frac{78.11 \text{ g}}{\text{mole}}$

$C_p(1 \text{ g}) = \frac{42.86 \text{ J}}{\text{K} \times 24.6 \text{ g}}$

$= \frac{136 \text{ J}}{\text{K}\cdot\text{mole}}$