SI Worksheet

4/14/22

Agenda:

Worksheet

1. Suppose 40.00 J of energy is transferred by heat to a system, while the system does 10.00 J of work. Later, heat transfers 25.00 J out of the system, while 4.00 J is done by work on the system. What is the net change in the system's internal energy?

$q = 40.00J - 25.00J = 15.00J$

$W = -10.00J + 4.00J = -6.00J$

$\Delta E = q + W$

$\Delta E = 15.00J + (-6.00J) = 9.00J$

2. A piece of unknown metal weighs 348 g. When the metal piece absorbs 6.64 kJ of heat, its temperature increases from 22.4 °C to 43.6 °C. Determine the specific heat of this metal and use the table below to determine the identity of the unknown metal.

Substance	Specific Heat (J/g*C)
Helium	5.193
Oxygen	0.918
Aluminum	0.897
Lead	0.130

$m = 348g$

$q = 6.64kJ$

$\Delta T = 43.6 - 22.4°C$

$q = mc \times \Delta T$

$6640J = (348g)c \times (21.2)$

$0.9000 = c$

prob aluminum

3. A 13.5 g sample of gold is heated, then places in a calorimeter containing 60.0 g of water. Temperature of water increases from 19.00 C to 20.00 C. The specific heat of gold is 0.130 J/gC. What was the initial temperature of the gold metal sample?

Au

$m = 13.5g$

$C = 0.130 J/g°C$

$\Delta T = 20.00°C - T_i$

H_2O

$m = 60.0g$

$C = 4.184 J/g°C$

$\Delta T = 1.00°C$

$q_{H_2O} = -q_{Au}$

$(60.0)(4.184)(1.00) = -((13.5)(0.130)(20.00 - T_i))$

$143.04 = -20.00 - T_i$

$163.04°C = T_i$

4. Given:

$N_2O_4(g) \rightarrow 2\,NO_2(g)$ $\quad \Delta H°_1 = +58$ kJ

$NO(g) + \frac{1}{2}\,O_2(g) \rightarrow NO_{2(g)}$ $\quad \Delta H°_2 = -56$ kJ

Calculate the standard enthalpy change for the following reaction:

$2\,NO(g) + O_2(g) \rightarrow N_2O_4(g)$

(1) reverse

$2NO_2 \longrightarrow N_2O_4$ $\quad \Delta H_1 = -58$ KJ

(2) multiply everything by 2

$2NO + O_2 \longrightarrow 2NO_2$ $\quad \Delta H°_2 = (-56)2$

$2NO_2 \longrightarrow N_2O_4$

$2NO + O_2 \longrightarrow 2NO_2$ $\quad \Delta H°_{rxn} = -170$ KJ

$2NO(g) + O_2(g) \longrightarrow N_2O_4$

5. Calculate the ΔH°_{rxn} for the reaction:

$4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$,

from the following data:

$N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$	$\Delta H_1 = -180.5$ kJ
$N_2\ (g) + 3H_2\ (g) \rightarrow 2\ NH_3$	$\Delta H_2 = -91.8$ kJ
$2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$	$\Delta H_3 = -483.6$ kJ

-361

(1) multiply by 2 $2N_2 + 2O_2 \longrightarrow 4NO$ $(-180.5)2$

(2) reverse and x2 $4NH_3 \longrightarrow 2N_2 + 6H_2$ $(+91.8)2$ $+183.6$

(3) multiply by 3 $6H_2 + 3O_2 \longrightarrow 6H_2O$ $(-483.6)3$ -1450.8

$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

$\Delta H_{rxn} = -1628.2$ kJ

6. If time…

Calculate the ΔH°_{rxn} for the reaction:

$CH_4\ (g) + NH_3\ (g) \rightarrow HCN\ (g) + 3H_2\ (g)$

from the following data:

$N_2\ (g) + 3H_2\ (g) \rightarrow 2\ NH_3\ (g)$	$\Delta H = -91.8$ kJ
$C(s) + 2\ H_2\ (g) \rightarrow CH_4\ (g)$	$\Delta H = -74.9$ kJ
$H_2\ (g) + 2\ C(s) + N_2\ (g) \rightarrow 2\ HCN\ (g)$	$\Delta H = +270.3$ kJ

+45.9

(1) reverse multiply by 1/2 $NH_3 \longrightarrow \frac{1}{2}N_2 + \frac{3}{2}H_2$ $(+91.8)\frac{1}{2}$

(2) reverse $CH_4 \longrightarrow C(s) + 2H_2$ $+74.9$ $+135.15$

(3) multiply by 1/2 $\frac{1}{2}H_2 + C(s) + \frac{1}{2}N_2 \longrightarrow HCN$ $(+270.3)\frac{1}{2}$

$NH_3 + CH_4 \longrightarrow HCN + 3H_2$ $\Delta H_{rxn} = 255.95$ kJ