83%

55/66

Hot Dog

[66 marks]

Communication [9 marks]

1. Enthalpy is a state function. Fully explain the connection between this statement and Hess' Law. [3 marks] 3

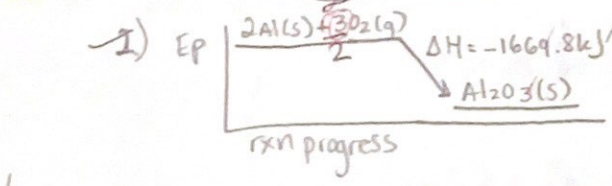
extensive property — changes depending on the amount

In state functions we only care about the amount of matter produced and the beginning and ending steps. In Hess' Law, we have many rxns but we only care about the energy change from beginning to end, not everything in between

-The enthalpy for a particular rxn also depends on the state of the substances

2. Use the four methods of representing an enthalpy change for the formation of solid aluminum oxide. Be sure to look up and include the value of the enthalpy of formation for solid aluminum oxide. [6 marks] 5

1) $2Al(s) + \frac{3}{2}O_2(g) \rightarrow Al_2O_3(s) \quad \Delta H°_f = -1669.8\ kJ/mol$



3) $2Al(s) + \frac{3}{2}O_2(g) \rightarrow Al_2O_3(s) + 1669.8\ kJ/mol$

4) $\Delta H°_f = -1669.8\ kJ/mol\ Al_2O_3(s)$

Making Connections [15 marks]

3. What kind of substance needs more energy to undergo a rise of 10 degrees in temperature – some... specific heat or a low specific heat? Explain thoroughly. [3 marks] 3

A substance w/ A high specific heat capacity. Say $q=?$, $\Delta T = 10°C$, $c=?$

$m = 1g$

→ $q = m\Delta Tc$ (for something with a low h.s.h.c)

$c = 0.900$

$q = 10(0.900)$

$q = 9$ kJ

→ For something with a high h.s.h.c $C = 4.184$

$q = 10(4.184) = 41.84$ kJ

The substance with the h... h.s.h.c needs only 9kJ to undergo a change in temp. of 10°C, and the substance with a high H.S.H.C needs 41.84kJ to undergo a change of 10°C

4. What mass of water could be heated from 22.5°C to 95.0°C by the combustion of 12.57 mol of liquid methanol (CH_3OH)? [12 marks]

7

$m_{H_2O} = ?$ $n_{methanol} = 12.57$ mol $M_{methanol} = 32.043$ g/mol

$M_{H_2O} = 18.016$ g/mol $c = 4.184$ J/g·°C

$\Delta T = 72.5$ °C

$m_{methanol} = nM$

$= (12.57)(32.043)$

$m = 402.78$g

-5

$2CH_3OH(l) + 3O_2(g) \rightarrow 4H_2O(g) + 2CO_2(g)$

$\downarrow$

$CH_3OH(l) + \frac{3}{2}O_2(g) \rightarrow 2H_2O(g) + CO_2(g)$

$\Delta H_f^\circ = \Sigma H_f^\circ(P) - \Sigma H_f^\circ(R)$

$= [(-393.5) + 2(-241.8)] - [\frac{3}{2}(0) + (-238.6)]$

$= [-877.1] - [-238.6]$

$\Delta H^\circ f = -638.5$ kJ/mol

$\Delta H = \frac{q}{n}$ ✓ $q = 80.26$ kJ $q/12.57$

$-638.5 = \frac{122.179}{n}$ not solving for n... you have mols = 12.57

$n = 0.1913$ mol

$q = m\Delta Tc$

$80.25,945 = m(4.184)(72.5)$

$m = 26.46$

$\frac{m_{H_2O}}{M_{H_2O}} = n_{H_2O}$ → $m = (0.1913)(18.016)$

$m = 3.447$g ✗

$q = m\Delta Tc$

$q = (402.78)(72.5)(4.184)$

$q = 122179.28$J

$q = 122.179$ kJ

[10 marks]

Given the following data:

$2NaCl(s) + H_2O(l) \rightarrow 2HCl(g) + Na_2O(s)$ $\Delta H = +507.31$ kJ

$NO(g) + NO_2(g) + Na_2O(s) \rightarrow 2NaNO_2(s)$ $\Delta H = -427.14$ kJ

$NO(g) + NO_2(g) \rightarrow N_2O(g) + O_2(g)$ $\Delta H = -42.68$ kJ

$2HNO_2(l) \rightarrow N_2O(g) + O_2(g) + H_2O(l)$ $\Delta H = +34.35$ kJ

calculate ΔH for the following reaction, which describes the preparation of unstable nitrous acid.

$HCl(g) + NaNO_2(s) \rightarrow HNO_2(l) + NaCl(s)$

Show all your work clearly. [10 marks]

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$\frac{1}{2}Na_2O(s) + HCl(g) \rightarrow \frac{1}{2}H_2O(l) + NaCl(s)$ ✓ $\Delta H = -53.655$ kJ ✓

$NaNO_2(s) \rightarrow \frac{1}{2}Na_2O(s) + \frac{1}{2}NO_2(g) + \frac{1}{2}NO(g)$ $\Delta H = 213.57$ kJ ✓

$\frac{1}{2}NO(g) + \frac{1}{2}NO_2(g) \rightarrow \frac{1}{2}N_2O(g) + \frac{1}{2}O_2(g)$ ✓ ✗ $\Delta H = -42.68$ kJ

$\frac{1}{2}H_2O(l) + \frac{1}{2}O_2(g) + \frac{1}{2}N_2O(g) \rightarrow HNO_2(l)$ ✓ $\Delta H = -17.175$ kJ ✓

$HCl(g) + NaNO_2(s) \rightarrow HNO_2(l) + NaCl(s)$ $\Delta H = -99.94$ kJ ✗

$\therefore \Delta H = -99.94$ kJ

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Knowledge & Understanding [5 + 27 = 32 marks]

6. If it takes 125.25 hours for a 345.2 g sample of a radioisotope to decay to 237.8 g, what is the half-life (in days) of the radioisotope? [5 marks]

5

$m_2 = m_1\left(\frac{1}{2}\right)^{t/t_{h1}}$ ✓

$m_1 = 345.2$ g

$m_2 = 237.8$ g

$t_{h1} = ?$ (days) ✓

$t = \frac{125.25 \text{ hours}}{24} = 5.21$ days

$237.8 = 345.2\left(\frac{1}{2}\right)^{\frac{5.21}{t_{h1}}}$ ✓

$0.688 = \left(\frac{1}{2}\right)^{\frac{5.21}{t_{h1}}}$

$\log 0.688 = \frac{5.21}{t_{h1}} \log 0.5$

$\frac{\log 0.688}{\log 0.5} = \frac{5.21}{t_{h1}}$ ✓

$\frac{5.21}{0.5376} = t_{h1}$ ✓

$t_{h1} = 9.7$ days