ARIS

50.0 mL of 2.00 M $HCl_{(aq)}$ is added to 100.0 mL of 1.00 M $Sr(OH)_{2(aq)}$ in a constant pressure calorimeter. Given:

$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$; $\Delta H^\circ = -56.2 \frac{kJ}{mol}$

and assuming $d_{soln} = 1.000\ g/mL$, $S_{soln} = 4.184 \frac{J}{g \cdot ^\circ C}$

what will the change in temp be?

$2HCl_{(aq)} + Sr(OH)_{2(aq)} \rightarrow SrCl_{2(aq)} + 2H_2O_{(l)}$

(MOL)

(FULL-IONIC)

$2H^+_{(aq)} + 2Cl^-_{(aq)} + Sr^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Sr^{2+}_{(aq)} + 2Cl^-_{(aq)} + 2H_2O_{(l)}$

NET-IONIC

$2H^+_{(aq)} + 2OH^-_{(aq)} \rightarrow 2H_2O_{(l)}$

LIMITING REAGENT!

mol H_2O is made ...

HCl (LR): $50.0\ mL \left| \frac{1\ L}{1000\ mL} \right| \frac{2.00\ mol\ HCl}{1\ L} \left| \frac{2\ mol\ H_2O}{2\ mol\ HCl} \right| = 0.100\ mol\ H_2O$

$Sr(OH)_2$ (XS): $100.0\ mL \left| \frac{1\ L}{1000\ mL} \right| \frac{1.00\ mol\ Sr(OH)_2}{1\ L} \left| \frac{2\ mol\ H_2O}{1\ mol\ Sr(OH)_2} \right| = 0.200\ mol\ H_2O$

$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$; $\Delta H^\circ = -56.2 \frac{kJ}{mol}$

$0.100\ mol\ H_2O \left| \frac{-56.2\ kJ}{1\ mol\ H_2O} \right| = -5.62\ kJ$

$q_{rxn} + q_{soln} = 0$

$\Rightarrow q_{soln} = -q_{rxn}$

$= +5.62\ kJ$

$q = m \cdot s \cdot \Delta t$

$\Rightarrow \Delta t = \frac{q}{m \cdot s} = \frac{5620\ J}{150.0\ g \times 4.184 \frac{J}{g \cdot ^\circ C}}$

$= 8.95\ ^\circ C$

$\Delta H_f^\circ = \Delta H_{rxn}^\circ$ where 1 mole of the substance is formed from its elements in their most stable form!

ex: $\Delta H_f^\circ (CO_2(g))$

$C_{(s,graphite)} + O_{2(g)} \longrightarrow CO_{2(g)} \; ; \Delta H_f^\circ$

ex: $\Delta H_f^\circ (CO(g))$

$C_{(s,graphite)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)} \; ; \Delta H_f^\circ$

Indirect method

Hess's Law

$A \longrightarrow B \quad \Delta H = x$

$\oplus \quad B \longrightarrow C \quad \Delta H = y$

$A + \cancel{B} \longrightarrow \cancel{B} + C \; ; \Delta H = x + y$

ex:

(1) $C_{(s,graphite)} + O_{2(g)} \longrightarrow CO_{2(g)} \; ; \Delta H^\circ = -393.5 \frac{kJ}{mol}$

(2) $CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)} \; ; \Delta H^\circ = -283.0 \frac{kJ}{mol}$

from these 2 eq's, we can find $\Delta H_f^\circ (CO_{(g)})$ which corresponds to rxn:

$C_{(s,graphite)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$

(1) $C + O_2 \longrightarrow CO_2 \; ; \Delta H = -393.5$

reverse(2) $CO_2 \longrightarrow CO + \frac{1}{2}O_2 \; ; \Delta H = +283.0$

$C + \frac{1}{2}O_2 + \cancel{CO_2} \longrightarrow \cancel{CO_2} + CO + \cancel{\frac{1}{2}O_2} \; ; \Delta H = -110.5 \frac{kJ}{mol}$

$C_{(s,graphite)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)} \; ; \Delta H^\circ = -110.5 \frac{kJ}{mol}$

Calculate $\Delta H_f^\circ (C_2H_2(g))$ given....

(1) $C_{(s,\text{graphite})} + O_{2(g)} \longrightarrow CO_{2(g)}$; $\Delta H^\circ = -393.5 \frac{kJ}{mol}$

(2) $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$; $\Delta H^\circ = -285.8 \frac{kJ}{mol}$

(3) $2C_2H_{2(g)} + 5O_{2(g)} \longrightarrow 4CO_{2(g)} + 2H_2O_{(l)}$; $\Delta H^\circ = -2598.8 \frac{kJ}{mol}$

Need:

$2C_{(s,\text{graphite})} + H_{2(g)} \longrightarrow C_2H_{2(g)}$; ΔH_f°

reverse + ½ eq (3)

$2CO_{2(g)} + H_2O_{(l)} \longrightarrow C_2H_{2(g)} + \frac{5}{2}O_{2(g)}$; $\Delta H = +1299.4 \frac{kJ}{mol}$

halved + reversed

(2) $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$; $\Delta H^\circ = -285.8 \frac{kJ}{mol}$

double (1)

$2C_{(s,\text{graphite})} + 2O_{2(g)} \longrightarrow 2CO_{2(g)}$; $\Delta H^\circ = -787.0 \frac{kJ}{mol}$

$2CO_2 + H_2O + H_2 + \frac{1}{2}O_2 \longrightarrow C_2H_2 + \frac{5}{2}O_2$

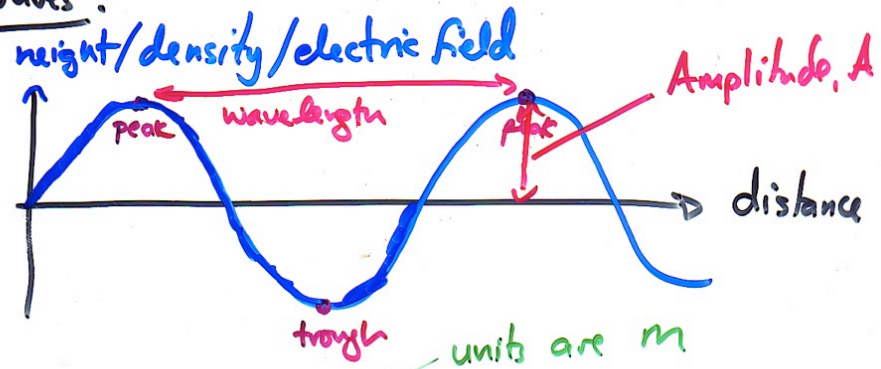
$+ 2C + 2O_2 \qquad + H_2O + 2CO_2$

$2C_{(s,\text{graphite})} + H_{2(g)} \longrightarrow C_2H_{2(g)}$; $\Delta H^\circ = +221.6 \frac{kJ}{mol}$

Chapter 7 Electrons + Atoms

electrons in atoms behave like WAVES.

Waves?



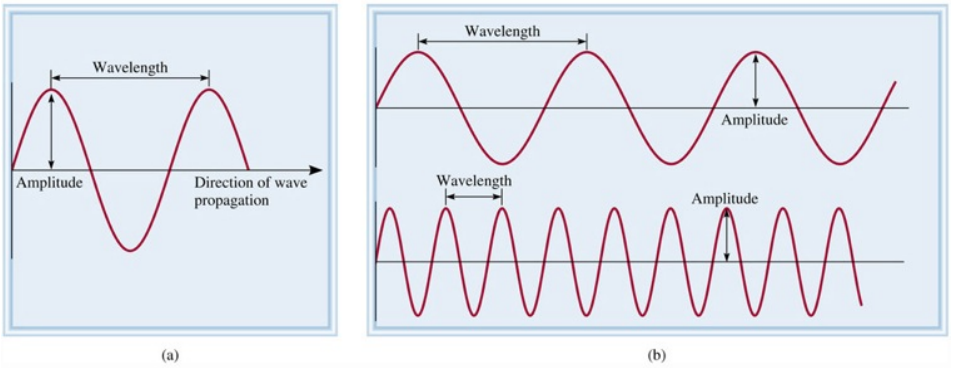
wavelength: λ (lambda) — units are m

one cycle

If you count the # of waves that pass through a point in 1 second

= frequency or ν (nu)

UNIT: $\frac{\text{cycles}}{\text{second}}$ $\frac{1}{s}$ or s^{-1} or H_z (Hertz)



(a) (b)

ex: 220 Hz (middle-C)

220 cycles/second

ex: Radio : 101.5 MHz (FM)

101.5×10^6 Hz

670 KHz (AM)

670,000 Hz