Warm Up

Determine the enthalpy change associated with converting 250. g of water to ice at 0.0 °C.

$m = 250.\,g$

$\Delta H_{solid} = ?$

$\Delta H_{solid} = n\Delta H_{solid}$

$\Delta H_{solid} = \left(\frac{250.\,g}{18.02\,g/mol}\right)\left(-6.03\,\frac{kJ}{mol}\right)$

$\Delta H_{solid} = -83.7\,kJ$

H_{fus} H_{vap}

$(s \rightarrow \ell)$

$6.03 \frac{kJ}{mol}$

$(\ell \rightarrow s)$

$-6.03 \frac{kJ}{mol}$. $H_{solid} = -H_{fus}$

H_{solid} $H_{cond} = -H_{vap}$

Homework - Worksheet

③ $m = 1.00\ t$

$\Delta H_{solid} = n H_{solid}$

$\Delta H_{solid} = \left(\frac{1000000\ g}{18.02\ g/mol}\right)\left(-6.03\ \frac{kJ}{mol}\right)$

$\Delta H_{solid} = -334000\ kJ$

Heat (q)

- change in kinetic energy
- measures transfer of energy when there are temperature changes (heating or cooling)

Enthalpy (H)

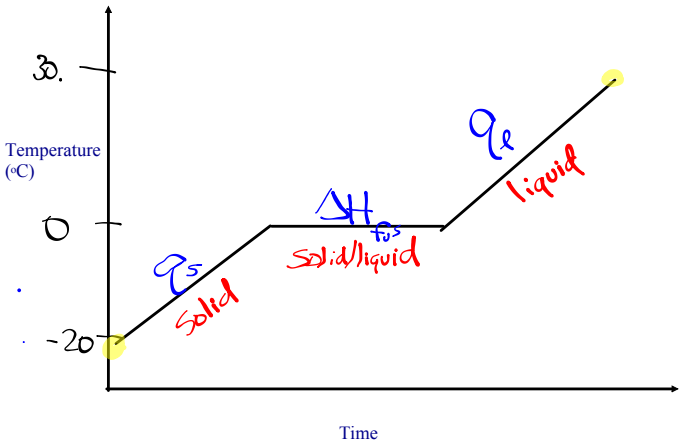
- measures potential energy
- change in energy transfer when system is at constant pressure and same initial and final temperatures

What we've looked at so far...

- Energy changes when the temperature changes
  (heating water from 20 °C to 50°C)
- Energy changes when the temperature remains the same.
  (melting of ice at 0°C)

What if you heat 10. g of ice at -20. °C until it is water at 30.°C?

Heating Curve of Water



$q_s = mC\Delta T$

$q_s = (10.0\,g)\left(2.01\,\frac{J}{g\cdot°C}\right)(20.0°C)$

$q_s = 402\,J$

$\Delta H_{fus} = n\Delta H_{fus}$

$\Delta H_{fus} = \left(\frac{10.0\,g}{18.02\,g/mol}\right)\left(6.03\,\frac{kJ}{mol}\right)$

$\Delta H_{fus} = 3.346\,kJ$

$q_\ell = mC\Delta T$

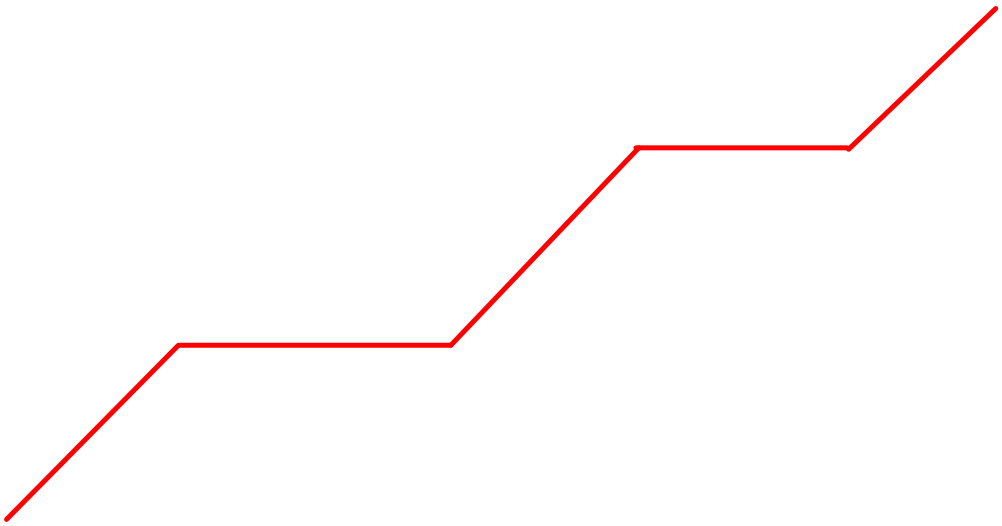
$q_\ell = (10.0\,g)\left(4.19\,\frac{J}{g\cdot°C}\right)(30.0°C)$

$q_\ell = 1257\,J$

$\Delta E_T = q_s + \Delta H_{fus} + q_\ell$

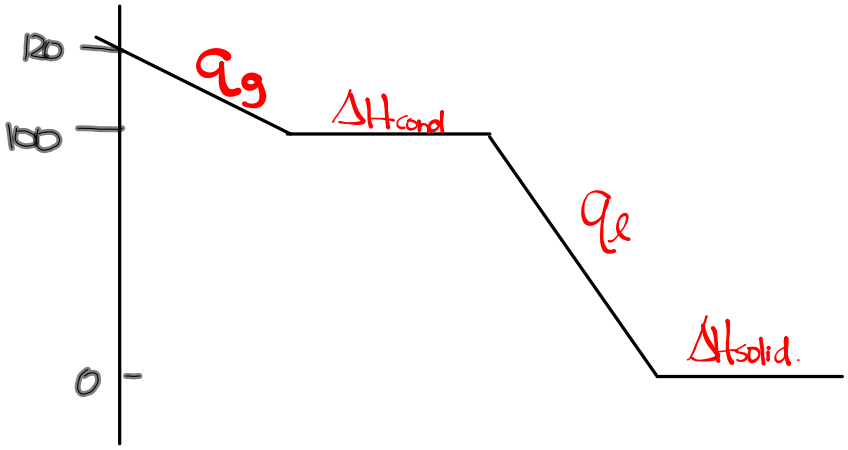
$\Delta E_T = (0.402\,kJ) + (3.346\,kJ) + (1.257\,kJ)$

$\boxed{\Delta E_T = 5.0\,kJ}$



Total Energy Changes

Ex. Calculate the total energy change if 2.50 g of steam at 120.0 °C is completely converted to ice at 0.0°C.



$$\Delta E_{total} = q_g + \Delta H_{cond} + q_\ell + \Delta H_{solid}$$

$q = mC\Delta T$

$q_g = (2.50\,g)\left(2.01\,\frac{J}{g\cdot°C}\right)(-20.0°C)$

$q_g = -100.5\ J$

$\Delta H_{cond} = nH_{cond}$

$\Delta H_{cond} = \left(\frac{2.50\,g}{18.02\,\frac{g}{mol}}\right)\left(-40.8\,\frac{kJ}{mol}\right)$

$\Delta H_{cond} = -5660\ kJ$

$q_\ell = mC\Delta T$

$q_\ell = (2.50\,g)\left(4.19\,\frac{J}{g\cdot°C}\right)(-100.°C)$

$q_\ell = -1047.5\ J$

$\Delta H_{solid} = \left(\frac{2.50\,g}{18.02\,\frac{g}{mol}}\right)\left(6.03\,\frac{kJ}{mol}\right)$

$\Delta H_{solid} = -0.837\ kJ$

$\Delta E_T = q_g + \Delta H_{cond} + q_\ell + \Delta H_{solid}$

$\Delta E_T = (-0.1005\,kJ) + (-5.660\,kJ) + (-1.0475\,kJ) + (-0.837\,kJ)$

$\Delta E_T = -7.65\ kJ$

Worksheet