# Homework - Worksheet

$\Delta H_{vap} = ?$

$m = 500.\,g$

$H_{vap} = 58.8\ \frac{kJ}{mol}$

$C_2H_4(OH)_2$

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

$\Delta H_{vap} = \left(\frac{500.\,g}{62.08\ g/mol}\right)\left(58.8\ \frac{kJ}{mol}\right)$

$\boxed{\Delta H_{vap} = 474\ kJ}$

④ $\Delta H_{fus} = ?$

$m = 9.53\,g$

$H_2O$

$H_{fus} = 6.01\ \frac{kJ}{mol}$

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

$\Delta H_{fus} = \left(\frac{9.53\,g}{18.02\ g/mol}\right)\left(6.01\ \frac{kJ}{mol}\right)$

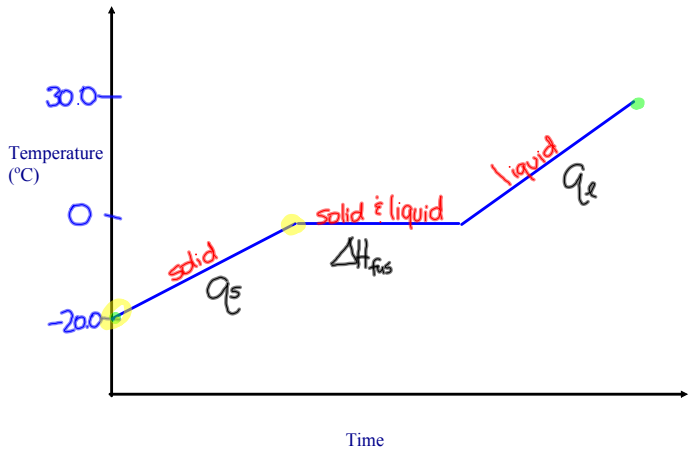
$\boxed{\Delta H_{fus} = 3.18\ kJ}$

What we've looked at so far...

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

**What if you heat 10.0 g of ice at -20.0°C until it is water at 30.0°C?**

## Heating Curve of Water




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

**Step 1: $q_s$**

$q_s = mC\Delta T$

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

$q_s = 402\,J$

**Step 2: $\Delta H_{fus}$**

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

$\Delta H_{fus} = \left(\frac{10.0\,g}{18.02\,g/mol}\right)\left(6.01\,\frac{kJ}{mol}\right)$

$\Delta H_{fus} = 3.335\,kJ$

**Step 3: $q_\ell$**

$q_\ell = mC\Delta T$

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

$q_\ell = 1257\,J$

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

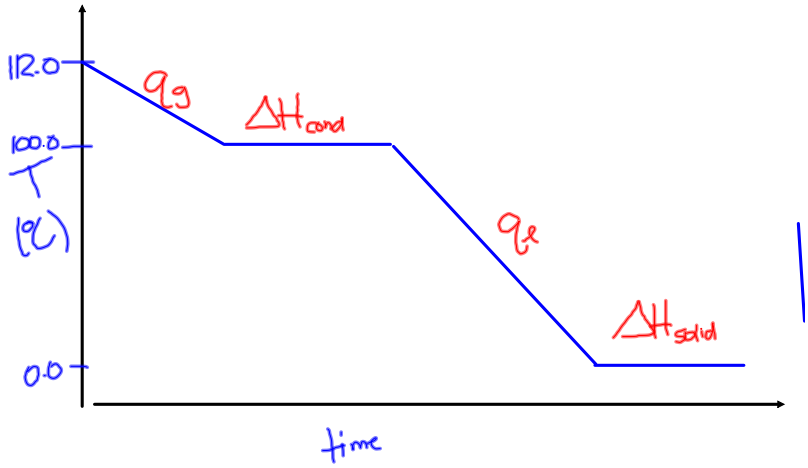
$E_T = (402\,J) + (3335\,J) + (1257\,J)$

$E_T = 4990\,J$

# Total Energy Changes

Ex. Calculate the total energy change if 2.50 g of steam at 112.0°C is completely converted to ice at 0.0°C.

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




**Step 1: $q_g$**

$q_g = mC\Delta T$

$q_g = (250g)\left(2.01\frac{J}{g°C}\right)(-12.0°C)$

$q_g = -6030J$

**Step 2: $\Delta H_{cond}$**

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

$\Delta H_{cond} = \left(\frac{2.50g}{18.02g/mol}\right)\left(\frac{-40.7kJ}{mol}\right)$

$\Delta H_{cond} = -5.65kJ$

**Step 3: $q_\ell$**

$q_\ell = mC\Delta T$

$q_\ell = (250g)\left(4.19\frac{J}{g°C}\right)(-100.0°C)$

$q_\ell = -1047.5J$

**Step 4: $\Delta H_{solid}$**

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

$\Delta H_{solid} = \left(\frac{250g}{18.02g/mol}\right)\left(\frac{-6.01kJ}{mol}\right)$

$\Delta H_{solid} = -0.833kJ$

$\Delta E_T = (-6030J) + (-5650J) + (-1047.5J) + (-833J)$

$\Delta E_T = -7590J$

# Total Energy Changes

## Worksheet

**1) 182 kJ**

**2) -31 000 kJ**

**3) -42.2 kJ**

**4) 401 kJ**