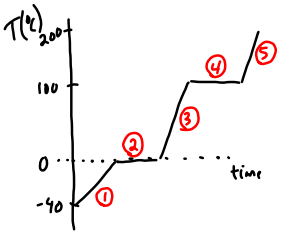
## Change in Temperature Through Changes in State

How much energy is required to heat 50g of ice at -40°C to become steam at 200°C ?




1. heating ice → temperature change.
2. melting ice → no temp. change
3. heating water → temperature chang
4. vaporizing water → no temp change.
5. heating steam → temp change.

① Heating ice from -40°C to 0°C $\left(c_{ice} = 2.08 \frac{J}{g°C}\right)$

$Q = mc\Delta T$ $\quad T_f - T_i$

$Q = (50g)\left(2.08 \frac{J}{g°C}\right)(0 - (-40°C))$

$Q = 4160J$

② Melting ice $\left(\Delta H°_{fus} = 333 \frac{J}{g}\right)$

$Q = m\Delta H°_{fus}$

$Q = (50g)\left(333 \frac{J}{g}\right)$

$Q = 16650J$

③ Heating water from 0° to 100°C $\left(c_{water} = 4.18 \frac{J}{g°C}\right)$

$Q = mc\Delta T$

$Q = (50g)\left(4.18 \frac{J}{g°C}\right)(100°C)$

$Q = 20900J$

④ Vaporizing water $\left(\Delta H°_{vap} = 2260 \frac{J}{g}\right)$

$Q = m\Delta H°_{vap}$

$Q = (50g)\left(2260 \frac{J}{g}\right)$

$Q = 113000J$

⑤ Heating Steam from 100°C t 200°C $\left(c_{steam} = 1.87 \frac{J}{g}\right)$

$Q = mc\Delta T$

$Q = (50g)\left(1.87 \frac{J}{g}\right)(100°C)$

$Q = 9350J$

TOTAL:

| | |
|---|---|
| ① | 4160J |
| ② | 16650J |
| ③ | 20900J |
| ④ | 113000J |
| ⑤ | 9350J |
| | 164060J |

$1.6 \times 10^5 J$

↑ least precise place value.