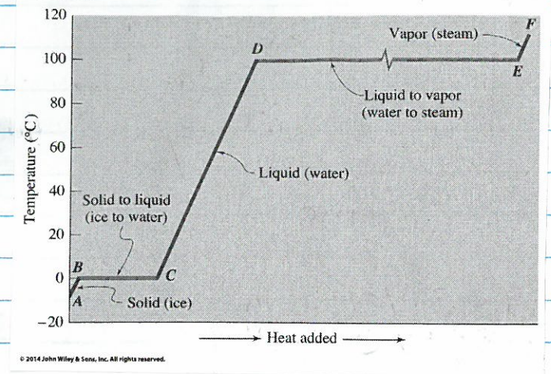
(13.4) Δes of state

heat of vaporization of water (ΔH_{vap}) = 2256 J/g @ 100°C



specific heat capacity (C)
- liquid H_2O = 4.184 J/(g·°C)
- water vapor = 2.03 J/(g·°C)

heat of fusion of water (ΔH_{fus}) = 333 J/g @ 0°C

q = heat

A → B solid (ice)
- add heat, temp ↑
- $q_{solid} = C_{solid} \cdot m \cdot \Delta T$

B → C solid to liquid (ice to water)
- Δ state, solid to liquid
- add heat, temp constant
- $q_{melt} = \Delta H_{fus} \cdot m$

C → D liquid (water)
- add heat, temp ↑
- $q_{liquid} = C_{liquid} \cdot m \cdot \Delta T$

D → E liquid to vapor (water to steam)
- Δ state, liquid to gas
- add heat, temp constant
- $q_{boil} = \Delta H_{vap} \cdot m$

E → F vapor (steam)
- add heat, temp ↑ $q_{gas} = C_{gas} \cdot m \cdot \Delta T$

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How many joules of energy are needed to change 10.0 g of ice at 0.00°C to water at 20.0°C?

energy = ? J
10.0 g ice → water
@ 0.00°C @ 20.0°C

Step 1 – ice → water, Δ state
$q_{melt} = \Delta H_{fus} \cdot m$
$= (333\ J/g)(10.0\ g)$
$= 3330\ J$

Step 2 – liquid, ↑ temp
$q_{liquid} = C_{liquid} \cdot m \cdot \Delta T$
$= (4.184\ J/(g \cdot °C))(10.0\ g)(20.0 - 0.00°C)$
$= 836.8\ J$

Step 3 – 3330 J + 837 J = 4167 J = 4170 J

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How many kilojoules of energy are needed to change 20.0 g of water at 20.°C to steam at 100.°C?

energy = ? kJ
20.0 g water → steam
@ 20. °C @ 100.°C

Step 1 – liquid, ↑ temp
$q_{liquid} = C_{liquid} \cdot m \cdot \Delta T$
$= (4.184\ J/g \cdot °C)(20.0\ g)(100. - 20.)$
$= 6694.4\ J \times \frac{1\ kJ}{1000\ J} = 6.6944\ kJ$

Step 2 – liquid → vapor, Δ state
$q_{boil} = \Delta H_{vap} \cdot m$
$= (2256\ J/g)(20.0\ g)$
$= 45120\ J \times \frac{1\ kJ}{1000\ J} = 45.12\ kJ$

Step 3 – 6.7 + 45.1 = 51.8 kJ = 51.8 kJ