Heating Curve for water

freezes/melts @ $0°C$

boils/condenses @ $100°C$

Consider heating an ice cube from $10°C$ to $120°C$:

① heating the ice cube to $0°C$

② melting the ice – no temp change

③ heating the water to $100°C$

④ evaporation of water no temp change

⑤ heating steam to $120°C$
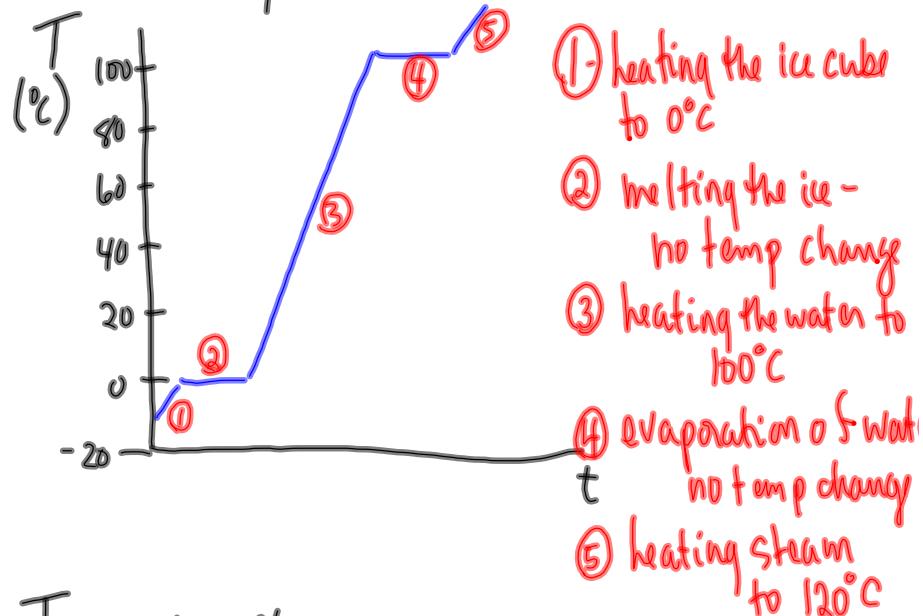
Temperature Changes => use $Q = mc\Delta T$

$$C_{ice} = 2.08 \frac{J}{g°C}$$

$$C_{water} = 4.18 \frac{J}{g°C}$$

$$C_{steam} = 1.87 \frac{J}{g°C}$$

Phase changes => $Q = m\Delta H°$

$$\Delta H°_{fus} = 333 \frac{J}{g}$$

$$\Delta H°_{vap} = 2260 \frac{J}{g}$$

<u>Example</u>

How much heat is needed to heat 50g of ice at -40°C
to become steam at 200°C?
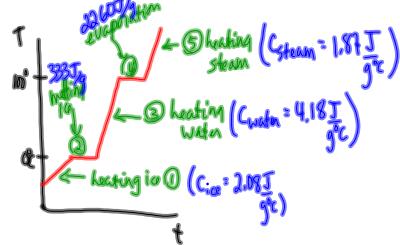
① - heating ice from -40°C to 0°C ($\Delta T = 40°C$)

$$Q = mc\Delta T$$

$$Q = (50g)(2.08\tfrac{J}{g°C})(40°C)$$

$$\boxed{Q = 4160 J}$$

② Phase change (melting)

$$Q = m\Delta H_{fus}$$

$$Q = (50g)(333\tfrac{J}{g})$$

$$\boxed{Q = 16650 J}$$

③ Heating water from 0°C to 100° ($\Delta T = 100°C$)

$$Q = mc\Delta T$$

$$Q = (50g)(4.18\tfrac{J}{g°C})(100°C)$$

$$\boxed{Q = 20900 J}$$

④ Evaporate the water

$$Q = m\Delta H_{vap}^0$$

$$Q = (50g)(2260\tfrac{J}{g})$$

$$\boxed{Q = 113000 J}$$

⑤ Heat the Steam from 100°C to 200°C ($\Delta T = 100°C$)

$$Q = mc\Delta T$$

$$Q = (50g)(1.87\tfrac{J}{g°C})(100°C)$$

$$\boxed{Q = 9350 J}$$

TOTAL Heat needed ⇒ ①   4160 J
     ②   16650 J
     ③   20900 J
     ④   113000 J
     ⑤   9350 J

          164060 J

          $\boxed{1.6 \times 10^5 J}$

② ice -35° ⟶ 18°C
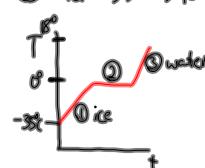
<u>TEST - Jan 18th</u>

• Accelerated Motion

- descriptions <-> v-t <-> a-t

- finding acc from slope of v-t
  - constant/ave/instantaneous

- acceleration equation

- directions (RCS + compass)

Weather Dynamics

- heat + temp

- history heat

- water + energy

- $Q = mc\Delta T$ + $Q = m\Delta H$

- Temp changes through change in state
  (heating/cooling curves)

- special properties of water (Fri or Mon)