Warm-up #2

- Who do you agree with and why?
- Noah Lot: “I can make water boil **hotter** if I add more heat!”
- Ima Smart: “I can make water boil **faster**, but at the same temperature, if I add more heat!”

Molar Enthalpy and Heating Curves

Thermochemistry is…

the study of heat changes in chemical reactions and physical states.

Heat is the energy transferred between samples of matter because of their differences in temperature.

Enthalpy

- Heat energy lost or gained in a reaction/process
- H=Heat of substance at a constant pressure

$$\Delta H = \text{enthalpy in KJ/mole}$$

Enthalpy

+ ΔH = endothermic rxn (absorbed)
- ΔH = exothermic rxn (released)

- Calorimetry is the measurement of heat changes in an insulator container and how we actually measure heat changes in a system.

- Enthalpy of Fusion—heat absorbed when 1 mole melts $+\Delta H_{fus}$ (6.01KJ/mol) (solid to liquid)

- Enthalpy of Solidification—heat lost when 1 mole freezes $-\Delta H_{solid}$ (-6.01 KJ/mol) (liquid to solid)

$+\Delta H_{fus} = -\Delta H_{solid}$ (same quantity; opposite direction)

- Enthalpy of Vaporization—heat absorbed when 1 mole vaporizes $+\Delta H_{vap}$ (40.79 KJ/mol) (liquid to gas)

- Enthalpy of Condensation—Heat lost when 1 mole condenses $-\Delta H_{cond}$ (gas to liquid) (-40.79 KJ/mol)

$+\Delta H_{vap} = -\Delta H_{cond}$ (same quantity, opposite direction)

Heats of state change

$$Q = m\Delta H_{\text{state change}}$$

Q= Energy or heat (kJ)

m= moles of the sample (mol)

$\Delta H_{\text{state change}}$= **molar enthalpy** of state change

Sample Problem

- **Calculate the energy needed to vaporize 10.0 g of water.** (convert g into moles then plug in)

$Q = (m) \times (H_{vap})$

$$10.0 \text{ g } H_2O \times \frac{1 \text{ mol } H_2O}{18 \text{ g } H_2O} = 0.56 \text{ moles}$$

$Q = (0.56 \text{ moles}) \times (40.7 \text{ kJ/mol})$

$Q = 22.61 \text{ kJ}$

Practice

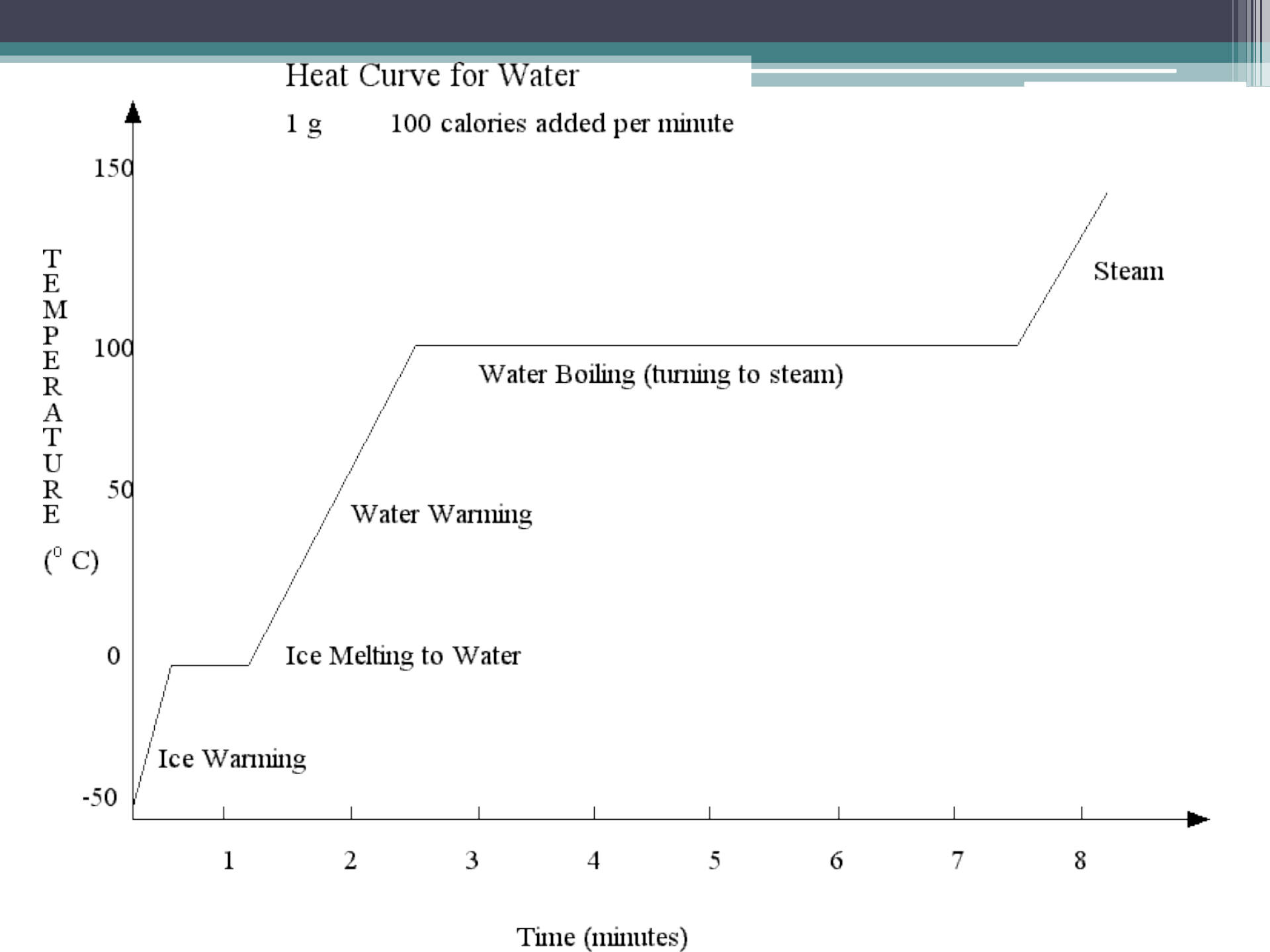
- How much energy is absorbed by 395 g of water as it vaporizes into steam at 100°C? Δh_{vap}=40.7 kJ/mol

- How much energy is released when 645g of water is converted into ice at 0°C?
  Δh_{solid}=-6.01 kJ/mol

Heating Curves

- Diagram representation of the phase changes for a given substance.

- What do you think it looks like if we plot time vs temperature for water's heat curve?


Heat Curve for Water
1 g
100 calories added per minute
150
100
50
0
-50
TEMPERATURE
(° C)
Steam
Water Boiling (turning to steam)
Water Warming
Ice Melting to Water
Ice Warming
1
2
3
4
5
6
7
8
Time (minutes)

Heating Curve practice- page 2

- Then practice problems page 3