Physics 2C 1/31

① Quick Review / Clickers

② Specific Heats & Latent Heats

③ Calorimetry Problems

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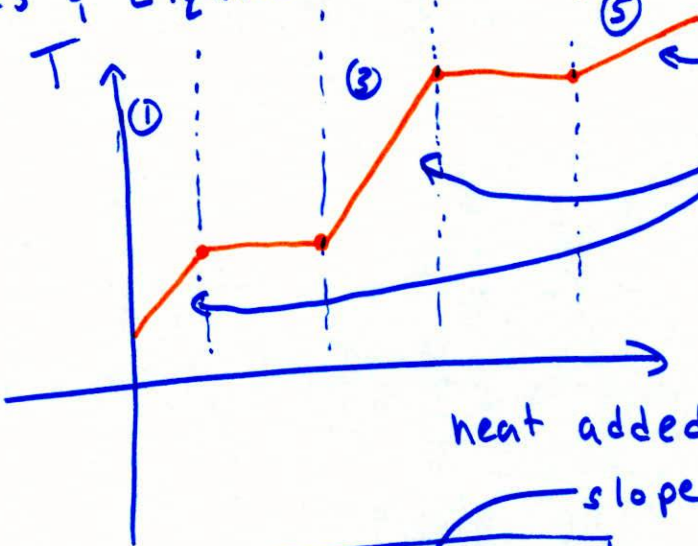
② Solids & Liquids : $W \approx 0$ $Q = \Delta E_{th} \propto \Delta T$ (new info!)



①, ③, ⑤ $\boxed{Q = mc\,\Delta T}$ slope on graph

m: mass

c: specific heat

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② and ④ are <u>phase changes</u>

$\boxed{Q = mL}$ latent heat

heat of transformation

$$\Delta E_{th} = W + Q \qquad W = -\int_{V_i}^{V_f} p\,dV$$

$$(-) \qquad (-) \quad (+)$$

A gas undergoes a process in which 30 J of heat is added to the gas yet its temperature goes down. Which of the options below best describes the change in volume of the gas?

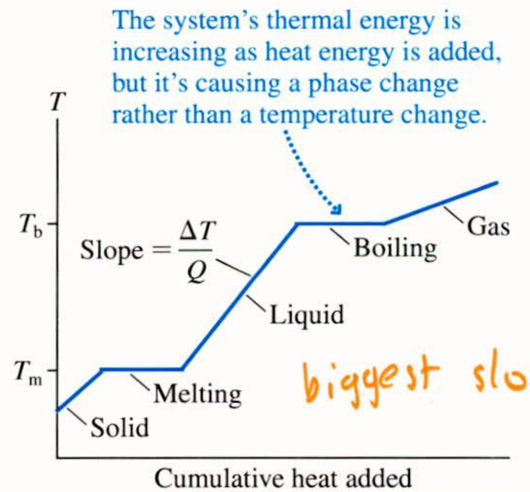
A) The gas expands
B) The gas contracts
C) The gas may have expanded or contracted; there isn't enough info.

$\Rightarrow$ gases do weird thing because $W \neq 0$

solids, liquids $\Rightarrow W = 0$

Suppose you have 1 Joule of energy to give to a substance via heat. A temperature vs. heat-added graph for the substance is given. Which phase should you give the energy to get the largest ΔT?

A) Solid
B) Liquid
C) Gas
D) I don't know



biggest slope!

$Q_{\text{ice melt}} + Q_{\text{water cool}} = 0$

$(T_f - T_i)$

The specific heat of water is 4.19 kJ/(kg K) and the heat of fusion of water is 333 kJ/kg. Suppose you have 1 kg of ice at its melting point and 1 kg of water at a temperature T_i. What should T_i be so that, when mixed, you have a pool of water (in equilibrium) at its freezing point?

How much energy req. to melt ice?

A) 7°C
B) 13°C
C) 20°C
D) 93°C
E) None of the above is close

$333\ kJ = (1\ kg)(4.19\ \frac{kJ}{kg})\Delta T$

$\Delta T = 79°C$

21. ‖ 30 g of copper pellets are removed from a 300°C oven and immediately dropped into 100 mL of water at 20°C in an insulated cup. What will the new water temperature be?

TABLE 19.2 Specific heats and molar specific heats of solids and liquids

Substance	c (J/kg K)	C (J/mol K)
Solids		
Aluminum	900	24.3
Copper	385	24.4
Iron	449	25.1
Gold	129	25.4
Lead	128	26.5
Ice	2090	37.6
Liquids		
Ethyl alcohol	2400	110.4
Mercury	140	28.1
Water	4190	75.4

Assume $20°C < T_f < 100°C$ (no phase change)

$$\underset{(-)}{Q_{Cu\,cool}} + \underset{(+)}{Q_{H_2O\,warm}} = 0$$

$$M_{Cu} C_{Cu} (T_f - 300°C) + m_{H_2O} C_{H_2O} (T_f - 20°C) = 0$$

$$\boxed{T_f = 27.5°C}$$

0.5 Kg

20. ‖ An experiment measures the temperature of a 500 g substance while steadily supplying heat to it. **FIGURE EX19.20** shows the results of the experiment. What are the (a) specific heat of the solid phase, (b) specific heat of the liquid phase, (c) melting and boiling temperatures, and (d) heats of fusion and vaporization?

(a) $\Delta Q = Mc\Delta T$

$$c = \left(\frac{\Delta Q}{\Delta T}\right)\frac{1}{M} = \left(\frac{20}{20}\right)\left(\frac{1}{0.5}\right) = 2\,\frac{kJ}{kg\,K}$$

(b) $c = 2.7\,\frac{kJ}{kg\,K}$

(c) −20°C & 40°C

(d) $L_f = \frac{20\,kJ}{0.50\,kg} = 4 \times 10^4\,J/kg$

$L_v = 1.2 \times 10^5\,J/kg$