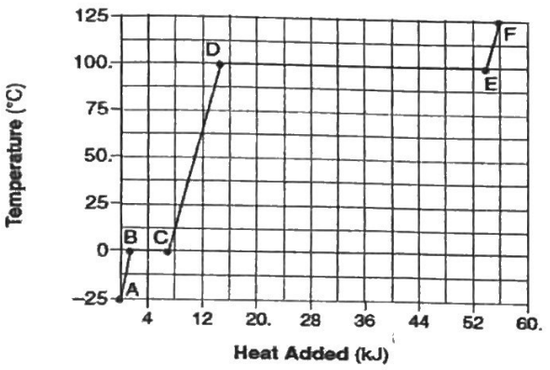
Name: KEY Official Class: _____ Date: _____

Teacher: _____ Period: _____ Class: _____

Calculating Heat Energy ($q = mC\Delta T$)

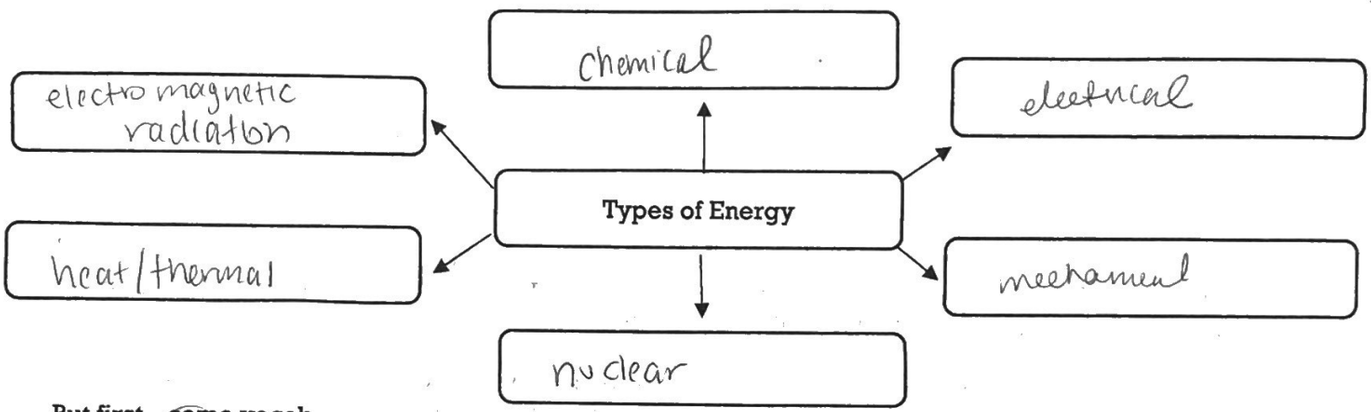
YOYO: Answer the questions below based on the diagram.

- Circle One: This is a (heating/cooling) curve.
- AB - KE: ↑ and PE: —
- BC - KE: — and PE: ↑
- CD - KE: ↑ and PE: —
- DE - KE: ↑ and PE: ↑
- EF - KE: ↑ and PE: —
- The boiling point of the compound is 100°C
- The melting point of the compound is 0°C
- The freezing point of this compound is 0°C
- True or False: There is no thing as "cold." Cold is just the absence of heat. True



Law of Conservation of Energy

- In any chemical or physical process, energy is neither created nor destroyed, it can be changed from one type of energy to another



But first...some vocab

- Exothermic Process: Energy is given off/released in a chemical reaction **from** the system **to** the surrounding – the system becomes cooler
- Endothermic Process: Energy is absorbed in a chemical reaction **by** the system **from** the surrounding – system becomes hotter
- Specific Heat Capacity: the amount of heat it takes to raise the temperature of 1 gram of the substance
  - Specific heat of water = 4.18 J/g•C (Table B)
    - 4.18 joules is needed to raise 1 gram of water 1 °C

The Equation

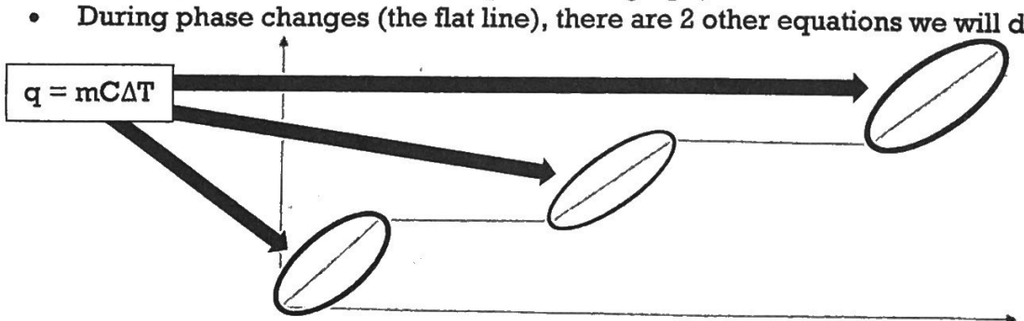
$$q = mC\Delta T$$

What do the symbols represent?

- q = heat
  - + q = endothermic
  - − q = exothermic
- m = mass
- C = specific
- ΔT = change in temp. ($T_{final} - T_{initial}$)

Relating Back to the Heating/Cooling Curve

- The $q = mC\Delta T$ is used ONLY when temperature is changing (when a substance either a solid, liquid, or gas) – (the slant part of the graph).
- During phase changes (the flat line), there are 2 other equations we will discuss tomorrow



KEY ★ answers come out in J

J → KJ ÷ 1000 (move decimal 3 spots to left).

Name: _____ Official Class: _____ Date: _____

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1. How many kilojoules of heat are absorbed when 1000 grams of water is heated from 18 °C to 85 °C

$q = ?$
$m = 1000\,g$
$c = 4.18\ J/g°C$
$\Delta T = 85 - 18 = 67°C$
$T_f = 85$
$T_i = 18°C$

$q = mc\Delta T$
$q = (1000)(4.18)(67)$
$q = 280{,}060\ J$
$280\ KJ$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

2. The temperature of a 95.5 grams of copper increases from 25 °C to 48 °C when copper absorbs 849 J of heat. What is the specific heat of copper?

$q = 849\ J$
$m = 95.5\,g$
$c = ?$
$\Delta T = 48 - 25 = 23°C$
$T_f = 48°C$
$T_i = 25°C$

$q = mc\Delta T$
$849 = (95.5)(c)(23)$
$\frac{849}{2196.5} = \frac{2196.5\,c}{2196.5}$
$c = 0.39\ J/g°C$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

3. 300 grams of ethanol at 10 °C is heated with 14640 Joules of energy. What is the final temperature of the ethanol? The specific heat of ethanol is 2.44 J/g·°C.

$q = 14640\ J$
$m = 300\,g$
$c = 2.44\ J/g°C$
$\Delta T = ?$
$T_f = ?$
$T_i = 10°C$

$q = mc\Delta T$
$14640 = (300)(2.44)(\Delta T)$
$\frac{14640}{732} = \frac{732(\Delta T)}{732}$
$20 = \Delta T$
$20 = T_f - 10$
$+10 \quad +10$
$T_f = 30°C$

$T_f = 30°C$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

4. How many joules of heat energy are released when 50.0 grams of water are cooled from 70 °C to 60 °C?

$q = ?$
$m = 50.0\,g$
$c = 4.18\ J/g°C$
$\Delta T = -10°C$
$T_f = 60°C$
$T_i = 70°C$

$q = mc\Delta T$
$q = (50.0)(4.18)(-10°C)$
$q = -2090\ J$
"−" = released

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

5. How much heat is absorbed when 500. g of copper, C = 0.385 J/g•C, goes from 25.0°C to 35.0 °C?

$q = ?$
$m = 500.\,g$
$c = 0.385\ J/g°C$
$\Delta T = 10°C$
$T_f = 35°C$
$T_i = 25°C$

$q = mc\Delta T$
$q = (500)(0.385)(10)$
$q = 1925\ J$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

6. How much heat is released when 150. g of iron cools from 525°C to 100°C? (C = 0.44 J/g•C)

$q = ?$
$m = 150.\,g$
$c = 0.44\ J/g°C$
$\Delta T = -425°C$
$T_f = 100°C$
$T_i = 525°C$

$q = mc\Delta T$
$q = (150)(0.44)(-425)$
$= -28{,}050\ J$
(−) = released energy

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

7. A 50.0 g block of glass (C = 0.50 J/g•C) absorbs 333 joules of heat energy. How much does the temperature of the glass rise?

$q = 333\ J$
$m = 50.0\,g$
$c = 0.50\ J/g°C$
$\Delta T = ?$
$T_f = -$
$T_i = -$

$q = mc\Delta T$
$333\ J = (50.0\,g)(0.50)(\Delta T)$
$\frac{333\ J}{25} = \frac{25\,\Delta T}{25}$
$13.3 = \Delta T$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED

8. 225 grams of water at 45 °C is heated with 189940 Joules of energy. What is the final temperature of the water?

$q = 189940\ J$
$m = 225\,g$
$c = 4.18\ J/g°C$
$\Delta T = ?$
$T_f = ?$
$T_i = 45°C$

$q = mc\Delta T$
$189940 = (225)(4.18)(\Delta T)$
$\frac{189940}{940.5} = \frac{(940.5)\,\Delta T}{940.5}$
$201.95 \rightarrow 202°C = \Delta T$

$\Delta T = T_f - T_i$
$202 = T_f - 45$
$+45 \quad +45$
$T_f = 247°C$

CIRCLE ONE:
This is an ENDOTHERMIC/EXOTHERMIC process because the heat is ABSORBED/RELEASED