Specific Heat
Chemistry

Name _____

$$Q = m\,C\,\Delta T$$

1. _____ is the amount of energy that it takes to raise the temperature of 1 gram of a substance by 1 K
2. _____ is the temperature at which all molecular motion ceases
3. _____ process is a change in matter in which energy is absorbed
4. _____ process is a change in matter in which energy is released
5. What is the specific heat of a substance that absorbs 2500 joules of heat when a sample of 100 g of the substance increases in temperature from 10 °C to 70°C?
6. If 200 grams of water is to be heated from 24.0°C to 100.0°C to make a cup of tea, how much heat must be added? The specific heat of water is 4.18 J/g·C
7. How many grams of water would require 2200 joules of heat to raise its temperature from 34°C to 100°C? The specific heat of water is 4.18 J/g·C
8. A block of aluminum weighing 140 g is cooled from 98.4°C to 62.2°C with the release of 1080 joules of heat. From this data, calculate the specific heat of aluminum. *Check your answer with a specific heat table.*
9. 100.0 mL of 4.0°C water is heated until its temperature is 37°C. If the specific heat of water is 4.18 J/g°C, calculate the amount of heat energy needed to cause this rise in temperature.
10. A total of 54.0 joules of heat are absorbed as 58.3 g of lead is heated from 12.0°C to 42.0°C. From these data, what is the specific heat of lead?

11. The specific heat of wood is 2.03 J/g·°C. How much heat is needed to convert 550 g of wood at -15.0°C to 10.0°C?

12. What is the total amount of heat needed to change 2.25 kg of silver at 0.0°C to 200.0°C? The specific heat of silver is 0.129 J/g·°C

13. Granite has a specific heat of 800 J/g·°C. What mass of granite is needed to store 150,000 J of heat if the temperature of the granite is to be increased by 15.5°C?

14. A 55 kg block of metal has an original temperature of 15.0°C and 0.45 J/g·°C. What will be the final temperature of this metal if 450 J of heat energy are added?

15. Object A specific heat is 2.45 J/g·°C and object B specific heat is 0.82 J/g·°C. Which object will heat up faster if they have the same mass and equal amount of heat is applied? Explain why.

Convert the following to Celsius.

1) 32° K _____
2) 45° K _____
3) 70° K _____
4) 1020 K _____
5) 200° F _____
6) 273 K _____
7) 350° F _____
8) 0° K _____
9) 100 ° F _____

Convert the following to Kelvin.

10) 0° F _____
11) -50° C _____
12) 90° C _____
13) 70° F _____
14) -150° C _____
15) 400° F _____

1. Specific heat is the amount of energy that it takes to raise the temperature of 1 gram of a substance by 1 degree kelvin

2. Absolute zero is the temperature at which all molecular motion ceases

3. Endothermic process is a change in matter in which energy is absorbed

4. Exothermic process is a change in matter in which energy is released

5. What is the specific heat of a substance that absorbs 2500 joules of heat when a sample of 100 g of the substance increases in temperature from 10 °C to 70°C?

   $Q = m\ C\ \Delta T \quad C = Q/\ m\ \Delta T = 2500\ J/\ 100\ g \cdot 60°C = 0.417\ J/g\ °C$

6. If 200 grams of water is to be heated from 24.0°C to 100.0°C to make a cup of tea, how much heat must be added? The specific heat of water is 4.18 J/g·C

   $Q = m\ C\ \Delta T = 200\ g \cdot 4.18\ J/g\ °C \cdot 76\ °C = 63{,}536\ J$

7. How many grams of water would require 2200 joules of heat to raise its temperature from 34°C to 100°C? The specific heat of water is 4.18 J/g·C

   $Q = m\ C\ \Delta T \quad m = Q/\ C\ \Delta T = 2200\ J/\ 4.18\ J/g\ °C \cdot 66°C = 7.97\ g$

8. A block of aluminum weighing 140 g is cooled from 98.4°C to 62.2°C with the release of 1080 joules of heat. From this data, calculate the specific heat of aluminum.

   $Q = m\ C\ \Delta T \quad C = Q/\ m\ \Delta T = 1080\ J/\ 140\ g \cdot 36.2°C = 0.213\ J/g\ °C$

9. 100.0 mL of 4.0°C water is heated until its temperature is 37°C. If the specific heat of water is 4.18 J/g°C, calculate the amount of heat energy needed to cause this rise in temperature.

   ($1\ mL\ H_2O = 1\ g\ H_2O$)

   $Q = m\ C\ \Delta T = 100\ g \cdot 4.18\ J/g\ °C \cdot 33\ °C = 13{,}794\ J$

10. A total of 54.0 joules of heat are absorbed as 58.3 g of lead is heated from 12.0°C to 42.0°C. From these data, what is the specific heat of lead?

    $Q = m\ C\ \Delta T \quad C = Q/\ m\ \Delta T = 54\ J/\ 58.3\ g \cdot 30\ °C = 0.031\ J/g\ °C$

11. The specific heat of wood is 2.03 J/g·°C. How much heat is needed to convert 550 g of wood at -15.0°C to 10.0°C?

    $Q = m\ C\ \Delta T = 550\ g \cdot 2.03\ J/g\ °C \cdot 25\ °C = 27{,}912.5\ J$

12. What is the total amount of heat needed to change 2.25 kg of silver at 0.0°C to 200.0°C? The specific heat of silver is 0.129 J/g·°C (2.25 kg = 2250 g)

    $Q = m\ C\ \Delta T = 2250\ g \cdot 0.129\ J/g\ °C \cdot 200\ °C = 58{,}050\ J$

13. Granite has a specific heat of 800 J/g·°C. What mass of granite is needed to store 150,000 J of heat if the temperature of the granite is to be increased by 15.5°C?

$Q = m\ C\ \Delta T \quad m = Q/\ C\ \Delta T = 150{,}000\ J/\ 800\ J/g\ °C \cdot 15.5°C = 1.86 \times 10^9\ g$

14. A 55 kg block of metal has an original temperature of 15.0°C and 0.45 J/g·°C. What will be the final temperature of this metal if 450 J of heat energy are added?

$Q = m\ C\ \Delta T \quad \Delta T = Q / m\ C \quad$ where $\Delta T = T_f - T_i \quad$ so $\quad T_f - T_i = Q/ m\ C \quad$ and $\quad T_f = Q/ m\ C + T_i$

$T_f = Q/ m\ C + T_i \quad = (450\ J/ 55{,}000\ g \cdot 0.45\ J/g\ °C) + 15.0°C = 15.018\ °C$

15. Object A specific heat is 2.45 J/g·°C and object B specific heat is 0.82 J/g·°C. Which object will heat up faster if they have the same mass and equal amount of heat is applied? Explain why.

Object B has a lower specific heat and requires less heat to raise 1 gram by 1 degree Celsius, therefore, it will heat up faster.

Temperature Conversion

$K^o = C^o + 273$ $\qquad$ $F^o = (9/5 \times C^o) + 32$

$C^o = K^o - 273$ $\qquad$ $C^o = 5/9\ (F^o - 32)$

Convert the following to Celsius (- 273)

1)	32° K	-241°C	4) 1020° K	747 °C	7) 350° K	77 °C
2)	45° K	-228 °C	5) 200° K	-73 °C	8) 0° K	-273 °C
3)	70° K	-203 °C	6) 273° K	0 °C	9) 100 ° K	-173 °C

Convert the following to Kelvin (+273)

10) 0° C	273 °K	13) 70° C	343 °K
11) -50° C	223 °K	14) -150° C	123 °K
12) 90° C	363 °K	15) 400° C	673 °K