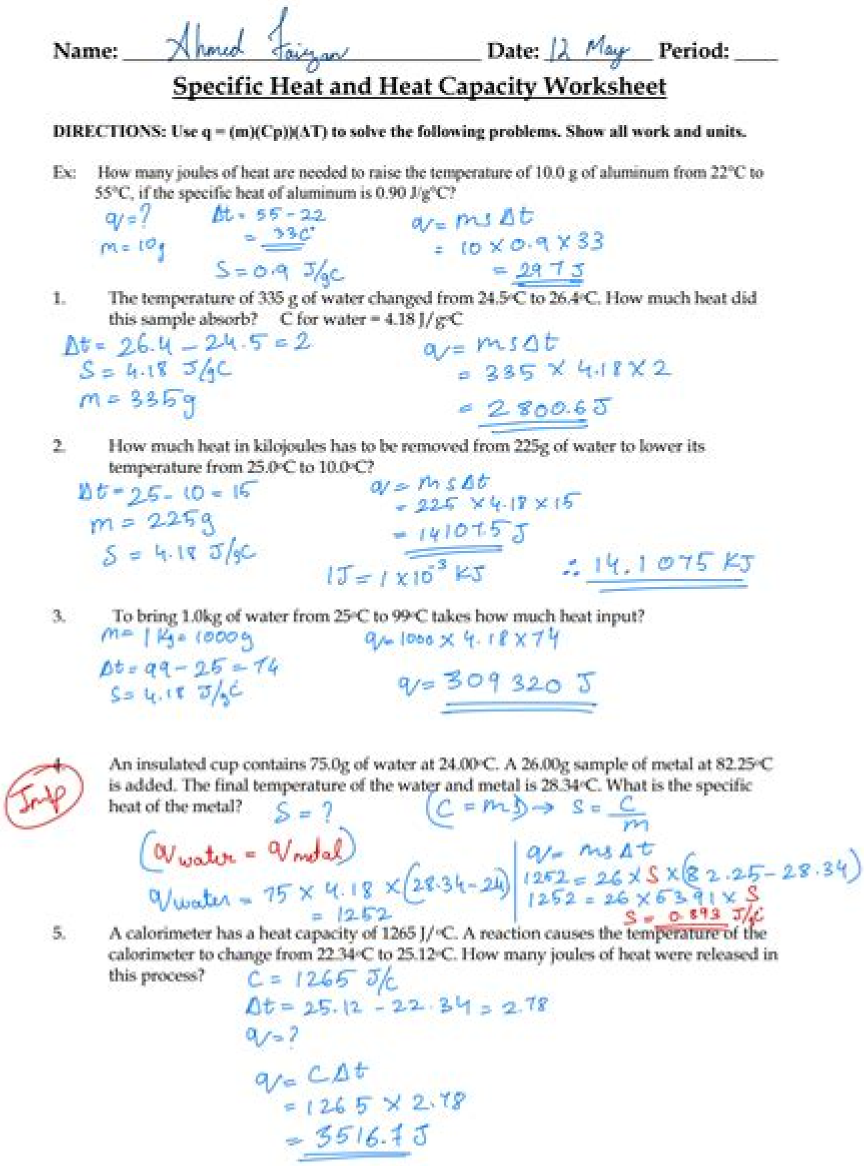
Specific Heat Capacity Worksheet Answers



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Specific Heat and Heat Capacity Worksheet

DIRECTIONS: Use q = (m)(Cp))(ΔT) to solve the following problems. Show all work and units.

Ex: How many joules of heat are needed to raise the temperature of 10.0 g of aluminum from 22°C to 55°C, if the specific heat of aluminum is 0.90 J/g°C?

q = ? m = 10g Δt = 55 − 22 = 33C° S = 0.9 J/gC q = msΔt = 10 × 0.9 × 33 = 297 J

1. The temperature of 335 g of water changed from 24.5°C to 26.4°C. How much heat did this sample absorb? C for water = 4.18 J/g°C

Δt = 26.4 − 24.5 = 2 S = 4.18 J/gC m = 335g q = msΔt = 335 × 4.18 × 2 = 2800.6 J

2. How much heat in kilojoules has to be removed from 225g of water to lower its temperature from 25.0°C to 10.0°C?

Δt = 25 − 10 = 15 m = 225g S = 4.18 J/gC q = msΔt = 225 × 4.18 × 15 = 14107.5 J 1J = 1 × 10^3 KJ ∴ 14.1075 KJ

3. To bring 1.0kg of water from 25°C to 99°C takes how much heat input?

m = 1 Kg = 1000g Δt = 99 − 25 = 74 S = 4.18 J/gC q = 1000 × 4.18 × 74 q = 309 320 J

4. An insulated cup contains 75.0g of water at 24.00°C. A 26.00g sample of metal at 82.25°C is added. The final temperature of the water and metal is 28.34°C. What is the specific heat of the metal?

Imp S = ? (C = mS → S = C/m) (q water = q metal) q water = 75 × 4.18 × (28.34 − 24) = 1252 q = msΔt 1252 = 26 × S × (82.25 − 28.34) 1252 = 26 × 53.91 × S S = 0.893 J/gC

5. A calorimeter has a heat capacity of 1265 J/°C. A reaction causes the temperature of the calorimeter to change from 22.34°C to 25.12°C. How many joules of heat were released in this process?

C = 1265 J/C Δt = 25.12 − 22.34 = 2.78 q = ? q = CΔt = 1265 × 2.78 = 3516.7 J

Specific heat capacity worksheet answers are essential for students and educators alike as they delve into the fascinating world of thermodynamics. Understanding specific heat capacity is crucial for grasping how different materials absorb and transfer heat. This article will explore the concept of specific heat capacity, provide sample problems typically found on worksheets, and present answers with explanations to enhance understanding.

Understanding Specific Heat Capacity

Specific heat capacity (often simply called "specific heat") is defined as the amount of heat energy required to raise the temperature of one unit mass of a substance by one degree Celsius (°C) or one Kelvin (K). It is a vital property of materials and varies significantly from one substance to another. The formula for calculating heat energy (Q) absorbed or released by a substance is given by:

$$Q = mc\Delta T$$

Where:
- Q = heat energy (in joules)
- m = mass of the substance (in kilograms)
- c = specific heat capacity (in joules per kilogram per degree Celsius, J/kg°C)
- ΔT = change in temperature (in °C or K)

Units of Specific Heat Capacity

The SI unit of specific heat capacity is joules per kilogram per degree Celsius (J/kg°C). However, it can also be expressed in calories per gram per degree Celsius (cal/g°C), particularly in chemistry contexts. One calorie is equivalent to approximately 4.184 joules.

Importance of Specific Heat Capacity

Specific heat capacity plays a crucial role in various scientific and practical applications:

- **Temperature Control:** Understanding how materials respond to heat helps in designing systems for temperature regulation, such as heating and cooling systems.
- **Material Selection:** Engineers choose materials based on their thermal properties, including specific heat, for applications ranging from cookware to aerospace.
- **Environmental Science:** Specific heat capacity is critical in modeling climate systems and understanding how oceans regulate temperature.

Sample Problems for Specific Heat Capacity Worksheets

To reinforce the understanding of specific heat capacity, students often encounter problems requiring the application of the specific heat formula. Here are a few sample problems that may appear on a worksheet:

Problem 1: Heating Water

A student heats 500 grams of water from 20°C to 80°C. Calculate the amount of heat energy absorbed by the water. (Specific heat capacity of water = 4.18 J/g°C)

Problem 2: Cooling Metal

A metal block with a mass of 2 kg is cooled from 150°C to 50°C. If the specific heat capacity of the metal is 0.9 J/g°C, calculate the heat lost by the metal.

Problem 3: Ice Melting

How much energy is required to melt 100 grams of ice at 0°C? (Latent heat of fusion for ice = 334 J/g)

Problem 4: Heating Oil

If 300 grams of cooking oil is heated from 25°C to 60°C, and the specific heat capacity of the oil is 2.0 J/g°C, how much heat energy is required?

Answers and Explanations

Now, let's provide answers to the sample problems presented above, along with detailed explanations for each.

Answer to Problem 1

Given:
- Mass of water (m) = 500 g
- Initial temperature (T1) = 20°C
- Final temperature (T2) = 80°C
- Specific heat capacity of water (c) = 4.18 J/g°C

First, calculate the change in temperature (ΔT):

$$ \Delta T = T2 - T1 = 80°C - 20°C = 60°C $$

Now, substitute the values into the formula:

$$ Q = mc\Delta T $$

$$ Q = 500 \, \text{g} \times 4.18 \, \text{J/g°C} \times 60°C $$

$$ Q = 125400 \, \text{J} $$

Thus, the amount of heat energy absorbed by the water is 125,400 joules.

Answer to Problem 2

Given:
- Mass of the metal (m) = 2 kg = 2000 g (since 1 kg = 1000 g)
- Initial temperature (T1) = 150°C
- Final temperature (T2) = 50°C
- Specific heat capacity of the metal (c) = 0.9 J/g°C

Calculate ΔT:

$$\Delta T = T2 - T1 = 50°C - 150°C = -100°C$$

Now, use the heat formula:

$$Q = mc\Delta T$$

$$Q = 2000 \, \text{g} \times 0.9 \, \text{J/g°C} \times (-100°C)$$

$$Q = -180000 \, \text{J}$$

The negative sign indicates that the metal is losing heat. Therefore, the heat lost by the metal is 180,000 joules.

Answer to Problem 3

Given:
- Mass of ice (m) = 100 g
- Latent heat of fusion for ice (L) = 334 J/g

The formula for calculating the energy required to melt ice is:

$$Q = mL$$

Substituting in the values:

$$Q = 100 \, \text{g} \times 334 \, \text{J/g}$$

$$Q = 33400 \, \text{J}$$

Thus, the energy required to melt 100 grams of ice is 33,400 joules.

Answer to Problem 4

Given:
- Mass of cooking oil (m) = 300 g
- Initial temperature (T1) = 25°C

- Final temperature (T2) = 60°C
- Specific heat capacity of the oil (c) = 2.0 J/g°C

Calculate ΔT:

$$ \Delta T = T2 - T1 = 60°C - 25°C = 35°C $$

Using the heat formula:

$$ Q = mc\Delta T $$

$$ Q = 300 \, \text{g} \times 2.0 \, \text{J/g°C} \times 35°C $$

$$ Q = 21000 \, \text{J} $$

Therefore, the heat energy required to heat the oil is 21,000 joules.

Conclusion

Specific heat capacity is a fundamental concept in physics and chemistry that allows for the understanding of heat transfer in various substances. By working through specific heat capacity worksheet answers, students can develop a deeper comprehension of how materials behave under changing temperatures. Mastering this topic not only aids in academic success but also has practical implications in everyday life, engineering, and environmental science. Understanding the problems and solutions surrounding specific heat capacity can empower students to apply their knowledge effectively in real-world scenarios.

Frequently Asked Questions

What is specific heat capacity?

Specific heat capacity is the amount of heat required to raise the temperature of one kilogram of a substance by one degree Celsius.

How do you calculate specific heat capacity using a worksheet?

To calculate specific heat capacity, use the formula: $c = Q / (m \Delta T)$, where c is specific heat capacity, Q is the heat added, m is mass, and ΔT is the change in temperature.

What units are used for specific heat capacity?

The units for specific heat capacity are typically joules per kilogram per degree Celsius (J/kg°C).

Why is it important to understand specific heat capacity?

Understanding specific heat capacity is crucial in fields like chemistry and physics because it helps predict how substances will respond to heat, which is essential for various applications, including engineering and environmental science.

What common materials have high specific heat capacities?

Water has a high specific heat capacity, approximately 4.18 J/g°C, which is why it's often used as a coolant and for temperature regulation.

How do phase changes affect specific heat capacity calculations?

During phase changes, the temperature remains constant while heat is added or removed, requiring the use of latent heat in calculations separate from specific heat capacity.

Can specific heat capacity be negative?

No, specific heat capacity cannot be negative; it represents the amount of energy needed to increase temperature and is always a positive value.

What is the purpose of a specific heat capacity worksheet?

A specific heat capacity worksheet provides practice problems and scenarios to help students understand and apply the concept of specific heat capacity in various contexts.

How do you interpret the answers on a specific heat capacity worksheet?

Interpreting answers involves checking the calculated specific heat capacities against known values for different materials to validate the results and understanding the principles behind them.

What are common mistakes when solving specific heat capacity problems?

Common mistakes include miscalculating the mass or temperature change, forgetting to convert units, or confusing heat with temperature.

Specific Heat Capacity Worksheet Answers

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The words "special" and "specific" are often used interchangeably, but there are some subtle differences in meaning between them. Both words can be used to describe people or things that are unique, but "special" usually refers to something that is positive or desirable, while "specific" can be either positive or negative.

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