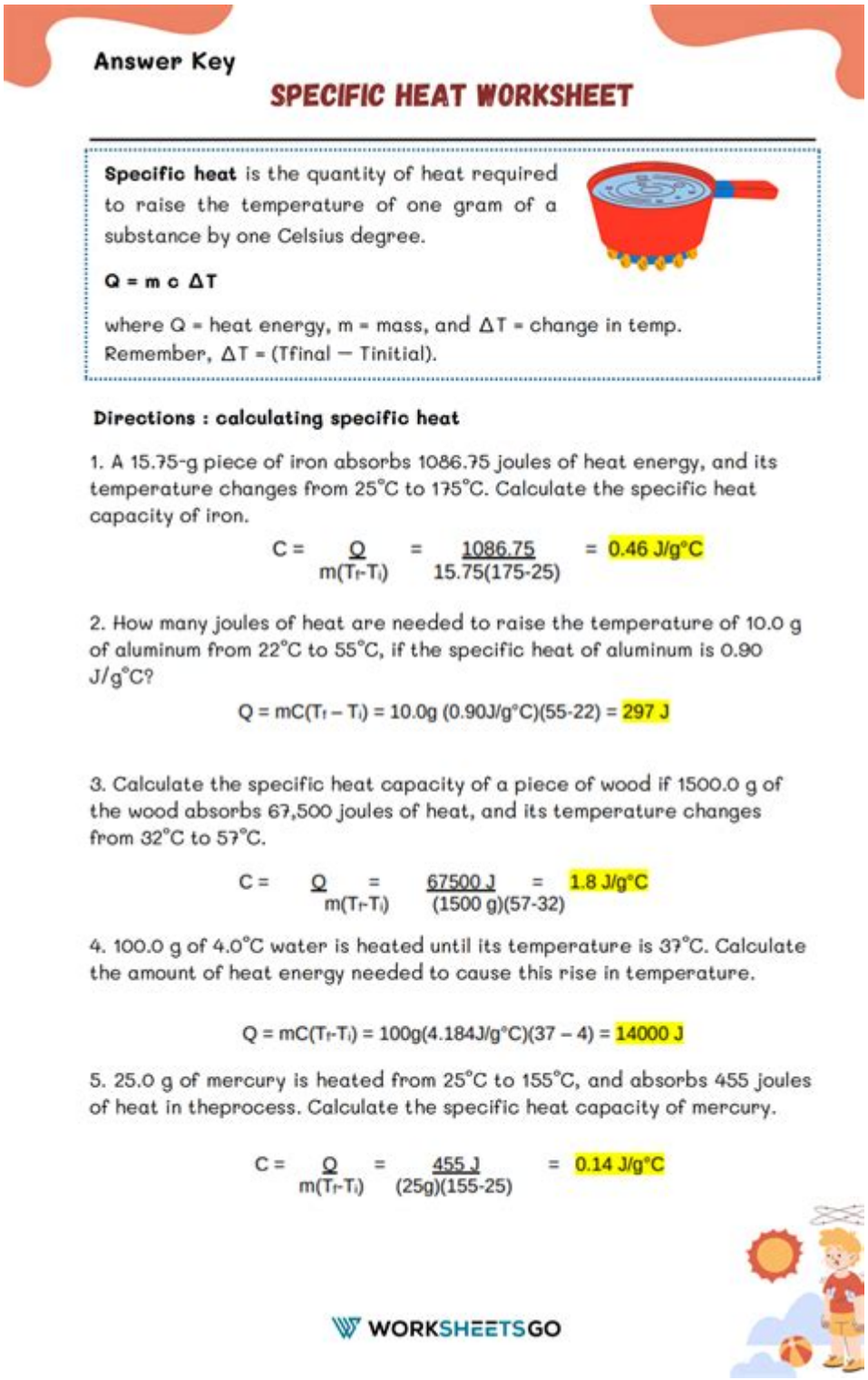
Specific Heat And Heat Capacity Worksheet Answers



Answer Key

SPECIFIC HEAT WORKSHEET

Specific heat is the quantity of heat required to raise the temperature of one gram of a substance by one Celsius degree.

Q = m c ΔT

where Q = heat energy, m = mass, and ΔT = change in temp.
Remember, ΔT = (Tfinal − Tinitial).

Directions : calculating specific heat

1. A 15.75-g piece of iron absorbs 1086.75 joules of heat energy, and its temperature changes from 25°C to 175°C. Calculate the specific heat capacity of iron.

$$C = \frac{Q}{m(T_f - T_i)} = \frac{1086.75}{15.75(175-25)} = 0.46\ J/g°C$$

2. 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?

$$Q = mC(T_f - T_i) = 10.0g\ (0.90J/g°C)(55-22) = 297\ J$$

3. Calculate the specific heat capacity of a piece of wood if 1500.0 g of the wood absorbs 67,500 joules of heat, and its temperature changes from 32°C to 57°C.

$$C = \frac{Q}{m(T_f - T_i)} = \frac{67500\ J}{(1500\ g)(57-32)} = 1.8\ J/g°C$$

4. 100.0 g of 4.0°C water is heated until its temperature is 37°C. Calculate the amount of heat energy needed to cause this rise in temperature.

$$Q = mC(T_f - T_i) = 100g(4.184J/g°C)(37 - 4) = 14000\ J$$

5. 25.0 g of mercury is heated from 25°C to 155°C, and absorbs 455 joules of heat in theprocess. Calculate the specific heat capacity of mercury.

$$C = \frac{Q}{m(T_f - T_i)} = \frac{455\ J}{(25g)(155-25)} = 0.14\ J/g°C$$

WORKSHEETSGO

Specific heat and heat capacity worksheet answers are essential for students and educators alike, as they provide a deeper understanding of thermal properties in materials. In the realm of physics and chemistry, the concepts of specific heat and heat capacity are fundamental to grasping how substances absorb and transfer heat. This article will cover the definitions, formulas,

and examples of these concepts, while also providing a comprehensive guide to solving related worksheet problems and understanding the answers.

Understanding Specific Heat and Heat Capacity

Definitions

1. Specific Heat (c): The specific heat of a substance is defined as the amount of heat required to raise the temperature of one gram of that substance by one degree Celsius (°C). It is expressed in units of joules per gram per degree Celsius (J/g°C).

2. Heat Capacity (C): Heat capacity is the amount of heat needed to change the temperature of an entire object by one degree Celsius. It is typically expressed in joules per degree Celsius (J/°C). Heat capacity depends on both the mass of the object and its specific heat.

Key Formulas

To calculate specific heat and heat capacity, the following formulas are commonly used:

1. Specific Heat Formula:
$$
c = \frac{q}{m \Delta T}
$$
where:
- c = specific heat (J/g°C)
- q = heat added or removed (J)
- m = mass of the substance (g)
- ΔT = change in temperature (°C)

2. Heat Capacity Formula:
$$
C = m \cdot c
$$
where:
- C = heat capacity (J/°C)
- m = mass of the substance (g)
- c = specific heat (J/g°C)

Examples of Specific Heat and Heat Capacity

Common Substances and Their Specific Heats

Here’s a list of specific heats for some common substances:

- Water: 4.18 J/g°C

- Aluminum: 0.897 J/g°C
- Copper: 0.385 J/g°C
- Iron: 0.449 J/g°C
- Air: 1.005 J/g°C

Example Problem 1: Calculating Specific Heat

Problem: A 50 g sample of water absorbs 4180 J of heat. What is the specific heat of water?

Solution:
Using the specific heat formula:
$$
c = \frac{q}{m \Delta T}
$$
Assuming the temperature change (ΔT) is 1°C (as it is not specified), we can rearrange the formula:
$$
c = \frac{4180 \, \text{J}}{50 \, \text{g} \times 1 \, \text{°C}} = \frac{4180}{50} = 83.6 \, \text{J/g°C}
$$
(Note: The actual specific heat of water is approximately 4.18 J/g°C, which implies an error in the assumption of ΔT or the problem setup. It highlights the importance of understanding the context of the problem.)

Heat Transfer and Its Applications

Understanding Heat Transfer

Heat transfer occurs through three primary modes:

1. Conduction: The transfer of heat through direct contact between materials.
2. Convection: The transfer of heat through the movement of fluids (liquids or gases).
3. Radiation: The transfer of heat through electromagnetic waves, such as sunlight.

Each of these modes plays a crucial role in thermal dynamics and the study of specific heat and heat capacity.

Practical Applications

Understanding specific heat and heat capacity has numerous practical applications, including:

- Cooking: Knowledge of specific heat allows chefs to determine how long to cook food to achieve the desired temperature.
- Engineering: Engineers use these principles to design systems that manage heat, such as engines and refrigerators.
- Meteorology: Understanding how different materials absorb and release heat helps in weather prediction and climate studies.

Worksheet Problems and Answers

Sample Worksheet Problems

1. Problem 1: A piece of metal weighing 200 g absorbs 3000 J of heat, raising its temperature from 25°C to 75°C. What is the specific heat of the metal?

2. Problem 2: A 100 g block of aluminum loses 1500 J of heat. What is the change in temperature of the aluminum? (Specific heat of aluminum = 0.897 J/g°C)

3. Problem 3: How much heat is required to raise the temperature of 250 g of air from 20°C to 30°C? (Specific heat of air = 1.005 J/g°C)

Answers to the Problems

1. Answer 1:
- Given: $q = 3000 \, \text{J}$, $m = 200 \, \text{g}$, $\Delta T = 75 - 25 = 50 \, \text{°C}$
- Using specific heat formula:
$$
c = \frac{3000 \, \text{J}}{200 \, \text{g} \times 50 \, \text{°C}} = \frac{3000}{10000} = 0.3 \, \text{J/g°C}
$$

2. Answer 2:
- Given: $q = -1500 \, \text{J}$, $m = 100 \, \text{g}$, $c = 0.897 \, \text{J/g°C}$
- Rearranging the specific heat formula:
$$
\Delta T = \frac{q}{m \cdot c} = \frac{-1500 \, \text{J}}{100 \, \text{g} \times 0.897 \, \text{J/g°C}} = \frac{-1500}{89.7} \approx -16.7 \, \text{°C}
$$

3. Answer 3:
- Given: $m = 250 \, \text{g}$, $\Delta T = 30 - 20 = 10 \, \text{°C}$, $c = 1.005 \, \text{J/g°C}$
- Using the heat formula:
$$
q = m \cdot c \cdot \Delta T = 250 \, \text{g} \times 1.005 \, \text{J/g°C} \times 10 \, \text{°C} = 2512.5 \, \text{J}
$$

Conclusion

In conclusion, specific heat and heat capacity worksheet answers are vital for understanding fundamental concepts in thermal dynamics. By mastering the definitions, formulas, and applications of specific heat and heat capacity, students can solve complex problems and apply their knowledge to real-world situations. Whether in the classroom or in practical applications, a solid grasp of these concepts enhances our understanding of heat transfer and its impact on materials. Through practice and analysis of worksheet problems,

learners can achieve competency in these essential scientific principles.

Frequently Asked Questions

What is the difference between specific heat and heat capacity?

Specific heat is the amount of heat required to raise the temperature of one unit mass of a substance by one degree Celsius, while heat capacity is the total amount of heat needed to raise the temperature of an entire object or substance by one degree Celsius.

How do you calculate specific heat from a worksheet problem?

To calculate specific heat, use the formula: specific heat (c) = heat added (q) / (mass (m) x change in temperature (ΔT)). Substitute the values provided in the worksheet to find the specific heat.

What units are typically used for heat capacity and specific heat?

Heat capacity is usually expressed in joules per degree Celsius (J/°C) or calories per degree Celsius (cal/°C), while specific heat is expressed in joules per gram per degree Celsius (J/g°C) or calories per gram per degree Celsius (cal/g°C).

Why is understanding specific heat important in chemistry?

Understanding specific heat is crucial in chemistry because it helps predict how substances will react to heat changes, which is essential for experiments, heating processes, and understanding thermal properties of materials.

What common errors should be avoided when solving specific heat problems on worksheets?

Common errors include miscalculating the mass or temperature change, using incorrect units, and not accounting for the specific heat of the correct substance. Always double-check calculations and unit conversions.

Specific Heat And Heat Capacity Worksheet Answers

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