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2017-2018



**WS 3.6 Energy Conversions**

1) Perform each of the following conversions:

a. 654 cal to joules b. 12.9 J to Calories c. 167 kJ to Calories d. 99.3 Cal to joules

e. 5.7 X 103 J to kilojoules f. 326 kJ to joules

2) In a chemical cold pack, two substances are kept separate by a divider. When the divider is broke, the substances mix and absorb heat from the surroundings. The chemical cold pack feels cold. Is the reaction endothermic or exothermic? Draw an energy diagram showing the relative energies of the reactants and products in the reaction.

3) Determine whether each of the following is exothermic or endothermic. a. Dry ice subliming (changing from a solid directly to a gas)

b. The wax in a candle melting c. A match burning

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**WS 3.7 Specific Heat Problems**

1. How many joules of heat are required to raise the temperature of 200 grams of water from 20.0C to 50.0C? (2.51 x 104)

2. If 700 grams of water loses 27.0 kilojoules of heat, what is its change in temperature? (9.22)

3. Some water is heated from 10.0C to 50.0C. During the process, 50.0 kilojoules of heat is added to the water. What is the mass (grams) of water heated? (299)

4. What is the specific heat of an unknown substance, if 950 J of heat raises the temperature of a 20.00 gram sample from 18.0C to 42.0C? (1.98)

5. Hg has a specific heat of 0.139 J/gC. How much heat is required to raise the temperature of a 22.80 g sample from 16.2 C to 32.5C? (51.7)

6. How many kJ of heat are needed to raise the temperature of 1.50 L of water from 20.0C

to 37.0C? (1.07 x 102)

7. The specific heats of three different substances are listed as: Carbon tetrachloride: 0.856 J/gC

Benzene: 1.74 J/gC

Acetic Acid: 2.05 J/gC

A chemistry student finds that 1.47 kJ of heat raise the temperature of 19.70 grams of an unknown substance by 36.4C. Which of the three substances is the unknown substance?

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8. How many kJ is released from a 2.00 L bottle of Surge when it cools from 80.0F (294 K)

to its freezing point? Assume that pop has the same properties as water. (-176)

9. What mass of glass (Cp = 0.749 J/gC) is needed to absorb 5.00  104 J of heat, if it starts at 26C and has a final temperature of 275C? (268)

10. What final temperature will 120.00 grams of benzene at 7.00C have after it absorbs 2.20 kJ of heat? The Cp of benzene is 1.74 J/gC. (17.5)

11. 3.0 kg of osmium metal at 241 K is heated to 394 K. How much heat energy is needed for this? The Cp of osmium is 0.130 J/gC. (6.0 x 104)

12. 14.22 grams of a substance absorbs 1.77 kJ of heat. Its temperature changes from −23.0C

to 31.0C. What is the specific heat of the substance? (2.31)

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**WS 3.8 Specific Heat Problems**

1) An object with a mass of 19 grams, has a specific heat of 0.59J/g°C. If the temperature of this object changes from 100°C to 125°C, how much heat did the object absorb? (2.8 x 102)

2) If 225 ml of water was cooled from 50°C to 35°C, how much heat was released from the water? (remember 1 ml = 1 g for water) (-1.4 x 104)

3) If a 24.3 grams piece of copper(specific heat = 0.384 J/g°C) at room temperature (22°C) is placed outside to absorb 2600 J of heat, what will the final temperature of the copper piece be? (3.0 x 102)

4) You have a 28.2 g sample of a metal heated to 95.2°C. You drop it into 100 grams of water at 25.1°C. The final temperature of the water is 31.0 °C. Assuming no heat loss to the surroundings nor the calorimeter, calculate the specific heat of the metal. (1.36)

5) A 140.0 gram sample of water at 25°C is mixed with 100.0 grams of a certain metal at

100.0°C. When the temperatures have equalized, the (final) temperature of the mixture is 29.6°C. What is the specific heat of the metal? (0.383)

6) How much heat is required to raise the temperature of a 6.21 gram sample of iron

(specific heat = 0.450 J/g°C) from 25.0 °C to 79.8°C? (153)

7) A sample of granite with a temperature of 50ºC is placed into a coffee cup calorimeter containing 250 grams of water at 23.2ºC. If the final temperature of the water is

25.1ºC, what was the mass of the granite sample? The specific heat of granite is 0.790

J/gºC. (101)

8) A piece of tungsten metal with a mass 23.8 grams is heated and dropped into 50.0 ml of water at 24.0°C. The final temperature of the system is 26.3°C. What is the initial temperature of the metal? (Tungsten = 0.134 J/gºC) (177.2)

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9) What is the final temperature when 33 grams of iron (specific heat = 0.450 J/g°C), at

950°C is dropped into 275 ml of water at 22°C? (34)

10) A 2.8 kg sample of a metal with a specific heat of 0.43 J/g°C is heated to 100.0°C then placed in a 50.0 g sample of water at 30.0°C. What is the final temperature of the metal and the water? (90)

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**3.9 Review**

1. Would each reaction described below be exothermic or endothermic?

a. Fireworks b. Ice melting

c. Water condensing

d. A light stick glowing

2. Convert the following units as instructed:

a. 1900 calories to Calories b. 450 calories to joules

c. 965 joules to calories

d. 12,500 joules to kJ



3. You wish to heat water to make coffee. How much heat (in joules) must be used to raise the temperature of 0.180 kg of water from 15°C to 96°C? (61002)

4. An iron skillet weighing 1.51 kg is heated on a stove to 278°C. If the skillet is cooled to room temperature, 21°C, how much heat energy (in joules) must be removed from the iron? The specific heat of iron is 0.450 J/g°C. (-174,632)

5. If a piece of aluminum with a mass of 3.90 grams and a temperature of 99.3°C is dropped into 10.0 ml of water at 22.6°C, what will be the final temperature of the water. The specific heat of aluminum is 0.903 J/g°C. (28.6)

6. 3.17 kJ of heat is applied to a 96.7 g sample of PCl3 at 31.7°C. What is the final temperature of the sample? The specific heat of PCl3 is 0.874J/g°C. (69.2)

7. An unknown metal with an initial temperature of 75.5ºC is placed in a calorimeter containing 100 ml of water. The temperature of the water changes from 23.9ºC to

27.2ºC. If the mass of the metal is 28 grams, what is its specific heat? (1.02)

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8. It takes 78.2 J to raise the temperature of 45.6 grams of lead by 13.3°C. What is the specific heat of lead? (0.129)

9. How many joules are required to raise the temperature of 0.500 kg of liquid water by

24.0°C? How many calories are needed? (50,208; 12,000)

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**WS 3.10 Review Specific Heat Problems**

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. (0.46)

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? (297)

3) A 36.9 g sample of metal is heated to 100.0 °C, and then added to a calorimeter containing 141.5 g of water at 23.1 °C. The temperature of the water rises to a maximum of 25.2 °C before cooling back down. First, did the water absorb heat or did it release heat? Second, what is the specific heat of the metal? (0.45)

4) To what temperature will a 50.0 g piece of glass raise if it absorbs 5275 joules of heat and its specific heat capacity is 0.50 J/g°C? The initial temperature of the glass is 20.0°C. (231)

5) What is the specific heat capacity of silver metal (in J/g°C) if 55.00 g of the metal absorbs

47.3 **calories** of heat and the temperature rises 15.0°C? (0.24)

6) A mass of metal (Cp = 1.84 J/g°C) is heated to 120°C and the dropped into a cup containing

100 ml of 25°C water. The final temperature of the mixture is 29°C. What is the mass of the metal sample? (10)

7) A 30.0 g sample of water at 7°C is mixed with 50.0 g of water at 57°C. Calculate the final temperature of the mixture assuming no heat loss to the surroundings. Remember that the heat gained by the cooler water is equal to the heat lost by the warmer water. (38.3)

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