

Practice Problems

Friday, 27 August 2021 3:15 PM

Heat Capacity and Calorimetry

[1]

How many calories are required to heat each of the following from 15°C to 65°C: (a) 1.0 g water; (b) 5.0 g Pyrex[®] glass; (c) 20 g platinum? (The specific heat of the glass is 0.20 cal/g · K; of platinum, 0.032 cal/g · K.)

Ans. (a) 50 cal; (b) 50 cal; (c) 32 cal

[2]

The ability to convert between calories and joules is extremely important. Express the answers in Problem 7.19 in joules and in kJ.

Ans. (a and b) 209.2 J and 0.2092 kJ; (c) 133.9 J and 0.1339 kJ

[3]

The combustion of 5.00 g of coke raised the temperature of water of 1.00 kg of water from 10°C to 47°C. Calculate the heating value of coke.

Ans. 7.4 kcal/g or 31 kJ/g

[4]

Assuming that 50% of the heat is useful, how many kilograms of water at 15°C can be heated to 95°C by burning 200 L of methane, CH₄, measured at S.T.P.? The heat of combustion for methane is 891 kJ/mol.

Ans. 12 kg water

[5]

The heat of combustion of ethane gas, C₂H₆, is 1561 kJ/mol. Assuming that 60% of the heat is useful, how many liters of ethane (S.T.P.) must be burned to supply enough heat to convert 50 kg of water at 10°C to steam at 100°C?

Ans. 3150 L

[6]

How much heat is required to change 10 g of ice at 0°C to steam at 100°C? The heat of vaporization of water at 100°C is 540 cal/g (2259 J/g).

Ans. 7.2 kcal or 30 kJ

[7]

A boiler that supplies a steam turbine used in an electric power plant must raise the temperature of water from the ambient temperature passing through a physical state change and then to live (very hot) steam. How much energy (kcal and kJ) would be required to raise 15,000 L of water from 25°C to steam at 175°C? (steam requires 0.5 cal/g · K)?

Ans. 9,800 kcal or 41,000 kJ

[8]

A Styrofoam[™] coffee cup serves as an inexpensive calorimeter for measurements that do not require high accuracy. One gram of KCl(s) was added to 25.0 ml of water in such a cup at 24.33°C. It dissolved completely and quickly with gentle stirring. The minimum temperature reached was 22.12°C. Estimate the ΔH° of the heat of solution of KCl in kJ/mol. You may assume the solution has the same heat capacity as water and that the heat capacity of the cup and thermometer need not be considered.

Ans. $\Delta H^\circ_{\text{solution}} = +17.2 \text{ kJ/mol}$

Unit 1 thermochemistry Review

J Dewey



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