in the sample as the sample is slowly cooled until it liquefies and then solidifies.

3.7 Calculating Energy Changes

QUESTIONS

41. Metallic substances tend to have (higher/lower) specific heat capacities than nonmetallic substances.

42. The quantity of energy required to change the temperature of a sample is calculated by taking the product of the mass of the sample, the specific heat capacity of the sample, and the _____ change undergone by the sample.

43. If it takes 654 J of energy to warm a 5.51-g sample of water, how much energy would be required to warm 55.1 g of water by the same amount?

44. If it takes 526 J of energy to warm 7.40 g of water by 17 °C, how much heat would be needed to warm 7.40 g of water by 55 °C?

45. Convert the following numbers of calories or kilocalories into joules and kilojoules. (Remember: kilo means 1000.)
    a. 75.2 kcal
    b. 75.2 cal
    c. 1.41×10^3 cal
    d. 1.41 kcal

46. Convert the following numbers of kilojoules into kilocalories. (Remember: kilo means 1000.)
    a. 462.4 kJ
    b. 18.28 kJ
    c. 1.014 kJ
    d. 190.5 kJ

47. Convert the following numbers of calories into kilocalories.
    a. 7518 cal
    b. 7.518×10^3 cal
    c. 1 cal
    d. 655,200 cal

48. Convert the following numbers of kilocalories into calories.
    a. 12.30 kcal
    b. 290.4 kcal
    c. 940,000 kcal
    d. 4201 kcal

49. Convert the following numbers of joules (J) into kilojoules (kJ). (Remember: kilo means 1000.)
    a. 243,000 J
    b. 4.184 J
    c. 0.251 J
    d. 450.3 J

50. Perform the indicated conversions.
    a. 76.52 cal into kilojoules
    b. 7.824 kJ into kilocalories
    c. 489.4 J into calories
    d. 1.598×10^4 J into kilocalories

51. Perform the indicated conversions.
    a. 89.74 kJ into kilocalories
    b. 1.756×10^4 J into kilojoules
    c. 1.756×10^4 J into kilocalories
    d. 1.00 kJ into calories

52. If 72.4 kJ of heat is applied to a 952-g block of metal, the temperature of the metal increases by 10.7 °C. Calculate the specific heat capacity of the metal in J/g °C.

53. Calculate the energy required in joules and calories to heat 29.2 g of aluminum from 27.2 °C to 41.5 °C. See Table 3.2.

54. A particular sample of iron requires 562 J to raise its temperature from 25.0 °C to 50.0 °C. What must be the mass of the sample of iron? See Table 3.2.

55. If 100. J of heat energy is applied to a 25-g sample of mercury, by how many degrees will the temperature of the mercury sample increase? See Table 3.2.

56. Calculate the quantity of heat required to raise the temperature of a 852.5-g sample of iron from 40.1 °C to 75.5 °C.

57. The specific heat capacity of silver is 0.24 J/g °C. Express this in terms of calories per gram per Celsius degree.

58. The specific heat capacity of gold is 0.13 J/g °C. Calculate the specific heat capacity of gold in cal/g °C.

59. Suppose you have samples of gold, iron, and aluminum, all of the same mass. If the same quantity of heat energy is applied in turn to each of the three samples, which sample of metal will end up at the highest temperature? Which will end up at the lowest temperature?

60. If the temperatures of separate 25.0-g samples of gold, mercury, and carbon are to be raised by 20. °C, how much heat (in joules) must be applied to each substance?

61. A 5.00-g sample of one of the substances listed in Table 3.2 was heated from 25.2 °C to 55.1 °C, requiring 133 J to do so. What substance was it?

62. A 35.2 g sample of metal Z requires 1251 J of energy to heat the sample by 25.0 °C. Calculate the specific heat capacity of metal Z.

Additional Problems

63. If solid iron pellets and sulfur powder are poured into a container at room temperature, a simple _____ has been made. If the iron and sulfur are heated until a chemical reaction takes place between them, a(n) _____ will form.

64. Pure substance X is melted, and the liquid is placed in an electrolysis apparatus such as that shown in Figure 3.3. When an electric current is passed through the liquid, a brown solid forms in one chamber and a white solid forms in the other chamber. Is substance X a compound or an element?

65. If a piece of hard white blackboard chalk is heated strongly in a flame, the mass of the piece of chalk will decrease, and eventually the chalk will crumble into a fine white dust. Does this change suggest that the chalk is composed of an element or a compound?

66. During a very cold winter, the temperature may remain below freezing for extended periods. However, fallen snow can still disappear, even though it cannot melt. This is possible because a solid can vaporize directly, without passing through the liquid state. Is this process (sublimation) a physical or a chemical change?

67. Perform the indicated conversions.
    a. 4.52 cal to kilocalories
    b. 5.27 kcal to joules
    c. 852,000 cal to kilojoules
    d. 352.4 kcal to kilojoules
    e. 5.72 kJ to calories
    f. 4.52×10^3 J to kilojoules

68. Calculate the amount of energy required (in joules) to heat 2.5 kg of water from 18.5 °C to 55.0 °C.

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Table 3.2 The Specific Heat Capacities of Some Common Substances

Substance	Specific Heat Capacity (J/g °C)
water (*l*)* (liquid)	4.184
water (*s*) (ice)	2.03
water (*g*) (steam)	2.0
aluminum (*s*)	0.89
iron (*s*)	0.45
mercury (*l*)	0.14
carbon (*s*)	0.71
silver (*s*)	0.24
gold (*s*)	0.13

*The symbols (*s*), (*l*), and (*g*) indicate the solid, liquid, and gaseous states, respectively.