Chapter 7 Energy and Chemical Change: Breaking and Making Bonds

Multiple Choice

Section 7.1

1. Which one of the following is a unit of energy, but not an SI unit of energy?

   a. joule
   b. newton
   c. pascal
   d. watt
   ! e. calorie

Section 7.1

2. Which one of the following is a unit of energy?

   a. pascal
   b. newton
   ! c. joule
   d. watt
   e. ampere

Section 7.1

3. Chemical energy is

   a. the kinetic energy resulting from violent decomposition of energetic chemicals
   b. the heat energy associated with combustion reactions
   c. the electrical energy produced by fuel cells
   ! d. the potential energy which resides in chemical bonds
   e. the energy living plants receive from solar radiation

Section 7.1

4. How much kinetic energy (KE) does an object with a mass of 500 g traveling in a straight line with a speed of 50 m s^{-1} possess?

   ! a. 0.625 kJ
   b. 1.25 kJ
   c. 2.5 kJ
   d. 6.25 kJ
   e. 25 kJ

Section 7.1

5. How much kinetic energy (KE) does an object with a mass of 900 g traveling in a straight line with a speed of 40 m s^{-1} possess?

! a. 0.72 kJ
b. 1.44 kJ
c. 2.88 kJ
d. 16.2 kJ
e. 18 kJ

Section 7.1

6. How much kinetic energy (KE) does an object with a mass of 1200 g traveling in a straight line with a speed of 50 m s^{-1} possess?

! a. 1.5 kJ
b. 3.0 kJ
c. 6.0 kJ
d. 36 kJ
e. 300 kJ

Section 7.3

9. A chemical reaction has just occurred in an insulated isolated system which caused an overall decrease in the potential energy of the system. Which statement below is true?

a. Heat was taken in from the surroundings by the system.
b. Heat was given off to the surroundings by the system.
! c. The temperature of the system increased.
d. The temperature of the system decreased.
e. The total energy of the system decreased.

Section 7.3

10. The internal energy of a chemical system is described by one of the equations below. Which one?

! a. E_{system} = (Kinetic Energy)$_{system}$ + (Potential Energy)$_{system}$
b. E_{system} = (Kinetic Energy)$_{system}$ - (Potential Energy)$_{system}$
c. E_{system} = (Potential Energy)$_{system}$ - (Kinetic Energy)$_{system}$
d. E_{system} = (Kinetic Energy)$_{system}$
e. E_{system} = (Potential Energy)$_{system}$

Section 7.3

11. A 500.0 gram sample of aluminum is initially at 25.0 ^{o}C. It absorbs 32.60 kJ of heat from its surroundings. What is its final temperature, in ^{o}C? (specific heat = 0.9930 J g^{-1} $^{o}C^{-1}$ for aluminum)

a. 40.4 ^{o}C
b. 64.7 ^{o}C
c. 65.7 ^{o}C
d. 89.7 ^{o}C
! e. 90.7 ^{o}C

Section 7.3

12. A 350.0 gram sample of copper is initially at 25.0 ^{o}C. It absorbs 12.50 kJ of heat from its surroundings. What is its final temperature, to the nearest tenth of a degree?
(specific heat = 0.3874 J g^{-1} $^{o}C^{-1}$ for copper)

a. 38.8 ^{o}C
b. 67.2 ^{o}C
c. 92.2 ^{o}C
! d. 117.2 ^{o}C
e. 156.7 ^{o}C

Section 7.3

15. A certain oil used in industrial transformers has a density of 1.086 g ml^{-1} and a specific heat of 1.826 J g^{-1} $^{o}C^{-1}$. Calculate the heat capacity of one gallon of this oil. (1 gallon = 3.785 liters)

a. 0.4442 kJ $^{o}C^{-1}$
b. 0.5239 kJ $^{o}C^{-1}$
c. 2.251 kJ $^{o}C^{-1}$
d. 6.364 kJ $^{o}C^{-1}$
! e. 7.506 kJ $^{o}C^{-1}$

Section 7.3

16. A certain oil used in industrial transformers has a density of 1.068 g ml^{-1} and a specific heat of 1.628 J g^{-1} $^{o}C^{-1}$. Calculate the heat capacity of one gallon of this oil. (1 gallon = 3.785 liters)

a. 0.3747 kJ $^{o}C^{-1}$
b. 0.4027 kJ $^{o}C^{-1}$
c. 2.483 kJ $^{o}C^{-1}$
d. 5.770 kJ $^{o}C^{-1}$
! e. 6.581 kJ $^{o}C^{-1}$

Section 7.3

18. A calorimeter consists of metal parts with a heat capacity of 925.0 J $^{o}C^{-1}$ and 1100 grams of oil with a specific heat of 2.184 J g^{-1} $^{o}C^{-1}$. Calculate the heat required, in kJ, to raise its temperature from 24.40 ^{o}C to 29.75 ^{o}C.

a. 0.827 kJ
b. 7.64 kJ
! c. 17.8 kJ
d. 23.7 kJ
e. 99.0 kJ

Section 7.3

19. A coffee cup calorimeter contains 480.0 grams of water at 25.00 ^{o}C. To it are added:

380.0 grams of water at 53.5 ^{o}C
525.0 grams of water at 65.5 ^{o}C

Assuming the heat absorbed by the styrofoam is negligible, calculate the expected final temperature. The specific heat of water is 4.184 J g^{-1} $^{o}C^{-1}$.

a. 38.2 ^{o}C
! b. 48.2 ^{o}C
c. 67.6 ^{o}C
d. 88.7 ^{o}C
e. 94.4 ^{o}C

Section 7.5

30. For a chemical reaction taking place at constant pressure, which one of the following is *not* true?

a. $\Delta E = E_{final} - E_{initial}$
b. $\Delta E = E_{products} - E_{reactants}$
c. $\Delta E = q + w$
! d. ΔE = Kinetic Energy - Potential Energy
e. $\Delta E = \Delta H - P\Delta V$

Section 7.5

31. For a chemical reaction taking place at constant pressure, which one of the following is true?

a. $\Delta H_{system} = (\text{Kinetic Energy})_{system} + (\text{Potential Energy})_{system}$
b. $\Delta H_{system} = (\text{Kinetic Energy})_{system} - (\text{Potential Energy})_{system}$
c. $\Delta H_{system} = \Delta E_{system} - q_p$
! d. $\Delta H_{system} = \Delta E_{system} + P\Delta V_{system}$
e. $\Delta H_{system} = \Delta E_{system} + q_p$

Section 7.5

32. An endothermic reaction is one in which there is

a. a positive value for the work (w > 0 joules)
b. a negative value for the work (w < 0 joules)
c. a negative value for ΔH ($\Delta H < 0$ joules)
! d. a positive value for ΔH ($\Delta H > 0$ joules)
e. a negative value for ΔE ($\Delta E > 0$ joules)

Section 7.5

37. For a change in a system taking place at constant pressure, which statement below is true?

a. $\Delta H = \Delta E$
b. $\Delta H = q_p - P\Delta V$
c. $\Delta H = \Delta E - q_p$
! d. $\Delta H = q_p$
e. $\Delta E = q_p$

Section 7.6

44. When aluminum metal reacts with iron(III) oxide to form aluminum oxide and iron metal, 429.6 kJ of heat are given off for each mole of aluminum metal consumed, under constant pressure and standard conditions. What is the correct value for the standard enthalpy of reaction in the thermochemical equation below?

$$2\,Al(s) + Fe_2O_3(s) \rightarrow 2\,Fe(s) + Al_2O_3(s)$$

a. +429.6 kJ
b. -429.6 kJ
c. +859.2 kJ
! d. -859.2 kJ
e. -1289 kJ

Section 7.7

46. Given the reaction, $4B + 3A \rightarrow 4C + 7D$, and some standard enthalpies of formation, ΔH_f^o:

A: +15.7 kJ mol^{-1} B: -86.4 kJ mol^{-1} C: -52.7 kJ mol^{-1} D: -71.6 kJ mol^{-1}

What is the standard enthalpy of reaction, in kJ for the reaction shown?

a. -53.6 kJ
! b. -413.5 kJ
c. -515.6 kJ
d. -853.6 kJ
e. -908.4 kJ

Section 7.7

47. Given the reaction, 3B + 5A $\rightarrow$ 7C + 3D, and some standard enthalpies of formation, ΔH_f^o:

A: -15.7 kJ mol^{-1} B: -86.4 kJ mol^{-1} C: -52.7 kJ mol^{-1} D: -71.6 kJ mol^{-1}

What is the standard enthalpy of reaction, in kJ for the reaction shown?

a. +26.6 kJ
b. -53.6 kJ
c. -198.8 kJ
! d. -246.0 kJ
e. -413.5 kJ

Section 7.8

56. Complete combustion of hydrocarbons, or compounds with C,H, and O as the only elements, gives CO_2 and H_2O as the only products. If carried out under standard conditions, the CO_2 is a gas while the H_2O is a liquid. Given these standard enthalpies of ***combustion***:

$C_2H_4(g)$ = -1411.08 kJ mol^{-1} $C_2H_2(g)$ = -1299.65 kJ mol^{-1}
$H_2(g)$ = -285.90 kJ mol^{-1} $C(s)$ = -393.50 kJ mol^{-1}

Calculate the standard enthalpy of reaction for the process, $C_2H_2(g) + H_2(g) \rightarrow C_2H_4(g)$

! a. -174.47 kJ
b. +397.33 kJ
c. -961.47 kJ
d. -2424.83 kJ
e. -2996.63 kJ

Section 7.8

57. Complete combustion of hydrocarbons, or compounds with C,H, and O as the only elements, gives CO_2 and H_2O as the only products. If carried out under standard conditions, the CO_2 is a gas while the H_2O is a liquid. Given these standard enthalpies of ***combustion***: $C_6H_{12}(l)$ = -3919.86 kJ mol^{-1}, $C_6H_6(l)$ = -3267.80 kJ mol^{-1}, $H_2(g)$ = -285.90 kJ mol^{-1}, $C(s)$ = -393.50 kJ mol^{-1}. Calculate the standard enthalpy of reaction for the process, $C_6H_6(l) + 3\ H_2(g) \rightarrow C_6H_{12}(l)$

! a. -205.64 kJ
b. +366.16 kJ
c. +759.66 kJ
d. +2155.36 kJ
e. +5684.36 kJ

Fill in the Blanks

Section 7.3

58. A 500.0 gram sample of water is initially at 25.0 °C. It absorbs 50.0 kJ of heat from its surroundings. What is its final temperature, in °C? Specific heat of water = 4.184 J g^{-1} $°C^{-1}$.
______ (! 48.9)

Section 7.3

59. A calorimeter consists of metal parts with a heat capacity of 925.0 J $^{o}C^{-1}$ and 975 grams of oil with a specific heat of 2.214 J g^{-1} $^{o}C^{-1}$. Both are at 25.40 ^{o}C. A 550 g iron slug, at 240.0 ^{o}C is added. What is the final temperature? Specific heat of iron = 0.4998 J g^{-1} $^{o}C^{-1}$. ______ (! 43.0 ^{o}C)

Section 7.7

67. Use these reactions and standard enthalpies, ΔH^{o}

2 ZbO(*s*) + ½ O_2(*g*) → Zb_2O_3(*s*)	-128.0 kJ
ZbO(*s*) + ½ O_2(*g*) → ZbO_2(*s*)	-380.0 kJ
2 ZbO(*s*) + 3/2 O_2(*g*) → Zb_2O_5(*s*)	-344.5 kJ

find the value for

Zb_2O_3(*s*) + O_2(*g*) → Zb_2O_5(*s*) ______ (! -216.5 kJ)

Section 7.8

72. Given the reaction, $7A + 5B \rightarrow 3C + 4D$, and some standard enthalpies of formation, ΔH_f^o:

A: 15.7 kJ mol^{-1} B: -86.4 kJ mol^{-1} C: -52.7 kJ mol^{-1} D: -71.6 kJ mol^{-1}

What is the standard enthalpy of reaction, in kJ for the reaction shown? ______ (! -122.4 kJ)

Section 7.8

73. Using the standard enthalpies of formation, ΔH_f^o:

$H_2O(l)$ = -285.9 kJ mol^{-1}; $C_2H_4(g)$ = 52.284 kJ mol^{-1}; $C_2H_5OH(l)$ = -277.63 kJ mol^{-1}

calculate the standard enthalpy of reaction for

$C_2H_4(g) + H_2O(l) \rightarrow C_2H_5OH(l)$ ______ (! -44.0 kJ)