Part 6. Periodic Properties

70. The elements **X**, **Y**, and **Z** form these compounds: XCl_4, XZ_2, and YO. What formula would you predict for the compound formed between **Y** and **Z**? (Assume normal oxidation states of Cl and O.)

(A) **YZ**   (B) **YZ$_2$**
(C) **Y$_2$Z**   (D) **YZ$_3$**

71. Which element in this periodic table will form an oxide Y_2O_3?

	Main Group Elements							
Group number	1	2	3	4	5	6	7	8
First period	D							E
Second period	G		J		K	L	M	
Third period	Q	R		T	X		Z	

(A) **E**   (B) **G**   (C) **J**
(D) **L**   (E) **R**

72. In which pair of particles is the first member larger than the second member?

(A) Li^+ ; Be^{2+} (C) Li^+ ; Na^+
(B) Li^+ ; Li   (D) Be ; Mg

73. Which ion has the largest radius?

(A) Te^{2-} (B) F^-
(C) Rb^+ (D) Mg^{2+}

74. The sizes of metal atoms

(A) generally increase progressively from bottom to top in a group in the periodic table.
(B) generally increase progressively from top to bottom in a group in the periodic table.
(C) generally increase progressively from left to right in a period.
(D) are smaller than those of the corresponding ions.
(E) do not change upon losing electrons.

75. Predict which element would have the largest difference between its first and second ionization energies.

(A) sodium   (C) phosphorus
(B) silicon   (D) magnesium

76. Which element has the highest first ionization energy?

(A) Na   (B) F
(C) Cs   (D) I

77. A neutral atom will have the lowest ionization potential when its electron configuration is

(A) $1s^1$ (D) $1s^2\,2s^2\,2p^6$
(B) $1s^2\,2s^2\,2p^2$ (E) $1s^2\,2s^2\,2p^6\,3s^1$
(C) $1s^2\,2s^2\,2p^5$

78. Five elements, **X**, **Y**, **Z**, **J**, and **Q**, have the indicated electron configurations, starting with the innermost shell. Which is the most metallic?

(A) **X** — 2, 8, 2   (D) **J** — 2, 8, 8, 4
(B) **Y** — 2, 8, 8   (E) **Q** — 2, 8, 8, 7
(C) **Z** — 2, 8, 8, 2

Part 7. Gases

79. Which is a basic assumption of the kinetic–molecular theory?

(A) Gas molecules have no motion.
(B) Gas molecules have curvilinear motion.
(C) Gas molecules are diatomic.
(D) Gas molecules are monatomic.
(E) Gas molecules have rapid straight line motion between collisions.

80. A liter of carbon dioxide gas is compared to a liter of hydrogen gas, both gases at 25 °C and 2 atm. Which statement is correct?

(A) The CO_2 and H_2 molecules have the same average speed.
(B) There are more molecules of H_2 than CO_2 present.
(C) The CO_2 and H_2 molecules hit the walls of the containers with the same frequency.
(D) The CO_2 molecules are on the average moving slower than the H_2 molecules.
(E) The average kinetic energy of the CO_2 molecules is greater than that of the H_2 molecules.

81. A sample of neon occupies a volume of 27.3 L at STP. What would be its volume at 177 °C and 0.100 atm pressure?

(A) 177 L   (B) 350 L
(C) 422 L   (D) 450 L

82. In a sample of a nearly ideal gas, this graph could represent a plot of

(A) *V* vs. *T* at a given constant *P*.
(B) *P* vs. *T* at a given constant *V*.
(C) *P* vs. *V* at a given constant *T*.
(D) *PV* vs. *P* at a given constant *T*.

83. The density of a gas is 1.96 g L^{-1} at 1.00 atm and 0 °C. What is the density of this gas at 0.855 atm and 25.0 °C?

(A) 0.00276 g L^{-1} (C) 1.54 g L^{-1}
(B) 0.651 g L^{-1} (D) 1.82 g L^{-1}

84. If 1 L of a gas at 30 °C and 720 mmHg has a mass of 2.00 g, the molar mass of this gas is

(A) 22.4 g.

(B) 44.8 g.

(C) somewhere between 22.4 and 44.8 g.

(D) more than 44.8 g.

85. A gas sample occupies a volume of 16.4 L at 27 °C and 0.300 atm. How many moles of gas are present?

(A) 0.200   (B) 0.450

(C) 3.50   (D) 10.0

86. The ideal gas law best describes the behavior of water vapor at

(A) 373 K and 1 atm.   (C) 473 K and 10 atm.

(B) 473 K and l atm.   (D) 0 K and 1 atm.

87. A mixture of 11.0 g of CO_2 and 8.00 g of O_2 and an undetermined amount of H_2 occupies 22.4 L at 760 mmHg and 0.00 °C. How many grams of H_2 are present?

(A) 0.100 g   (B) 0.500 g

(C) 1.00 g   (D) 2.00 g

88. A certain gas has a density of 2.23 g L^{-1} at 0 °C and 760 mmHg. Its molar mass is

(A) 5.00   (B) 50.0

(C) 49.0   (D) 51.0

89. The partial pressures of a gaseous mixture are given in the table. What is the mole percent of hydrogen?

Partial Pressures	
hydrogen	200 mmHg
carbon dioxide	150 mmHg
methane	320 mmHg
ethylene	105 mmHg

(A) 20.0   (B) 25.8

(C) 38.8   (D) 41.7

90. Methane, CH_4, diffuses in a given apparatus at the rate of 30 mL min^{-1}. At what rate would a gas with a molar mass of 100 diffuse under the same conditions?

Given: Molar Mass of CH_4: 16.0 g mol^{-1}

(A) 0.77 mL min^{-1} (D) 30 mL min^{-1}

(B) 6.7 mL min^{-1} (E) 75 mL min^{-1}
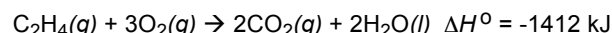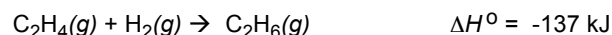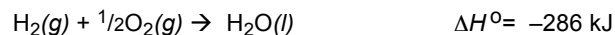
(C) 12 mL min^{-1}

Part 8. Thermochemistry

91. When 45.0 g of an alloy at 100.0 °C is dropped into 100.0 g of water at 25.0 °C, the final temperature is 37.0 °C. What is the specific heat of the alloy? Given: specific heat of water is 4.184 J g^{-1} $°C^{-1}$

(A) 0.423 J g^{-1} $°C^{-1}$ (C) 9.88 J g^{-1} $°C^{-1}$

(B) 1.77 J g^{-1} $°C^{-1}$ (D) 48.8 J g^{-1} $°C^{-1}$

92. What is the standard enthalpy of combustion of C_2H_6 in kJ mol^{-1}?

Thermochemical Data

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\Delta H^O = -286$ kJ

$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$ $\Delta H^O = -137$ kJ

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ $\Delta H^O = -1412$ kJ

(A) −1275 kJ   (C) −1561 kJ

(B) −1548 kJ   (D) +1834 kJ

93. Calculate the value of ΔH for this reaction.

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$
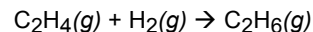
| Substance	ΔH_f^O (kJ mol^{-1})
$C_2H_4(g)$	52.5
$C_2H_6(g)$	−84.7

(A) −137.2 kJ   (C) 32.2 kJ

(B) −32.2 kJ   (D) 137.2 kJ

94. A 1.00 g sample of NH_4NO_3 is decomposed in a bomb calorimeter. The heat capacity of the system is 1.23 kJ K^{-1}. The temperature increases by 6.12 K. What is the molar heat of decomposition for ammonium nitrate? Given: molar mass of NH_4NO_3 is 80.0 g mol^{-1}

(A) −602 kJ mol^{-1} (C) 7.53 kJ mol^{-1}

(B) −398 kJ mol^{-1} (D) 164 kJ mol^{-1}

95. The heat of combustion for one mole of carbon is 410 kJ.

$$C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H^O = -140 \text{ kJ}$$
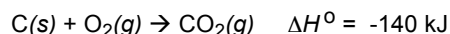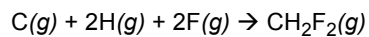
The reaction is exothermic to the right. How many kJ of heat would be liberated on the complete combustion of 60 g of carbon? Given: atomic mass of carbon is 12.0 g mol^{-1}

(A) 5 x 410 kJ   (C) 44 x 410 kJ

(B) 12 x 410 kJ   (D) 60 x 410 kJ

96. Given the reaction:

$$C(g) + 2H(g) + 2F(g) \rightarrow CH_2F_2(g)$$

What is the heat of reaction, ΔH, in kJ at 25 °C?

Bond Energies (kJ mol^{-1}) at 25 °C	
C—H	414
C—F	486
H—H	435
F—F	159
H—F	569

(A) ΔH = +900 kJ   (C) ΔH = –900 kJ

(B) ΔH = –465 kJ   (D) ΔH = –1800 kJ

Answers

70. A

71. C
72. A
73. A
74. B
75. A

76. B
77. E
78. C
79. E
80. D

81. D
82. C
83. C
84. D
85. A

86. B
87. C
88. B
89. B
90. C

91. B
92. C
93. A
94. A
95. A

96. D