1) 890 kJ is released when 1 mole of $CH_4(g)$ is burned. Calculate ΔH in (kJ) when 5.8 g of $CH_4(g)$ is burned?

A) -890 B) -320 C) -2455.2 D) -5162

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2) What is the amount of heat required to raise The temperature of 7.40g of H_2O from 29.0 ºC to 46.0 ºC?

A) 1424 B) 526 C) 897.9 D) 29.2

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3) Given the following thermal equation for the complete combustion of acetone "C_2H_5OH":

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ $\Delta H^o_{comb} = -1367.0$ kJ

And knowing that:

$\Delta H^o_f[(C_2H_5OH(l)] = -277.7$ kJ/mol

and $\Delta H^o_f[(H_2O)_l] = -285.8$ kJ/mol

The heat of formation (in kJ/mol) of $CO_2(g)$, $\Delta H^o_f[(CO_2(g)]$ is:

A) –787.3 B) –393.7 C) –1358.9 D) –679.5

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4) From the enthalpies of the following reactions:

$S(g) + 1.5O_2(g) \longrightarrow SO_3C(g)$ ΔH = –395.2 kJ

$2SO_2(g) + O_2(g) \longrightarrow 2SO_3C(g))$ ΔH = –198.2 kJ

The heat of formation (in kJ/mol) of $SO_2(g)$, $\Delta H^o_f[(SO_2(g)]$ is:

A) –593.4 B) –296.1 C) –197.0 D) –395.2

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5) For the following reaction:

$C_aO(s) + 2HCl(g) \longrightarrow CaCl_2(s) + H_2O(g)$ $\Delta H^o = -2171$ kJ

Calculate ΔE^o in (kJ) ?

A) -219.6 B) -214.6 C) -212.1 D) -222.1

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6) Knowing that liquid chloroform boils at 76.8°C and its molal boiling-point-elevation constant (K_b) is 5.02°C m^{-1}, the boiling point, in °C, of a solution of 41.0 g of solid naphthalene ($C_{10}H_8$) in 500 g of liquid chloroform is:

A) 3.21 B) 80.00 C) 82.24 D) 76.8

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7) At 30.0ºC, the vapor pressure of pure benzene "C_6H_6" is 120.0 torr and that of pure toluene "C_7H_8" is 40.0 torr. What is the vapor pressure (in torr) of an ideal solution that is formed from 3.0 mol of benzene and 1.0 mol of toluene at 30.0ºC?

A) 80.0 B) 60.0 C) 90.0 D) 100.0

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8) The osmotic pressure of an 0.01 M aqueous solution of $CaCl_2$ (an electrolyte nonvolatile solute) is found to be 0.602 atm at 25ºC. What is the Van't Hoff factor "I" of this solution?

A) 2.46 B) 2.63 C) 2.75 D) 2.86

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9) 58.5 g of NaCl and 180 g of glucose ($C_6H_{12}O_6$) were separately dissolved in 1000 ml of water. Identify the correct statement regarding the depression of freezing point (f.p.) of the resulting solutions.

A) NaCl solution will show lower f.p.
B) Glucose solution will show lower f.p.
C) Both the solutions will show equal depression of f.p
D) The f.p. will be 0ºC for both of the solutions.

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10) 15 g of a nonvolatile, nonelectrolyte solute are dissolved in 100 grams of water. The freezing point of the solution is -4.65°C and the mole fraction of solute is 0.0430. Kf of water is 1.86°C/molal. Calculate the molecular weight of the solute in the above solution.
A) 18.6 B) 6.0 C) 60.0 D) 2.5

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1. The mass (in g) of CF_4 that contains 3.2×10^{24} atom of fluorine "F" is:

A) 109.8 B) 112.5 C) 116.9 D) 105.7

2. The mass in grams of Na_3N that contains 1.3×10^{23} sodium "Na" atoms is:

A) 6.0 B) 7.0 C) 8.0 D) 9.0

3. The percent by mass of copper metal "Cu" in the mineral chalcopyrite "$CuFeS_2$" is:

A) 39.25 B) 37.85 C) 36.18 D) 34.62

4. 1.52 g sample of nitrogen oxide contains 0.96 g of oxygen. The emperical formula for this nitrogen oxide is:

A) N_2O_5 B) N_2O_3 C) NO_2 D) NO

5. The volume in ml of 0.251 M KI solution that contains 13.5 g of KI is:

A) 324 B) 345 C) 363 D) 382

6. A closed gas cylinder contains exactly equal masses of the three gases CO_2, N_2 and O_2. Which one of the following statements is true?

A) The three partial pressures for the three gases are exactly equal.
B) The partial pressure of the CO_2 gas is the highest.
C) The partial pressure of the N_2 gas is the highest.
D) The partial pressure of the O_2 gas is the highest.

7. If equal masses of oxygen gas "O_2" and carbon dioxide gas "CO_2" are in two separate containers of equal volume and at equal temperature. Which one of the following statements is true:
1-The average kinetic energy of an O_2 molecule is greater than that of a CO_2 molecule.
2-The average kinetic energy of a CO_2 molecule is greater than that of an O_2 molecule.
3- Both of them have the same average kinetic energy
4-The pressure inside the CO_2 container is higher than that inside the O_2 container.

A) 1, 3 only B) 2, 4 only C) 3 only D) 4 only

8. The constant "b" that appears in the van der Waals ideal gas equation corrects for:

A) The average speed of the gas molecules.
B) The volume of the gas molecules.
C) The attractive forces between the gas molecules.
D) The average kinetic energy of the gas molecules.

9. The amount of heat (in J) required to raise the temperature of 350.0 g of copper from 25ºC to 85ºC is: (the specific heat of copper is 0.385 J/g ºC)

A) 8085 B) 7676 C) 6806 D) 6485

10. Given the following thermochemical equations:

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ $\Delta H^o = -1411$ kJ
$C(gr) + O_2(g) \rightarrow CO_2(g)$ $\Delta H^o = -393.5$ kJ
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\Delta H^o = -286$ kJ

The standard enthalpy of formation (in kJ) of ethylene "C_2H_4" is:

A) 87 B) –87 C) –68 D) 52

SOLUTION

$2CO_2(g) + 2H_2O(L) \rightarrow C_2H_4(g) + 3O_2(g)$ $\Delta H = +1411$ kJ
$2C(gr) + 2O_2(g) \rightarrow 2CO_2(g)$ $\Delta H = -787$ kJ
$2H_2(g) + O_2(g) \rightarrow 2H_2O(L)$ $\Delta H = -572$ kJ

$2H_2(g) + 3C(gr) \rightarrow 2C_2H_4(g)$ $\Delta H = +52$ kJ

11. Which of the following exothermic reactions $\Delta H = \Delta E$?

1-$C(graphite) + O_2(g) \rightarrow CO_2(g)$
2-$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
3-$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g)$
4-$N_2H_4(g) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

A) 1 B) 2 C) 3 D) 4

SOLUTION

$\Delta E = \Delta H - RT\Delta n_g$

To make ΔE less negative than ΔH, "Δn_g" must be negative.

1- $\Delta n_g = 0$
2- $\Delta n_g = -1$
3- $\Delta n_g = -1$
4- $\Delta n_g = +1$

12. The solubility of a gas in a liquid depends on:

1-The nature of the liquid solvent.
2-The nature of the gas.
3-The temperature.
4-The partial pressure of the gas on the surface of the liquid solvent.

A) all of them B) 2,3, 4 only C) 1,3,4 only D) 3,4 only

SOLUTION

The solubility of a gas in a liquid depends on for factors:

1-The nature of the liquid solvent.

2-The nature of the gas.

3-The temperature.

4-The partial pressure of the gas on the surface of the liquid solvent.

13. The molality of a 20% by mass ammonium sulfate $(NH_4)_2SO_4$ aqueous solution is:

A) 2.15 m B) 1.89 m C) 1.25 m D) 0.87 m

SOLUTION

molality = $\frac{n_2}{m_1 + m_2}$ = $\frac{20 \div 132.154}{80 + 1000}$ = 1.89 molal

14. What is the freezing point of an aqueous solution of a nonvolatile-nonelectrolyte solute that has a boiling point of 103.8 (for water K_f = 1.86 °C/m and K_b = 0.52 °C/m)?

A) –13.6 °C B) –11.2 °C C) –9.8 °C D) –7.7 °C

SOLUTION

molality = $\frac{\Delta T_b}{K_b}$ = $\frac{3.8}{0.52}$ = 7.308 molal

$\Delta T_f = K_f m$ = 13. 59 °C

T_f = – 13. 59 °C

1. According to the following equation:

$$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$$

calculate the mass in grams of HCl which can be prepared (theoretically) when reacting 150.0 g of NaCl with 150.0 g of H_2SO_4 is:

SOLUTION

$2NaCl$	+	H_2SO_4	→	Na_2SO_4	+	$2HCl$
2		1		1		2
$\frac{150}{58.44} = 2.566$		$\frac{150}{98.086} = 1.53$				n
$\frac{2.566}{2} = 1.283$		$\frac{1.53}{1} = 1.53$				n = 2.566

$m = n \times M = 2.566 \times 36.458 = 93.6\ g$

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1. The number of nitrogen atoms " N " are present in 1.00 g of $(NH_4)_2Cr_2O_7$, is:

   A) 4.78×10^{21} B) 2.39×10^{21} C) 6.82×10^{21} D) 3.88×10^{21}

2. A compound contains only C, H, and N. Combustion of 35.0 mg of the compound produces 33.5 mg CO_2 and 41.1 mg H_2O. The empirical formula of the compound is:

   A) C_3H_6N B) $C_4H_8N_3$ C) CH_6N_2 D) $C_2H_7N_2$

3. Consider the reaction:

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

   The mass of iron(III) oxide (Fe_2O_3) must be used to produce 15.0 g iron (Fe) is:

   A) 42.8 g B) 21.5 g C) 31.5 g D) 12.9 g

4. The molality of a 20% by mass ammonium sulfate $(NH_4)_2SO_4$ aqueous solution, is:

   A) 2.15 m B) 1.25 m C) 1.89 m D) 0.87 m

5. The amount of water (in mL) are needed to dilute 505 mL of a 0.125 M " HCl " solution to exactly 0.100 M, is:

   A) 126.25 B) 631.25 C) 404.10 D) 101.10

6. The volume (in L) of 3.01×10^{23} molecules of Cl_2 gas at STP, is:

A) 22.7 B) 10.9 C) 15.6 D)33.5

7. A closed gas cylinder contains exactly equal masses of the three gases: helium (He), neon (Ne) and argon (Ar). It is true that:

A) The three gasses partial pressures are exactly equal.

B) The partial pressure of the He gas is the highest.

C) The partial pressure of the Ne gas is the highest.

D) The partial pressure of the Ar gas is the highest.

8. The constant "b" that appears in the van der Waals ideal gas equation corrects:

A) The average speed of the gas molecules.

B) The volume of gas molecules.

C) The attractive forces between the gas molecules.

D) The average kinetic energy of the gas molecules.

9. Given the following thermochemical reaction

$$4Fe\,(s) + 3O_2\,(g) \longrightarrow 2Fe_2O_3\,(s) \qquad \Delta H = -1652\ kJ$$

When 10.0 g of iron (Fe) is reacted with excess amount of oxygen (O_2), the amount of heat given off (in kJ), is:

A) -74 B) -296 C) -413 D) -592

10. When 0.22g of propane (C_3H_8) is used to heat 200g of water at 20ºC. If The combustion enthalpy of propane per mole at constant pressure is -2220 kJ/mol, then, the final temperature of the water will be: (Cs of water 4.18 J/g.ºC)

A) 51.9 B) 33.3 C) 98.2 D) 76.4

11. Given the following thermochemical reactions:

$$2B\,(s) + 3/2\,O_2\,(g) \longrightarrow B_2O_3\,(s) \qquad \Delta H = -1273\ kJ$$

$$B_2H_6\,(g) + 3\,O_2\,(g) \longrightarrow B_2O_3\,(s) + 3H_2O\,(g) \qquad \Delta H = -2035\ kJ$$

$$H_2\,(g) + 1/2\,O_2\,(g) \longrightarrow H_2O\,(l) \qquad \Delta H = -286\ kJ$$

$$H_2O\,(l) \longrightarrow H_2O\,(g) \qquad \Delta H = 44\ kJ$$

Calculate "ΔH" (in kJ) for the following reaction?

$$2B\,(s) + 3H_2\,(g) \longrightarrow B_2H_6\,(g)$$

A) -685 B) -258 C) +1252 D) +36

12. An ideal gas absorbs 1900 J as heat and its internal energy increases with 1100 J. The amount of work (in J) evolved in this process, is:

A) -800 B) +3000 C) +800 D) -3000

13. The vapor pressure of a solution prepared by dissolving nonvolatile solute in methanol (CH_3OH), is 556.0 torr at 65.0 ºC. The mole fraction of methanol is:
(vapor pressure of pure methanol is 638 torr at 65.0ºC)

A) 0.13 B) 0.87 C) 0.67 D) 0.39

14. A 4.7 mg sample of a protein is dissolved in water to make 25.0 mL of solution. The osmotic pressure of the solution is 0.56 torr at 25 ºC. The molar mass (in g/mol) of the protein is:

A) $6.2X10^3$ B) $2.1X10^2$ C) $3.2X10^4$ D) $1.2X10^3$

15. A 1.60 g of naphthalene is dissolved in 20.0 g benzene (C_6H_6). The freezing point of the solution decreased by 2.7 ºC. The molar mass (in g/mol) of naphthalene is:
(K_f of benzene is 5.12 ºC.kg/mol)

A) 188.2 B) 122.4 C) 151.6 D) 218.8

16. When 13.5 g of acetylene (C_2H_2) dissolves in 250 mL of acetone (C_3H_6O) at 1.0 atm, the Henry's law constant (in mol/L.atm), is:

A) 1.1 B) 2.1 C) 1.6 D) 2.6