CHEM 101+103 SECOND SEMISTER 1431-1432H
FIRST EXAM SOLUTINS

1. The number of hydrogen "H" atoms present in 6.20 g of table sugar "$C_{12}H_{22}O_{11}$" is:

A) 2.4×10^{23} B) 2.6×10^{23} C) 2.7×10^{23} D) 2.9×10^{23}

SOLUTION

$n = \frac{m}{M} = \frac{6.2}{342} = 0.018$ mol

1 mol $C_{12}H_{22}O_{11}$ contains 22 mol H

0.018 mol $C_{12}H_{22}O_{11}$ contains n mol H

$n = \frac{22 \times 0.081}{1} = 0.399$ mol

$N = N \times N_A = 0.399 \times 6.022\ 10^{23} = 2.4 \times 10^{23}$ atom

2. The mass (in g) of sodium "Na" present in 30.0 g of Na_2SO_4 is:

A) 12.2 B) 11.8 C) 10.5 D) 9.7

SOLUTION

1 mol Na_2SO_4 contains 2 mol Na

$\frac{30}{140} = 0.21$ mol Na_2SO_4 contains 0.42 mol Na

$m = n \times M = 0.24 \times 23 = 9.66$ g

3. Copper "Cu" is usually added to gold "Au" to obtain a hard alloy suitable for making jewelry. A 24.0 g piece of such jewelry contains 5.70×10^{22} atom of Cu. The percentage by mass of gold in this jewelry is:

A) 72.72% B) 74.94% C) 76.85% D) 78.75%

SOLUTION

$\frac{N}{N_A} \times 100 = \frac{5.7 \times 10^{22}}{6.022 \times 10^{23}} = 0.095$ mol

$m = n \times M = 0.095 \times 63.54 = 6.02$ g

$m_{Au} = m_{total} - m_{Cu} = 24 - 6.02 = 17.98$ g

$Au\% = \frac{m_{Au}}{m_{total}} \times 100 = \frac{17.98}{24} \times 100 = 74.95\ \%$

4. The empirical formula of a certain pesticide which has the percentage by mass composition of 19.36% Ca, 34.26% Cl and 46.38% O is:

A) $CaCl_2O_3$ B) $CaCl_2O_4$ C) $CaCl_2O_6$ D) $CaCl_3O_4$

SOLUTION

Ca : Cl : O

$\frac{19.36}{40} : \frac{34.26}{35.45} : \frac{46.38}{16}$

0.484 : 0.966 : 2.899

1 : 2 : 6

"$CaCl_2O_6$"

5. A metal "M" reacts with oxygen to give M_2O_3 metal oxide. If 9.6 g of oxygen combines with 10.8 g of this metal, the atomic mass (in a.m.u.) of this metal is:

A) 27 B) 45 C) 51 D) 55

SOLUTION

$$2M \quad + \quad 1.5O_2 \rightarrow M_2O$$

2 mol 1.5 mol

$$n \qquad \frac{9.6}{32} = 0.3 \text{ mol}$$

$$n = \frac{0.3 \times 2}{1.5} = 0.4 \text{ mol} \quad , \quad \text{atomic mass} = \frac{m}{n} = \frac{10.8}{0.4} = 27 \text{ amu}$$

6. GeF_3H is formed from GeH_4 and GeF_4 in the combination reaction:

$$GeH_4 + 3GeF_4 \rightarrow 4GeF_3H$$

If the reaction yield is 92.6%, the numbers of moles of GeF_4 needed to produce 8.0 moles of GeF_3H are:

A) 6.18 B) 6.48 C) 6.78 D) 6.98

SOLUTION

$$\text{yield \%} = \frac{\text{actual yield}}{\text{theoritical yield}} = 92.6 = \frac{8}{\text{theoritical yield}} \times 100$$

theoretical yield = 8.6393 mol

$$GeH_4 \quad + \quad 3GeF_4 \rightarrow 4GeF_3H$$

1 mol 3 mol 4 mol

n 8.6393 mol

$$n = \frac{3 \times 8.6393}{4} = 6.48 \text{ mo}$$

7. According to the following reaction:

$$2S + 3O_2 \rightarrow 2SO_3$$

The maximum mass of SO_3 (in g) that can be produced by the reaction of 8.0 g of sulfur, S, with 10.0 g of oxygen "O_2" gas is:

A) 15.2 B) 17.6 C) 16.7 D) 18.4

SOLUTION

$$2S \quad + \quad 3O_2 \quad \rightarrow \quad 2SO_2$$

2 mol 3 mol 2 mol

$$\frac{8}{32} = 0.25 \text{ mol} \qquad \frac{10}{32} = 0.3125 \text{ mol}$$

$$\frac{0,25}{2} = 0.125 \qquad \frac{0.3125}{3} = 0.01042$$

O_2 is the limiting reactant

3 mol O_2 produce 2 mol SO_2

0.3125 mol O_2 produce n mol SO_2

$$n = \frac{0.3125 \times 2}{3} = 0.2083 \text{ mol} \quad , \quad m \times n \;\; M = 0.2083 \times 80 = 16.7 \text{ g}$$

8. The volume (in mL) of 0.251 M potassium iodide "KI" solution that contains 13.5 g KI is:

A) 385 B) 368 C) 346 D) 324

SOLUTION

$$V\,(L) = \frac{n_{solute}}{molarity} = \frac{\frac{m}{M}}{0.251} = \frac{\frac{13.5}{166}}{0.251} = 0.324\ L = 324\ mL$$

9. The molality "m" of a 25% by mass of glucose "$C_6H_{12}O_6$" solution is:

A) 1.85 B) 1.75 C) 2.25 D) 2.15

SOLUTION

$$molality = \frac{n_{solute}}{m_{solvent}(kg)} = \frac{\frac{m}{M}}{100-25} = \frac{\frac{25}{180}}{75} = 1.85\ molal$$

10. The number of moles of NH_3 gas present in 50 L cylinder at 31.5°C and a pressure equals 20.0 atm is:

A) 40 B) 42 C) 45 D) 50

SOLUTION

$$n = \frac{PV}{RT} = \frac{20 \times 50}{0.0821 \times 304.5} = 40\ mol$$

11. 18.39 g of Freon gas occupies 3 L at STP. Therefore, the molar mass of this gas is:

A) 142.6 B) 137.4 C) 132.8 D) 128.7

SOLUTION

$$M = \frac{mRT}{PV} = \frac{18.39 \times 0.0821 \times 273}{1 \times 3} = 137.4\ g/mol$$

12. The density (in $g.L^{-1}$) of N_2O_5 gas at 33°C and 1.0 atm pressure is:

A) 4.3 B) 3.9 C) 3.6 D) 3.2

SOLUTION

$$d = \frac{PM}{RT} = \frac{1 \times 108}{0.0821 \times 306} = 4.3\ g/L$$

13. The volume (in L) of oxygen gas "O_2" at 153°C and 0.820 atm that can be produced by the decomposition of 22.4 g of $KClO_3$ is:

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

A) 10.5 L B) 10.8 L C) 11.2 L D) 11.7 L

SOLUTION

$2KClO_3$	$\rightarrow$	$2KCl$	$+$	$3O_2$
2 mol				3 mol
$\frac{22.4}{122.45} = 0.183\ mol$				n

$$n = \frac{0.183 \times 3}{2} = 0.274\ mol$$

$$V = \frac{nRT}{P} = \frac{0.274 \times 0.0821 \times 426}{0.82} = 11.7\ L$$

14. Two identical balloons are filled at the same temperature and pressure. One contains Argon gas "Ar" and the other contains Helium "He" gas. The argon gas leaks out of its balloon at a rate of 150 mL per hour. Therefore, the rate of leakage (in mL per hour) of helium gas of its balloon is:

A) 1497 B) 848 C) 474 D) 424

SOLUTION

$\frac{r_{Ar}}{r_{He}} = \sqrt{\frac{M_{He}}{M_{Ar}}}$, $\frac{150}{r_{He}} = \sqrt{\frac{4}{40}} =$, r_{He}= 474 mL/hr

15. At STP, the average kinetic energy of the molecules of N_2 gas, O_2 gas and Cl_2 gas is:

A) equal for the three gases.
B) the greatest for the N_2 gas molecules.
C) the greatest for the O_2 gas molecules.
D) the greatest for the Cl_2 gas molecules.

SOLUTION

Because T is the same, KE is the same.