Key

Percent Composition Questions

Determine the empirical and molecular formulas for the following compounds from the percent compositions and molar masses.

1) Glyoxal is 41.4% C, 3.45% H, and 55.2% O. Glyoxal has a molar mass of 58 g/mol.

$41.4\text{g C} \times \frac{\text{mole}}{12.01\text{g}} = 3.45 \div 3.42 = 1$

$3.45\text{g H} \times \frac{\text{mole}}{1.008\text{g}} = 3.42 \div 3.42 = 1$

$55.2\text{g O} \times \frac{\text{mole}}{16.00\text{g}} = 3.45 \div 3.42 = 1$

E.F. = $C_1H_1O_1$

$12 + 1 + 16 = 29$

$58 \div 29 = 2$

m.F. = $C_2H_2O_2$

2) Ethylene diamine is 40.0% C, 13.3% H, and 46.7% N. Ethylene diamine has a molar mass of 60 g/mol.

$40.0\text{g C} \times \frac{\text{mole}}{12.01\text{g}} = 3.33 \div 3.33 = 1$

$13.3\text{g H} \times \frac{\text{mole}}{1.008\text{g}} = 13.19 \div 3.33 = 3.96$

$46.7\text{g N} \times \frac{\text{mole}}{14.01\text{g}} = 3.33 \div 3.33 = 1$

E.F. = $\underbrace{CH_4N}_{30}$

m.F. = $C_2H_8N_2$

3) Erthrose is 40.0% C, 6.67% H, and 53.3% O. The molar mass is 120 g/mol.

$40.0\text{g C} \times \frac{\text{mole}}{12.01\text{g}} = 3.31 \div 3.3 = 1$

$6.67\text{g H} \times \frac{\text{mole}}{1.008\text{g}} = 6.61 \div 3.3 = 2$

$53.3\text{g O} \times \frac{\text{mole}}{16.00\text{g}} = 3.33 \div 3.3 = 1$

EF = $\underbrace{CH_2O}_{30}$

mF = $C_4H_8O_4$

4) Valeric acid is 58.8% C, 9.80% H and 31.4% O. The molar mass is 102 g/mol.

$58.8\text{g} \times \frac{1\text{mole}}{12.01\text{g}} = 4.9 \div 2 = 2.5 \times 2 = 5$

$9.80\text{g} \times \frac{1\text{mole}}{1.008\text{g}} = 9.7 \div 2 = 5 \times 2 = 10$

$31.4\text{g} \times \frac{1\text{mole}}{16.00\text{g}} = 2.0 \div 2 = 1 \times 2 = 2$

EF

$C_5H_{10}O_2$

mF

$C_5H_{10}O_2$

5) Resorcinol is 65.5% C, 5.45% H, and 29.1% O. The molar mass is 110 g/mol.

$65.5\,g\,C \times \frac{mole}{12.01\,g} = 5.45 \div 1.82 = 3.0$

$5.45\,g\,H \times \frac{mole}{1.008\,g} = 5.41 \div 1.82 = 2.97$

$29.1\,g\,O \times \frac{mole}{16.00\,g} = 1.82 \div 1.82 = 1$

EF = C_3H_3O

55

mF = $C_6H_6O_2$

6) Ascorbic acid is 40.9% C, 4.54% H, and 54.5% O. The molar mass is 176 g/mol.

$40.9\,g\,C \times \frac{mole}{12.01\,g} = 3.4 \div 3.4 = 1 \times 3 = 3$

$4.54\,g\,H \times \frac{mole}{1.008\,g} = 4.5 \div 3.4 = 1.3 \times 3 = 4$

$54.5\,g\,O \times \frac{mole}{16.00\,g} = 3.4 \div 3.4 = 1 \times 3 = 3$

EF:

$C_3H_4O_3$

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mF:

$C_6H_8O_6$

Answers : 1) Glyoxal $C_2H_2O_2$ 2)Ethylene diamine $C_2H_8N_2$ 3) Erythrose $C_4H_8O_4$
4) Valeric acid $C_5H_{10}O_2$ 5) Resorcinol $C_6H_6O_2$ 6) Ascorbic acid $C_6H_8O_6$