Key

Ch 1 Quantitative Chemistry

1.) C

CH_3COOH

$\text{molar mass} = 2(12.01) + 2(16.00) + 4(1.01) = 60.06g$

$\frac{60.06g}{mol} \times \frac{1\,mol}{6.02 \times 10^{23}\,molecules} = 9.977 \times 10^{-23}\,g/molec.$

$(\approx 1 \times 10^{-22})$

2.) C

Hydrogen is diatomic, H_2!

so, $2(6.02 \times 10^{23}\,atoms) = 1.204 \times 10^{24}\,atoms\ H$

3.) B

$24g\,C \times \frac{1\,mol}{12.01} = 2.0\,mol\,C$

$4g\,H \times \frac{1\,mol}{1.01} = 4\,mol\,H$

$32g\,O \times \frac{1\,mol}{16.00} = 2\,mol$

CH_2O

4.) A

i) $3(6.02 \times 10^{23}) = 1.8 \times 10^{24}\,atoms$ True!

ii) $(32.06g) + 2(16.00g) = 64g$ True!

5.) D

Rewrite $C_6H_5(OH)_2$ as

$C_6H_7O_2$

(which cannot be reduced)

6.) D $\underline{1}P_4 + \underline{5}O_2 \rightarrow \underline{1}P_4O_{10}$

$1+5+1 = \boxed{7}$

7.) A

$4.86\text{g Mg} \times \frac{1\text{ mol}}{24.31\text{g}} \times \frac{1\text{ mol } H_2}{1\text{ mol Mg}} \times \frac{2.02\text{g } H_2}{1\text{ mol}} = 0.403\text{g } H_2$

$(0.100\text{L HCl})(2.00\ \frac{\text{mol}}{\text{L}}) \times \frac{1\text{ mol } H_2}{2\text{ mol HCl}} \times \frac{2.02\text{g}}{1\text{ mol}} = \boxed{0.202\text{g } H_2}$

[Recall $\text{mol dm}^{-3} = \frac{\text{mol}}{\text{L}}$]

↑ Least amount

8.) B Note: only need to determine the L.R.

$11.6\text{g } C_4H_{10} \times \frac{1\text{ mol}}{58.14\text{g}} \times \frac{13\text{ mol } O_2}{2\text{ mol } C_4H_{10}} \times \frac{32.00\text{g}}{1\text{ mol } O_2}$

$= 41.5\text{g } O_2$ needed.

But you only have $11.6\text{g } O_2$, ∴ O_2 is L.R.

9.) A

First, determine the number of moles HCl present in each solution.

$$(0.250\,L)(3.00\,M) = 0.750\,mol$$

$$(0.350\,L)(2.00\,M) = 0.700\,mol$$

Then determine concentration

$$[HCl]_{final} = \frac{(0.750 + 0.700)\,mol}{(0.250 + 0.350)\,L} = 2.42\,M$$

10.) A

$$(0.025\,L)\left(0.125\,\frac{mol\ H_2SO_4}{L}\right) \times \frac{2\,mol\ NaOH}{1\,mol\ H_2SO_4}$$

$$= 0.00625\,mol\ NaOH$$

$$M = \frac{mol}{L} \rightarrow L = \frac{mol}{M}$$

$$L = \frac{0.00625\,mol}{0.250\,M} = 0.0250\,L$$

$$= 25.0\,mL$$

$$(25\,cm^3)$$

11.) B (see #12 Below first!)

$$d_1 = d_2$$
$$P_1 = P_2 \qquad (M = \text{molecular mass})$$
$$T_1 = T_2$$

$$\therefore \frac{\cancel{P_1} M_1}{\cancel{R} \cancel{T_1}} = \frac{\cancel{P_2} M_2}{\cancel{R} \cancel{T_2}}$$

$$M_1 = M_2$$

12.) C

$$n = \frac{\text{mass}}{M}$$

$$PV = nRT$$

or

$$PV = \left(\frac{m}{M}\right) RT$$

$$\text{density} = \frac{m}{V} = \boxed{\frac{PM}{RT}}$$

13.) D From problem 12,

$$PV = \frac{mRT}{M}$$

$T = 35 + 273$

$$M = \frac{mRT}{VP} = \frac{(1.42)(82.05)(308)}{(250)(0.85)}$$

14.) a.) $15.0g\ C_7H_6O_3 \times \frac{1 mol}{138.13g} \times \frac{1 mol\ C_4H_6O_3}{2 mol\ C_7H_6O} \times \frac{102.10g}{1 mol} =$

$5.54g\ C_4H_6O_3$ Required

$\therefore C_7H_6O_3$ is L.R. (2-hydroxybenzoic acid)

b.) L.R. → $15.0g\ C_7H_6O_3 \times \frac{1 mol}{138.13g} \times \frac{2 mol\ C_9H_8O_4}{2 mol\ C_7H_6O} \times \frac{180.17g}{1 mol}$

$= 19.6g\ C_9H_8O_4$

c.) $\frac{13.7g}{19.6g} \times 100 = 69.9\%$

15.) Need a balanced chemical equation –

$$Ba(NO_3)_2 + M_2SO_4 \rightarrow BaSO_4 + 2MNO_3$$

↑"M" is yet unknown!

a.) By "amount", they mean moles.

$$9.336g\ BaSO_4 \times \frac{1\ mol}{233.40g} = \boxed{0.04000\ mol\ BaSO_4}$$

b.) Since "excess" $Ba(NO_3)_2$ was added, you can assume SO_4^{2-} is L.R.

$$0.04000\ mol\ BaSO_4 \times \frac{1\ mol\ SO_4^{2-}}{1\ mol\ BaSO_4} = \boxed{0.04000\ mol\ SO_4^{2-}}$$

c.) $M_r = \frac{mass}{moles} = \frac{14.48}{0.04000} = \boxed{362}$

Recall M_r has no units

d.) M_2SO_4 molar mass = 362 (from above)

$$2(\text{atomic mass of } M) + (32.06) + 4(16.00) = 362$$

↑ S ↑ O

$$\text{atomic mass of } M = \frac{362 - (32.06) - 4(16.00)}{2} = 133$$

$\therefore$ $\boxed{Cs}$