NCh0 1999

(C) 9. $\underline{2}\ As_2S_3 + \underset{4\frac{1}{2}}{\underline{9}}\ O_2 \rightarrow \underline{2}\ As_2O_3 + \underline{\frac{6}{3}}\ SO_2$

(A) 10. $24.0\,g\,O \times \frac{1\,mol\,O}{16.00\,g\,O} \times \frac{1\,mol\,MgCO_3}{3\,mol\,O} \times \frac{84.3\,g\,MgCO_3}{1\,mol\,MgCO_3} = \boxed{42.2\,g\,MgCO_3}$

(D) 11. $9\,mol\,H \times \frac{6.02\times10^{23}\ atoms}{1\,mol} = \boxed{5.4\times10^{24}\ atoms}$

(B) 12. $\frac{2.0\,mol\,H_2 \mid 1\,mol\,CH_4}{3\,mol\,H_2} = \boxed{0.67\,mol\,CH_4}$ $\qquad \frac{2.0\,mol\,CO \mid 1\,mol\,CH_4}{1\,mol\,CO} = 2.0\,mol\,CH_4$

(D) 13. $\frac{1.90\,g\,MgCl_2 \mid 1\,mol\,MgCl_2 \mid 2\,mol\,Cl^-}{95.2\,g\,MgCl_2 \mid 1\,mol\,MgCl_2} = \frac{0.0399\,mol\,Cl^-}{.25\,L} = \boxed{0.16\,M}$

(A) 14. $3.0\,L\,SO_2 + 2.0\,L\,O_2 = 5.0\,L$ gas initially

$\underline{2}\ SO_2(g) + \underline{\ }\ O_2(g) \rightarrow 2\ SO_3(g)$

$3.0\,L\ SO_2$ reacts w/ $1.5\,L\ O_2$ to form $3.0\,L\ SO_3$ and $0.5\,L\ O_2$ is leftover

Final gas volume = $3.0\,L\,SO_2 + 0.5\,L\,O_2 = 3.5\,L$ gas final

$5.0 - 3.5 = \boxed{1.5\,L\ \text{decrease}}$

(A) 15. $\frac{0.164\,mol\,NaOH \mid 32.63\,mL\,NaOH}{1000\,mL} = 5.35\times10^{-3}\,mol\,NaOH \times \frac{\frac{1}{2}\,mol\,H_2SO_4}{1\,mol\,NaOH} = \frac{2.68\times10^{-3}\,mol\,H_2SO_4}{.02500\,L\,H_2SO_4}$

$= \boxed{0.107\,M\,H_2SO_4}$

NCh0 1998

(B) 7. $\frac{1\,mol\,Fe}{1\,mol\,FeX} = \frac{55.85\,g\,Fe}{55.85\,g\,Fe + x\,g\,X} = \frac{4.6\,Fe}{100\,FeX}$

$5585 = 4.6(55.85 + x)$

$5585 = 256.91 + 4.6x$

$4.6x = 5328.09$

$x = 1158.2804\,g$

$FeX = 55.85 + 1158 = 1213.85\,g\,FeX \approx \boxed{1200\,g/mol\ FeX}$

(D) 8. $0.046\,g\,C_2H_5OH \times \frac{1\,mol\,C_2H_5OH}{46\,g} \times \frac{6\,mol\,H}{1\,mol\,C_2H_5OH} \times \frac{6.02\times10^{23}\,atoms\,H}{1\,mol\,H} = \boxed{3.6\times10^{21}\,atoms\,H}$

(C) 9. $\frac{2H_2O}{BaCl_2\cdot2H_2O} \times 100 = \frac{36}{244.23} \times 100 = 14.7\%$

$\frac{6H_2O}{CaCl_2\cdot6H_2O} \times 100 = \frac{108}{218.08} \times 100 = \boxed{49.3\%}$

$\frac{5H_2O}{CuSO_4\cdot5H_2O} \times 100 = \frac{90}{249.61} \times 100 = 36.1\%$

$\frac{6H_2O}{Ni(ClO_4)_2\cdot6H_2O} \times 100 = \frac{108}{365.59} \times 100 = 29.5\%$

(C) 10. $\_(NH_4)_2Cr_2O_7 \rightarrow \_N_2 + \frac{4}{4}H_2O + \_Cr_2O_3$

(B) 11. $(7.5\,mL)(12\,m\,HCl) = (x)(.15\,M\,HCl)$

$x = 600\,mL = \boxed{.60\,L}$

(C) 12. $355\,g\,Fe \times \frac{1\,mol\,Fe}{55.85\,g\,Fe} \times \frac{1\,mol\,Fe_2O_3}{2\,mol\,Fe} = \boxed{3.18\,mol\,Fe_2O_3}$

(B) 13. $\_MgCl_{2(aq)} + \underline{2}KOH_{(aq)} \rightarrow \underline{2}KCl_{(aq)} + \_Mg(OH)_{2(s)}$

$15\,mL \times \frac{.20\,mol}{1000\,mL} = .0030\,mol\,MgCl_2 \times \frac{1\,mol\,Mg(OH)_2}{1\,mol\,MgCl_2} = 0.0030\,mol\,Mg(OH)_2$

$25\,mL \times \frac{0.18\,mol}{1000\,mL} = 0.0045\,mol\,KOH \times \frac{1\,mol\,Mg(OH)_2}{2\,mol\,KOH} = \boxed{0.0023\,mol\,Mg(OH)_2}$

(A) 14. $1.5\,mL\,HCl_{(g)}$ reacts with $1.5\,mL\,NH_{3(g)}$ to form $NH_4Cl_{(s)}$

∴ 0.5 mL of $HCl_{(g)}$ remains

(D) 15. $250.\,mL \times \frac{.10\,mol\,NaCl}{1000\,mL} \times \frac{58.44\,g\,NaCl}{1\,mol\,NaCl} = 1.46\,g\,NaCl$ needed

NChO 1997

(D) 6. vol of coin = 22.9 − 22.2 = 0.7 mL

$D = \frac{m}{V} = \frac{13.5243\,g}{0.7\,mL} = 19.3204\,g/mL = \boxed{20\,g/mL}$ 1 s.f.

(A) 7. $2.3\times10^{-4}\ g\ Si \times \frac{1\ mol\ Si}{28.09\ g\ Si} \times \frac{6.02\times10^{23}\ atoms}{1\ mol\ Si} = \boxed{4.9\times10^{18}\ atoms\ Si}$

(A) 8. $\_\ H_2S + (2)\ O_2 \rightarrow \_\ SO_3 + \_\ H_2O$

(B) 9. $1\ L\ NO \times \frac{5\ O_2}{4\ NO} = \boxed{1.25\ L\ O_2}$

(B) 10. $1.73\ g\ Sb \times \frac{1\ mol\ Sb}{121.75\ g\ Sb} \times \frac{1\ mol\ Sb_2S_3}{2\ mol\ Sb} \times \frac{339.7\ g\ Sb_2S_3}{1\ mol\ Sb_2S_3} = 2.41\ g\ Sb_2S_3$ ← Theoret. yield

$$\%\ yield = \frac{1.40\ g\ Sb_2S_3}{2.41\ g\ Sb_2S_3} \times 100 = \boxed{58.1\ \%}$$

(D) 11. limiting reagent is used up first.

(D) 12. $50.0\ g\ CuSO_4\cdot5H_2O \times \frac{1\ mol\ CuSO_4\cdot5H_2O}{249.68\ g} \times \frac{9\ mol\ O}{1\ mol\ CuSO_4\cdot5H_2O} \times \frac{16.00\ g\ O}{1\ mol\ O} = \boxed{28.8\ g\ O}$

(B) 13. $200\ mL \times \frac{0.50\ mol\ Cl^-}{1000\ mL} \times \frac{1\ mol\ CaCl_2\cdot6H_2O}{2\ mol\ Cl^-} \times \frac{219\ g\ CaCl_2\cdot6H_2O}{1\ mol} = 10.95\ g = \boxed{11\ g}$

(C) 14. $\frac{5000}{10^6} = (5\times10^{-3}) \times (100) = \boxed{0.5\ \%}$

1996 NChO

(A) 9. $3\ O_{2(g)} \rightarrow 2\ O_{3(g)}$

$48.0\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} \times \frac{2\ mol\ O_3}{3\ mol\ O_2} = \boxed{1.00\ mol\ O_3}$

(B) 10. $0.50\ mol\ C_{12}H_{22}O_{11} \times \frac{12\ mol\ C}{1\ mol\ C_{12}H_{22}O_{11}} \times \frac{12.01\ g\ C}{1\ mol\ C} = \boxed{72.6\ g\ C}$

(C) 11. $\_\ Ca(OH)_2 + \underline{2}\ HCl_{(g)} \rightarrow \_\ CaCl_2 + \underline{2}\ H_2O$

$$0.160\,mol\ HCl \times \frac{1\,mol\ CaCl_2}{2\,mol\ HCl} \times \frac{111.0\,g\ CaCl_2}{1\,mol\ CaCl_2} = \boxed{8.88\,g\ CaCl_2}$$

(B) 12. $$250\,mL \times \frac{0.100\,mol\ Cl^-}{1000\,mL} \times \frac{1\,mol\ CaCl_2}{2\,mol\ Cl^-} = 0.0125\,mol\ CaCl_2\ needed$$

$$0.0125\,mol\ CaCl_2 \times \frac{1000\,mL}{0.500\,mol\ CaCl_2} = \boxed{25.0\,mL\ of\ CaCl_2\ solution}$$