4.5 Review questions

1. a) $1.26 \text{ mol M} \times \frac{2 \text{ mol CuO}}{1 \text{ mol M}} = 2.52 \text{ mol CuO}$ ✓✓

b) $1.5 \text{ Kg} \times \frac{10^3 \text{ g}}{1 \text{ Kg}} \times \frac{1 \text{ mol M}}{221.0 \text{ g}} \times \frac{2 \text{ mol CuO}}{1 \text{ mol M}} \times \frac{79.5 \text{ g}}{1 \text{ mol}} = 1100 \text{ g}$ ✓✓

c) $706 \text{ g} \times \frac{1 \text{ mol}}{79.5 \text{ g CuO}} \times \frac{1 \text{ mol } CO_2}{2 \text{ mol CuO}} \times \frac{22.4 \text{ L } CO_2}{1 \text{ mol } CO_2} = 99.5 \text{ L}$ ✓✓

2. a) $3160 \text{ g} \times \frac{1 \text{ mol } CH_3NO_2}{61.0 \text{ g}} \times \frac{2 \text{ mol } N_2}{4 \text{ mol } CH_3NO_2} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 580. \text{ L}$ ✓✓

b) $955 \text{ g} \times \frac{1 \text{ mol } N_2}{28.0 \text{ g}} \times \frac{4 \text{ mol } CH_3NO_2}{2 \text{ mol } N_2} \times \frac{61.0 \text{ g}}{1 \text{ mol}} = 4160 \text{ g}$ ✓✓

c) $3.5 \times 10^{25} \text{ molec } N_2 \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molec}} \times \frac{6 \text{ mol } H_2O}{2 \text{ mol } N_2} \times \frac{18.0 \text{ g}}{1 \text{ mol}} = 3100 \text{ g}$ ✓✓

3. $10.0 \text{ mL} \times \frac{0.45 \text{ mol HCl}}{1000 \text{ mL}} \times \frac{1 \text{ mol Zn}}{2 \text{ mol HCl}} \times \frac{65.4 \text{ g}}{1 \text{ mol}} = 0.15 \text{ g}$

4. $12.2 \text{ g Na} \times \frac{1 \text{ mol Na}}{23.0 \text{ g Na}} \times \frac{124.7 \text{ KJ}}{4 \text{ mol Na}} = 16.5 \text{ KJ}$ ✓✓

5. $3.225 \text{ g} \times \frac{1 \text{ mol } H_2C_2O_4}{90.0 \text{ g}} \times \frac{2 \text{ mol } KMnO_4}{5 \text{ mol } H_2C_2O_4} \times \frac{1000 \text{ mL}}{0.250 \text{ mol}} = 6450 \text{ mL}$

6. $2Al + 3Cl_2 \rightarrow 2AlCl_3$ $\quad 4.56 \text{ Kg} \times \frac{1 \text{ mol}}{0.1335 \text{ Kg}} \times \frac{3 \text{ mol } Cl_2}{2 \text{ mol } AlCl_3} \times \frac{71.0 \text{ g}}{1 \text{ mol}} = 3640 \text{ g}$ ✓

7. $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ $\quad 0.034 \text{ mol KOH} \times \frac{1 \text{ mol } H_2SO_4}{2 \text{ mol KOH}} = 0.017 \text{ mol}$ ✓

8. $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ ✓

$35.00 \text{ g } C_2H_5OH \times \frac{1 \text{ mol}}{46.0 \text{ g}} \times \frac{3 \text{ mol } H_2O}{1 \text{ mol } C_2H_5OH} \times \frac{18.0 \text{ g}}{1 \text{ mol}} = 41.1 \text{ g}$ ✓✓

9. $2HCl + FeS \rightarrow H_2S + FeCl_2$ ✓

$21.7 \text{ L} \times \frac{1 \text{ mol } H_2S}{22.4 \text{ L}} \times \frac{1 \text{ mol FeS}}{1 \text{ mol } H_2S} \times \frac{87.9 \text{ g}}{1 \text{ mol}} = 85.2 \text{ g}$ ✓✓

10. $CaCO_{3(s)} + 2HCl \rightarrow CaCl_2 + H_2O + CO_{2(g)}$ ✓

$15.0 \text{ g } CaCO_3 \times \frac{1 \text{ mol } CaCO_3}{100.1 \text{ g}} \times \frac{1 \text{ mol } CO_2}{1 \text{ mol } CaCO_3} \times \frac{44.0 \text{ g } CO_2}{1 \text{ mol } CO_2} = 6.59 \text{ g}$ ✓✓

11. $N_2 + 3H_2 \rightarrow 2NH_3$ ✓ $\quad 40.0 \text{ L } NH_3 \times \frac{3 \text{ L } H_2}{2 \text{ L } NH_3} = 60.0 \text{ L}$ ✓✓

12. $5.00 \text{ g } PbI_2 \times \frac{1 \text{ mol } PbI_2}{461.0 \text{ g}} \times \frac{46.5 \text{ KJ}}{1 \text{ mol } PbI_2} = 0.504 \text{ KJ}$ ✓✓

13. $2Zn + Sn(NO_3)_4 \rightarrow 2Zn(NO_3)_2 + Sn$ ✓ (Zn is the R.A.)

$27.5 \text{ g Sn} \times \frac{1 \text{ mol Sn}}{118.7 \text{ g Sn}} \times \frac{2 \text{ mol Zn}}{1 \text{ mol Sn}} \times \frac{65.3 \text{ g Zn}}{1 \text{ mol Zn}} = 30.3 \text{ g}$ ✓✓

14. $Ba(NO_3)_2 + K_2SO_4 \rightarrow BaSO_{4(s)} + 2KNO_3$ ✓

$6.5 \text{ mol } Ba(NO_3)_2 \times \frac{1 \text{ mol } BaSO_4}{1 \text{ mol } Ba(NO_3)_2} \times \frac{233.4 \text{ g}}{1 \text{ mol}} = 1500 \text{ g}$ ✓✓

15. See Q 10 for EQN $\quad 12.2 \text{ L } CO_2 \times \frac{1 \text{ mol } CO_2}{22.4 \text{ L } CO_2} \times \frac{1 \text{ mol } CaCO_3}{1 \text{ mol } CO_2} \times \frac{100.1 \text{ g}}{1 \text{ mol}} = 54.5 \text{ g}$ ✓✓

3 16) $N_2O_4 \rightarrow 2NO_2 \quad \Delta H = 56\ kJ/mol_{N_2O_4}$ ✓ ✓✓

$$1.25g\ NO_2 \times \frac{1\ mol\ NO_2}{46.0g\ NO_2} \times \frac{1\ mol\ N_2O_4}{2\ mol\ NO_2} \times \frac{56\ kJ}{1\ mol\ N_2O_4} = 0.76\ kJ$$

3 17) $2HBr + K_2CO_3 \rightarrow 2KBr + H_2O + CO_2$ ✓ ✓✓

$$450\ mL \times \frac{0.500\ mol\ HBr}{1000\ mL} \times \frac{1\ mol\ K_2CO_3}{2\ mol\ HBr} \times \frac{138.2\ g}{1\ mol} = 16\ g$$

18) $2\ CH_3COOH + Pb(NO_3)_2 \rightarrow Pb(CH_3COO)_{2\,(s)} + 2HNO_3$ ✓

3 $$8.64g \times \frac{1\ mol\ Pb(CH_3COO)_2}{325.2\ g} \times \frac{2\ mol\ CH_3COOH}{1\ mol\ Pb(CH_3COO)_2} \times \frac{1\ L}{2.5\ mol} =$$ ✓✓

0.021 L (21mL)

19) $3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$ ✓ ✓✓

3 $$25.0mL \times \frac{0.356\ mol\ H_3PO_4}{1000\ mL} \times \frac{3\ mol\ NaOH}{1\ mol\ H_3PO_4} \times \frac{1000\ mL}{0.610\ mol} = 43.8mL$$

20) $Zn + 2HI \rightarrow ZnI_2 + H_2$ ✓ ✓✓

3 $$150\ mL \times \frac{0.185\ mol\ HI}{1000\ mL} \times \frac{1\ mol\ H_2}{2\ mol\ HI} \times \frac{22.4\ L\ H_2}{1\ mol\ H_2} = 0.31\ L$$