ANSWER KEY – LIMITING REACTANTS

1) $5C + 2SO_2 \rightarrow CS_2 + 4CO$

$$17.5\,g\,C \left| \frac{1\,mol\,C}{12.0\,g\,C} \right| \frac{1\,mol\,CS_2}{5\,mol\,C} = 0.292\,mol\,CS_2$$

$$39.5\,g\,SO_2 \left| \frac{1\,mol}{64.1\,g} \right| \frac{1\,mol\,CS_2}{2\,mol\,SO_2} = 0.308\ mol\ CS_2$$

∴ C is the limiting reactant

SO_2 is in excess.

mass of CS_2 produced:

$$0.292\,mol \left| \frac{76.1\,g\,CS_2}{1\,mol\,CS_2} \right. = 22.2\,g\,CS_2$$

mass of SO_2 used in rxn:

(limiting reactant) $\rightarrow$

$$17.5\,g\,C \left| \frac{1\,mol\,C}{12.0\,g\,C} \right| \frac{2\,mol\,SO_2}{5\,mol\,C} \left| \frac{64.1\,g\,SO_2}{1\,mol\,SO_2} \right. = 37.4\,g\,SO_2\ used$$

mass SO_2 left over:

$$39.5\,g - 37.4\,g = 2.1\,g\,SO_2$$

2) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

$$87.0\,g\,Cu \left| \frac{1\,mol\,Cu}{63.5\,g\,Cu} \right| \frac{2\,mol\,NO}{3\,mol\,Cu} = 0.913\,mol\,NO$$

$$225\,g\,HNO_3 \left| \frac{1\,mol\,HNO_3}{63.0\,g\,HNO_3} \right| \frac{2\,mol\,NO}{8\,mol\,HNO_3} = 0.893\,mol\,NO$$

∴ HNO_3 is the limiting reactant

Cu is in excess.

OVER.

mass NO produced:

$$0.893 \text{ mol NO} \left| \frac{30.0 \text{ g NO}}{1 \text{ mol NO}} \right. = 26.8 \text{ g NO}$$

mass Cu used in rxn:

limiting reactant →

$$225 \text{ g } HNO_3 \left| \frac{1 \text{ mol } HNO_3}{63.0 \text{ g}} \right| \frac{3 \text{ mol Cu}}{8 \text{ mol } HNO_3} \left| \frac{63.5 \text{ g Cu}}{1 \text{ mol Cu}} \right. = 85.0 \text{ g Cu}$$

mass Cu left over:

$$87.0 \text{ g} - 85.0 \text{ g} = 2.0 \text{ g Cu}$$

3) $K_2Cr_2O_7 + 6KBr + 7H_2SO_4 \rightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 3Br_2 + 7H_2O$

$$25.0 \text{ g } K_2Cr_2O_7 \left| \frac{1 \text{ mol } K_2Cr_2O_7}{294.2 \text{ g } K_2Cr_2O_7} \right| \frac{3 \text{ mol } Br_2}{1 \text{ mol } K_2Cr_2O_7} = 0.255 \text{ mol } Br_2$$

$$55.0 \text{ g KBr} \left| \frac{1 \text{ mol KBr}}{119.0 \text{ g KBr}} \right| \frac{3 \text{ mol } Br_2}{6 \text{ mol KBr}} = 0.231 \text{ mol } Br_2$$

$$60.0 \text{ g } H_2SO_4 \left| \frac{1 \text{ mol } H_2SO_4}{98.1 \text{ g } H_2SO_4} \right| \frac{3 \text{ mol } Br_2}{7 \text{ mol } H_2SO_4} = 0.262 \text{ mol } Br_2$$

∴ KBr is the limiting reactant and $K_2Cr_2O_7$ and H_2SO_4 are in excess

mass Br_2 produced:

$$0.231\,mol\,Br_2 \left| \frac{159.8\,g\,Br_2}{1\,mol\,Br_2} \right. = 36.9\,g\,Br_2$$

mass of $K_2Cr_2O_7$ and H_2SO_4 used in rxn:

limiting reactant

$$55.0\,g\,KBr \left| \frac{1\,mol\,KBr}{119.0\,g\,KBr} \right| \frac{1\,mol\,K_2Cr_2O_7}{6\,mol\,KBr} \left| \frac{294.2\,g\,K_2Cr_2O_7}{1\,mol\,K_2Cr_2O_7} \right. = 22.7\,g\,K_2Cr_2O_7$$

$$55.0\,g\,KBr \left| \frac{1\,mol\,KBr}{119.0\,g\,KBr} \right| \frac{7\,mol\,H_2SO_4}{6\,mol\,KBr} \left| \frac{98.1\,g\,H_2SO_4}{1\,mol\,H_2SO_4} \right. = 52.9\,g\,H_2SO_4.$$

mass of $K_2Cr_2O_7$ and H_2SO_4 left over:

mass $K_2Cr_2O_7$ left = $25.0\,g - 22.7\,g = 2.3\,g$

mass H_2SO_4 left: $60.0\,g - 52.9\,g = 7.1\,g$

4) $$0.0250\,L\,C_5H_{12} \left| \frac{626.0\,g\,C_5H_{12}}{1\,L\,C_5H_{12}} \right| \frac{1\,mol\,C_5H_{12}}{72.0\,g\,C_5H_{12}} \left| \frac{5\,mol\,CO_2}{1\,mol\,C_5H_{12}} \right. = 1.09\,mol\,CO_2$$

$$40.0\,L\,O_2 \left| \frac{1\,mol}{22.4\,L} \right| \frac{5\,mol\,CO_2}{8\,mol\,O_2} = 1.12\,mol\,CO_2$$

∴ C_5H_{12} is the limiting reactant.

volume CO_2 produced:

$$1.09\,mol\,CO_2 \left| \frac{22.4\,L\,CO_2}{1\,mol\,CO_2} \right. = 24.4\,L\,CO_2$$

OVER