SOLUTIONS PART 1 : C, B, D, C, A

PART 2 **SHORT ANSWERS** **40 MARKS**

Answer each of the following questions in the spaces provided.

1. Write ionic equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'.

   In each case describe **in full** what you would observe; including any colours, odours, precipitates (give the colour), gases evolved (give the colour or describe as colourless). If no change is observed, you should state this.

   a. Dilute sulfuric acid is added to a solution of barium nitrate

   Equation: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ ✓✓

   Observation: 2× ccs to give white ppte ✓

   [3 marks]

   b. Solutions of copper(II) nitrate and sodium phosphate are mixed.

   Equation: $3Cu^{2+} + 2PO_4^{3-} \rightarrow Cu_3(PO_4)_2$ ✓✓

   Observation: b.c.s + c.c.s blue ppte (Work out by colour of ions) ✓

   [3 marks]

2. 5.00 g of sodium sulfate is added to 50.0 mL of pure water. Density water (1.0g/L)
   What is the concentration of sodium ions in: Na_2SO_4

a. g/L	b. ppm
5.0 g / 50mL = 100g/L = 1.00×10^2 g/L ✓	100g in 1000g soln = 100g in 1 kg = $\frac{100 \times 1000}{1}$ = 100×10^5 ppm ✓
c. % w/w	**d. molL-1**
100g in 1000g = 1g in 100g = 1% WW ✓	100g in 1L = $\frac{100}{142.04}$ ✓ = 0.704 molL^{-1} ✓

[4 marks]

5

3. 26.0 ml of 4.50 % cloudy ammonia is dissolved in 50.0 ml of water. What is the final concentration of ammonia in $molL^{-1}$? Density of cloudy ammonia = 0.977 g/mL.

$V_{soln} = 76.0\,mL$

$m(NH_3) = \frac{4.5}{100} \times 0.977 \times 26$ ✓

$= 1.143\,g$ in $76.0\,mL$ ✓

$[NH_3] = \frac{1.143}{17.03} / 76 \times 10^{-3}$ ✓

$= 0.883\,mol\,L^{-1}$ ✓

[4 marks]

4. 5.00 g of magnesium metal is added to phosphoric acid according to this unbalanced equation.

$$Mg + H_3PO_4 \text{ ------> } Mg_3(PO_4)_2 + H_2$$

a. Write a balanced equation in the space below.

$3Mg + 2H_3PO_4 \rightarrow Mg_3(PO_4)_2 + 3H_2$ ✓

b. What volume of H_2 gas is produced at STP?

$n(Mg) = \frac{5.00}{24.31}$ ✓

$= 0.2056\,mol$

$n(H_2) = n(Mg)$ ✓

$V(H_2) = 0.2056 \times 22.4$ **OR** 0.2056×22.71

$= 4.61\,L$ ✓ $= 4.66\,L$ ✓

[4 marks]

5. The labels have fallen off 5 identical bottles, each of which contains clear solutions. The labels read:
Sodium carbonate, potassium nitrate, copper (II) nitrate, magnesium nitrate, zinc sulfate.
Briefly describe any method which could be used in turn to identify the contents of each of the four bottles. You may use any reagents. Please write down any relevant equations and observations.

Test	Observation	Substance Identified	Equation
Observe the solutions	One of the solutions is blue, the rest are colorless.	Copper Nitrate	No equation.
To a small amount of the remaining solutions add a few drops of $Ba(NO_3)_2$ soln.	Two of the solutions form a white ppte The others remain colourless	Na_2CO_3 $ZnSO_4$ ✓	$Ba^{2+} + CO_3^{2-} \rightarrow BaCO_3$ ✓ $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ ✓
To a small amount of the remaining solutions add a few drops of Na_2CO_3 solution	One solution gives a white ppte the other gives no reaction	$Mg(NO_3)_2$ ✓ KNO_3 ✓	$Mg^{2+} + CO_3^{2-} \rightarrow MgCO_3$ ✓
To the solutions identified as Na_2CO_3 or $ZnSO_4$ add a few drops of Na_2CO_3 solution	One solution gives a white ppte. The other gives no visible reaction	$ZnSO_4$ ✓	$Zn^{2+} + CO_3^{2-} \rightarrow ZnCO_3$

[8 marks]

10

6. 20.0 mL of C_5H_{12} is added to 80.0 mL of O_2 to produce CO_2 and H_2O at STP.

a. What is the limiting reagent?

$C_5H_{12} + 8O_2 \longrightarrow 5CO_2 + 6H_2O$ ✓

$SR = \frac{V(O_2)}{V(C_5H_{12})} = \frac{8}{1}$ ✓ Actual $= \frac{80}{20} = 4$ ✓

$\therefore$ O_2 is LR. ✓

b. What volume of CO_2 is produced at STP?

$V(CO_2) = \frac{5}{8} n(O_2)$ ✓

$= \frac{5}{8} \times 80$

$= 50\,mL$ ✓

c. What volume of:

i. C_5H_{12} remains?

$V(C_5H_{12})_{left} = 20 - \frac{1}{8} n(80)$ ✓

$= 20 - 10$

$= 10\,mL$ ✓

ii. O_2 remains?

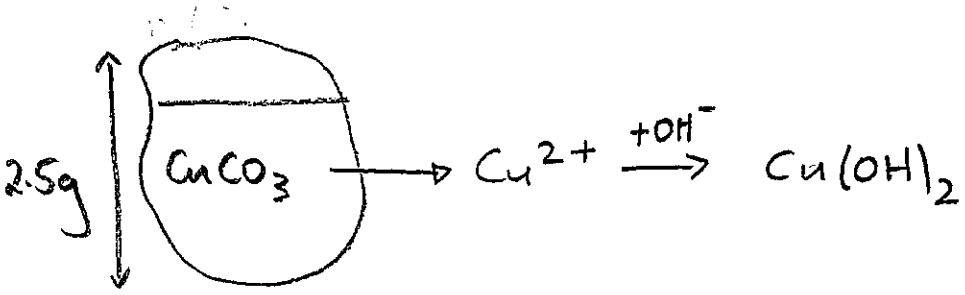
0L ✓

[9 marks]

7. A student had a sample of malachite, which is impure copper (II) carbonate. To determine the purity of the malachite he dissolved 2.50 g of the malachite in excess sulfuric acid. After filtering out undissolved solids, he added excess sodium hydroxide solution to the filtrate and produced 1.69 g of a copper (II) hydroxide.

$(CuCO_3)$

Calculate the % purity of the malachite.



$n(Cu(OH)_2) = \frac{1.69}{97.56}$

$= 1.732 \times 10^{-2}$ mol ✓

$= n(Cu^{2+})$

$= n(CuCO_3)$ in 2.50g sample ✓

$m(CuCO_3) = 123.55\ g\,mol^{-1}$ ✓

$\therefore\ m(CuCO_3) = 1.732 \times 10^{-2}\ (123.55)$

$= 2.14\ g$ ✓

$\therefore\ \%\ Cu = \frac{2.14}{2.50} \times \frac{100}{1}$

$= \underline{85.6\%}$ ✓

[5 marks]

END OF PAPER