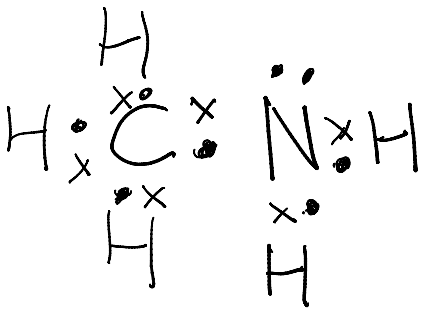
2013 Sec 3 Chemistry EOY Marking Scheme

Paper 1

1	A	**11**	D	**21**	B
2	A	**12**	C	**22**	A
3	A	**13**	D	**23**	B
4	B	**14**	B	**24**	A
5	D	**15**	B	**25**	C
6	A	**16**	A	**26**	B
7	B	**17**	B	**27**	D
8	C	**18**	B	**28**	A
9	C	**19**	C	**29**	B
10	C	**20**	C	**30**	B

Paper 2

Question	Answers	Marks
A1	(a) Magnesium carbonate / Lead (II) iodide	1
	(b) Potassium hydroxide and Ammonium sulfate	2
	(c) Ethanoic acid / Ammonium sulfate	1
A2	(a) Lewis Dot Diagram 	1
	(b) Number of moles of acid: 20.0/1000 x 0.0625 = 0.00125mol	1
	Ratio of methylamine to acid is <u>20:1</u>.	1

A3	(a) 1 : 1	1
	(b) No. of moles of oxygen = 23.9/16 = 1.494 mol	1
	Percentage of Y = 100- 23.9 = 76.1%	
	M_r of Y = 76.1/1.494 = 50.9 or 51(**accept either**)	1
	Hence Y is Vanadium.	1
	(c) Amphoteric	1
	Lead (II) oxide / Zinc oxide / Aluminium oxide / Other acceptable amphoteric oxides	1
	(d)	
	(i) There are strong electrostatic forces of attraction between the oppositely charged ions in the crystal lattice.	1
	Hence a large amount of heat energy is needed to overcome the forces of attraction.	1
	(ii) Substance Z is able to conduct electricity in aqueous state / molten state but not in solid state.	1
	In the aqueous and molten state, the crystal lattice is broken down, the ions are no longer held in the fixed lattice structure and can move to conduct electricity.	1
	[Accepted: any other suitable properties such as soluble in water but not organic solvents / hard and brittle]	
A4	Relative abundance for X-96 = 2.8%	
	A_r of X = (51.5% × 90 + 11.2% × 91+17.1% × 92 + 17.4% × 94 +2.8% × 96) = 91.4	1
	Identity of X = Zr (zirconium)	1
	(ECF possible for identity of metal. However, examples where ECF marks are not given:	
	i. A_r = 88.6, rounded off to 88, then identity of element is wrong.	
	ii. If the relative abundance is not calculated but Zr is obtained due to averaging, only 1 mark given)	
A5	(a) When black solid (CuO) stops dissolving, CuO is in excess. **(Not accepted: precipitate or white precipitate observed or unreacted CuO)**	1 1
	(b) The mass of copper(II)oxide	1
	It is added in excess.	1
	(c) When it cooled, the solubility decreases and thus some of the copper(II) nitrate will reappear as crystals.	1
	(d) $CuO(s) + 2H^+(aq) \rightarrow Cu^{2+}(aq) + H_2O(l)$	1

	(e) No. of moles of HNO_3 = 250/1000 x 2 = 0.5 mol 2 mol of HNO_3 : 1 mol of $Cu(NO_3)_2$ No. of mol of $Cu(NO_3)_2$ = 0.5x ½ = 0.25 mol. Mass of $Cu(NO_3)_2$ = 0.25 x 188 = 47.0 g **(f)** By <u>lowering the temperature further</u> / allowing the solution <u>more time to cool</u>, more crystals can be formed due to the further decrease in the solubility. **(Not accepted: heat longer, heat until saturated or heat until half of it original volume)**	1 1 1 1
A6	(a) Number of mol of NO_2 = 0.12 /24 = 0.005 mol Number of molecules = 0.005 X $6X10^{23}$ = 3 X 10^{21} (b) (i) The molecules are <u>closely packed</u> together in a fixed <u>orderly arrangement.</u> The molecules can only <u>vibrate about fixed positions</u>. (ii) Melting	1 1 1 1 1
A7	(a) $SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$ $2H_2SO_3(aq) + O_2(g) \rightarrow 2H_2SO_4(aq)$ (b) Pass the air sample through a solution of <u>acidified</u> potassium manganate (VII)/ or paper. The purple colour will be decolourised / $KMnO_4$ turns from purple to colourless. (c) 1) Add sulfuric acid to excess <u>lead(II) nitrate</u>. 2) <u>Filter</u> and collect the <u>residue</u>. 3) <u>Dry</u> the residue with filter paper.	1 1 1 1 1 1 1
B8a)	Bubble the gas into limewater. A white precipitate is formed if carbon dioxide is present.	1
b)	Ba^{2+}, SO_4^{2-}	1
c)	The blue ppt dissolves to form a dark blue solution.	1
d)	$CuSO_4$	1
e)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	1
f)	There was <u>no effervescence</u> observed when acid was addd. / A <u>precipitate was observed</u> despite the addition of dilute nitric acid./ <u>If</u> carbonate ion was present, the <u>precipitate would have dissolved</u> upon addition of nitric acid	1
g)	A is $ZnCl_2$ or $AlCl_3$. B is $CuCO_3$	1 for each; total 3
(h)	<u>Excess</u> aqueous ammonia	1

<table>
<tr><td>B9a)</td><td>124 g/mol</td><td>1</td></tr>
<tr><td>b)</td><td>24 / 24.0 dm^3</td><td>1</td></tr>
<tr><td>c)</td><td>No. of moles of $CuCO_3$ = 31.0 ÷ 124 = 0.250 mol</td><td>1</td></tr>
<tr><td>d)</td><td>$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$
0.250 moles of HCl would react with 0.125 moles of $CuCO_3$.
Hence HCl is the limiting reactant.</td><td>1
1
1</td></tr>
<tr><td>e)</td><td>Mole ratio of HCl to CO_2 is 2:1
Maximum volume of CO_2 produced = ½ × 0.250 × 24000 = 3000 cm^3</td><td>1 for ratio, 1 for volume of gas</td></tr>
<tr><td>f)</td><td>Percentage yield of CO_2 = 2800 ÷ 3000 × 100% = 93.3%</td><td>1</td></tr>
<tr><td>g)</td><td>Carbon dioxide is slightly soluble in water.</td><td>1</td></tr>
<tr><td>B10
EITHER</td><td></td><td></td></tr>
<tr><td>(a)</td><td>
<table>
<tr><th>Titration number</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Final burette reading/ cm^3</td><td>26.50</td><td>26.90</td><td>27.60</td><td>26.00</td></tr>
<tr><td>Initial burette reading / cm^3</td><td>0.00</td><td>0.60</td><td>1.30</td><td>0.20</td></tr>
<tr><td>Volume of ferrous solution used /cm^3</td><td>26.50</td><td>26.30</td><td>26.30</td><td>25.80</td></tr>
<tr><td>Best titration (✓)</td><td></td><td>✓</td><td>✓</td><td></td></tr>
</table>
Average volume of ferrous ammonium sulfate: (26.30 + 26.30)/2 = 26.30 cm^3
</td><td>1 (subtraction correct, 2dp)
1

1</td></tr>
<tr><td>(b)</td><td>Purple</td><td>1</td></tr>
</table>

(c)	Molar mass of $(NH_4)_2SO_4.FeSO_4.6H_2O$ = 392.0 g/mol. Concentration of $FeSO_4$ solution = $\frac{7.84 \times 1000}{392 \times 250}$ = 0.0800 mol dm^{-3} Therefore no of moles of $FeSO_4$ which reacted = $\frac{26.30}{1000}$ x 0.0800 = 0.002104 mol = 0.00210 mol (3sf)	1 1
(d)	No of moles of $KMnO_4$ reacted = $\frac{25.0}{1000}$ x 0.0168 = 0.0004200 mol = 0.000420 mol (3sf)	1
(e)	$\frac{\text{No of moles of } FeSO_4}{\text{No of moles of } KMnO_4} = \frac{0.002104}{0.0004200} = 5.00$ x =5 , y = 1 z = 8	1 1 1

B10 OR		
a)	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ No of moles of sodium hydroxide which reacted: 12.6/1000 x 0.250 = 0.00315 mol From equation, $NaOH:H_2SO_4$ is 2:1 No of moles of excess sulfuric acid: 0.000315 x ½ = 0.0001575 = 0.00158 mol (3sf) **(Note: any method which calculates the "number of moles" of the impure substance will be penalized)**	 1 1 for ratio, 1 for no of moles
b)	No of moles of acid originally: $\frac{25.0 \times 1.25}{1000} = 0.3125$ mol No of moles of acid which reacted with carbonate: 0.03125-0.001575= 0.02968 mol = 0.0297mol (3sf)	1 1
c)	$K_2CO_3 + H_2SO_4 \rightarrow K_2SO_4 + CO_2 + H_2O$ No of moles of potassium carbonate reacted = 0.02968 x 1 = 0.02968 mol Therefore mass of potassium carbonate reacted = 0.02968 x 138 = 4.096g Percentage purity = $\frac{4.096}{4.80} \times 100\% = 85.3\%$	 1 1 1
d)	Calcium carbonate will react with sulfuric acid to form <u>calcium sulfate</u> which is <u>insoluble in water</u>	1 1