National 5 Chemistry
Unit 1.3a Chemical Formulae

JAB chem

JAB chem

Lesson

Traffic Light: Red | Amber | Green

37

Compound names are derived from the names of the elements from which they are formed.

Ending	Meaning	Example
-ide	2 elements in compound	Copper sulphide = copper + sulphur
-ate	2 elements in compound + oxygen	Copper sulphate = copper + sulphur + oxygen
-ite	2 elements in compound + oxygen	Sodium sulphite = sodium + sulphur + oxygen

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Chemical formulae can be written for two element compounds using valency rules and a Periodic Table.

- The valency of an element is worked out from the group number:

Group Number	1	2	3	4	5	6	7	0
Valency	1	2	3	4	3	2	1	0

- The formula of a simple 2-element compound is worked out by the cross-over rule:

Write down element symbols	Write down Valency below each element's symbol	Put in Cross-over Arrows	Follow arrows and cancel down if necessary to get formula
Si O	Si O 4 2	Si O 4 2	Si_2O_4 ↓ SiO_2

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Roman numerals in the name of a compound indicate the valency of an element.

Roman Numeral	I	II	III	IV	V	VI	VII
Valency	1	2	3	4	5	6	7

The cross over rule is followed as usual once the valency of the metal has been worked out from the roman numeral

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The chemical formula can also be determined from names with prefixes.

Compound	carbon **mono**xide	carbon **di**oxide	sulphur **tri**oxide	carbon **tetra**chloride
Formula	CO	CO_2	SO_3	CCl_4
Meaning	Mono = 1	Di = 2	Tri = 3	Tetra = 4

41

The chemical formula of a covalent molecular substance gives the number of each type of atom present in a molecule.

- The formula of a covalent network gives the simplest ratio of each type of atom in the substance.

42

Ions containing more than one type of atom are often referred to as group ions.

43

Chemical formulae can be written for compounds containing group ions

- The valency of a group ion can be worked out from the charge of the ion

Write down element symbols	Write down Valency below each element's symbol	Put in Cross-over Arrows	Follow arrows and cancel down if necessary to get formula
Al SO_4^{2-}	Al SO_4^{2-} 3 2	Al SO_4^{2-} 3 2	$Al_2(SO_4)_3$

44
45

Ionic formulae give the simplest ratio of each type of ion in the substance and can show the charges on each ion, if required.

- charges must be superscript and numbers of atoms/ions must be subscript

Work out the formula of the substance	Work out the ion formed by the metal	Work out the ion of the non-metal/group ion	Put the ion in brackets if there is more than one of that ion to get ionic formula
$Al_2(SO_4)_3$	Al^{3+}	SO_4^{2-}	$(Al^{3+})_2(SO_4^{2-})_3$

National 5 Chemistry
Unit 1.3b Mole Calculations & Balanced Equations

JAB chem

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Chemical equations, using formulae and state symbols, can be written and balanced.

Write down correct chemical formula of all reactants before the arrow and all products after the arrow.

$Na_{(s)} + O_{2(g)} \longrightarrow Na_2O_{(s)}$

There are 2 oxygen atoms on left hand side but only 1 oxygen atom on right hand side. As the formula of Na_2O cannot be changed, double the number of Na_2O molecules by adding the number 2 *in front* of the formula

$Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$

There is 1 sodium atom on the LHS but 4 sodium atoms on the RHS. As the formulae of Na and Na_2O are set and cannot be changed, we must add the number 4 in front of the Na on the LHS to balance the number of Na atoms

$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$

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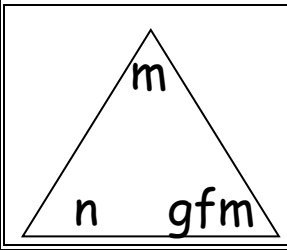
The mass of a mole of any substance, in grams, is equal to the gram formula mass and can be calculated using relative atomic masses. e.g. calculate the gfm of glucose $C_6H_{12}O_6$.

Write Element Symbol	Number of each atom from formula		Relative Atomic Mass (p7 data book)		Total
C	6	x	12	=	72
H	12	x	1	=	12
O	6	x	16	=	96
			gfm	=	180

48a

Calculations can be performed using the relationship between the mass and the number of moles of a substance.



m = mass	n = no. of moles	GFM = gram formula mass
$m = n \times gfm$	$n = \frac{m}{gfm}$	$gfm = \frac{m}{n}$

48b

Changing number of moles ⟶ number of grams

e.g. Calculate the number of moles in 3.6g of water.

Calculate the gfm of H_2O

H	2	x	1	=	2
O	1	x	16	=	16
			gfm	=	18g

then

$$\text{no. of mol} = \frac{\text{mass}}{\text{gfm}}$$

$$= \frac{3.6}{18}$$

$$= \mathbf{0.2mol}$$

48c

Changing number of grams ⟶ number of moles

e.g. calculate the mass if 0.1 moles of CO_2

Calculate the gfm of CO_2

C	1	x	12	=	12
O	2	x	16	=	32
			gfm	=	44g

then

mass = no. of mol x gfm
= 0.1 x 44
= **4.4g**

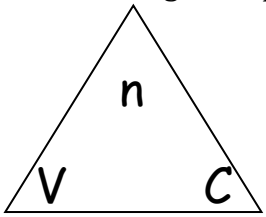
49

A solution is formed when a solute is dissolved in a solvent.

Name	Definition
solution	a mixture formed when a solute dissolves in a solvent
solute	The substance that is dissolved
solvent	The liquid that does the dissolving

50

The number of moles of solute, volume of solution and concentration of solution can be calculated using the equation:



n	=	C	x	V
no. of moles	=	**Concentration**	x	**volume**
(mol)		(mol l^{-1})		(litres)

$n = V \times C$ $\quad C = \frac{mol}{V}$ $\quad V = \frac{mol}{C}$

51	Given a balanced equation, the mass or number of moles of a substance can be calculated given the mass or number of moles of another substance in the reaction. e.g. calculate the mass of carbon dioxide produced if 5g of calcium carbonate reacts with gfm $CaCO_3$: Ca 1 x 40 = 40; C 1 x 12 = 12; O 3 x 16 = 46; gfm = 100g gfm CO_2: C 1 x 12 = 12; O 2 x 16 = 32; gfm = 44g $n = \frac{m}{gfm} = \frac{5}{100} = 0.05mol$ $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ 1mol 2mol 1mol 1mol 1mol 0.05mol 0.05mol m = n x gfm = 0.05 X 44 = 2.2g		☹	😐	☺
52	The percentage composition of an element in any compound can be calculated from the formula of the compound. Calculate mass of 1 mole: Fe_2O_3 = (2x56) + (3x16) = 112 + 48 = 160g Find mass of element: 2 x Fe = (2x56) = 112g Percentage Fe in Fe_2O_3 calculation: $\frac{112g}{160g}$ x 100 = 70%		☹	😐	☺

Nat5
Traffic Lights

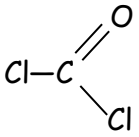
Past Paper Question Bank
Unit 1.3a Chemical Formulae

JABchem

Outcome	Original Specimen Paper	New Specimen Paper	Nat5 2014	Nat5 2015	Nat5 2016	Nat5 2017	Nat5 2018	Nat5 2019								
37		L6e						L8b								
38			L11c					L8c								
39					mc7		L15c									
40							L5c									
41																
42																
43																
44 45	L5a	mc23 L3a	mc3 L3d	mc6 L6b		mc3		L11a								
46	L4a(i)	L5a(i)	mc4	mc8 L14a(i)	mc1 L5c(i) L6b	mc7	L10a(i)									
47							L13a(ii)	L2d								
48a			L3b	mc9		mc8										
48b	L13a	L15a		L7b		L2c										
48c																
49								mc9								
50	L13b	L15b		L7b	L12d	mc9	mc7 L14b(iii)	L12a(ii)								
51	L4b(i)	L5b(i)	L10b		L3c(ii)	L12c	L16c	L5c(i) L12b(iv)								
52	L11a	L12a	L12b		L4b	L10b		mc10								
Marking Scheme	Back of Paper	Back of Paper	SQA Nat5 2014 Msch	SQA Nat5 2015 Msch	SQA Nat5 2016 Msch	SQA Nat5 2017 Msch	SQA Nat5 2018 Msch	SQA Nat5 2019 Msch								

Nat5	Answer	% Correct	Reasoning
2014 3	A	51	Phosphate PO_4^{3-} is listed in data booklet page 8 $\therefore$ Total negative charge in $Zn_3(PO_4)_2$ formula is 6- as there are two phosphate ions All ionic compounds are neutral over all so the total positive charge must be 6+ $\therefore$ Total positive charge in the 3 zinc ions = 6+ $\therefore$ Positive charge on each zinc ion = $^{6+}/_{3}$ = 2+
2014 4	C	89	$Fe_2O_3 + CO \rightarrow Fe + CO_2$ Fe: 2xFe before arrow but 1xFe after arrow $\therefore$ *double Fe after arrow* $Fe_2O_3 + CO \rightarrow \mathbf{2}Fe + CO_2$ O: 4xO before arrow but 2xO after arrow $\therefore$ *double CO_2 after arrow* $Fe_2O_3 + CO \rightarrow 2Fe + \mathbf{2}CO_2$ C: 1xC before arrow but 2xC after arrow $\therefore$ *double CO before arrow* $Fe_2O_3 + \mathbf{2}CO \rightarrow 2Fe + 2CO_2$ O: 5xO before arrow but 4xO after arrow $\therefore$ *increase CO to 3 before arrow* $Fe_2O_3 + \mathbf{3}CO \rightarrow 2Fe + 2CO_2$ C: 3xC before arrow but 2xFe after arrow $\therefore$ *increase CO_2 to 3 after arrow* $Fe_2O_3 + 3CO \rightarrow 2Fe + \mathbf{3}CO_2$
2015 6	C	51	Chromium chloride has the formula: $CrCl_3$ | Chloride ions have the formula: Cl^- | 3 chloride ions per chromium chloride: $Cr^{n+}(Cl^-)_3$ | Chromium ion must have 3+ charge to balance charge: $Cr^{3+}(Cl^-)_3$
2015 8	B	90	$2Al_{(s)} + 3Br_{2(l)} \longrightarrow 2AlBr_{3(s)}$
2015 9	A	69	☑A 1mol SO_2 = (1x32)+(2x16) = 32+32 = 64g $\therefore$0.2 mol SO_2 = 12.8g ☒B 1mol CO = (1x12)+(1x16) = 12+16 = 28g $\therefore$0.2 mol CO = 5.6g ☒C 1mol CO_2 = (1x12)+(2x16) = 12+32 = 44g $\therefore$0.2 mol CO_2 =8.8g ☒D 1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g $\therefore$0.2 mol NH_3 = 3.4g
2016 1	D	62	☒A products of dissolving should be aqueous solutions of $Na^+_{(aq)}$ and $Cl^-_{(aq)}$ ions ☒B correct formula for water should be $H_2O_{(l)}$ as water does not dissolve in water ☒C $NaCl_{(aq)}$ does not exist as $NaCl_{(s)}$ splits up its lattice into $Na^+_{(aq)} + Cl^-_{(aq)}$ ions ☑D $NaCl_{(s)}$ dissolves in $H_2O_{(l)}$ to form the ions $Na^+_{(aq)} + Cl^-_{(aq)}$
2016 7	A	45	☑A silver (I) oxide has the formula Ag_2O ☒B silver (II) oxide has the formula AgO ☒C silver (III) oxide has the formula Ag_2O_3 ☒D silver (IV) oxide has the formula AgO_2
2017 3	A	67	Dichromate ion formula is $Cr_2O_7^{2-}$ $\therefore$ $Cr_2O_7^{2-}$ ion must be balanced by a 2+ ion $\therefore$ Zn^{2+}
2017 7	C	86	$2H_2O_2 \longrightarrow 2H_2O + O_2$

2017 8	B	70	**gfm** = $\frac{\textbf{m}\text{ass}}{\textbf{n}\text{o. of mol}} = \frac{7g}{0.25mol} = 28g\ mol^{-1}$ ☒A gfm C_2H_6 = (2x12)+(6x1) = 24+6 = 30g ☑B gfm C_2H_4 = (2x12)+(4x1) = 24+4 = 28g ☒C gfm C_3H_8 = (3x12)+(8x1) = 36+8 = 44g ☒D gfm C_3H_6 = (3x12)+(6x1) = 36+6 = 42g
2017 9	A	56	☑A **n**o of mol = **v**olume x **c**oncentration = 0.1litres x 0.4mol l^{-1} = 0.04mol ☒B **n**o of mol = **v**olume x **c**oncentration = 0.2litres x 0.3mol l^{-1} = 0.06mol ☒C **n**o of mol = **v**olume x **c**oncentration = 0.3litres x 1.0mol l^{-1} = 0.3mol ☒D **n**o of mol = **v**olume x **c**oncentration = 0.4litres x 0.5mol l^{-1} = 0.2mol
2018 7	C	-	**c**oncentration = $\frac{\textbf{n}\text{o of moles}}{\textbf{v}\text{olume}} = \frac{0.1\ mol}{0.25\ litres} = 0.4\ mol\ l^{-1}$
2019 9	A	-	☑A Calcium hydroxide is the solute as it is the solid which is dissolved ☒B Water is the solvent as it is the liquid doing the dissolving ☒C Calcium hydroxide solution is the solution with the solute dissolved in solvent ☒D Calcium hydroxide must be soluble if it dissolves
2019 10	B	-	1mol NH_4NO_3 = (1x14)+(4x1)+(1x14)+(3x16) = 14+4+14+48 = 80 %N = $\frac{\text{Mass of nitrogen}}{\text{gfm}} \times 100 = \frac{28}{80} \times 100 = 35\%$

Nat5	Answer	Reasoning
2014 3b	0.022 mol	From passage: 0.86g of potassium in 100g of raisins **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.86}{39} = 0.022$ mol
2014 3d	KNO_3	Write down Valency below each ion's symbol: K NO_3^- ; 1 1 Put in Cross-over Arrows: K NO_3^- ; 1 1 Follow arrows and cancel down to get formula: KNO_3
2014 10b	99g	gfm C_9H_{20} = (9x12)+(20x1) = 108+20 = 128g **n**o of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{32}{128} = 0.25mol$ $C_9H_{20} + 14O_2 \longrightarrow 9CO_2 + 10H_2O$ 1mol 9mol 0.25mol 2.25mol gfm CO_2 = (1x12)+(2x16) = 12+32 = 44g **m**ass = **n**o of mol x **gfm** = 2.25 x 44 = 99g
2014 11c		<table><tr><th>Element</th><th>Group</th><th>Valency</th><th>No of Bonds Element Makes</th></tr><tr><td>Carbon</td><td>4</td><td>4</td><td>4</td></tr><tr><td>Oxygen</td><td>6</td><td>2</td><td>2</td></tr><tr><td>Chlorine</td><td>7</td><td>1</td><td>1</td></tr></table>
2014 12b	70%	% Fe = $\frac{\text{total mass of Fe}}{\text{gfm } Fe_2O_3} \times 100 = \frac{(2x56)}{(2x56)+(3x16)} \times 100 = \frac{112}{160} \times 100 = 70\%$

2014 13b	0.08 mol l^{-1}	**n**o. of mol = **v**olume x **c**oncentration = 0.016litres x 0.1 mol l^{-1} = 0.0016mol $2HCl + Na_2CO_3 \longrightarrow 2NaCl + CO_2 + H_2O$ 2mol 1mol 0.0016mol 0.0008mol **c**oncentration = $\frac{\textbf{no. of mol}}{\textbf{volume}} = \frac{0.0008\ mol}{0.01\ litres} = 0.08\ mol\ l^{-1}$
2015 6b	Fe_2O_3	Write down Valency below each element's symbol: Fe O / 3 2 Put in Cross-over Arrows: Fe O / 3 2 Follow arrows to get formula: Fe_2O_3
2015 7b	0.2	1mol $CuSO_4$ = (1x63.5) + (1x32) + (4x16) = 63.5+32+64 = 159.5g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{3.19}{159.5} = 0.02mol$ **c**oncentration = $\frac{\textbf{no. of mol}}{\textbf{volume}} = \frac{0.02}{0.1} = 0.2\ mol\ l^{-1}$
2015 14a(i)	Carbon monoxide	$TiO_2 + 2Cl_2 + 2C \longrightarrow TiCl_4 + 2CO$
2015 15b	0.0032	**n**o. of moles = **v**olume x **c**oncentration = 0.016 x 0.005 = 0.00008 mol $C_6H_8O_6 + I_2 \longrightarrow C_6H_6O_6 + 2HI$ 1mol 1mol 0.00008mol 0.00008mol **c**oncentration = $\frac{\textbf{no. of mol}}{\textbf{volume}} = \frac{0.00008mol}{0.025litres} = 0.0032\ mol\ l^{-1}$
2016 3c(ii)	0.36	$2Al + 6HNO_3 \longrightarrow 2Al(NO_3)_3 + 3H_2$ 2mol 6mol 2mol 3mol 0.01mol 0.015mol 1mol gas = 24litres 0.015mol gas = 24litres x $\frac{0.015}{1} = 0.36litres$
2016 4b	17.3	Gfm Al_2SiO_5 = (2x27) + (1x28) + (5x16) = 54+28+80 = 162g % Si = $\frac{\text{total mass of Si}}{\text{gfm } Al_2SiO_5} \times 100 = \frac{28}{162} \times 100 = 17.3\%$
2016 5c(i)	$CO + O_2 \longrightarrow CO_2$	carbon monoxide + oxygen → carbon dioxide Formula is derived directly from name (mono = 1) oxygen is one of the seven diatomic elements Formula is derived directly from name (di = 2) $CO + O_2 \longrightarrow CO_2$
2016 6b	$H_3PO_4 + 3NH_4OH$ ↓ $(NH_4)_3PO_4 + 3H_2O$	$H_3PO_4 + 3NH_4OH \longrightarrow (NH_4)_3PO_4 + 3H_2O$
2016 12d	0.02	**n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.8}{90} = 0.02\ mol$

2017 2c	20.5	m=41g gfm H_2 = 2g mol^{-1} **n**o of moles = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{41g}{2g\ mol^{-1}}$ = 20.5 mol
2017 10b	15.8	gfm $Al_2(SO_4)_3$ = (2x27)+(3x32)+(12x16) = 54+96+192 = 342 %Al = $\frac{\text{total mass of Al}}{\text{gfm } Al_2(SO_4)_3} \times 100 = \frac{(2x27)}{342} \times 100 = \frac{54}{342} \times 100$ = 15.8%
2017 12c	21.0g	1mol geraniol = (10x12)+(18x1)+(1x16) = 120+18+16 = 154g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{15.4}{154}$ = 0.1mol geraniol + propanoic acid ⟶ geranyl propanoate + water $C_{10}H_{18}O$ + $C_3H_6O_2$ ⟶ $C_{13}H_{22}O_2$ + H_2O 1mol 1mol 0.1 mol 0.1mol 1mol geranyl propanoate = (13x12)+(22x1)+(2x16) = 156+22+32 = 210g **mass** = **n**o of mol x **gfm** = 0.1 x 210 = 21.0g
2018 5c	SiO_2	Write down Valency below each element's symbol: Si O / 4 2 Put in Cross-over Arrows: Si O / 4 2 Follow arrows to get formula: Si_2O_4 Cancel Down: SiO_2
2018 10a(i)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$	
2018 13a(ii)	134	Gfm $C_4H_6O_5$ = (4x12)+(6x1)+(5x16) = 48 + 6 + 80 = 134g
2018 14b(iii)	0.000161	**n**umber of moles = **v**olume x **c**oncentration = 0.00805litres x 0.02mol l^{-1} = 0.000161mol
2018 15c	Fe_2O_3 ↓ $O_2 + Fe_5O_7$	Problem Solving Question
2018 16c	960	gfm CH_3OH = (1x12)+(4x1)+(1x16) = 12+4+16 = 32g **n** = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{640g}{32g\ mol^{-1}}$ = 20mol $CH_3OH + H_2S \longrightarrow CH_3SH + H_2O$ 1mol 1mol 20mol 20mol gfm CH_3SH = (1x12)+(4x1)+(1x32) = 12+4+32 = 48g **mass** = **n**o of mol x **gfm** = 20mol x 48g mol^{-1} = 960g
2019 2d	90	Lactic acid is the harmless product mentioned in the text. Formula of lactic acid = $C_3H_6O_3$ 1 mol = (3x12) + (6x1) + (3x16) = 36 + 6 + 48 = 90

2019 5c(i)	140	1mol C_6H_{10} = (6x12) + (10x1) = 72 + 10 = 82g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{410}{82}$ = 5mol $C_2H_4 + C_4H_6 \longrightarrow C_6H_{10}$ 1mol 1mol 5mol 5mol 1mol C_2H_4 = (2x12) + (4x1) = 24 + 4 = 28g **m**ass = **n**o of mol x **gfm** = 5 x 28 = 140g
2019 8b	beryllium aluminium silicon oxygen	Beryl is beryllium aluminium silicate. Silicate means both silicon and oxygen are also found in the compound.
2019 8c	$BeCl_2 + K \rightarrow Be + KCl$	Beryllium chloride + Potassium → Beryllium + Potassium chloride $BeCl_2$ + K → Be + KCl $BeCl_2$ + 2K → Be + 2KCl
2019 11a	$Ca^{2+}CO_3^{2-}$	Write down Valency below each element's symbol: Ca CO_3 ; 2 2 Put in Cross-over Arrows Follow arrows to get formula: $Ca_2(CO_3)_2$ Cancel Down $CaCO_3$
2019 12a(ii)	21.2	**n**o. of moles = **v**olume x **c**oncentration = 0.2litres x 1 mol l^{-1} = 0.2mol gfm Na_2CO_3 = (2x23)+(1x12)+(3x16) = 46 + 12 + 48 = 106g mol^{-1} **m**ass = **n**o of mol x **gfm** = 0.2mol x 106 g mol^{-1} = 21.2g
2019 12b(iv)	1.5	**n**o of mol Na_2CO_3 = **v**olume x **c**oncentration = 0.015 litres x 1mol l^{-1} = 0.015mol $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ 1mol 2mol 0.015mol 0.030mol **c**oncentration = $\frac{\textbf{n}\text{o of moles}}{\textbf{v}\text{olume}} = \frac{0.030\text{mol}}{0.02\text{litres}}$ = 1.5 mol l^{-1}

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Past Paper Question Bank
Unit 1.3a Chemical Formulae

JABchem

Outcome	Int2 2000	Int2 2001	Int2 2002	Int2 2003	Int2 2004	Int2 2005	Int2 2006	Int2 2007	Int2 2008	Int2 2009	Int2 2010	Int2 2011	Int2 2012	Int2 2013	Int2 2014	Int2 2015
37						mc2					L11b(i)	mc2				
38			L1a													
39	L5b			L13c				L11c		mc11 L14a		L4a(ii)	L1b	mc7		
40																
41																
42																
43		L4a	mc4	mc8	L14d	L2a(i)	mc8		L15a		mc7			L6c	L14b	
44 45		mc6	mc5				L3a					mc8			mc6	mc9 L4b(ii)
46	mc25 L11b	L6c(ii)	L4a	L2b	mc2 L2a	mc8 L5a	L1b(i)	L4a(i) L8a	L3a	mc5 L4a	mc8 L2b	L3a	L2b	mc2 mc8	mc9	Mc11 L5b(i)
47	L5c		mc7	mc29			mc10							mc9	mc10	mc10
48a																
48b		mc8			L5b	L4c(ii)	mc9	L14b	mc9				L4c	L6a		
48c																
49							mc2	mc5	mc2	mc2	L2c			mc3	mc2	mc4
50		L4b(ii)	mc22	mc17	mc21	mc21	L13a(i)	mc21	mc23	L12c(i) L12c(ii)			L15a(i)	mc21	L10a	
51	L6b	L9b	L12b L13a	L9d	L8b	L13c	L5b L13a(ii)	L4b	L11a	L4b	mc20 L4b	L3d L5b	L15a(ii)	L12c	L4c(ii)	L12b
52																
Marking Scheme	Not Published	Not Published	Not Published	SQA Int2 2003 MSch	SQA Int2 2004 MSch	SQA Int2 2005 MSch	SQA Int2 2006 MSch	SQA Int2 2007 MSch	SQA Int2 2008 MSch	SQA Int2 2009 MSch	SQA Int2 2010 MSch	SQA Int2 2011 MSch	SQA Int2 2012 MSch	SQA Int2 2013 MSch	SQA Int2 2014 MSch	SQA Int2 2015 MSch

Int2	Answer	% Correct	Reasoning
2000 25	B	73	concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.25\text{ mol}}{0.5\text{ litres}} = 0.5\text{ mol l}^{-1}$
2001 6	B	30	Write down formula: $Fe_2(SO_4)_3$ Reverse cross-over rule: $Fe\ SO_4$ → 3 2 Lift valency from each ion: Fe 3, SO_4 2 Write Ionic Formula: $(Fe^{3+})_2(SO_4^{2-})_3$
2001 8	A	49	gfm Na_2CO_3 = (2x23) + (1x12) + (3x16) = 46 + 12 + 48 = 106g no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{5.3}{106} = 0.05\text{mol}$
2002 4	B	74	Write down Formulae of ions: $Mg\ SO_3^{2-}$ Write down Valency below each ion: $Mg\ SO_3^{2-}$ → 2 2 Put in Cross-over Arrows: $Mg\ SO_3$ → 2 2 Follow arrows and cancel down to get formula: $MgSO_3$
2002 5	C	42	Write down Formulae: $CrCl_3$ Reverse crossover rule from formula: $Cr\ Cl$ → 3 1 Work out valency from cross over rule: Cr 3, Cl 1 Ionic Formula: $Cr^{3+}(Cl^-)_3$
2002 7	C	84	1 mol of $(NH_4)_2SO_4$ = (2x14)+(8x1)+(1x32)+(4x16) = 28+8+32+64 = 132g
2002 22	B	28	☒A no of mol = volume x concentration = 0.1 x 4 = 0.4mol ☑B no of mol = volume x concentration = 0.2 x 3 = 0.6mol ☒C no of mol = volume x concentration = 0.3 x 1 = 0.3mol ☒D no of mol = volume x concentration = 0.4 x 0.5 = 0.2mol
2003 8	B	89	Write down Formulae of ions: $Al\ SO_4^{2-}$ Write down Valency below each ion: $Al\ SO_4$ → 3 2 Put in Cross-over Arrows: $Al\ SO_4$ → 3 2 Follow arrows to get formula: $Al_2(SO_4)_3$
2003 17	C	55	concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.25\text{ mol}}{0.5\text{ litres}} = 0.5\text{ mol l}^{-1}$
2003 29	C	93	1 mol of $(NH_4)_2CO_3$ = (2x14)+(8x1)+(1x12)+(3x16) = 28+8+12+48 = 96g

2004 2	A	78	☑A $HCl(g) + H_2O(l) \rightarrow H^+(aq) + OH^-(aq)$ is the correct equation ☒B Solution of H^+ and OH^- are written as $H^+(aq) + OH^-(aq)$ not $H^+(l) + OH^-(l)$ ☒C Hydrogen chloride gas is written as $HCl(g)$ not $HCl(aq)$ ☒D Solution of H^+ and OH^- are written as $H^+(aq) + OH^-(aq)$ not $H^+(l) + OH^-(l)$
2004 21	D	70	$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.5 \text{ mol}}{0.250 \text{ litres}} = 2 \text{ mol } l^{-1}$
2005 2	D	61	☒A magnesium hydroxide contains magnesium, hydrogen and oxygen ☒B magnesium phosphate contains magnesium, phosphate and oxygen ☒C magnesium sulphite contains magnesium, sulphur and oxygen ☑D magnesium nitride contains magnesium and nitrogen
2005 8	D	53	1mol $CaSiO_3$ = (1x40) + (1x28) + (3x16) = 40 + 28 + 48 = 118g 1mol CaO = (1x40) + (1x16) = 40 + 16 = 56g 1mol SiO_2 = (1x28) + (2x16) = 28 + 32 = 62g 1 mol of reactants = 118g and 1 mol of products = 56g+62g = 118g
2005 21	C	50	$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.2 \text{ mol}}{0.1 \text{ litres}} = 2 \text{ mol } l^{-1}$
2006 2	A	63	Solute: Sugar / Lemon Juice / carbon dioxide — The substance which is dissolved Solvent: Water — The liquid which does the dissolving Solution: Lemonade — The mixture produced when solute dissolves in solvent
2006 8	C	71	Write down Formulae of ions: $Al\ SO_4^{2-}$ Write down Valency below each ion: $Al\ SO_4$; 3 2 Put in Cross-over Arrows: $Al\ SO_4$; 3 2 Follow arrows to get formula: $Al_2(SO_4)_3$
2006 9	B	71	1mol $C_6H_{12}O_6$ = (6x12) + (12x1) + (6x16) = 72 + 12 + 96 = 180g $\text{no. of mol} = \frac{\text{mass}}{\text{gfm}} = \frac{18}{180} = 0.1 \text{ mol}$
2006 10	A	76	☑A 1 mol SO_2 = (1x32) + (2x16) = 32+32 = 64g ☒B 1 mol CO = (1x12) + (1x16) = 12+16 = 28g ☒C 1 mol CO_2 = (1x12) + (2x16) = 12+32 = 44g ☒D 1 mol NH_3 = (1x14) + (3x1) = 14+3 = 17g
2007 5	C	68	Solute: Ethanoic acid — The substance which is dissolved Solvent: Water — The liquid which does the dissolving Solution: Vinegar — The mixture produced when solute dissolves in solvent
2007 21	B	69	Volume: $100cm^3$ — Concentration: 1 mol l^{-1} — No of Moles: 0.1mol — Mass of Solid: 14.2g Volume: $50cm^3$ — Concentration: 2 mol l^{-1} — No of Moles: 0.1mol — Mass of Solid: 14.2g
2008 2	C	67	☒A Ethanoic Acid is the solute (substance which is dissolved) ☒B Saturated describes a solution where no more solute will dissolve in the solvent ☑C Water is the solvent (the liquid which does the dissolving) ☒D Vinegar is the solution (ethanoic acid dissolved in water)

2008 9	A	81	1 mol NH_3 = (1x14) + (3x1) = 17g **n**o. of mol = $\frac{\textbf{m}ass}{\textbf{gfm}} = \frac{1.7}{17}$ = 0.1mol
2008 23	B	47	☒A **n**o. of mol = **v**ol x **c**oncentration = 0.25 x 0.4 = 0.1mol ☑B **n**o. of mol = **v**ol x **c**oncentration = 0.25 x 4 = 1mol ☒C **n**o. of mol = **v**ol x **c**oncentration = 0.2 x 0.5 = 0.1mol ☒D **n**o. of mol = **v**ol x **c**oncentration = 0.2 x 1 = 0.2mol
2009 2	C	69	Solute is the solid being dissolved. • adding more solute will **increase** the concentration of the solution. • Solvent is the liquid which is doing the dissolving • adding more solvent will **decrease** the concentration.
2009 5	B	74	☒A Solutions of ions are written $Na^+(aq) + Cl^-(aq)$ not $Na^+(l) + Cl^-(l)$ ☑B (s) = solid, (l) = liquid, (g) = gas and (aq) = aqueous ☒C water is written as $H_2O(l)$ as water is the solvent not the solute ☒D NaCl is a solid before it is dissolved in the solvent water.
2009 11	A	44	Write down Formulae: Ag_2O Write Down Reverse of Cross Over Rule: Ag O / 1 2 Follow arrows to get formula: Valency of Ag=1; Valency of O=2
2010 7	B	79	Write down Valency below each ion's symbol: $Mg\ SO_3^{2-}$ / 2 2 Put in Cross-over Arrows: $Mg\ SO_3^{2-}$ / 2 2 Follow arrows and cancel down to get formula: $MgSO_3$
2010 8	B	89	❶ Write down reactants and product formulae $Al(s) + Br_2(l) \rightarrow AlBr_3(s)$ ❷ 1 aluminium on each side ∴ *no action* $Al(s) + Br_2(l) \rightarrow AlBr_3(s)$ ❸ 2xBr before arrow and 3xBr after arrow ∴ *make both sides up to 6xBr* $Al(s) + 3Br_2(l) \rightarrow 2AlBr_3(s)$ ❹ 1xAl before arrow and 2xAl after arrow ∴ *make both sides up to 2xAl* $2Al(s) + 3Br_2(l) \rightarrow 2AlBr_3(s)$
2010 20	C	63	**n**o. of mol $(NH_4)_2SO_4$ = **v**olume x **c**oncentration = 0.5litres x 1mol l^{-1} = 0.5mol gfm $(NH_4)_2SO_4$ = (2x14)+(8x1)+(1x32)+(4x16) = 28+8+32+64 = 132g **m**ass = **n**o.of mol x **gfm** = 0.5 x 132 = 66g
2011 2	D	71	☒A magnesium hydroxide contains 3 elements (magnesium, hydrogen and oxygen) ☒B magnesium phosphate contains 3 elements (magnesium, phosphorus and oxygen) ☒C magnesium sulphite contains 3 elements (magnesium, sulphur and oxygen) ☑D magnesium nitride contains 2 elements (magnesium and nitrogen)
2011 8	C	54	Chromium chloride has the formula: $CrCl_3$ Chloride ions have the formula: Cl^- 3 chloride ions per chromium chloride: $Cr^{n+}(Cl^-)_3$ Chromium ion must have 3+ charge to balance charge: $Cr^{3+}(Cl^-)_3$

2013 2	A	83	☑A $HCl_{(g)} + H_2O_{(l)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$ is the correct equation including state symbols ☒B hydrogen chloride HCl is a gas in the question but a liquid in the equation ☒C hydrogen chloride HCl is a gas in the question but an aqueous in the equation ☒D H^+ and Cl^- ion are aqueous (aq) when in solution not liquids
2013 3	B	69	Solute: Substance which is dissolved (ethanol) Solvent: Liquid which does the dissolving (water) Solution: Mixture of solute dissolved in the solvent (whisky)
2013 7	B	39	☒A vanadium (V) oxide has a formula V_2O_5 ☑B vanadium (IV) oxide has a formula VO_2 ☒C vanadium (III) oxide has a formula V_2O_3 ☒D vanadium (II) oxide has a formula VO
2013 8	A	64	Equation in question: $4NH_3 + xO_2 \rightarrow 4NO + yH_2O$ 12H before arrow ∴ $6H_2O$ required to balance 12H: $4NH_3 + xO_2 \rightarrow 4NO + 6H_2O$ $4NO + 6H_2O$ before arrow = 10xO ∴ $5O_2$ required to balance 10xO: $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
2013 9	D	82	☒A gfm of CO = (1x12) + (1x16) = 12 + 16 = 28g ☒B gfm of CO_2 = (1x12) + (2x16) = 12+32 = 44g ☒C gfm of N_2 = (2x14) = 28g ☑D gfm of CH_4 = (1x12) + (4x1) = 12+4 = 16g
2013 21	C	60	concentration = $\frac{\text{no. of moles}}{\text{volume}} = \frac{0.25 \text{ mol}}{0.5 \text{ litres}} = 0.5 \text{ mol } l^{-1}$
2014 2	A	76	☑A water is the liquid which does the dissolving ∴ water is the solvent ☒B sugar is a solid which is dissolved ∴ sugar is a solute ☒C lemon juice is a liquid which is dissolved ∴ lemon juice is a solute ☒D carbon dioxide is a gas which is dissolved ∴ carbon dioxide is a solute
2014 6	A	54	Phosphate PO_4^{3-} is listed in data booklet page 8 ∴ Total negative charge in $Zn_3(PO_4)_2$ formula is 6- as there are two phosphate ions All ionic compounds are neutral over all so the total positive charge must be 6+ ∴ Total positive charge in 3 zinc ions = 6+ ∴ Positive charge on zinc ion = $^{6+}/_3$ = 2+
2014 9	C	90	$Fe_2O_3 + CO \rightarrow Fe + CO_2$ Fe: 2xFe before arrow but 1xFe after arrow ∴ *double Fe after arrow* $Fe_2O_3 + CO \rightarrow \mathbf{2}Fe + CO_2$ O: 4xO before arrow but 2xO after arrow ∴ *double CO_2 after arrow* $Fe_2O_3 + CO \rightarrow 2Fe + \mathbf{2}CO_2$ C: 1xC before arrow but 2xC after arrow ∴ *double CO before arrow* $Fe_2O_3 + \mathbf{2}CO \rightarrow 2Fe + 2CO_2$ O: 5xO before arrow but 4xO after arrow ∴ *increase CO to 3 before arrow* $Fe_2O_3 + \mathbf{3}CO \rightarrow 2Fe + 2CO_2$ C: 3xC before arrow but 2xFe after arrow ∴ *increase CO_2 to 3 after arrow* $Fe_2O_3 + 3CO \rightarrow 2Fe + \mathbf{3}CO_2$
2014 10	C	81	☒A 1mol CH_4 = (1x12)+(4x1) = 12+4 = 16g ∴ 0.5mol = 8g ☒B 1mol CO_2 = (1x12)+(2x16) = 12+32 = 44g ∴ 0.5mol = 22g ☑C 1mol NO_2 = (1x14)+(2x16) = 14+32 = 46g ∴ 0.5mol = 23g ☒D 1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g ∴ 0.5mol = 8.5g

2015 4	B	83	☒A Solute: the substance which is dissolved ☑B Solvent: the liquid which does the dissolving ☒C Solution: the mixture formed when solute dissolves in solvent ☒D Saturated: a solution where no more solute can dissolve in the solvent
2015 9	B	68	<table><tr><th>Iron nitrate has the formula</th><th>Nitrate ions have the formula</th><th>3 nitrate ions per iron nitrate</th><th>iron ion must have 3+ charge to balance charge</th></tr><tr><td>$Fe(NO_3)_3$</td><td>NO_3^-</td><td>$Fe^{n+}(NO_3^-)_3$</td><td>$Fe^{3+}(NO_3^-)_3$</td></tr></table>
2015 10	A	87	☑A 1mol SO_2 = (1x32)+(2x16) = 32+32 =64g ∴ 0.2mol = 64 x 0.2 = 12.8g ☒B 1mol CO = (1x12)+(1x16) = 12+16 =28g ∴ 0.2mol = 28 x 0.2 = 5.6g ☒C 1mol CO_2 = (1x12)+(2x16) = 12+32 =44g ∴ 0.2mol = 44 x 0.2 = 8.8g ☒D 1mol NH_3 = (1x14)+(3x1) = 14+1 =17g ∴ 0.2mol = 17 x 0.2 = 3.4g
2015 11	C	49	$2Al + CuSO_4 \longrightarrow 3Cu + Al_2(SO_4)_3$ 2mol 3mol 1mol 1.5mol

<table>
<tr><th>Int2</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>2000
5b</td><td>SnF_2</td><td>
<table>
<tr><th>Write down Formulae of elements</th><th>Write down Valency below each ion</th><th>Put in Cross-over Arrows</th><th>Follow arrows and cancel down to get formula</th></tr>
<tr><td>Sn F</td><td>Sn F
2 1</td><td>Sn F
2 1</td><td>SnF_2</td></tr>
</table>
</td></tr>
<tr><td>2000
5c</td><td>144g</td><td>1mol Na_2PO_3F = (2x23) + (1x31) + (3x16) + (1x19) = 46 + 31 + 48 + 19 = 144g</td></tr>
<tr><td>2000
6b</td><td>145.5kg</td><td>gfm CO_2 = (1x12) + (2x16) = 12 + 32 = 44g
$\textbf{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{200000}{44} = 4545.5\text{mol}$
$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$
6mol 1mol 4545.5mol — 6mol 1mol 4545.5mol
1mol O_2 = 2x16 = 32g
$\textbf{mass} = \textbf{no. of mol} \times \textbf{gfm} = 4545.5 \times 32 = 145454g = 145.5kg$</td></tr>
<tr><td>2000
11b</td><td>$4Al + 3O_2 \rightarrow 2Al_2O_3$</td><td>$4Al + 3O_2 \rightarrow 2Al_2O_3$</td></tr>
<tr><td>2001
4a</td><td>$Cu(NO_3)_2$</td><td>
<table>
<tr><th>Write down Formulae of ions</th><th>Write down Valency below each ion</th><th>Put in Cross-over Arrows</th><th>Follow arrows and cancel down to get formula</th></tr>
<tr><td>$Cu\ NO_3^-$</td><td>$Cu\ NO_3^-$
2 1</td><td>Cu NO_3
2 1</td><td>$Cu(NO_3)_2$</td></tr>
</table>
</td></tr>
<tr><td>2001
4b(ii)</td><td>0.05</td><td>no. of mol = volume x concentration = 0.25litres x 0.2 mol l^{-1} = 0.05mol</td></tr>
<tr><td>2001
6c(ii)</td><td>$Fe_2O_3 + 3CO$
↓
$2Fe + 3CO_2$</td><td>$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$</td></tr>
<tr><td>2001
9b</td><td>600.9g</td><td>1mol $LiClO_4$ = (1x7) + (1x35.5) + (4x16) = 7 + 35.5 + 64 = 106.5g
$\textbf{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1000}{106.5} = 9.39\text{mol}$
$LiClO_4 \longrightarrow LiCl + 2O_2$
1mol — 2mol
9.39mol — 18.78mol
1mol O_2 = (2x16) = 32g
$\textbf{mass} = \textbf{no. of mol} \times \textbf{gfm} = 18.78 \times 32 = 600.9g$</td></tr>
</table>

2002 1a	$BaCl_2$	Write down Formulae of elements: Ba Cl Write down Valency below each atom: Ba (2) Cl (1) Put in Cross-over Arrows: Ba Cl → 2 1 Follow arrows to get formula: $BaCl_2$
2002 4a	$C_4H_{10} + 13N_2O$ ↓ $4CO_2 + 5H_2O + 13N_2$	$C_4H_{10} + 13N_2O \longrightarrow 4CO_2 + 5H_2O + 13N_2$
2002 12b	605g	gfm C_3H_6 = (3x12) + (6x1) = 36 + 6 = 42g **n**o. of mol = $\frac{\textbf{m}ass}{\textbf{gfm}} = \frac{100}{42} = 2.38mol$ $I_2 + C_3H_6 \longrightarrow C_3H_6I_2$ 1mol 1mol 2.38mol 2.38mol gfm I_2 = (2x127) = 254g **m**ass = **n**o. of mol x **gfm** = 2.38 x 254 = 605g
2002 13a	31.9	**n**o. of mol = **v**olume x **c**oncentration = 0.4 litres x 0.50 mol l^{-1} – 0.2 mol **m**ass = **n**o. of mol x **gfm** = 0.2 mol x 159.5g mol^{-1} = 31.9g
2003 2b	2 mol	$2N_2O \longrightarrow 2N_2 + O_2$ 2mol 1mol 4mol 2mol
2003 9d	24.1g	gfm Mg = 24.5g **n**o. of mol = $\frac{\textbf{m}ass}{\textbf{gfm}} = \frac{4.9}{24.5} = 0.2mol$ $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$ 1mol 1mol 0.2mol 0.2mol Gfm $MgSO_4$ = (1x24.5) + (1x32) + (4x16) = 24.5 + 32 + 64 = 120.5g **m**ass = **n**o. of mol x **gfm** = 0.2 x 120.5 = 24.1g
2003 13c	Cr_2O_3	Write down Formulae of ions: Cr O Write down Valency below each ion: Cr (3) O (2) Put in Cross-over Arrows: Cr O → 3 2 Follow arrows to get formula: Cr_2O_3
2004 2a	$2CO + 2NO$ ↓ $2CO_2 + N_2$	$2CO + 2NO \longrightarrow 2CO_2 + N_2$
2004 5b	0.5	1 mol urea H_2NCONH_2 = (4x1) = (2x14) + (1x12) + (1x16) = 4 + 28 + 12 + 16 = 60g **n**o. of mol = $\frac{\textbf{m}ass}{\textbf{gfm}} = \frac{30}{60} = 0.5$ mol

<table>
<tr><td>2004
8b</td><td>304</td><td>gfm FeO = (1x56) + (1x16) = 56 + 16 = 72g
no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{144000}{72}$ = 2000 mol
$FeO + H_2SO_4 \longrightarrow FeSO_4 + H_2O$
1mol 1mol
2000mol 2000mol
1mol $FeSO_4$ = (1x56) + (1x32) + (4x16) = 56 + 32 + 64 = 152g
mass = no. of mol x gfm = 2000 x 152 = 304000g = 304kg</td></tr>
<tr><td>2004
14d</td><td>$Na_2S_2O_8$</td><td><table><tr><th>Write down Formulae of ions</th><th>Write down Valency below each ion</th><th>Put in Cross-over Arrows</th><th>Follow arrows to get formula</th></tr><tr><td>Na $S_2O_8^{2-}$</td><td>Na $S_2O_8^{2-}$
1 2</td><td>Na S_2O_8
1 2</td><td>$Na_2S_2O_8$</td></tr></table></td></tr>
<tr><td>2005
2a(i)</td><td>Na_2CO_3</td><td><table><tr><th>Write down Formulae of ions</th><th>Write down Valency below each ion</th><th>Put in Cross-over Arrows</th><th>Follow arrows to get formula</th></tr><tr><td>Na CO_3^{2-}</td><td>Na CO_3
1 2</td><td>Na CO_3
1 2</td><td>Na_2CO_3</td></tr></table></td></tr>
<tr><td>2005
4c(ii)</td><td>0.02</td><td>no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{1.27}{63.5}$ = 0.02 mol</td></tr>
<tr><td>2005
5a</td><td>$C_2H_4 + 3O_2$
↓
$2CO_2 + 2H_2O$</td><td>$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$</td></tr>
<tr><td>2005
13c</td><td>3.18g</td><td>1mol NH_4Cl = (1x14) + (4x1) + (1x35.5) = 14 + 4 + 35.5 = 53.5g
no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{10}{53.5}$ = 0.187 mol
$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$
1mol 1mol
0.187mol 0.187mol
1mol NH_3 = (1x14) + (3x1) = 14 + 3 = 17g
mass = no. of mol x gfm = 0.187 x 17 = 3.18g</td></tr>
<tr><td>2006
1b(i)</td><td>$2CH_3SH + H_2$
↓
$C_2H_6 + 2H_2S$</td><td>$2CH_3SH + H_2 \longrightarrow C_2H_6 + 2H_2S$</td></tr>
<tr><td>2006
3a</td><td>2-</td><td><table><tr><th>Formula</th><th>Ionic Formula</th><th>Charge on oxide ion</th></tr><tr><td>Fe_2O_3</td><td>$(Fe^{3+})_2(O^{2-})_3$</td><td>O^{2-}</td></tr></table></td></tr>
</table>

2006 5b	30g	gfm of CH_3OH = (1x12) + (4x1) + (1x16) = 12 + 4 + 16 = 32g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{16}{32}$ = 0.5 mol $CH_3OH + CO \longrightarrow CH_3COOH$ 1mol 1mol 0.5mol 0.5mol gfm CH_3COOH = (2x12) + (4x1) + (2x16) = 24 + 4 + 32 = 60g **m**ass = **n**o. of mol x **gfm** = 0.5 x 60 = 3.18g
2006 13a(i)	0.1	**n**o. of mol = **v**olume x **c**oncentration = 0.1 litres x 1 mol l^{-1} = 0.1 mol
2006 13a(ii)	0.3	citric acid + sodium hydrogencarbonate $\longrightarrow$ products 1mol 3mol 0.1mol 0.3mol
2007 4a(i)	(aq)	Magnesium chloride is soluble in water (p8 of data booklet) The symbol of dissolved in water is (aq), which means aqueous
2007 4b	0.4	gfm Mg = 24.3g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{4.9}{24.5}$ = 0.2 mol $Mg + 2HCl \longrightarrow MgCl_2 + H_2$ 1mol 1mol 0.2mol 0.2mol gfm H_2 = 2g **m**ass = **n**o. of mol x **gfm** = 0.2 x 2 = 0.4g
2007 8a	$C_6H_{12}O_6$ ↓ $2C_2H_5OH + 2CO_2$	$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$
2007 11c	Fe_2O_3	Write down Valency below each element's symbol: Fe O / 3 2 Put in Cross-over Arrows: Fe O / 3 2 Follow arrows to get formula: Fe_2O_3
2007 14b(i)	3.6g	45% of 8g = $\frac{45}{100}$ x 8g = 3.6g
2007 14b(ii)	0.075mol	**n**o of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{3.6}{48}$ = 0.075 mol
2008 3a	$4N_2O + CH_4$ ↓ $4N_2 + CO_2 + 2H_2O$	$4N_2O + CH_4 \longrightarrow 4N_2 + CO_2 + 2H_2O$

<table>
<tr><td>2008
11a</td><td>1.62</td><td>gfm Al = 27g
no of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{0.135}{27} = 0.005$ mol
$3Ag_2S + 2Al \longrightarrow 6Ag + Al_2S_3$
2mol 6mol
0.005mol 0.015mol
gfm Ag = 108g
mass = no. of mol x gfm = 0.015 x 108 = 1.62g</td></tr>
<tr><td>2008
15a</td><td>$KMnO_4$</td><td><table><tr><th>Write down Formulae of ions</th><th>Write down Valency below each ion</th><th>Put in Cross-over Arrows</th><th>Follow arrows to get formula</th></tr><tr><td>K^+ MnO_4^-</td><td>K^+ MnO_4^-
1 1</td><td>K MnO_4
1 1</td><td>$KMnO_4$</td></tr></table></td></tr>
<tr><td>2009
4a</td><td>$Fe_2O_3 + 3CO$
↓
$2Fe + 3CO_2$</td><td>$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$</td></tr>
<tr><td>2009
4b</td><td>5600</td><td>gfm C = 12g
no of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{1200000g}{12\ g\ mol^{-1}} = 100000$ mol
$CO_2 + C \longrightarrow 2CO$
1mol 2mol
100000mol 200000mol
Gfm Co = (1x12)+(1x16) = 12+16 = 28g
mass = no. of mol x gfm = 200000 x 28 = 5600000g = 5600kg</td></tr>
<tr><td>2009
12c(i)</td><td>0.1</td><td>no. of moles = volume x concentration = 0.1litres x 1.0 mol l^{-1} = 0.1mol</td></tr>
<tr><td>2009
12c(ii)</td><td>0.25</td><td>$2MnO_4^- + 5C_2H_2O_4 + 6H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
2mol 5mol
0.1mol 5mol x $^{0.1}/_{2}$
= 0.25mol</td></tr>
<tr><td>2009
14a</td><td>Fe_2O_3</td><td><table><tr><th>Write down Valency below each element's symbol</th><th>Put in Cross-over Arrows</th><th>Follow arrows to get formula</th></tr><tr><td>Fe O
3 2</td><td>Fe O
3 2</td><td>Fe_2O_3</td></tr></table></td></tr>
<tr><td>2010
2b</td><td>(s) (l) (aq)</td><td>$NH_4NO_{3(s)} + H_2O_{(l)} \longrightarrow NH_4NO_{3(aq)}$</td></tr>
<tr><td>2010
2c</td><td>Solvent</td><td><table><tr><td>Solute</td><td>Substance which is dissolved</td></tr><tr><td>Solvent</td><td>Liquid which does the dissolving</td></tr><tr><td>Solution</td><td>Mixture of solute dissolved in the solvent</td></tr></table></td></tr>
</table>

2010 4b — 1.24

gfm Ag = 108g

$$\text{no of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.08}{108} = 0.01 \text{ mol}$$

$$4Ag + 2H_2S + O_2 \longrightarrow 2Ag_2S + 2H_2O$$

4mol	2mol
2mol	1mol
0.01mol	0.005mol

gfm Ag_2S = (2x108)+(1x32) = 216+32 = 248

mass = **no.** of mol x **gfm** = 0.005 x 248 = 1.24g

2010 11b(i) — calcium, carbon and oxygen

Ending	Meaning	Example
-ide	2 elements in compound	Copper sulphide = copper + sulphur
-ate	2 elements in compound + oxygen	Copper sulphate = copper + sulphur + oxygen
-ite	2 elements in compound + oxygen	Sodium sulphite = sodium + sulphur + oxygen

2011 3a — $2H_2O_2 \rightarrow O_2 + 2H_2O$

$$2H_2O_2 \longrightarrow O_2 + 2H_2O$$

2011 3d — 0.6

$$2H_2O_2 \longrightarrow O_2 + 2H_2O$$

34g	12litres
1.7g	12litres x $^{1.7}/_{34}$
	= 0.6litres

2011 4a(ii) — $RuCl_2$

Write down Valency below each element's symbol	Put in Cross-over Arrows	Follow arrows to get formula
Ru Cl 2 1	Ru Cl 2 1	$RuCl_2$

2011 5b — 9.6

1mol $(NH_4)_2SO_4$ = (2x14) + (8x1) + (1x32) + (4x16) = 28+8+32+64 = 132g

$$\text{no of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{13200g}{132g\ mol^{-1}} = 100 \text{ mol}$$

$$(NH_4)_2CO_3 + CaSO_4 \longrightarrow (NH_4)_2SO_4 + CaCO_3$$

1mol	1mol
100mol	100mol

1mol $(NH_4)_2CO_3$ = (2x14) + (8x1) + (1x12) + (3x16) = 28+8+12+48 = 96g

mass = **no.** of mol x **gfm** = 100 x 96 = 9600g = 9.6kg

2012 1b — Sb_2O_3

Write down Valency below each element's symbol	Put in Cross-over Arrows	Follow arrows to get formula
Sb O 3 2	Sb O 3 2	Sb_2O_3

2012 2b — $NaN_3 \rightarrow Na + N_2$

NaN_3	$\rightarrow$	Na	+	N_2
sodium azide Formula given in question		sodium metal Metal elements come as single atoms		nitrogen gas Nitrogen is a diatomic element

2012 4c — 0.02

$$\text{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.8}{90} = 0.02 \text{ mol}$$

2012 15a(i)	0.5	**n**o. of mol = **v**olume x **c**oncentration = 0.25 litres x 2 mol l^{-1} = 0.5 mol
2012 15a(ii)	40g	gfm Fe_2O_3 = (2x56)+(3x16) = 112+48 = 160g $Fe_2O_3 + 2H_3PO_4 \longrightarrow 2FePO_4 + 3H_2O$ 1mol 2mol 0.25mol 0.5mol **M**ass Fe_2O_3 = **n**o. of mol x **gfm** = 0.25 x 160 = 40g
2013 6a	0.01	**n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{1.57}{157}$ = 0.01 mol
2013 6c	$Ca_3(PO_4)_2$	Write down Valency below each ion's symbol: $Ca \quad PO_4^{3-}$; 2 3 Put in Cross-over Arrows: $Ca \quad PO_4^{3-}$; 2 3 Follow arrows and cancel down to get formula: $Ca_3(PO_4)_2$
2013 12c	8.52	gfm $C_{18}H_{36}O_2$ = 890g (in question) **n**o of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{8.9}{890}$ = 0.01 mol glyceryl tristearate + water $\longrightarrow$ glycerol + stearic acid $C_{57}H_{110}O_6 + 3H_2O \longrightarrow C_3H_8O_3 + 3C_{18}H_{36}O_2$ 1mol 3mol 0.01mol 0.03mol gfm $C_{18}H_{36}O_2$ = (18x12)+(36x1)+(2x16) = 216+36+32 = 284g **m**ass = **n**o. of mol x **gfm** = 0.03 x 284 = 8.52g
2014 4c(ii)	1490	1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g **n**o of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{510}{17}$ = 30 mol $3NH_3 + H_3PO_4 \longrightarrow (NH_4)_3PO_4$ 3mol 1mol 30mol 10mol 1mol $(NH_4)_3PO_4$ = (3x14)+(12x1)+(1x31)+(4x16) = 42+12+31+64 = 149g **m**ass = **n**o. of mol x **gfm** = 10 x 149 = 1490g
2014 10a	1	1mol CH_3COOH = (2x12)+(4x1)+(2x16) = 24+4+32 =60g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{6}{60}$ = 0.1 mol **c**oncentration = $\frac{\textbf{no. of mol}}{\textbf{volume}} = \frac{0.1\text{mol}}{0.1\text{litres}}$ = 1 mol l^{-1}
2014 14b	$Al(OH)_3$	Write down Valency below each ion's symbol: $Al \quad OH^-$; 3 1 Put in Cross-over Arrows: $Al \quad OH^-$; 3 1 Follow arrows and cancel down to get formula: $Al(OH)_3$

2015 4b(ii)	Na^+H^-	Sodium is a group 1 metal so forms an sodium ion with formula Na^+ The negative ion to balance this is the hydride ion will formula H^-. The cross over rule would give the formula NaH as both ions have a valency of one.
2015 5b(i)	$TiCl_4 + 4Na$ ↓ $Ti + 4NaCl$	$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$
2015 12b	0.2	1mol $CuSO_4$ = (1x63.5)+(1x32)+(4x16)=63.5+32+64 = 159.5g $\text{no of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{3.19}{159.5} = 0.02\text{mol}$ $\text{concentration} = \frac{\textbf{no of mol}}{\textbf{volume}} = \frac{0.02\text{mol}}{0.1\text{litres}} = 0.2\text{mol } l^{-1}$

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.3a Chemical Formulae

Outcome	2000 Credit	2001 Credit	2002 Credit	2003 Credit	2004 Credit	2005 Credit	2006 Credit	2007 Credit	2008 Credit	2009 Credit	2010 Credit	2011 Credit	2012 Credit	2013 Credit		
37		13a(i)						17a						11a(i)		
38	13a											16b(ii)				
39							11c									
40								17d								
41																
42																
43																
44 45		18b	14d		17a			19b	20b	10b	13c 16a(i)	18c	15d	16b(ii)		
46	13e	12a	12a(i)	10b(i)	17b(i)	16a	16a	10c(i)	12b	16b	14b(i)	20a(i)	15a			
47																
48a																
48b				19b												
48c					11b(ii)					16d			21c(ii)			
49																
50		14c	19a(ii)	19b	21b(ii)			20a	14c			20c(ii)	17b	18b(i)		
51	18b	12c	15b(ii)	12c		20b	15a		20a	19c	12e	17b		17c		
52		13c(ii)	12b	15c	11b(i) 17c	11b	11b	17c	16a	14b	16a(ii)		15c 21c(i)	16b(i)		

SG Credit	Answer	Reasoning
2000C 13a	SiO_2	Si in group 4 has valency = 4, O in group 6 has valency = 2 Use cross over rule and cancel down to achieve formula SiO_2 Write down Valency below each ion's symbol: Si (4) O (2) → Put in Cross-over Arrows: Si O, 4 2 → Follow arrows and cancel down to get formula: Si_2O_4 → SiO_2
2000C 13b	Chlorine Cl_2 gas	Problem Solving Question: $Si + 2Cl_2 \longrightarrow SiCl_4$
2000C 18b	36g	1mol C_3H_8 = (3x12) + (8x1) = 36 + 8 = 44g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{22g}{44g\ mol^{-1}} = 0.5mol$ $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$ 1mol : 4mol 0.5mol : 2mol 1mol H_2O = (2x1)+(1x16) = 2 + 16 = 18g **m**ass = **n**o. of mol x **gfm** = 2mol x 18g mol^{-1} = 36g
2001C 12a	$CH_4 + 2O_2$ ↓ $CO_2 + 2H_2O$	$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
2001C 12c	48g	1mol H_2S = (2x1) + (1x32) = 2 + 32 = 34g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{34g}{34g\ mol^{-1}} = 1mol$ $2H_2S + SO_2 \longrightarrow 2H_2O + 3S$ 2mol : 3mol 1mol : 1.5mol 1mol S = 32g **m**ass = **n**o. of mol x **gfm** = 1.5mol x 32g mol^{-1} = 48g
2001C 13a(i)	ammonium phosphate	Data booklet p8 gives names of NH_4^+ and PO_4^{3-} ions
2001C 13c(ii)	46.7%	gfm $CO(NH_2)_2$ = (1x12) + (1x16) + (2x14) + (4x1) = 12 + 16 + 28 + 4 = 60g $\%N = \frac{\text{mass of N}}{\text{gfm}} \times 100 = \frac{28}{60} \times 100 = 46.67\%$
2001C 14c	0.01mol l^{-1}	1mol Ca = 40g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{0.4g}{40g\ mol^{-1}} = 0.01mol$ concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.01mol}{1\ litre} = 0.01mol/l$
2001C 18b	$Ca^{2+}(OH^-)_2$	Write down Valency below each ion's symbol: Ca (2) OH^- (1) → Put in Cross-over Arrows: Ca OH^-, 2 1 → Follow arrows and cancel down to get formula: $Ca(OH)_2$ Work out charges on ions. If more than one of ion put ion in brackets and number outside $Ca^{2+}(OH^-)_2$

2002C 12a(i)	$TiCl_4 + 2H_2O$ ↓ $TiO_2 + 4HCl$	$TiCl_4 + 2H_2O \longrightarrow TiO_2 + 4HCl$
2002C 12b	60%	gfm TiO_2 = (1x48) + (2x16) = 48 + 32 = 80g $\%Ti = \frac{\text{mass of Ti}}{\text{gfm}} \times 100 = \frac{48}{80} \times 100 = 60\%$
2002C 14d	$(Na^+)_2CO_3^{2-}$	Write down Valency below each ion's symbol: Na CO_3^{2-} ; 1 2 Put in Cross-over Arrows: Na CO_3^{2-} ; 1 2 Follow arrows and cancel down to get formula: Na_2CO_3 Work out charges on ions. If more than one of ion put in brackets and number outside: $(Na^+)_2CO_3^{2-}$
2002C 15b(ii)	1120 tonnes	1mol Fe_2O_3 = (2x56) + (3x16) = 112 + 48 = 160g no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{1600g}{160g\ mol^{-1}} = 10mol$ $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$ 1mol 2mol 10mol 20mol 1mol Fe = 56g mass = no. of mol x gfm = 20mol x 56g mol^{-1} = 1120g 160g Fe_2O_3 produces 1120g of Fe ∴ 160tonnes Fe_2O_3 produces 1120tonnes of Fe
2002C 19a(ii)	0.00201mol	no. of mol = volume x concentration = 0.0201litres x 0.1 mol/l = 0.00201 mol
2003C 10b(i)	$CH_4 + 2O_2$ ↓ $CO_2 + 2H_2O$	$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
2003C 12c	32.75g	no. of mol H_2 = 0.5mol (in question) $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$ 1mol 1mol 0.5mol 0.5mol 1mol Zn = 65.5g mass = no. of mol x gfm = 0.5mol x 65.5g mol^{-1} = 32.75g
2003C 15c	38.7%	gfm $Ca_3(PO_4)_2$ = (3x40) + (2x31) + (8x16) = 120 + 62 + 128 = 310g $\%Ca = \frac{\text{mass of Ca}}{\text{gfm}} \times 100 = \frac{120}{310} \times 100 = 38.7\%$
2003C 19b	6.725g	1 mol $CuCl_2$ = (1x 63.5) + (2x35.5) = 134.5g no. of mol = volume x concentration = 0.05litres x 1 mol/l = 0.05mol mass of $CuCl_2$ = no. of mol x gfm = 0.05mol x 134.5g mol^{-1} = 6.725g

2004C 11b(i)	0.287g	5% of 5.74g = $\frac{5}{100}$ x 5.74g = 0.287g
2004C 11b(ii)	0.0106 mol	1mol Al = 27g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}}$ = $\frac{0.287g}{27g\ mol^{-1}}$ = 0.0106mol
2004C 17a	$Na^+HCO_3^-$	Write down Valency below each ion's symbol: Na HCO_3^- ; 1 1 Put in Cross-over Arrows: Na HCO_3^- ; 1 1 Follow arrows and cancel down to get formula: $NaHCO_3$ Work out charges on ions. If more than one of ion put ion in brackets and number outside: $Na^+HCO_3^-$
2004C 17b(i)	$3Ag_2S + 2Al \rightarrow 6Ag + Al_2S_3$	$3Ag_2S + 2Al \longrightarrow 6Ag + Al_2S_3$
2004C 17c	36%	gfm Al_2S_3 = (2x27) + (3x32) = 54 + 96 = 150g %C = $\frac{\text{mass of Al}}{gfm}$ x 100 = $\frac{54}{150}$ x 100 = 36%
2004C 21b(ii)	0.00412 mol	**n**o. of mol = **v**olume x **c**oncentration = 0.0206litres x 0.20 mol/l = 0.00412 mol
2005C 11b	92.3%	gfm C_8H_8 = (8x12) + (8x1) = 96 + 8 = 104g %C = $\frac{\text{mass of C}}{gfm}$ x 100 = $\frac{96}{104}$ x 100 = 92.3%
2005C 16a	Equation showing:	$2HCl + Na_2S_2O_3 \longrightarrow 2NaCl + S + SO_2 + H_2O$
2005C 20b	0.15	1 mol Al = 31g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}}$ = $\frac{1.35g}{27g\ mol^{-1}}$ = 0.05mol $2Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$ 2mol : 3mol 0.05mol : 0.075mol 1mol H_2 = 2x1 = 2g **m**ass = **n**o. of mol x **gfm** = 0.075mol x 2g mol^{-1} = 0.15g
2006C 11b	90.7%	gfm Pb_3O_4 = (3x207) + (4x16) = 621 + 64 = 685g %Pb = $\frac{\text{mass of Pb}}{gfm}$ x 100 = $\frac{621}{685}$ x 100 = 90.7%
2006C 11c	Cr_2O_3	Write down Valency below each element's symbol: Cr O ; 3 2 Put in Cross-over Arrows: Cr O ; 3 2 Follow arrows and cancel down if necessary to get formula: Cr_2O_3

2006C 15a	8g	1mol N_2O = (2x14) + (1x16) = 28 + 16 = 44g no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{22g}{44g\ mol^{-1}} = 0.5mol$ $2N_2O \longrightarrow 2N_2 + O_2$ 2mol 1mol 0.5mol 0.25mol 1mol O_2 = 32g **m**ass = **n**o. of mol x **gfm** = 0.25mol x 32g mol^{-1} = 8g
2006C 16a	$Ba(OH)_2 + 2NH_4Cl$ ↓ $2NH_3 + BaCl_2 + 2H_2O$	$Ba(OH)_2 + 2NH_4Cl \longrightarrow 2NH_3 + BaCl_2 + 2H_2O$
2007C 10c(i)	$2AgNO_3 + Cu$ ↓ $2Ag + Cu(NO_3)_2$	$2AgNO_3 + Cu \longrightarrow 2Ag + Cu(NO_3)_2$
2007C 17a	zinc sulphide	-ide: Compound contains the two named elements -ate: Compound contains 3 elements (two named elements + oxygen) -ite: Compound contains 3 elements (two named elements + oxygen) NB metal always comes first in name
2007C 17c	51.3%	1 mol CaF_2 = 40 + 19 + 19 = 78g $\%Ca = \frac{\text{mass of Ca}}{\text{mass of } CaF_2} \times 100 = \frac{40}{78} \times 100 = 51.3\%$
2007C 17d	$Fe_2O_3 + CO$ ↓ $Fe + CO_2$	The reaction in a blast furnace has the reduction of iron ore (Fe_2O_3) by carbon monoxide. Carbon monoxide is made by incomplete combustion of carbon in the blast furnace. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
2007C 19b	$Ni^{2+}(NO_3^-)_2$	NO_3^- ions have a valency of 1. Use cross over rule to calculate formula
2007C 20a	0.2	**n**o. of mol = **v**olume x **c**oncentration = 0.05litres x 4 mol/l = 0.2 mol
2008C 12b	$2NaN_3 \longrightarrow N_2 + 2Na$	Balancing Equation Exercise [Clue: Get 6 Nitrogens on both sides]
2008C 14c	0.0033	**n**o. of mol. = **v**olume x **c**oncentration = 0.33l x 0.01 mol/l = 0.0033 mol
2008C 16a	68.3%	1 mol $PbSO_4$ = 207 + 32 + (4x16) = 207 + 32 + 64 = 303g $\%Pb = \frac{\text{mass of Pb}}{\text{mass of } PbSO_4} \times 100 = \frac{207}{303} \times 100 = 68.3\%$
2008C 20a	28g	1 mole Fe_2O_3 = (2x56) + (3x16) = 112 + 48 = 160g no. of mol = $\frac{\text{mass}}{\text{gfm}} = \frac{40g}{160g\ mol^{-1}} = 0.25mol$ $2Al + Fe_2O_3 \longrightarrow 2Fe + Al_2O_3$ 1mol 2mol 0.25mol 0.5mol 1mol Fe = 1x56 = 56g **m**ass = **n**o. of mol x **gfm** = 0.5mol x 56g mol^{-1} = 28g
2008C 20b	3+	Fe with valency 3 will give formula of Fe_2O_3 via cross-over rule. Iron with valency of 3 will give iron ions with 3+ charge (Fe^{3+})

2009C 10b	$(Al^{3+})_2(O^{2-})_3$	Al^{3+} O^{2-} → 3, 2 → $(Al^{3+})_2(O^{2-})_3$
2009C 14b	35%	1 mol NH_4NO_3 = (2x14) + (4x1) + (3x16) = 28 + 4 + 48 = 80g %N = $\frac{\text{Weight of N}}{\text{Weight of } NH_4NO_3} = \frac{28}{80} \times 100 = 35\%$
2009C 16b	$C_6H_{12}O_6 \downarrow 2C_2H_5OH + 2CO_2$	glucose $\xrightarrow{\text{yeast}}$ alcohol + carbon dioxide $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$
2009C 16d	5	1 mol C_2H_5OH = (2x12) + (6x1) + (1x16) = 24 + 6 + 16 = 46g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{230g}{46g\ mol^{-1}} = 5mol$
2009C 19c	9	1mol of C_9H_{20} = (9x12) + (20x1) = 108 + 20 = 128g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{6.4g}{128g\ mol^{-1}} = 0.05mol$ $C_9H_{20} + 14O_2 \longrightarrow 9CO_2 + 10H_2O$ 1mol 10mol 0.05mol 0.5mol 1mol of H_2O = (2x1) + (1x16) = 2 + 16 = 18g **mass** = **no.** of mol x **gfm** = 0.5mol x 18g mol^{-1} = 9g
2010C 12e	0.4g	1 mol Mg = 24.5g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{4.9g}{24.5g\ mol^{-1}} = 0.2mol$ $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$ 1mol 1mol 0.2mol 0.2mol 1mol H_2 = 2x1 = 2g **mass** = **no.** of mol x **gfm** = 0.2mol x 2g mol^{-1} = 0.4g
2010C 13c	$Ni^{2+}CrO_4^{2-}$	Write down Valency below each element's symbol: Ni^{2+} CrO_4^{2-} (2, 2) Put in Cross-over Arrows Follow arrows and cancel down to get formula: $Ni^{2+}CrO_4^{2-}$
2010C 14b(i)	$TiCl_4 + 4Na \downarrow Ti + 4NaCl$	$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$
2010C 16a(i)	2+	Sulphur is a group 6 non-metal element and forms S^{2-} ions For PbS to be balanced in charge, lead ion must have charge Pb^{2+}
2010C 16a(ii)	86.6%	1 mol PbS = (1x207) + (1x32) = 207 + 32 = 239g %Pb = $\frac{\text{mass of Pb}}{\text{mass of PbS}} = \frac{207}{239} \times 100 = 86.6\%$

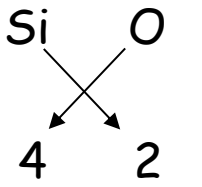
2011C 16b(ii)	Al_2O_3	Write down Valency below each element's symbol: Al O / 3 2 → Put in Cross-over Arrows → Follow arrows and cancel down if necessary to get formula: Al_2O_3
2011C 17b	51g	1mol H_2NCONH_2 = (1x12)+(2x14)+(1x16)+(4x1) = 12+28+16+4 = 60g no. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{90g}{60g\ mol^{-1}} = 1.5mol$ $H_2NCONH_2 + H_2O \longrightarrow CO_2 + 2NH_3$ 1mol : 2mol 1.5mol : 3mol 1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g **m**ass = **n**o. of mol x **gfm** = 3mol x 17g mol^{-1} = 51g
2011C 18c	Co^{2+} or 2+	Chlorine is a non-metal in group 7, with a valency of 1 and forms the Cl^- ion. $CoCl_2$ has two Cl^- ions ∴ Cobalt ion must be 2+ to balance charge ∴ Co^{2+} ion
2011C 20a(i)	$Pb(NO_3)_2 + 2NaI \downarrow PbI_2 + 2NaNO_3$	$Pb(NO_3)_2 + 2NaI \longrightarrow PbI_2 + 2NaNO_3$
2011C 20c(ii)	0.002	**n**o. of moles = **v**olume x **c**oncentration = 0.02litres x 0.1 mol l^{-1} = 0.002 mol
2012C 15a	$2KOH + H_2SO_4 \downarrow K_2SO_4 + 2H_2O$	$2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$
2012C 15c	44.8%	gfm K_2SO_4 = (2x39) + (1x32) + (4x16) = 78+32+64 = 174g % K = $\frac{\text{mass K}}{\text{gfm}} = \frac{78}{174} \times 100 = 44.8\%$
2012C 15d	$(NH_4^+)_3PO_4^{3-}$	Formula of ammonium phosphate is $(NH_4)_3PO_4$ Ammonium ions have a formula of NH_4^+ and phosphate ions PO_4^{3-}
2012C 17b	0.005mol	**n**o. of moles = **v**olume x **c**oncentration = 0.05litres x 0.1mol l^{-1} = 0.005mol
2012C 21c(i)	25	Mass Al = 10% of 250g = $\frac{10}{100} \times 250g = 25g$
2012C 21c(ii)	0.926	**n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{25g}{27g} = 0.926mol$
2013C 11a(i)	Sodium phosphate	Metal comes first in the name: sodium — Non-metal comes second in the name: phosph- — 3rd element is oxygen = -ate: -ate
2013C 16b(i)	86.2%	gfm HgS = (1x200.5) + (1x32) = 200.5 + 32 = 232.5g %Hg = $\frac{\text{mass of Hg}}{\text{total mass}} \times 100 = \frac{200.5}{232.5} \times 100 = 86.2\%$

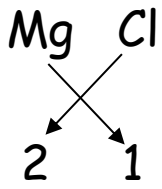
2013C 16b(ii)	Hg^{2+}	Hg (mercury) is a transition metal and does not have a set valency to work out the charge on the metal ion. • The sulphide ion has a negative charge as it is a non-metal ion • The sulphide ion has a two negative charge as sulphur is in group 6 and has a valency of 2 ∴ S^{2-} ion • The mercury ion must have a positive charge as it is a metal ion The mercury ion has a two positive charge to balance the two negative charge of the S^{2-}ion ∴ Hg^{2+}
2013C 17c	35.5g	1mol N_2 = 2x14 = 28g $\text{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{7g}{28g\ mol^{-1}} = 0.25mol$ $N_2 + 3F_2 \longrightarrow 2NF_3$ 1mol 2mol 0.25mol 0.5mol 1mol NF_3 = (1x14)+(3x19) = 14+57 = 71g **m**ass = **n**o. of mol x **gfm** = 0.5mol x 71g mol^{-1} = 35.5g
2013C 18b(i)	0.001	**n**o. of moles = **v**olume x **c**oncentration = 0.02litres x 0.05 mol l^{-1} = 0.001 mol
2013C 18b(ii)	0.04	$\textbf{c}\text{oncentration} = \frac{\textbf{n}\text{o. of mol}}{\textbf{v}\text{olume}} = \frac{0.001\ mol}{0.025\ litres} = 0.04\ mol\ l^{-1}$

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.3a Chemical Formulae

Outcome	2000 General	2001 General	2002 General	2003 General	2004 General	2005 General	2006 General	2007 General	2008 General	2009 General	2010 General	2011 General	2012 General	2013 General		
37					14a	10c	13a		10c		13a					
38				12b				14c(ii)		10b(i)			16c(ii)	19a		
39																
40							16b		15b(i)							
41																
42																
43						16b										
44 45																
46																
47																
48a																
48b																
48c																
49					14b						18a			10c(i)		
50																
51																
52																

<table>
<tr><th>SG General</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>2003G
12b</td><td>SiO_2</td><td>The two most common elements in the pie chart are silicon and oxygen:
<table>
<tr><th>Write down Elements and their valency below</th><th>Write Down Arrow of Cross Over Rule</th><th>Follow arrows and cancel down to get formula</th></tr>
<tr><td>Si O
4 2</td><td> 
Si O
4 2</td><td>SiO_2</td></tr>
</table></td></tr>
<tr><td>2004G
14a</td><td>magnesium, sulphur & oxygen</td><td>
<table>
<tr><th>Ending</th><th>Meaning</th><th>Example</th></tr>
<tr><td>-ide</td><td>2 elements in compound</td><td>copper sulphide = copper + sulphur</td></tr>
<tr><td>-ate</td><td>2 elements in compound + oxygen</td><td>copper sulphate = copper + sulphur + oxygen</td></tr>
<tr><td>-ite</td><td>2 elements in compound + oxygen</td><td>sodium sulphite = sodium + sulphur + oxygen</td></tr>
</table></td></tr>
<tr><td>2004G
14b</td><td>solvent</td><td>
<table>
<tr><td>solution</td><td>a mixture formed when a solute dissolves in a solvent</td></tr>
<tr><td>solute</td><td>the substance that is dissolved</td></tr>
<tr><td>solvent</td><td>the liquid that does the dissolving</td></tr>
</table></td></tr>
<tr><td>2005G
10c</td><td>calcium, iodine and oxygen</td><td>
<table>
<tr><td>-ide</td><td>Compound contains the two named elements</td></tr>
<tr><td>-ate</td><td>Compound contains 3 elements (two named elements + oxygen)</td></tr>
<tr><td>-ite</td><td>Compound contains 3 elements (two named elements + oxygen)</td></tr>
</table></td></tr>
<tr><td>2005G
16b</td><td>$BaCO_3$</td><td>
<table>
<tr><th>Write down Valency below each element's symbol</th><th>Put in Cross-over Arrows</th><th>Follow arrows and cancel down to get formula</th></tr>
<tr><td>Ba CO_3^{2-}
2 2</td><td>Ba CO_3^{2-}
2 2</td><td>$BaCO_3$</td></tr>
</table></td></tr>
<tr><td>2006G
13a</td><td>lead, nitrogen and oxygen</td><td>
<table>
<tr><th>Ending</th><th>Meaning</th><th>Example</th></tr>
<tr><td>-ide</td><td>2 elements in compound</td><td>Copper sulphide = copper + sulphur</td></tr>
<tr><td>-ate</td><td>2 elements in compound + oxygen</td><td>Copper sulphate = copper + sulphur + oxygen</td></tr>
<tr><td>-ite</td><td>2 elements in compound + oxygen</td><td>Sodium sulphite = sodium + sulphur + oxygen</td></tr>
</table></td></tr>
<tr><td>2006G
16b</td><td>NO_2</td><td>
<table>
<tr><td>Prefix</td><td>mono-</td><td>di-</td><td>tri-</td><td>tetra-</td></tr>
<tr><td>Meaning</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Example</td><td>carbon monoxide</td><td>carbon dioxide</td><td>sulphur trioxide</td><td>carbon tetrachloride</td></tr>
</table></td></tr>
<tr><td>2007G
14c(ii)</td><td>Al_2O_3</td><td>
<table>
<tr><th>Write down Valency below each element's symbol</th><th>Put in Cross-over Arrows</th><th>Follow arrows to get formula</th></tr>
<tr><td>Al O
3 2</td><td>Al O
3 2</td><td>Al_2O_3</td></tr>
</table></td></tr>
<tr><td>2008G
10c</td><td>alumiunium + silicon + oxygen</td><td>
<table>
<tr><td>-ide</td><td>Compound contains the two named elements</td></tr>
<tr><td>-ate</td><td>Compound contains 3 elements (two named elements + oxygen)</td></tr>
<tr><td>-ite</td><td>Compound contains 3 elements (two named elements + oxygen)</td></tr>
</table></td></tr>
<tr><td>2008G
15b(i)</td><td>CO_2</td><td>
<table>
<tr><td>Prefix</td><td>Mono-</td><td>Di-</td><td>Tri-</td><td>Tetra</td></tr>
<tr><td>Meaning</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
</table></td></tr>
</table>

<table>
<tr>
<td>2009G
10b(i)</td>
<td>$MgCl_2$</td>
<td>
<table>
<tr>
<td>Write down Valency below each element's symbol
Mg Cl
2 1</td>
<td>Put in Cross-over Arrows
 
</td>
<td>Follow arrows to get formula
$MgCl_2$</td>
</tr>
</table>
</td>
</tr>
<tr>
<td>2010G
13a</td>
<td>Potassium, carbon and oxygen</td>
<td>
<table>
<tr><th>Ending</th><th>Meaning</th><th>Example</th></tr>
<tr><td>-ide</td><td>2 elements in compound</td><td>Copper sulphide = copper + sulphur</td></tr>
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<tr><td>-ite</td><td>2 elements in compound + oxygen</td><td>Sodium sulphite = sodium + sulphur + oxygen</td></tr>
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</td>
</tr>
<tr>
<td>2010G
18a</td>
<td>Solvent</td>
<td>
<table>
<tr><td>solution</td><td>a mixture formed when a solute dissolves in a solvent</td></tr>
<tr><td>solute</td><td>The substance that is dissolved</td></tr>
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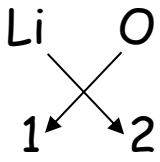
</table>
</td>
</tr>
<tr>
<td>2012G
16c(ii)</td>
<td>Li_2O</td>
<td>
<table>
<tr>
<td>Write down Valency below each element's symbol
Li O
1 2</td>
<td>Put in Cross-over Arrows
 
</td>
<td>Follow arrows to get formula
Li_2O</td>
</tr>
</table>
</td>
</tr>
<tr>
<td>2013G
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<td>solute</td>
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<table>
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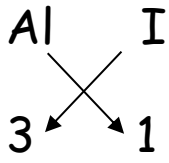
</table>
</td>
</tr>
<tr>
<td>2013G
19a</td>
<td>AlI_3</td>
<td>
<table>
<tr>
<td>Write down Valency below each element's symbol
Al I
3 1</td>
<td>Put in Cross-over Arrows
 
</td>
<td>Follow arrows to get formula
AlI_3</td>
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