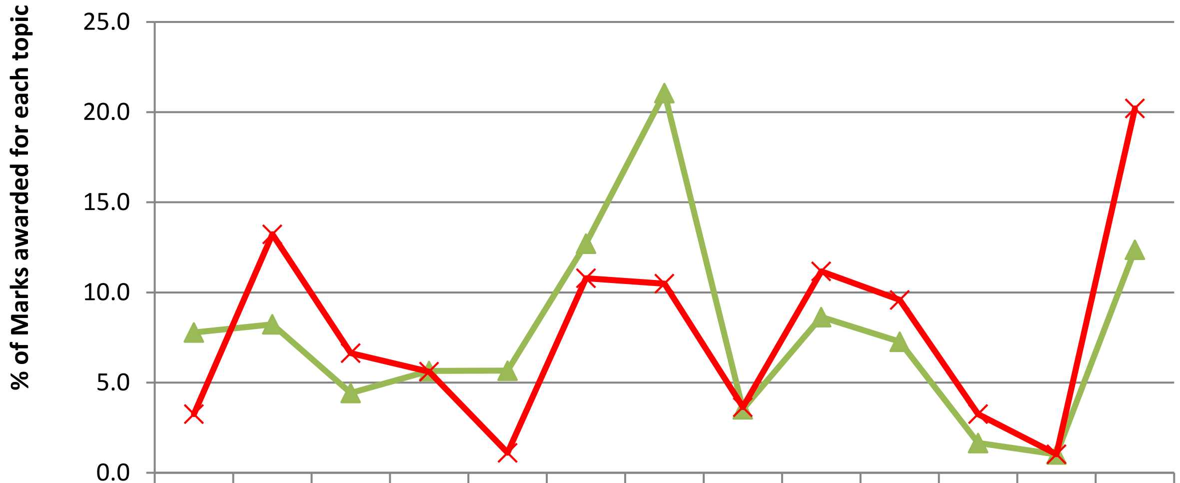
Name

iG Chem 4 EQ P3 15w to 10s 4Teachers NEW 39marks

PAPERS 1, 3 and 6

Percentage of all WEIGHTED marks awarded for each topic from w2001 to w2015 (green) and % of Paper 3 marks (red)

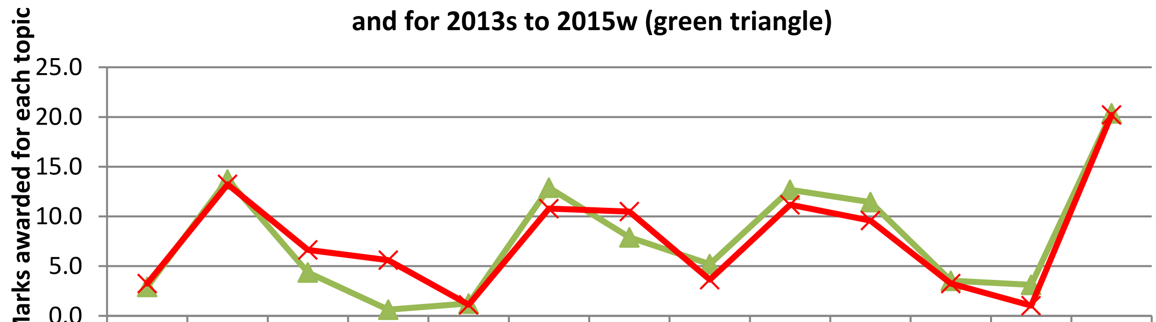


	1	3	4	5	6	7	8	9	10	11	12	13	14
% Marks	7.8	8.2	4.4	5.6	5.7	12.7	21.1	3.5	8.6	7.3	1.7	1.0	12.4
Paper 3 %	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2

ALL PAPERS Topic Number

PAPER 3

Percentage of all marks awarded for each topic from w2001 to w2015 (red cross) and for 2013s to 2015w (green triangle)



	1	3	4	5	6	7	8	9	10	11	12	13	14
P3 2Yrs	2.9	13.7	4.4	0.6	1.2	12.9	7.9	5.2	12.7	11.4	3.5	3.1	20.4
P3 ALL	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2

Paper 3 Topic Number

	Total	Chem 1	Chem 3	Chem 4	Chem 5	Chem 6	Chem 7	Chem 8	Chem 9	Chem 10	Chem 11	Chem 12	Chem 13	Chem 14
Total Marks	2320	74	312	155	81	26	256	246	85	296	231	76	24	474
% of Marks	2336	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3
# of Questions		19	59	39	18	6	47	54	19	58	48	14	5	80
Average marks per Q		**3.9**	**5.3**	**4.0**	**4.5**	**4.3**	**5.4**	**4.6**	**4.5**	**5.1**	**4.8**	**5.4**	**4.8**	**5.9**

	1st Paper	1st P rank	Last Paper	Last P rank	Total # Papers	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Weight per paper	Weight per mark
Paper 1	2002s	5	2012w	26	22	40	880	869	-11	30	0.75
Paper 3	2001w	4	2015w	32	29	80	2320	2336	16	50	0.625
Paper 6	2001w	4	2015w	32	29	60	1740	1890	150	20	0.625

Topic	14	3	10	7	8	11	4	5	9	1	12	6	13
Rank ALL Papers	2	4	5	3	1	6	9	8	11	7	12	10	13
Rank P3: A* Focus	1	2	3	4	5	6	7	8	9	10	10	12	13
All Syllabus Word Count RANK	1	2	5	3	6	4	9	7	10	8	12	11	13

CIE iGCSE Chemistry Syllabus Details – Changes from 2016 onwards

(syllabus code 0620)
Before 2016:
For the highest grades students had to sit three different papers (P1, P3 & P6):
Paper 1 (multiple choice) was easier (didn't contain supplement material)
Paper 3 was the extension paper, needed to get grades higher than a C

2016 and later:
Still need to sit three papers (**P2, P4 & P6**), but:
Paper 2 is a new multiple choice paper which also contains supplement material (is harder)
Paper 4 is the new name for the extension paper. So **if you are looking for the types of questions that you will be asked on Paper 4 from 2015 and earlier they will be found in paper 3 revision packs.**

Material that is new or changed in 2016 is highlighted with BLACK LINES next to it.

4. Stoichiometry

4.1 Stoichiometry

Core
- Use the symbols of the elements and write the formulae of simple compounds
- Deduce the formula of a simple compound from the relative numbers of atoms present
- Deduce the formula of a simple compound from a model or a diagrammatic representation
- Construct word equations and simple balanced chemical equations
- Define *relative atomic mass*, A_r, as the average mass of naturally occurring atoms of an element on a scale where the ^{12}C atom has a mass of exactly 12 units
- Define *relative molecular mass*, M_r, as the sum of the relative atomic masses (*Relative formula mass* or M_r will be used for ionic compounds.)

  (Calculations involving reacting masses in simple proportions may be set. Calculations will **not** involve the mole concept.)

Supplement
- Determine the formula of an ionic compound from the charges on the ions present
- Construct equations with state symbols, including ionic equations
- Deduce the balanced equation for a chemical reaction, given relevant information

4.2 The mole concept	**Supplement** • Define the *mole* and the *Avogadro constant* • Use the molar gas volume, taken as 24 dm^3 at room temperature and pressure • Calculate stoichiometric reacting masses, volumes of gases and solutions, and concentrations of solutions expressed in g/dm^3 and mol/dm^3 (Calculations involving the idea of limiting reactants may be set. Questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will **not** be set.) • Calculate empirical formulae and molecular formulae • Calculate percentage yield and percentage purity

Q# 1/ iGCSE Chemistry/2013/w/Paper 31/ Q4

(d) Calculate the maximum mass of carbon dioxide given off when 20.0 g of small lumps of calcium carbonate react with 40 cm^3 of hydrochloric acid, concentration 2.0 mol/dm^3.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

number of moles of HCl used =

mass of carbon dioxide = ... g [4]

Q# 2/ iGCSE Chemistry/2013/w/Paper 31/

(c) Basic lead(II) carbonate has a formula of the type $xPbCO_3.yPb(OH)_2$ where x and y are whole numbers.
Determine x and y from the following information.

$$PbCO_3 \rightarrow PbO + CO_2$$

$$Pb(OH)_2 \rightarrow PbO + H_2O$$

When heated, the basic lead(II) carbonate gave 2.112 g of carbon dioxide and 0.432 g of water.

Mass of one mole of CO_2 = 44 g
Mass of one mole of H_2O = 18 g

Number of moles of CO_2 formed = ... [1]

Number of moles of H_2O formed = ... [1]

x = ... and y = ...

Formula of basic lead(II) carbonate is .... [1]

Q# 3/ iGCSE Chemistry/2013/s/Paper 31/ Q6

Ammonia is a compound with the molecular formula NH_3

(c) Another compound which contains only nitrogen and hydrogen is hydrazine, N_2H_4.

Complete the equation for the preparation of hydrazine from ammonia.

$$.....NH_3 + NaClO \rightarrow N_2H_4 + ... + H_2O$$ [2]

Q# 4/ iGCSE Chemistry/2013/s/Paper 31/

3 A small piece of marble, $CaCO_3$, was added to 5.0 cm^3 of hydrochloric acid, concentration 1.0 mol/dm^3, at 25 °C. The time taken for the reaction to stop was measured. The experiment was repeated using 5.0 cm^3 of different solutions of acids. The acid was in excess in all of the experiments.

Typical results are given in the table.

experiment	temperature/°C	acid solution	time/min
1	25	hydrochloric acid 1.0 mol/dm^3	3

(b) The equation for the reaction in experiment 1 is:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Complete the following ionic equation.

$$CaCO_3(s) + 2H^+(aq) \rightarrow .... + ... + ...$$

[1]

Q# 5/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(c) In the above experiment, 50.0 cm^3 of hydrochloric acid of concentration 2.0 mol/dm^3 was used. 6.4 g of $SrCl_2.6H_2O$ was made.
Calculate the percentage yield.

number of moles of HCl used = ...

number of moles of $SrCl_2.6H_2O$ which could be formed = ...

mass of one mole of $SrCl_2.6H_2O$ is 267 g

theoretical yield of $SrCl_2.6H_2O$ = ...g

percentage yield = ...% [4]

Q# 6/ iGCSE Chemistry/2012/w/Paper 31/ Q2

(c) Fluorine, the most reactive halogen, forms compounds with the other halogens. It forms two compounds with bromine.
Deduce their formulae from the following information.

compound 1
The mass of one mole of this compound is 137 g.

Its formula is .... [1]

compound 2
0.02 moles of this compound contain 0.02 moles of bromine atoms and 0.1 moles of fluorine atoms.

Its formula is .... [1]

Q# 7/ iGCSE Chemistry/2012/s/Paper 31/

8 Iron and steel rust when exposed to water and oxygen. Rust is hydrated iron(III) oxide.

(b) A sample of rust had the following composition:

51.85 g of iron   22.22 g of oxygen   16.67 g of water.

Calculate the following and then write the formula for this sample of rust.

number of moles of iron atoms, Fe = ... [1]

number of moles of oxygen atoms, O = ... [1]

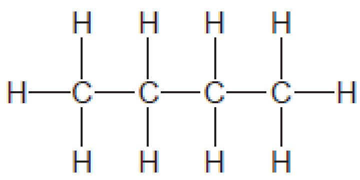
number of moles of water molecules, H_2O = ... [1]

simplest mole ratio Fe : O : H_2O is .... : .... : ....

formula for this sample of rust is .... [1]

Q# 8/ iGCSE Chemistry/2012/s/Paper 31/

6 Butane is an alkane. It has the following structural formula.



(a) The equation for the complete combustion of butane is given below. Insert the two missing volumes.

$$2C_4H_{10}(g) \ + \ 13O_2(g) \ \rightarrow \ 8CO_2(g) \ + \ 10H_2O(g)$$

....   40   volume of gas / cm^3

[2]

Q# 9/ iGCSE Chemistry/2011/w/Paper 31/ Q7

(c) There are three possible equations for the thermal decomposition of sodium hydrogencarbonate.

$2NaHCO_3(s) \rightarrow Na_2O(s) + 2CO_2(g) + H_2O(g)$ **equation 1**

$NaHCO_3(s) \rightarrow NaOH(s) + CO_2(g)$ **equation 2**

$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$ **equation 3**

The following experiment was carried out to determine which one of the above is the correct equation.

A known mass of sodium hydrogencarbonate was heated for ten minutes. It was then allowed to cool and weighed.

Results
Mass of sodium hydrogencarbonate = 3.36 g
Mass of the residue = 2.12 g

Calculation
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) Number of moles of $NaHCO_3$ used = ... [1]

(ii) If residue is Na_2O, number of moles of Na_2O = ...

If residue is NaOH, number of moles of NaOH = ...

If residue is Na_2CO_3, number of moles of Na_2CO_3 = ... [2]

(iii) Use the number of moles calculated in **(i)** and **(ii)** to decide which one of the three equations is correct. Explain your choice.

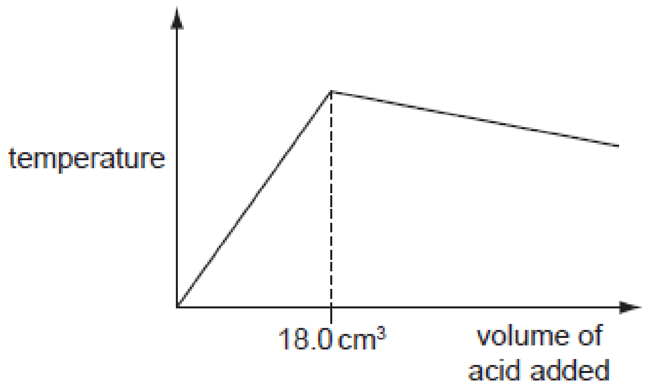
....

....

.... [2]

Q# 10/ iGCSE Chemistry/2011/s/Paper 31/ Q5

(d) 20.0 cm^3 of aqueous sodium hydroxide, 2.00 mol / dm^3, was placed in a beaker. The temperature of the alkali was measured and 1.0 cm^3 portions of hydriodic acid were added. After each addition, the temperature of the mixture was measured. Typical results are shown on the graph.



$$NaOH(aq) + HI(aq) \rightarrow NaI(aq) + H_2O(l)$$

(iii) In another experiment, it was shown that 15.0 cm^3 of the acid neutralised 20.0 cm^3 of aqueous sodium hydroxide, 1.00 mol / dm^3. Calculate the concentration of the acid.

....

.... [2]

Q# 11/ iGCSE Chemistry/2010/w/Paper 31/ Q5

(b) 6.0 g of cobalt(II) carbonate was added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3. Calculate the maximum yield of cobalt(II) chloride-6-water and show that the cobalt(II) carbonate was in excess.

$$CoCO_3 + 2HCl \rightarrow CoCl_2 + CO_2 + H_2O$$

$$CoCl_2 + 6H_2O \rightarrow CoCl_2.6H_2O$$

Maximum yield

Number of moles of HCl used = ...

Number of moles of $CoCl_2$ formed = ...

Number of moles of $CoCl_2.6H_2O$ formed = ...

Mass of one mole of $CoCl_2.6H_2O$ = 238 g

Maximum yield of $CoCl_2.6H_2O$ = ... g [4]

To show that cobalt(II) carbonate is in excess

Number of moles of HCl used = ... (use value from above)

Mass of one mole of $CoCO_3$ = 119 g

Number of moles of $CoCO_3$ in 6.0 g of cobalt(II) carbonate = ... [1]

Number of moles of HCl used = ... (use value from above)

Mass of one mole of $CoCO_3$ = 119 g

Number of moles of $CoCO_3$ in 6.0 g of cobalt(II) carbonate = ... [1]

Explain why cobalt(II) carbonate is in excess ....

.... [1]

Q# 12/ iGCSE Chemistry/2010/s/Paper 31/ Q7

(e) The titanium ore contains 36.8% iron, 31.6% titanium and the remainder is oxygen.

(i) Determine the percentage of oxygen in this titanium compound.

percentage of oxygen = ... % [1]

(ii) Calculate the number of moles of atoms for each element.
The number of moles of Fe is shown as an example.
number of moles of Fe = 36.8 / 56 = 0.66

number of moles of Ti = ...

number of moles of O = ... [1]

(iii) What is the simplest ratio for the moles of atoms?

Fe	:	Ti	:	O
....		....		....

[1]

(iv) What is the formula of this titanium compound?

.... [1]

Mark Scheme

Q# 1/ iGCSE Chemistry/2013/w/Paper 31/ Q4

(d) number of moles of HCl in 40 cm^3 of hydrochloric acid,
concentration 2.0 mol / dm^3 = 0.04 × 2.0 = 0.08 [1]
maximum number of moles of CO_2 formed = 0.04 [1]
mass of one mole of CO_2 = 44 g [1]
maximum mass of CO_2 lost = 0.04 × 44 = 1.76 g [1]

Q# 2/ iGCSE Chemistry/2013/w/Paper 31/ Q6

(c) number of moles of CO_2 formed = 2.112 / 44 = 0.048 [1]
number of moles of H_2O formed = 0.432 / 18 = 0.024 [1]

x = 2 and y = 1 **NOT:** ecf from this line

formula is $2PbCO_3.Pb(OH)_2$ / $Pb(OH)_2.\ 2PbCO_3$ [1]

Q# 3/ iGCSE Chemistry/2013/s/Paper 31/ Q6

(c) $2NH_3 + NaClO \rightarrow N_2H_4 + NaCl + H_2O$ [2]
not balanced only 1

Q# 4/ iGCSE Chemistry/2013/s/Paper 31/ Q3

(b) experiment 1 Ca^{2+} + CO_2 + H_2O [1]

Q# 5/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(c) number of moles of HCl used = 0.05 × 2 = 0.1 [1]
number of moles of $SrCl_2.6\ H_2O$ which could be formed. = 0.05 [1]
mass of one mole of $SrCl_2.6H_2O$ is 267 g
theoretical yield of $SrCl_2.6H_2O$ = 0.05 × 267 = 13.35 g [1]
percentage yield = 6.4 / 13.35 × 100 = 47.9% [1]
accept: 48%
allow: ecf

Q# 6/ iGCSE Chemistry/2012/w/Paper 31/ Q2

(c) BrF_3 / F_3Br; [1]
BrF_5 / F_5Br; [1]

Q# 7/ iGCSE Chemistry/2012/s/Paper 31/

(b) moles of Fe = 51.85/56 = 0.926 (0.93); [1]
moles of O = 22.22/16 = 1.389 (1.39); [1]
moles of H_2O = 16.67/18 = 0.926 (0.93); [1]

if given as 0.9 1.4 0.9
three of the above correct = [2]
two of the above correct = [1]

simplest whole number mole ratio Fe : O : H_2O is 2: 3: 2 / $Fe_2O_3.2H_2O$; [1]
allow: ecf for a formula based on an incorrect whole number ratio

Q# 8/ iGCSE Chemistry/2012/s/Paper 31/

6 **(a)** 10 cm^3; [1]
65 cm^3; [1]

Q# 9/ iGCSE Chemistry/2011/w/Paper 31/ Q7

(c) calculation:
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) number of moles of $NaHCO_3$ used = 3.36/84 = 0.04 [1]

(ii) if residue is Na_2O, number of moles of Na_2O = 2.12/62
=0.034 / 0.03

if residue is NaOH, number of moles of NaOH = 2.12/40
= 0.053 / 0.05

if reside is Na_2CO_3, number of moles of Na_2CO_3 = 2.12/106 =0.02 all three correct [2]
note: two correct = 1

(iii) equation 3 [1]
mole ratio 2:1 agrees with equation [1]

Q# 10/ iGCSE Chemistry/2011/s/Paper 31/ Q5 (d)

(iii) 1.33 / 1.3 / 1.3333 (mol/dm^3) scores both marks [2]
not 1.34
for a correct method – $M_1 V_1$ / moles of NaOH = 0.02
with an incorrect answer **only** [1]

Q# 11/ iGCSE Chemistry/2010/w/Paper 31/ Q5

(b) number of moles of HCl used = 0.04 × 2 = 0.08
number of moles $CoCl_2$ formed = 0.04
number of moles $CoCl_2.6H_2O$ formed = 0.04
mass of one mole of $CoCl_2.6H_2O$ = 238 g
maximum yield of $CoCl_2.6H_2O$ = 9.52g [4]
accept 9.5 g
mark ecf to moles of HCl
do **not** mark ecf to integers

to show that cobalt(II) carbonate is in excess

number of moles of HCl used = 0.08 must use value above **ecf**
mass of one mole of $CoCO_3$ = 119g
number of moles of $CoCO_3$ in 6.0g of cobalt(II) carbonate = 6.0/119 = 0.050 [1]
reason why cobalt(II) carbonate is in excess 0.05 > 0.08/2 [1]

Q# 12/ iGCSE Chemistry/2010/s/Paper 31/ Q7

(e) **(i)** percentage of oxygen = 31.6 % [1]

(ii) calculate the number of moles of atoms for each element

number of moles of Ti = 31.6/48 = 0.66

number of moles of O = 31.6/16 = 1.98 **accept** 2 [1]
both correct for one mark

(iii) the simplest <u>whole number ratio</u> for moles of atoms:

Fe	:	Ti	:	O
1		1		3

[1]

(iv) formula is $FeTiO_3$ **accept** $TiFeO_3$ [1]
must be whole numbers from **(iii)** or cancelled numbers from **(iii)**
mark **ecf** throughout