



Rewarding Learning

General Certificate of Secondary Education

2016

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 2
Foundation Tier

[GCH21]

WEDNESDAY 22 JUNE, MORNING

MV18

Time

1 hour 30 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Complete in blue or black ink only.

Answer **all six** questions.

Information for Candidates

The total mark for this paper is 90.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **4(b)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

- 1 (a) The first national report examining the impact of water fluoridation on children was published in 2014. The dental health of five year olds and twelve year olds living in fluoridated water and non-fluoridated water areas was measured.

Data from this report is shown in the table below.

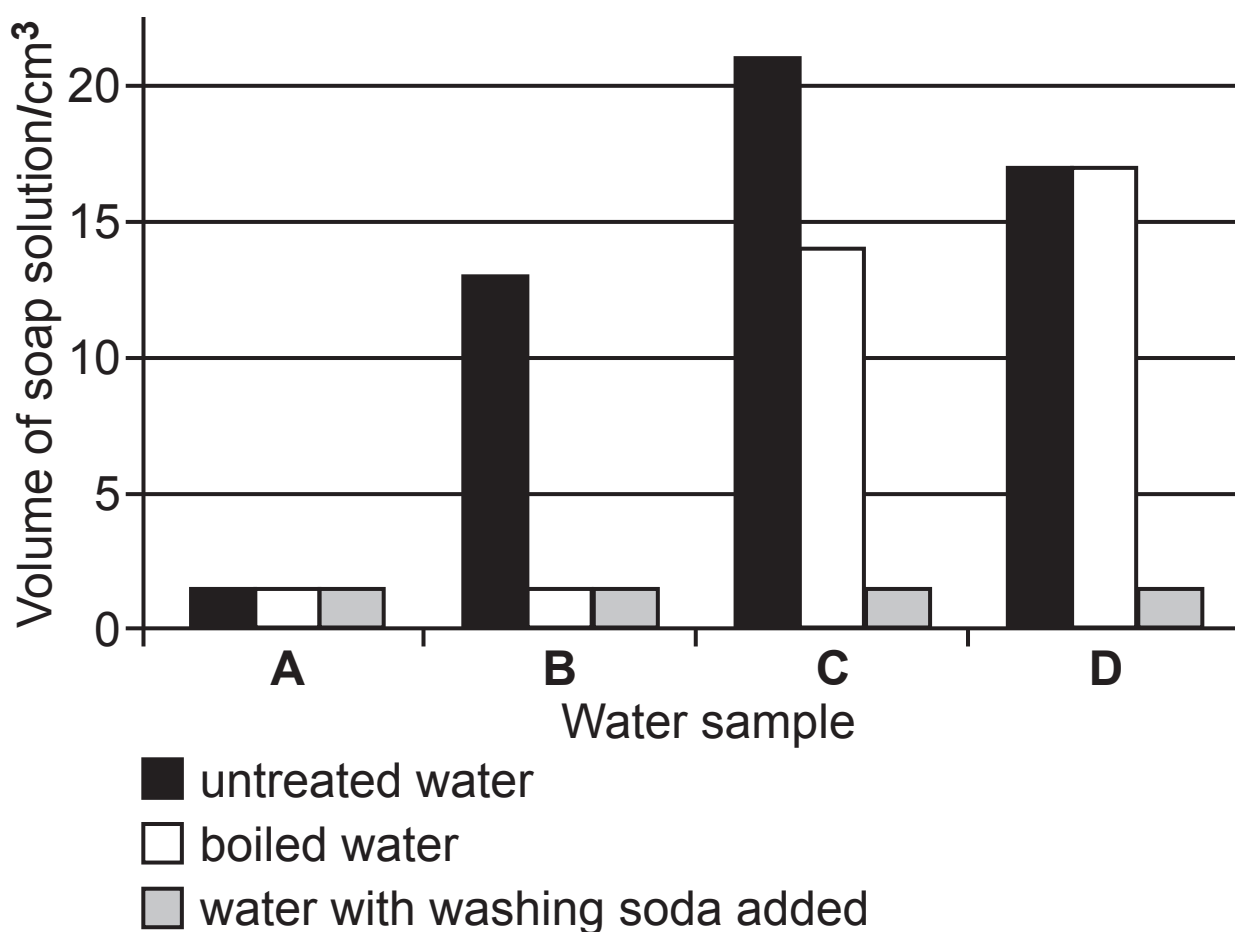
	In fluoridated water areas	In non-fluoridated water areas
% of twelve year olds with tooth decay	22	37
% of five year olds with tooth decay	13	42
% of hospital admissions for children aged 1–4 for tooth decay	2	20

(i) Use the data in the table to deduce the effect, if any, of the presence of fluoride in water on the dental health of children. [2 marks]

(ii) State one reason why some people are against the fluoridation of drinking water. [1 mark]

(b) Four samples of water, A, B, C and D, were tested for hardness. Soap solution was added, with shaking, to each of the four 20.0 cm³ samples of water. The volume of soap solution required to produce 1 cm height of lather was recorded.

The experiment was repeated, with fresh boiled samples of water and then again with fresh samples of water which had been treated with washing soda. The results of the experiment are shown below.



(i) What is meant by the term hard water? [1 mark]

(ii) Which one of the samples, A, B, C or D is the hardest water? Explain your answer. [2 marks]

Sample: _____

(iii) What type of hardness is present in the following samples? [2 marks]

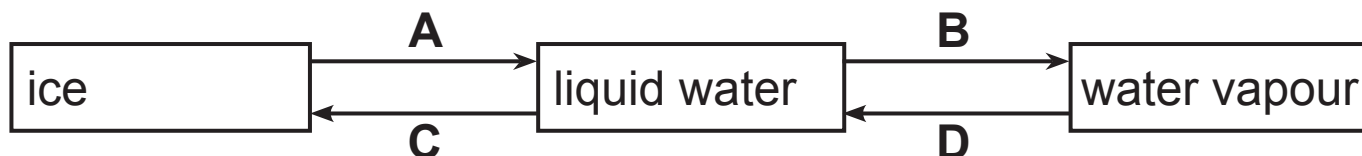
Sample B _____

Sample D _____

(iv) Explain why hard water is considered to be good for your health. [1 mark]

(c) Water can exist in three different states of matter.

(i) The changes of state are represented by the letters A, B, C and D, in the diagram below.



Complete the table below giving the name of the change of state represented by each letter.

[4 marks]

Change of state	Name of the change of state
A	
B	
C	
D	

(ii) Name a chemical which could be used to test for the presence of water. [1 mark]

2 Cyclohexane, cyclohexene, ethanol and ethanoic acid are colourless liquids at room temperature. Each one belongs to a different homologous series.

(a) What is meant by the term homologous series?

[3 marks]

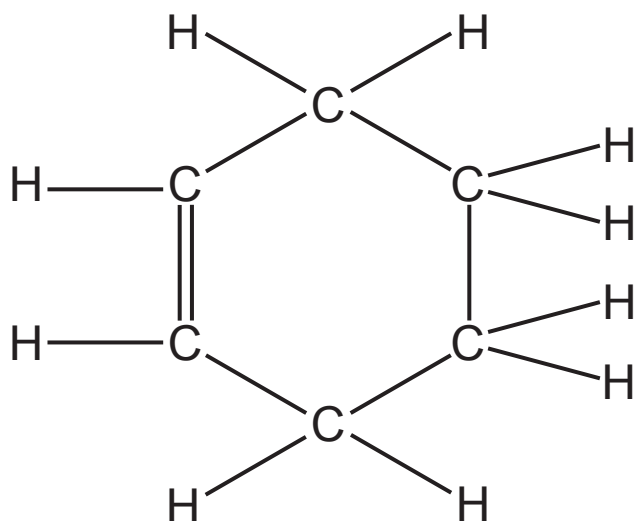
(b) Cyclohexane is a colourless liquid alkane.

(i) What is the general formula for the alkanes?

[1 mark]

(ii) Draw the structural formula of ethane. [1 mark]

(c) The colourless liquid cyclohexene is a hydrocarbon with the molecular formula C_6H_{10} . The structural formula of cyclohexene is shown below.



(i) What is the functional group in cyclohexene?
[1 mark]

(ii) Why is cyclohexene described as a hydrocarbon?
[1 mark]

(iii) Name the two products formed when cyclohexene is burned in excess oxygen. [2 marks]

1. _____

2. _____

(iv) Name the two **compounds** formed when cyclohexene is burned in a limited supply of oxygen.
[2 marks]

1. _____

2. _____

(d) Ethanol is a colourless liquid which can be made by fermentation.

(i) Describe the process of fermentation. [4 marks]

(ii) State one use of ethanol. [1 mark]

(e) Ethanoic acid is a colourless liquid with a sharp smell.

(i) State one use of ethanoic acid. [1 mark]

(ii) Complete the word equation below. [1 mark]

ethanoic acid + sodium carbonate →

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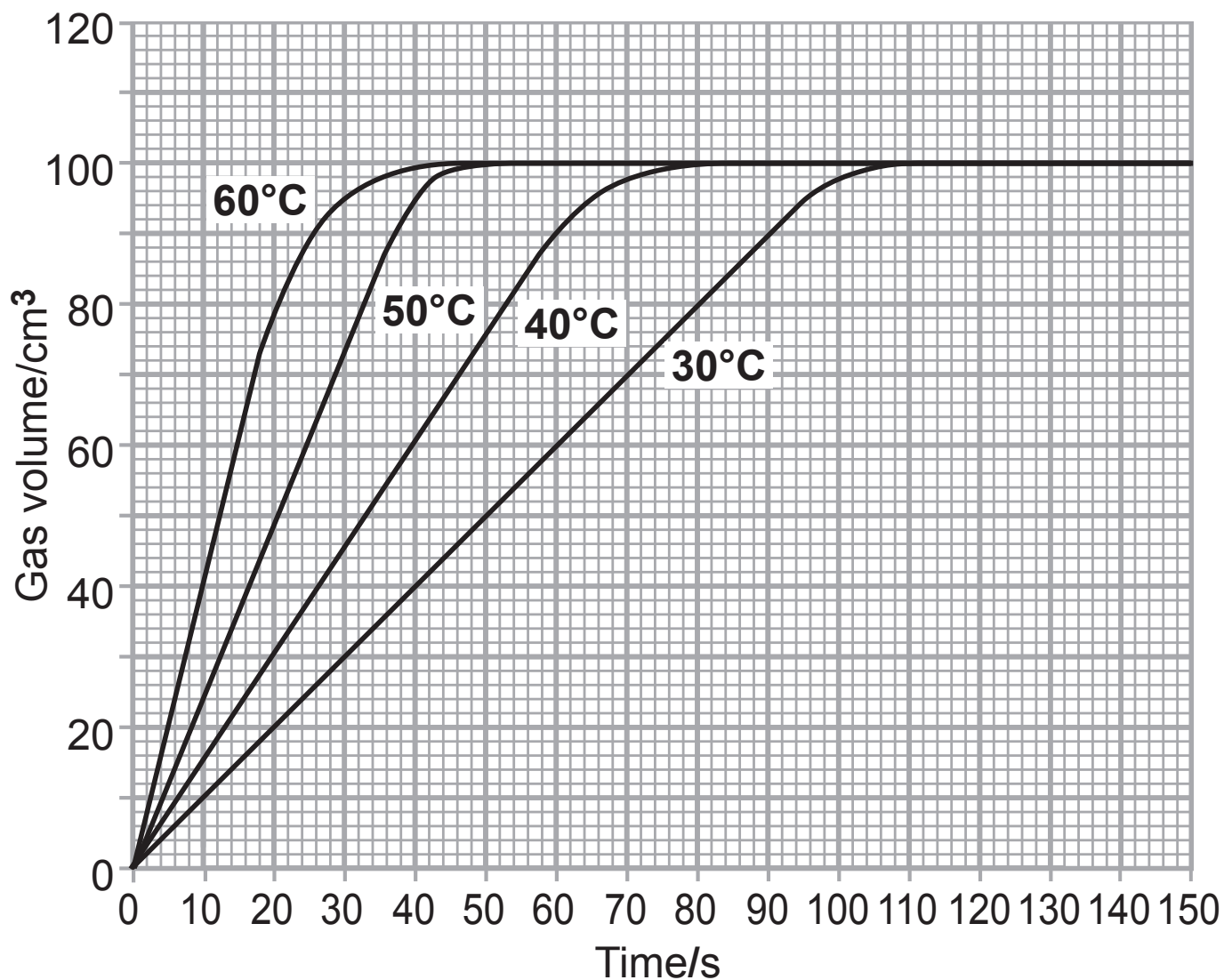
3 Hydrogen peroxide decomposes rapidly into water and oxygen in the presence of a catalyst.

(a) (i) Write a balanced symbol equation for the decomposition of hydrogen peroxide. [3 marks]

(ii) Name the catalyst used for this reaction in the laboratory. [1 mark]

(iii) What is meant by the term catalyst? [3 marks]

(b) The volume of gas produced by the catalytic decomposition of hydrogen peroxide was measured at four different temperatures. The results were plotted on the graph below.



(i) What was the gas volume at 40 seconds when the temperature was 30 °C? State the units. [2 marks]

(ii) Complete the table below giving the time taken for the reaction to finish at 60°C. Calculate the rate based on this time. [2 marks]

Temperature (°C)	Time taken for reaction to finish (s)	Rate = $\frac{1}{\text{time}}$ (s ⁻¹)
30	108	0.00926
40	79	0.01266
50	48	0.02083
60		

(iii) Using the data from the table above, state how rate changes as temperature increases. [1 mark]

4 (a) The element carbon is found in all living things.

(i) Write a balanced symbol equation for carbon burning in air to form carbon dioxide gas. [2 marks]

(ii) Describe a chemical test for carbon dioxide gas and state the result for a positive test. [3 marks]

(b) Acid rain has been a major environmental problem for decades. Sulfur impurities in fossil fuels contribute to acid rain.

Describe in detail how these sulfur impurities lead to the formation of acid rain. Describe the effects of acid rain and methods used to prevent it.

Your answer should include:

- A description of how sulfur impurities lead to acid rain. (Include balanced symbol equations)
- At least two detrimental effects of acid rain on the environment
- At least two methods used to prevent acid rain.

5 Chemical reactions involve reactants being converted into products.

(a) Some signs of a chemical reaction occurring are given in the box below.

colour change	gas produced
formation of a precipitate	

For each of the chemical reactions in the table below, choose a sign from the box above which would indicate that a chemical reaction is occurring. [2 marks]

Chemical reaction	Sign
magnesium + hydrochloric acid	
copper(II) oxide + hydrochloric acid	

(b) Chemical reactions may be classified as exothermic or endothermic reactions.

(i) Explain the meaning of the term endothermic.
[1 mark]

(ii) Complete the following table by placing a tick (✓) in the appropriate column. [2 marks]

Chemical Reaction	Exothermic	Endothermic
Neutralisation		
Thermal decomposition		

(iii) Fill in the missing words to complete the passage below. [2 marks]

During a chemical reaction, bonds in the reactants are broken and this process _____ energy. New bonds are formed in the products and this process _____ energy.

(c) Rusting of iron is a major problem costing millions of pounds every year.

(i) Name the two substances that react with iron to form rust. [2 marks]

1. _____

2. _____

(ii) Describe the appearance of rust. [2 marks]

(iii) State a method used to prevent iron from rusting and explain how it works. [2 marks]

Method _____

Explanation _____

(d) Iron is extracted from its ore, haematite, in a Blast Furnace. Haematite is mainly iron(III) oxide which is reduced by carbon monoxide to produce iron and carbon dioxide.

(i) Write a balanced symbol equation for the reaction between iron(III) oxide and carbon monoxide. [3 marks]

(ii) Explain why iron(III) oxide is said to be reduced in this reaction. [2 marks]

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(Questions continue overleaf)

- 6 (a) The reactivity of metals can be studied using displacement reactions. If a displacement reaction occurs there is a temperature rise.

In an experiment the following method was used:

- Pour some copper(II) sulfate solution into a polystyrene cup and record the temperature of the solution.
- Add a known mass of metal and stir.
- Record the maximum temperature of the mixture.
- Repeat the experiment.

The results of this experiment are shown in the table below.

Metal	Temperature increase (°C)		Average temperature rise (°C)
	Experiment 1	Experiment 2	
magnesium	11.5	16.5	14.0
silver	0.0	0.0	0.0
iron	3.0	4.0	3.5
gold	0.0	0.0	0.0
zinc	7.0	8.0	7.5

(i) State two factors which should be kept the same in this experiment to make it a fair test. [2 marks]

1. _____

2. _____

(ii) State and explain which of the metals gave the least reliable temperature rise. [1 mark]

(iii) State and explain which of the metals used in the experiment is the most reactive. [2 marks]

(iv) Explain why there is no temperature rise when silver is added to copper(II) sulfate solution. [1 mark]

(v) Why do the results make it impossible to decide which of the metals is the least reactive? [1 mark]

(vi) Write a balanced symbol equation for the displacement reaction between zinc and copper(II) sulfate solution. [2 marks]

(b) Aluminium is extracted from its ore by electrolysis.

(i) Explain what is meant by the term electrolysis.
[2 marks]

(ii) Name the ore from which aluminium is extracted.
[1 mark]

(iii) The ore of aluminium contains aluminium ions and oxide ions. State the formulae of these ions.
[2 marks]

aluminium ion _____

oxide ion _____

THIS IS THE END OF THE QUESTION PAPER

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Question Number	Marks
1	
2	
3	
4	
5	
6	

Total Marks	
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Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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Symbols of Selected Ions	4
Solubility of Common Salts	4

gcse . Science

chemistry
double award
single award



THE PERIODIC TABLE OF ELEMENTS

Group

																	0		
1	2											3	4	5	6	7	4		
																			He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10		
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18		
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36		
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54		
133 Cs Caesium 55	137 Ba Barium 56	139 La * Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86		
223 Fr Francium 87	226 Ra Radium 88	227 Ac † Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112								

* 58 – 71 Lanthanum series
 † 90 – 103 Actinium series

a	x
b	

 a = relative atomic mass (approx)
 x = atomic symbol
 b = atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103