Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016–2017

Science: Single Award

Unit 2 (Chemistry)
Higher Tier

GSS22

[GSS22]

THURSDAY 23 FEBRUARY 2017, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all eleven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **3(b)** and **8(b)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
Total Marks	

1 **(a)** Carbon dioxide is produced when sodium hydrogencarbonate is heated.

(i) Complete the word equation for this reaction.

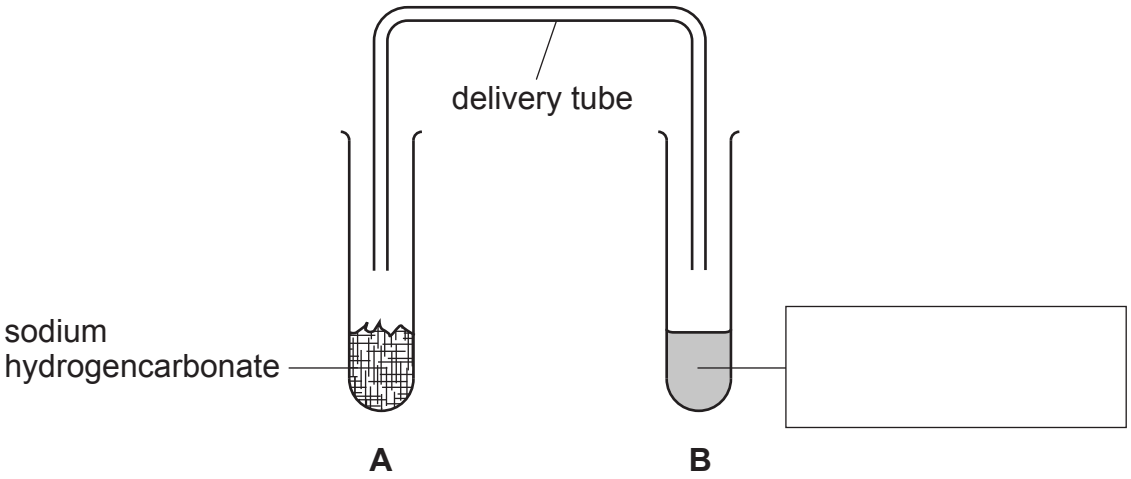
sodium hydrogencarbonate $\xrightarrow{\text{heat}}$ carbon dioxide + ☐ + ☐

[2]

(ii) What name is given to this **type** of reaction?

_____ [1]

(b) A student wanted to use the apparatus shown below to make and test for carbon dioxide. However, it did not work as it was not correctly set up.



Source: Principal Examiner

(i) On the diagram above, name the chemical in test tube **B**, that is used to test for carbon dioxide. [1]

(ii) Describe one mistake in the set-up of test tube **A** and one mistake in the set-up of test tube **B**.

Test tube **A** _____

_____ [1]

Test tube **B** _____

_____ [1]

Examiner Only	
Marks	Remark

(c) Baking powder contains sodium hydrogencarbonate and is used in making cakes.

(i) Name the chemical added to sodium hydrogencarbonate to make baking powder.

_____ [1]

(ii) State **one** reason why baking powder is used in making cakes.

_____

_____ [1]

Examiner Only	
Marks	Remark

2 The table below gives some properties of five materials.

material	relative heaviness	relative strength	relative stiffness	relative cost
steel	7800	10	105	low
Kevlar	1400	30	70	high
graphene	1000	2000	5	very high
glass reinforced plastic	1900	15	10	medium
wood	5000	5	40	low

Using **only** the information in the table, answer the questions below.

(a) Traditionally, canoe bodies were made from wood. However, modern canoes can be made from Kevlar.

© Jim West / Science Photo Library

State the main advantage and the main disadvantage of using Kevlar.

Advantage _____

Disadvantage _____ [2]

(b) The first tennis rackets were made from wood. However, scientists are now investigating the use of graphene instead of wood.
Describe fully how graphene tennis rackets will be different from wooden rackets when used.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** **(i)** What is meant by the term **hard water**?

_____

_____ [2]

(ii) Name **one** ion that can cause water to be hard.

_____ [1]

(b) Describe an experiment to distinguish between the two types of hard water.

Your answer should include:

- the names of the two types of hard water
- a method for the experiment including how to make it a fair test
- the expected results for each type of hard water

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

_____

_____

_____

_____

_____

_____

_____

_____

_____

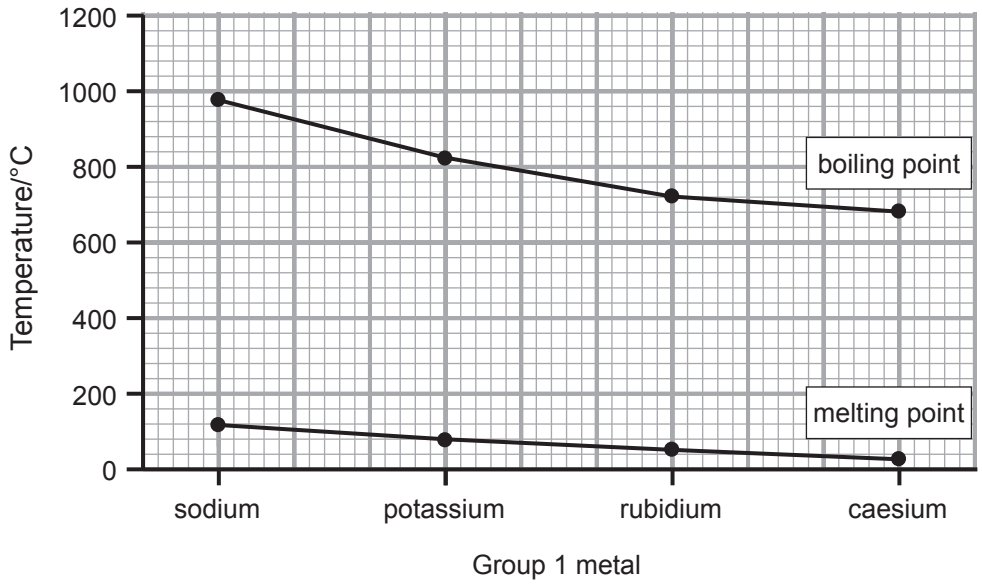
_____

_____

_____ [6]

Examiner Only	
Marks	Remark

4 The graph below shows the melting and boiling points of some Group 1 metals.



You may find your Data Leaflet helpful.

(a) Give **one** similarity and **one** difference between the trends in melting points and boiling points of the metals in Group 1.

Similarity _____

_____ [1]

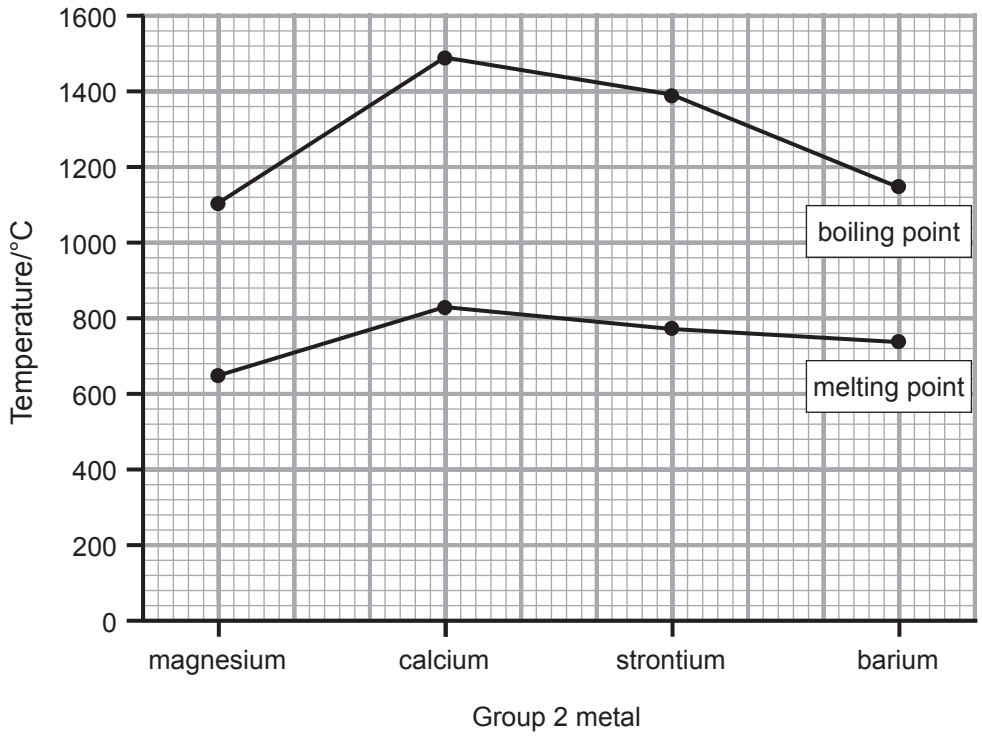
Difference _____

_____ [1]

(b) What name is given to the metals in Group 1 of the Periodic Table?

_____ [1]

The graph below shows the melting and boiling points of some Group 2 metals.



You may find your Data Leaflet helpful.

(c) Describe fully the trend in **boiling** points of the metals in Group 2.

_____

_____

_____ [2]

(d) Predict the melting point of radium, which is another Group 2 metal.

_____ °C [1]

Examiner Only

Marks	Remark

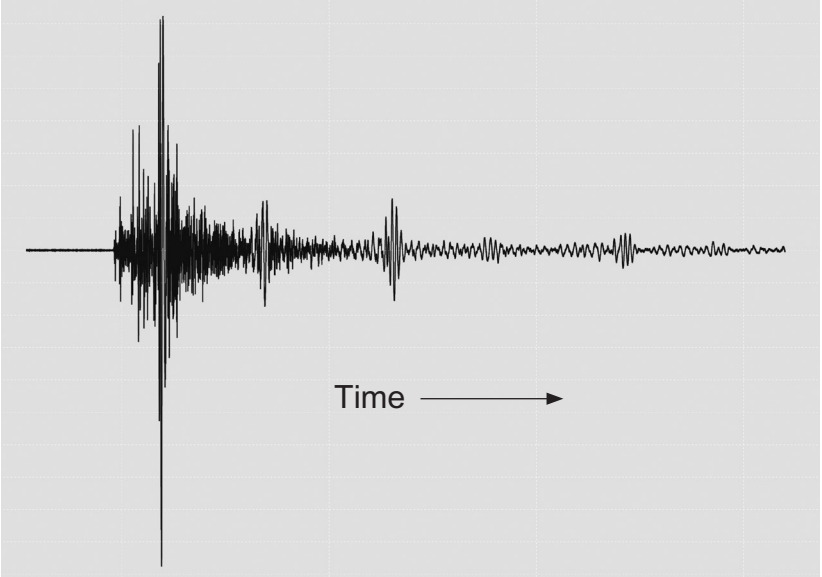
Examiner Only	
Marks	Remark

5 **(a)** Below is a printout from a seismometer that records earthquake data.

On the printout, label:

(i) the major **earthquake** using the letter **E**.

(ii) one of the **aftershocks** using the letter **A**. [2]



© Sebastien_B / iStock / Thinkstock

(b) Name the scale that is used to measure the magnitude of an earthquake.

_____ [1]

(c) During the twentieth century many scientists put forward ideas about the cause of earthquakes. In 1915 Alfred Wegener proposed the idea of continental drift.

(i) Describe the theory of continental drift.

_____

_____

_____

_____ [2]

(ii) Give **one** piece of evidence that supports Wegener's theory.

_____

_____ [1]

Examiner Only	
Marks	Remark

6 Below are the symbol equations for some chemical reactions.

A $CuO + H_2 \rightarrow Cu + H_2O$

B $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

C $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

D $NaOH + HCl \rightarrow NaCl + H_2O$

(a) Which reaction (**A**, **B**, **C** or **D**) represents a neutralisation reaction?

_____ [1]

(b) Which reaction (**A**, **B**, **C** or **D**) represents a combustion reaction?

_____ [1]

(c) One of these equations represents a reduction reaction. Explain the term reduction.

_____

_____ [1]

Examiner Only	
Marks	Remark

7 **(a)** The table below contains information about the structure of the atoms of four elements **W**, **X**, **Y** and **Z**.

Element	Number of protons	Number of neutrons	Number of electrons
W	3	4	3
X	12	12	12
Y	7	7	7
Z	18	22	18

You may find your Data Leaflet helpful.

(i) Calculate the mass number of element **W**.

_____ [1]

(ii) Name the element **X**.

_____ [1]

(iii) Which element (**W**, **X**, **Y** or **Z**) has only one electron in its outer shell?

_____ [1]

(iv) Which element (**W**, **X**, **Y** or **Z**) is an alkaline earth metal?

_____ [1]

(b) Emerald is a precious green gem. It has the formula $Be_3Al_2(SiO_3)_6$.

(i) How many different elements are represented by this formula?

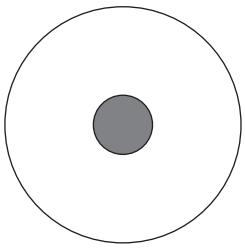
_____ [1]

(ii) How many oxygen atoms are represented by this formula?

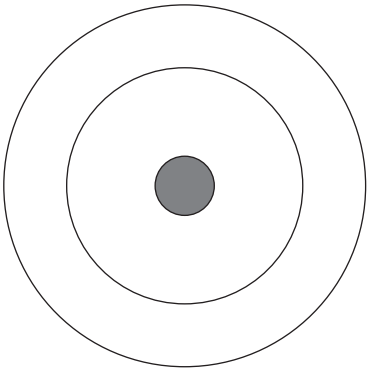
_____ [1]

Examiner Only	
Marks	Remark

8 **(a)** Complete the diagrams below to show how **all** of the electrons are arranged in an atom of hydrogen and an atom of oxygen.



Hydrogen atom



Oxygen atom

[2]

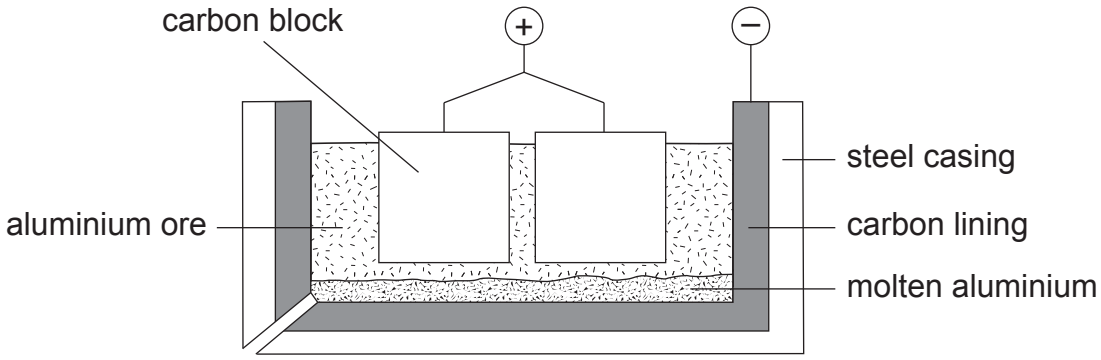
(b) Explain fully, in terms of electrons and the atoms involved, how oxygen and hydrogen join to form a molecule of water. You should include the chemical formula for water in your answer.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark

9 Electrolysis can be used to extract aluminium as shown in the diagram below.



Source: Principal Examiner

(a) Complete the table below.

Part of electrolysis cell	Charge of electrode	Name of electrode
carbon lining	negative	
carbon block	positive	

[1]

(b) State **two** reasons why electrodes are made from carbon.

1. _____

2. _____ [2]

(c) Describe, with reference to electrons, how the molten aluminium is formed at the carbon lining.

_____

_____

_____ [3]

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(Questions continue overleaf)

10 A student investigated the reactions of some metals and their compounds. His observations are shown in the table below.

Reaction number	Reactants	Observations
1	silver + iron(II) sulfate solution	nothing happened
2	iron + zinc sulfate solution	nothing happened
3	copper + silver nitrate solution	colourless solution turned blue, silver coloured solid formed
4	iron + copper(II) nitrate solution	blue solution faded, pink/brown solid formed
5	zinc + copper(II) sulfate solution	blue solution turned colourless, pink/brown solid formed

(a) These reactions can be described as displacement reactions.

Define the term displacement.

_____

_____

_____ [2]

(b) Complete the word equation for copper reacting with silver nitrate.

copper + silver nitrate ⟶ [ ] + [ ]

[2]

(c) Name the pink/brown solid that is formed in reactions 4 and 5.

_____ [1]

Examiner Only

Marks	Remark

(d) Zinc is the most reactive metal used by the student. Complete the reactivity series below for the metals used.

Examiner Only	
Marks	Remark

1 zinc

2 _____

3 _____

4 _____ [1]

(e) Suggest **one** reason why the student did **not** use potassium in this investigation.

_____

_____ [1]

Examiner Only	
Marks	Remark

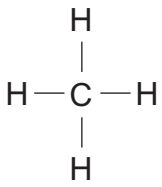
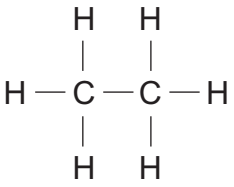
11 Hydrocarbons are often used as fuels.

(a) Define the term hydrocarbon.

_____

_____ [2]

(b) Complete the table below about different hydrocarbons.

Hydrocarbon	Molecular formula	Structural formula
methane	CH_4	
ethane		
	C_3H_8	

[3]

(c) Name the family of hydrocarbons that methane and ethane belong to.

_____ [1]

(d) A major source of hydrocarbons is crude oil. Name and describe the process used to separate hydrocarbons from crude oil.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

(e) Balance the symbol equation below.

$$CH_4 \quad + \quad O_2 \quad \rightarrow \quad CO_2 \quad + \quad H_2O$$

[1]

(f) The table below shows the percentage of gases released from a factory chimney.

Gas	Formula	Percentage/%
sulfur dioxide	SO_2	0.05
carbon monoxide	CO	0.10
nitrogen oxide	NO	0.15
carbon dioxide	CO_2	
oxygen	O_2	15.00
nitrogen and water vapour	N_2 and H_2O	74.70

(i) Calculate the percentage of carbon dioxide that is released from this factory chimney.

_____ % [1]

(ii) Name the **element** that is present in all the compounds shown in the table above.

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

113159

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	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

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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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.

Contents **Page**

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THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
							1 H Hydrogen 1										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						

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

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

a
b x

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