



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CHEMISTRY

0620/22

Paper 2

May/June 2015

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

You may lose marks if you do not show your working or if you do not use appropriate units.

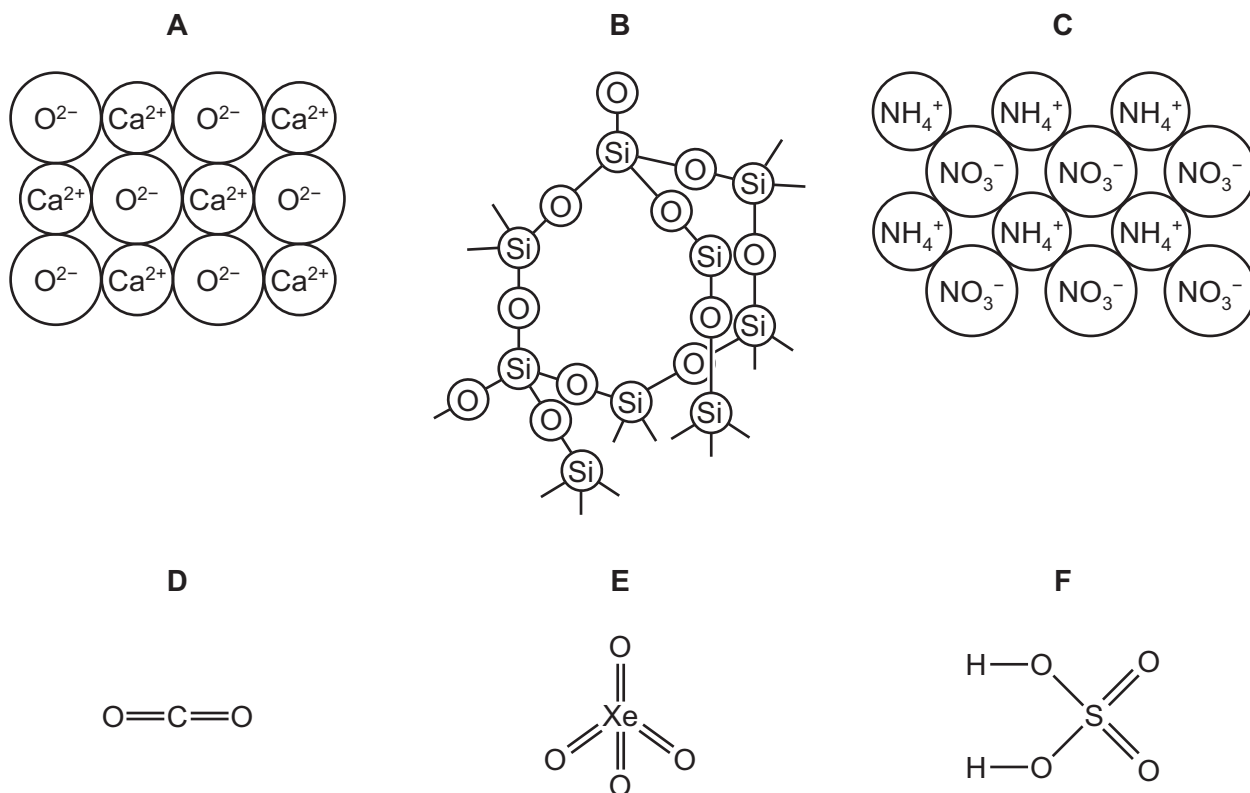
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **16** printed pages.

1 The structures of six compounds containing oxygen are shown below.



(a) Answer the following questions about these compounds. Each compound, **A**, **B**, **C**, **D**, **E** or **F**, may be used once, more than once or not at all.

- (i) Which compound is a compound of a noble gas?[1]
- (ii) Which compound can be used as a fertiliser?[1]
- (iii) Which compound can be used to neutralise acidic soil?[1]
- (iv) Which compound is a greenhouse gas?[1]
- (v) Which **two** compounds are ionic? and[1]
- (vi) Which **two** compounds react to form calcium sulfate? and[1]

(b) Complete the symbol equation for the reaction of compound **A** with hydrochloric acid.



(c) Complete the following sentence about compounds using words from the list below.

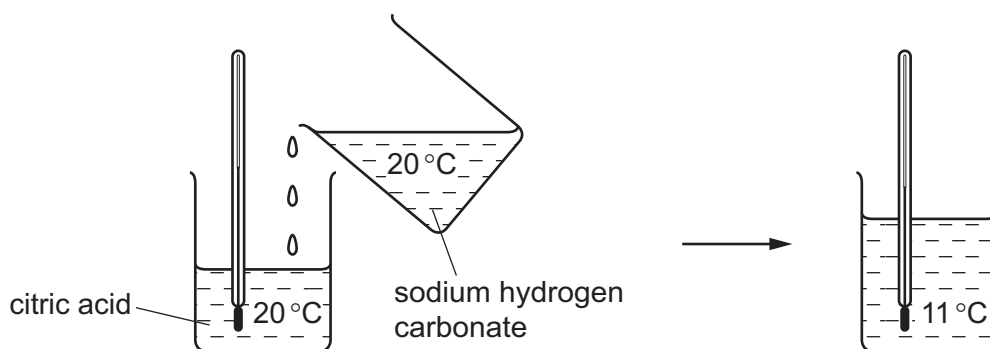
atoms **combined** **mixtures**
molecules **separated** **unreactive**

A compound is a substance containing two or more different which are
chemically

[2]

[Total: 10]

- 2 An aqueous solution of sodium hydrogen carbonate is added to an aqueous solution of citric acid. The mixture is stirred. The temperature is measured before and after the addition.



- (a) Explain how this experiment shows that the reaction is endothermic.

.....[1]

- (b) Citric acid reacts with sodium hydroxide to form the soluble salt sodium citrate.

Describe how you could prepare pure dry crystals of sodium citrate from citric acid and sodium hydroxide.

.....

[3]

- (c) Citric acid can be made by fermentation.

Ethanol can also be made by fermentation.

Which of the following are required to make ethanol by fermentation?

Tick **two** boxes.

enzymes from yeast

temperature above 100°C

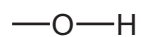
high pressure

concentrated sulfuric acid

glucose

[2]

(d) Complete the structure of ethanol to show all atoms and all bonds.



[1]

(e) Ethanol can be made from ethene.

Complete the following sentence about the formation of ethanol from ethene using words from the list below.

carbonate **catalyst**

hydrogen **proton** **steam**

Ethanol can be made by reacting ethene with in the presence of

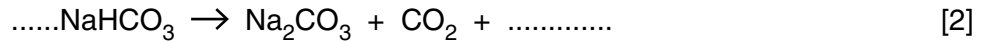
a

[2]

[Total: 9]

3 When sodium hydrogen carbonate is heated at 60 °C, carbon dioxide is given off.

(a) (i) Complete the equation for this reaction.



(ii) What type of chemical reaction is this?

Tick **one** box.

addition

neutralisation

oxidation

thermal decomposition

[1]

(b) An aqueous solution of sodium hydrogen carbonate is slightly alkaline.

Which one of the following pH values is slightly alkaline?

Put a ring around the correct answer.

pH 2

pH 7

pH 8

pH 13

[1]

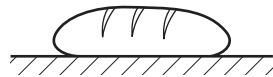
(c) Baking powder contains sodium hydrogen carbonate and crystals of a weak acid.

When water is added, the acid reacts with the sodium hydrogen carbonate.

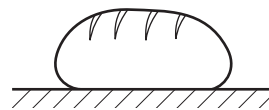
(i) Complete the general equation for the reaction of an acid with a carbonate.



(ii) The diagram below shows bread baked with and without the addition of baking powder. All other conditions were kept the same.



bread baked
without baking powder



bread baked
with baking powder

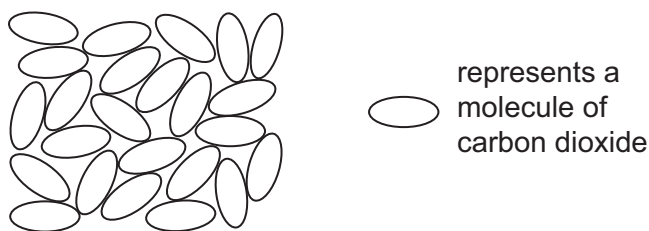
Why is the bread baked with baking powder bigger?

.....
 [1]

(iii) Explain why the sodium hydrogen carbonate used in breadmaking must be pure.

..... [1]

- (d) The diagram shows the arrangement of carbon dioxide molecules at -25°C and 100 atmospheres pressure.



What is the state of carbon dioxide under these conditions?

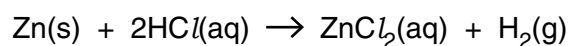
Use the kinetic particle theory and the information in the diagram to explain your answer.

.....

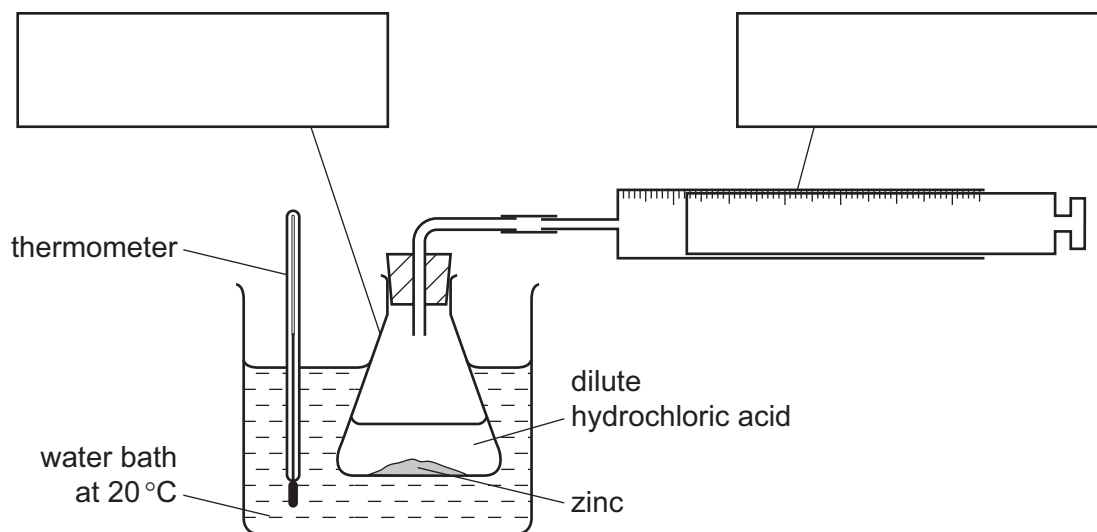
[3]

[Total: 11]

- 4 A student investigated the rate of reaction of zinc with dilute hydrochloric acid.

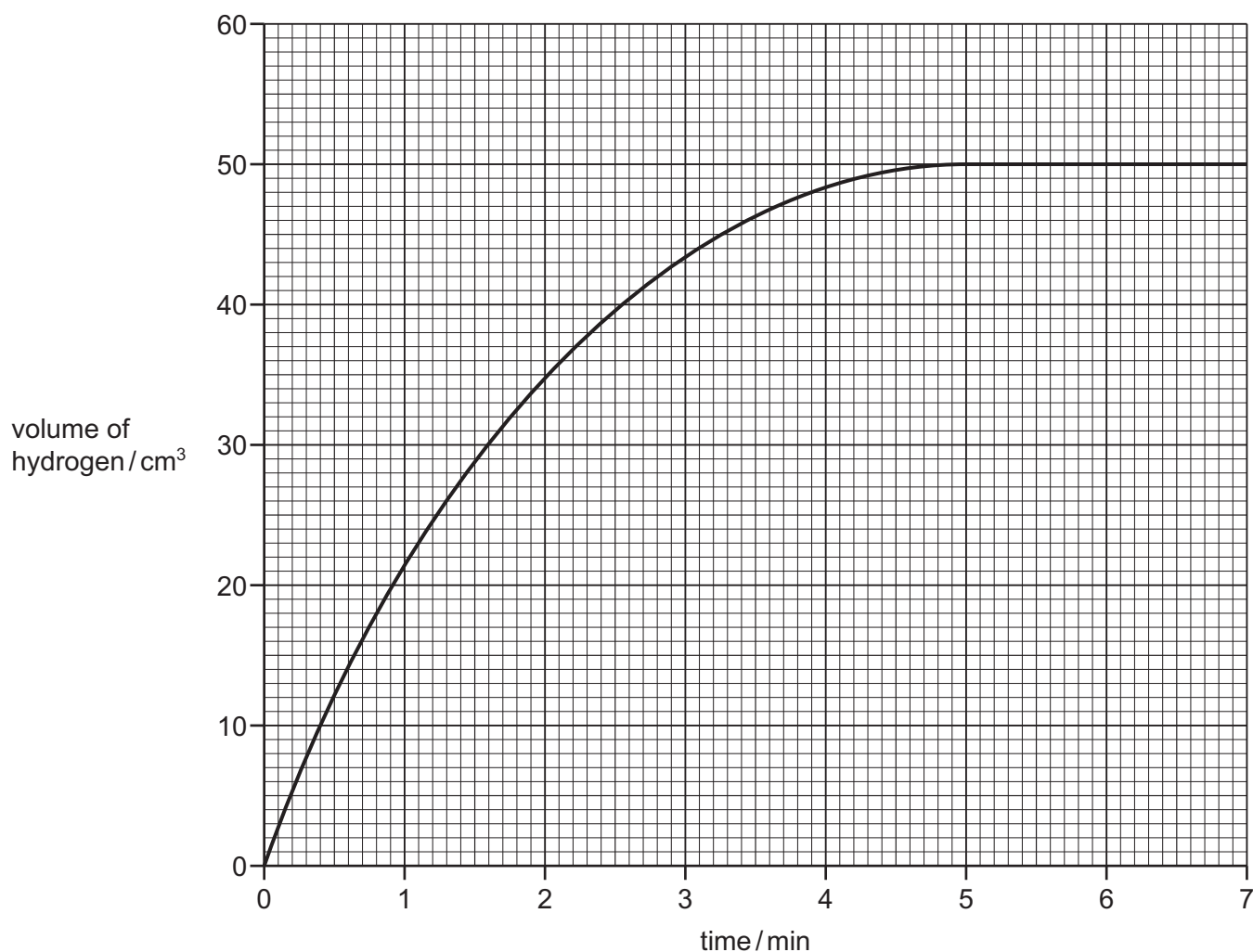


- (a) Complete the labelling of the apparatus by filling in the two boxes.



[2]

- (b) The student carried out the reaction at 20°C using small pieces of zinc. She measured the volume of hydrogen given off as the reaction proceeded.



- (i) Describe how the volume of hydrogen changes with time.

.....
 [2]

- (ii) At what time did the reaction stop?

..... [1]

- (iii) What volume of gas was produced over the first two minutes of the reaction?

..... [1]

- (iv) On the graph above draw a line to show how the volume of hydrogen changes when the reaction was carried out at 30°C. All other conditions remain the same. [2]

(c) How does the rate of reaction change when larger pieces of zinc are used?

All other conditions remain the same.

.....[1]

(d) Molten zinc chloride can be electrolysed using graphite electrodes.

(i) State the names of the product formed at:

the anode

the cathode.

[2]

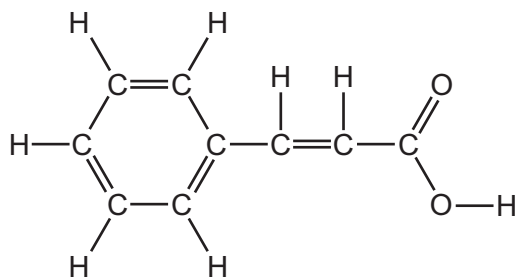
(ii) Graphite conducts electricity. Give one other reason why graphite electrodes are used.

.....[1]

[Total: 12]

5 Cinnamic acid is found in plants called balsams.

The structure of cinnamic acid is shown below.



(a) On the structure of cinnamic acid above, put a ring around the carboxylic acid functional group. [1]

(b) Cinnamic acid is an unsaturated compound.

(i) What is the meaning of the term *unsaturated*?

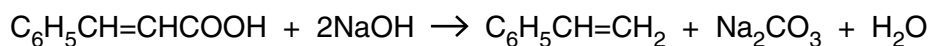
.....
[1]

(ii) Describe a test for an unsaturated compound.

.....

[2]

(c) Cinnamic acid reacts with sodium hydroxide to form styrene.



Complete the word equation for this reaction.

cinnamic acid + sodium hydroxide \rightarrow styrene + +

[2]

(d) Styrene is used to make the polymer poly(styrene).

Poly(ethene) is also a polymer.

Describe how poly(ethene) is made.

In your answer include the words:

- addition
- ethene
- monomer
- polymerisation

.....

.....

.....[3]

(e) Balsam flowers contain a mixture of pigments.

(i) Describe how you could obtain a solution of this mixture of pigments from balsam flowers.

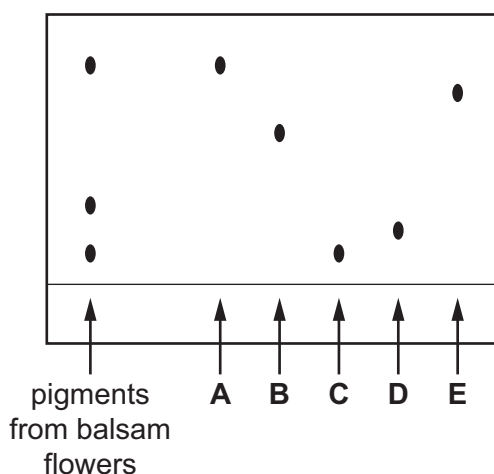
.....

.....

.....[3]

(ii) A student uses chromatography to separate the pigments in balsam flowers. He puts the pigment mixture on a sheet of chromatography paper as well as 5 spots of pure pigments **A, B, C, D** and **E**.

The diagram below shows the results after chromatography.



Which of the pigments **A, B, C, D** and **E** are present in balsam flowers?

.....[1]

[Total: 13]

6 The table shows some properties of aluminium, copper, iron and sodium.

metal	electrical conductivity	density in g/cm ³	melting point/°C	strength	colour
aluminium	very good	2.70	660	fairly strong	silver
copper	very good	8.92	1083	very strong	pink-brown
iron	good	7.86	1535	very strong	silver
sodium	good	0.97	98	weak	silver

(a) Which two metals in the table are transition elements? Explain your answer by referring to a specific property of transition elements given in the table.

.....

 [2]

(b) Use the information in the table to suggest

(i) why overhead electricity cables are made from aluminium with a steel core,

.....
 [2]

(ii) one reason why sodium is not used for electricity cables.

.....
 [1]

(c) Cobalt chloride is a transition element compound.

Calcium chloride is a compound of a Group II metal.

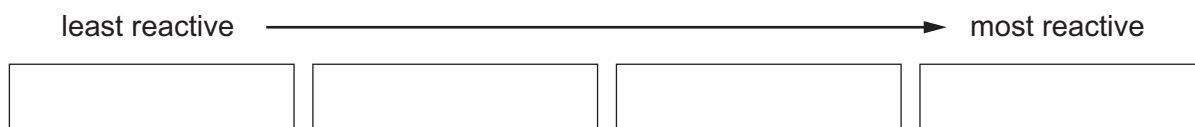
Describe one difference between cobalt chloride and calcium chloride.

.....
 [1]

(d) The table below shows some observations about the reaction of four metals with water or steam.

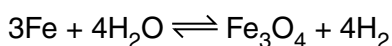
metal	observations
aluminium	reacts with steam when strongly heated
lithium	reacts rapidly with cold water
magnesium	reacts very slowly with cold water but rapidly with steam
silver	does not react with steam

Place these metals in order of their reactivity.



[1]

(e) When iron is heated with steam, hydrogen is given off.



(i) What does the sign \rightleftharpoons mean?

.....[1]

(ii) Describe a test for hydrogen.

test

result

[2]

(f) Steel is an alloy of iron. Write about alloys of iron.

In your answer refer to:

- the meaning of the term alloy,
- why alloys are used instead of pure iron,
- an example of the use of an alloy of iron.

.....

.....

.....

.....

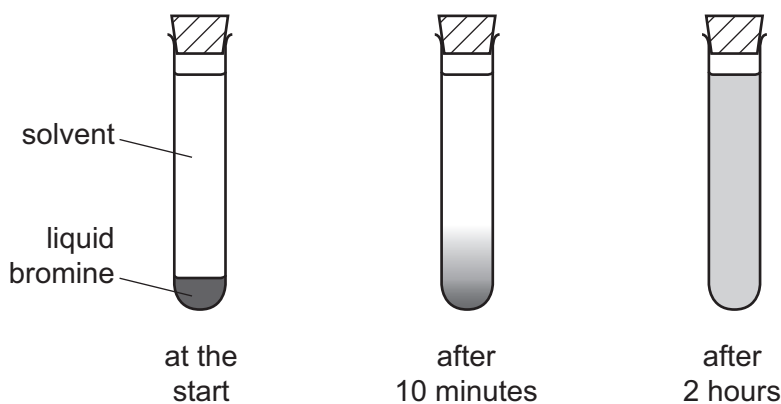
.....

.....

.....[4]

[Total: 14]

- 7 A teacher placed a few drops of liquid bromine in the bottom of a test-tube containing a solvent. After 10 minutes, the brown colour of the bromine had spread a little way through the solvent. After 2 hours, the brown colour had spread throughout the solvent.



- (a) Use the kinetic particle theory to explain these observations.

.....

 [3]

- (b) Bromine is a halogen in Group VII.

The properties of some halogens are given in the table below.

halogen	melting point/°C	boiling point/°C	density at boiling point in g/cm ³	electron arrangement of halogen atom
fluorine	-220	-188	1.51	2,7
chlorine	-101	-35	1.56	2,8,7
bromine	-7	+59		2,8,18,7
iodine	+114	+184	4.93	2,8,18,18,7

Use the information in the table to:

- (i) Deduce the state of fluorine at -200 °C.

..... [1]

(ii) Describe how the melting point changes down Group VII.

.....[1]

(iii) Estimate the density of bromine.

.....[1]

(iv) Deduce the number of completely filled electron shells in an atom of chlorine.

.....[1]

(c) Aqueous bromine reacts with aqueous potassium iodide to form iodine and potassium bromide.

(i) Complete the equation for this reaction.



(ii) Explain why aqueous bromine does not react with an aqueous solution of potassium chloride.

.....[1]

(d) Bromine reacts with fluorine to form bromine trifluoride, BrF_3 .

Calculate the relative molecular mass of bromine trifluoride.

Show all your working.

[2]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

		Group																	
I	II	III	IV	V	VI	VII	0												
		1 H Hydrogen 1					4 He Helium 2												
7 Li Lithium 3	9 Be Beryllium 4		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	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18												
39 K Potassium 19	40 Ca Calcium 20		32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36												
87 Rb Rubidium 37	88 Sr Strontium 38	27 Ga Gallium 31	50 In Indium 49	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54												
133 Cs Caesium 55	137 Ba Barium 56		80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86										
223 Fr Francium 87	226 Ra Radium 88		201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86										
* 58–71 Lanthanoid series																			
† 90–103 Actinoid series																			
<table style="width: 100%; border: none;"> <tr> <td style="border: none; width: 10%;"></td> <td style="border: none; width: 10%; text-align: right;">a</td> <td style="border: none; width: 10%; text-align: center;">X</td> <td style="border: none; width: 10%; text-align: left;">b</td> <td style="border: none; width: 10%;"></td> <td style="border: none; width: 10%; text-align: right;">a = relative atomic mass</td> <td style="border: none; width: 10%; text-align: center;">X = atomic symbol</td> <td style="border: none; width: 10%; text-align: left;">b = atomic (proton) number</td> </tr> </table>													a	X	b		a = relative atomic mass	X = atomic symbol	b = atomic (proton) number
	a	X	b		a = relative atomic mass	X = atomic symbol	b = atomic (proton) 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	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103						

The volume of one mole of any gas is 24dm³ at room temperature and pressure (r.t.p.).