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RECOGNISING ACHIEVEMENT

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GENERAL CERTIFICATE OF SECONDARY EDUCATION **A323/02/RB**

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

Unit 3 Ideas in Context plus C7 (Higher Tier)

RESOURCE BOOKLET

JUNE 2008

To be opened and given to candidates upon receipt

CUP/T60179

INSTRUCTIONS TO CANDIDATES

- This booklet contains one article required to answer question 1.
- Take this article away and read it through carefully.
- Spend some time looking up any technical terms or phrases you do not understand.
- For the examination on **Friday 23 May 2008** you will be given a fresh copy of this article, together with a question paper.
- You will **not** be able to take your original copy into the examination with you.

This document consists of **4** printed pages.

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The Periodic Table

Is there a pattern?

There are over a hundred different chemical elements, each with its own properties. But is there a pattern to these properties? Chemists spent many years trying to arrange the elements in a sensible order. For a long time they could not agree on one common idea. Several ideas were suggested, but none seemed to work for all of the elements.

In 1829, **Johann Dobereiner** showed that many of the elements known at that time could be arranged in groups of three, which he called Triads. The three elements in each Triad showed similar properties, for example:

- lithium, sodium and potassium were in one Triad
- chlorine, bromine and iodine were in another Triad.

This was a step forward but did not help with all of the other elements that Dobereiner had not put into groups of three.

In 1863, **John Newlands** suggested a 'Law of Octaves'. He arranged the elements in order of their relative atomic masses. He then put them into vertical groups. This brought together elements with similar properties in a basic Periodic Table. His ideas did not gain acceptance amongst other chemists because there were several major flaws. Newlands assumed that all the elements had been discovered, but at the time more new elements were being discovered every year. He placed two elements in the same position several times in his law of octaves. He also put some elements with quite different properties in the same group.

In 1869, **Dmitri Mendeleev** published a table showing a much clearer pattern of the elements. He followed Newlands' idea of putting the elements in order of relative atomic mass. Mendeleev noticed that elements with similar properties occurred at regular intervals. Every eighth element was similar.

He used this periodic pattern to put elements into groups. For example, he put lithium, sodium and potassium in one group. Where elements seemed to be in the wrong place in the table, he moved them. He put them in the best place for their properties.

Another key feature of Mendeleev's arrangement was to leave gaps in the correct places for elements that had not already been discovered. Based on the properties of elements already in his Periodic Table, he predicted the properties of the missing elements. When these elements were discovered, his predictions were found to be very accurate.

These features helped Mendeleev's Periodic Table to be accepted by other chemists. Mendeleev's table is the basis for the modern Periodic Table of elements we use today.

The modern Periodic Table

In the modern Periodic Table, elements are arranged in order of proton number rather than relative atomic mass. The arrangement is similar to that of Mendeleev's Periodic Table, with rows of elements across and groups of elements with similar properties going down. A major difference is that elements Cu, Zn, Ti, V, Cr, Mn, Fe, Co and Ni have been moved. Mendeleev put them in Groups 1 to 8. They are now placed in a central block of 'transition elements'.

Dobereiner's Triads

element	relative atomic mass
Li	7
Na	23
K	39

element	relative atomic mass
Cl	35.5
Br	80
I	127

Newlands' Law of Octaves

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe

Properties of some elements

proton number	relative atomic mass	element	properties
1	1	hydrogen	a very reactive gas
2	4	helium	an unreactive gas
3	7	lithium	a soft very reactive metal
4	9	beryllium	a reactive metal
5	11	boron	a solid non-metal
6	12	carbon	a solid non-metal
7	14	nitrogen	a gaseous non metal
8	16	oxygen	a reactive non-metal
9	19	fluorine	a very reactive gaseous non-metal
10	20	neon	an unreactive gas
11	23	sodium	a soft very reactive metal
12	24	magnesium	a reactive metal
13	27	aluminium	a reactive metal
14	28	silicon	a solid non-metal
15	31	phosphorus	a solid non-metal
16	32	sulfur	a reactive non-metal
17	35.5	chlorine	a very reactive gaseous non-metal
18	40	argon	an unreactive gas
19	39	potassium	a soft very reactive metal
20	40	calcium	a reactive metal

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Mendeleev's Periodic Table

	1	2	3	4	5	6	7	8
1	H							
2	Li	Be	B	C	N	O	F	
3	Na	Mg	A*l*	Si	P	S	C*l*	
4	K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni