Trilogy C1- Atomic structure and The Periodic Table Page 1

Chromatography the substance.

above solvent.

pencil as ink will

the paper.

dissolve and run up

All substances are made up of atoms. Atoms are the smallest part of an element that can possibly exist.

Atoms, Elements and Compounds

Atoms have a radius of around 1 nm $(1 \times 10^{-10} \text{ m})$

Atoms of each element are represented by a chemical symbol: O for oxygen If the Ca for calcium symbol only contains 1

If the symbol letter, this contains 2 letters. letter must the first must be be capital. capital and the second must be lower case. An element is a substance made up of only one

type of atom. Compounds contain two more elements

chemically combined in fixed proportions: CaCl₂ for calcium chloride

A small 2 after the No small number

CI means there are after Ca means there 2 chlorine atoms in is 1 calcium atom in calcium chloride. calcium chloride.

Compounds are not easily separated. They can

Compounds can be named using the following rules:

only be separated by chemical reaction.

- The name of the metal goes first
- The name of the non-metal goes second Change the non-metal name ending from -ine
- to -ide Word equation: lithium + bromine > lithium bromide Symbol equation:

Li + Br → LiBr

Chromatography - used to separate a mixture of Filtration - used to separate insoluble solids from substances dissolved in a solvent e.g. inks

Solvent

front

paper lPencil Sólvent Spots of ink Crystallisation - used to obtain crystals from a solution
• Evaporating water from a |basin_ Copper solution on a water bath is sulphate gentler than heating crystals directly. You should stop heating at #hmmm# the point of crystallisation - when crystals appear. The excess water can then Tripod be left on a window sill to heat evaporate. Structure of the atom: In an atom The centre the number proton is called of protons is

the nucleus

particle mass charge electron 0.005 -1 +1 proton neutron Atoms have no overall charge This is the mass number. It tells you how many protons + neutrons

in the atom. This is the chemical symbol. ⁶ This is the atomic number. It is the number of protons in the atom.

 Distance travelled by the spot depends

on the solubility of Pencil line must be Must be drawn in

a liquid or solution. - Filter funnel Filter paper

Insoluble solid particles are too big Unreacted coppe to fit through holes in the filter paper. Soluble particles break up when they dissolve to they are Conical flask small enough to pass

Distillation - used to separate a mixture of liquids

Particles are heated in the round bottomed flask until condenser water to sink

Filtrate

heat

they **evaporate**. The gases travel down the condenser where they condense. • The pure liquid is then collected. water from faucet The liquid with the higher boiling point is left behind. Ions and isotopes

through filter paper.

neutron

equal to the

number of

electrons.

The shell closest to the nucleus (1st shell) is filled first and can hold up to 2 electrons. The 2nd shell can hold up to 8 electrons. The 3rd shell can hold up to 8 electrons.

nucleus in shells.

Electronic structure

Electrons are arranged around the

e.g. Oxygen has 8 electrons in total. Its electron structure is 2,6.

Atoms can lose or gain electrons to become charged.

Charged atoms are called ions.

They have charges because there

protons to electrons. E.g. the Li⁺ ion has 3

protons and 2 electrons. Atoms with the same number of

are a different number of

protons but different number of neutrons are called isotopes.

Isotopes are the same element but with different masses.

Periodic Table

The periodic table is a list of elements arranged according to their atomic number.

Elements in the same Group have the same number of outer shell electrons (e.g. group 1 all have 1 electron in their outer shell) and similar properties

(e.g. the noble gases are all very unreactive gases). The number of electrons in an elements out shell determines its chemical properties.

Metals and non-metals

Metals are found on the left side of the periodic table and non-metals are found on the right.

Li

lithium

potassium

19

85

Rb

rubidium

37

133

Cs

caesium

55

Be

beryllium

calcium

20

88

38

137

Ba

barium

56

Metals form positive ions (Li+) Non-metals form negative ions (O²-) History of the atom

Dalton: Indivisible spheres. Thomson: Plum puddingpositive ball with embedded electrons. Rutherford: Nuclear model

Experiment with gold foil shows most of an atom empty (helium nuclei pass through) with a positive

nucleus (helium nuclei deflected). Bohr: Planetary modelelectrons in fixed orbits

around the nucleus.

Protons discovered. Chadwick: Discovered the neutron.

Н

hydrogen

General physical properties

Metals	Non-Metals
Lustrous (shiny)	Dull

Good conductor Poor conductor High density Low density

Strong Malleable and ductile

11

В

boron

5

27

ΑI

aluminium

13

70

Ga

gallium

31

115

ln

indium

49

12

C

carbon

28

Si

silicon

14

73

Ge

germaniun

32

119

Sn

50

207

High melting point Low melting point

Non- Metals

Ν

nitrogen 7

31

Р

hosphorus

15

75

As

arsenic

33

122

Sb

antimony

51

209

Bi

16

0

oxygen 8

32

S

sulfur

16

79

Se

selenium

34

128

Te

tellurium

52

[209]

Po

19

F

fluorine

9

35.5

CI

chlorine

17

80

Br

bromine

35

127

iodine

53

[210]

At

astatine

Brittle

He

helium

2

20

Ne

neon

10

40

Ar

argon

18

84

Kr

krypton

36

131

Xe

xenon

54

[222]

Rn 6

radon

1

2

4

History of the Periodic Table Before the discovery of subatomic

particles (electrons, neutrons and protons) periodic tables were arranged based on atomic weight.

Mendeleev and Newlands both suggested different periodic tables

Newlands Mendeleev Ordered elements by atomic weight

Included only the Left gaps for undiscovered elements known at the time elements

Arranged by atomic weight atomic weight and adjusted for chemical only properties Every 8th Elements in element had groups had similar properties

Arranged by

similar

properties

Not believed

left for new

(Newlands' Law Of Octaves) grouping

Criticised for until the gaps he elements with very different

elements proved to be correct. properties. Following the discovery of protons our modern periodic table is now arranged by atomic number.

The discovery of isotopes made it possible to explain why ordering elements by atomic weight was not always correct... as Mendeleev thought (look at Ar and K).

Each Column is a group

The group number tells you how many electrons are in the elements out shell.

Each row is a **period**

The period number tells you how many

3 4 atomic (proton) number 23 Na Mg sodium nagnesium 12 11 39 40 45 48 51 Ca Sc Τi

scandium

21

89

Υ

yttrium

39

139

La*

lanthanun

57

titanium

22

91

Zr

zirconium

40

178

Hf

hafnium

72

Metals

Cr

chromium

24

96

Mο

olybden

42

184

W

tungsten

74

Kev

relative atomic mass

atomic symbol

vanadium

23

93

Nb

41

181

Ta

tantalum

73

52 55

anganese

25

[98]

Tc

43

186

Re

rhenium

75

Mn Fe

iron

26

101

Ru

utheniun

44

190

0s

osmium

76

Co Ni cobalt nickel 27

103

Rh

rhodium

45

192

iridium

77

Cu copper 28 29 106

195

Pt

platinum

78

108 Pd Ag oalladium silver

112 Cd 47 197

63.5

cadmium 48 201 Hg Αu gold mercury 79

65

Zn

zinc

30

204 ΤI thallium 80

Pb

bismuth polonium 83

Elements with atomic numbers 112 - 116 have been reported but not fully authenticated

[227] [266] [223] [226] [261] [262] [264] [277] [268] [271] [272] Ra Ac* Rf Db Mt Ds Fr Sg Hs Rg francium radium actinium utherfordiu seaborgium bohrium meitnerium dubnium hassium armstadti entgenium shells an element 89 104 87 88 105 106 107 108 109 110 111 has