Answers Periodic Table

Year 10 Science Chapter 4

p69

1 An **element** is a pure substance that cannot be separated into a simpler substance. An element is a sustance that consists only of atoms which have the same number of **protons**.

2 **An atom** has a nucleus, made of protons and neutrons, with electrons in orbit around the nucleus.

3 **Protons** have a positive electrical charge.

4 **Neutrons** have no electrical charge.

5 **Electrons** have a negative electrical charge.

6 The **atomic number** of an element is the number of protons found in the nucleus of the atom.

7 Nitrogen has an atomic number of 7. Nitrogen has 7 protons.

8 Silver has the symbol Ag. If an atom of silver were to lose an electron to become an ion. The symbol for the silver ion would be Ag^{+}.

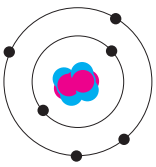
p71

1 An atom with the atomic number 15 has 15 protons and 15 electrons.

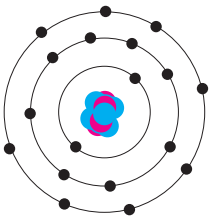
2 An atom with the electron configuration 2,8,13 has an atomic number of 23.

3 Draw a sketch of the electron configuration of the atoms of each of the following elements:

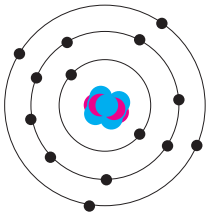
a) Carbon (Atomic number = 6)



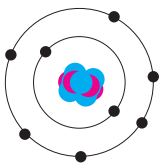
b) Argon (Atomic number = 18)



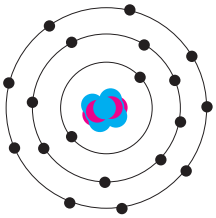
c) Silicon (Atomic number = 14)



d) Oxygen (Atomic number = 8)



e) Potassium (Atomic number = 19)



4 Argon would be expected to be unreactive (Has completed outermost shell).

5 Potassium and oxygen would be expected to be most reactive of above (Oxygen close to completing outer shell and potassium can easily lose outer electrons).

p73

1 The **atomic mass number** of an atom is the average total number of protons and neutrons in the atom.

2 **Isotopes** are different atoms of the same element. **Isotopes** are atoms with the same number of protons but **a different number of neutrons**.

3 Calculate the atomic mass number of chlorine given that chlorine has two major isotopes: ^{35}Cl (76%) and ^{37}Cl (24%).

76% (or 0.76) of atoms have mass number of 35.
24% (or 0.24) of atoms have mass number of 37.
Atomic mass number $= 0.76\times35 + 0.24\times37 = 35.48$
Atomic mass number $= 35.48$

4 Calculate the atomic mass number of copper given that copper has two major isotopes: ^{63}Cu (69%) and ^{65}Cu (31%).

69% (or 0.69) of atoms have mass number of 63.
31% (or 0.31) of atoms have mass number of 65.
Atomic mass number $= 0.69\times63 + 0.31\times65 = 63.62$
Atomic mass number $= 63.62$

5 Calculate the atomic mass number of sulphur given that sulphur has two major isotopes: ^{32}S (95%) and ^{34}S (5%).

95% (or 0.95) of atoms have mass number of 32.
5% (or 0.05) of atoms have mass number of 34.
Atomic mass number $= 0.95\times32 + 0.05\times34 = 32.1$
Atomic mass number $= 32.1$

6 Calculate the atomic mass number of neon given that neon has three major isotopes: ^{20}Ne (90.5%), ^{21}Ne (0.3%), and ^{22}Ne (9.2%).

90.5% (or 0.905) of atoms have mass number of 20.
0.3% (or 0.003) of atoms have mass number of 21.
9.2% (or 0.092) of atoms have mass number of 22.
Atomic mass number $= 0.905\times20 + 0.003\times21 + 0.092\times22 = 20.19$
Atomic mass number $= 20.19$

7 For each of the following elements, find:

i) **a)** The number of electrons = 19
b) The number of protons = 19
c) The average number of neutrons = 39.098 - 19 = 20.098
d) *Electron shells (2 - 8 - 18 - 32)*
19 electrons thus:
2 electrons first shell
8 electrons second shell
9 electrons third shell

39.098
K
Potassium
19

ii) **a)** The number of electrons = 12
b) The number of protons = 12
c) The average number of neutrons = 24.305 - 12 = 12.305
d) *Electron shells (2 - 8 - 18 - 32)*
12 electrons thus:
2 electrons first shell
8 electrons second shell
2 electrons third shell

24.305
Mg
Magnesium
12

p73

iii) **a)** The number of electrons = 17
b) The number of protons = 17
c) The average number of neutrons = 35.45 - 17 = 18.45
d) *Electron shells (2 - 8 - 18 - 32)*
17 electrons thus:
2 electrons first shell
8 electrons second shell
7 electrons third shell

35.450
Cl
Chlorine
17

iv) **a)** The number of electrons = 7
b) The number of protons = 7
c) The average number of neutrons = 14.007 - 7 = 7.007
d) *Electron shells (2 - 8 - 18 - 32)*
7 electrons thus:
2 electrons first shell
5 electrons second shell

14.007
N
Nitrogen
7

v) **a)** The number of electrons = 20
b) The number of protons = 20
c) The average number of neutrons = 40.078 - 20 = 20.078
d) *Electron shells (2 - 8 - 18 - 32)*
20 electrons thus:
2 electrons first shell
8 electrons second shell
10 electrons third shell

40.078
Ca
Calcium
20

vi) **a)** The number of electrons = 13
b) The number of protons = 13
c) The average number of neutrons = 26.982 - 13 = 13.982
d) *Electron shells (2 - 8 - 18 - 32)*
13 electrons thus:
2 electrons first shell
8 electrons second shell
3 electrons third shell

26.982
Al
Aluminium
13

8 Silicon has three isotopes with mass numbers 28, 29, and 30. If the atomic mass number of silicon is 28.085, which isotope is the most abundant? {Abundant means large quantity}

Because the atomic mass number, the average of the isotope mass numbers, is closest to the isotope with mass number 28, and because mass number 28 is the lowest, the isotope with mass number 28 is the most abundant.

p75

1 The vertical columns of the periodic table are called groups.

2 The horizontal rows of the periodic table are called rows or periods.

3 Five of the first 18 elements are metals?

4 Elements in the same group, column, tend to have similar properties. If Argon, Ar, is used to help reduce unwanted reactions in welding, name another element that probably could be used for the same purpose?

Other elements in the same group as Argon are helium and Neon. Neon may be expected to help reduce unwanted reactions in welding.

p77

1 Mendeleev's basic rule in organising the periodic table was to put elements with similar chemical and physical properties in the same column (group).

2 Briefly describe the chemical properties of group 1 - the alkali metals.

The group 1 metals are amongst the most reactive metals. Alkali metals react violently with water to form hydroxides. The metals further down the alkali list are more reactive.

3 Briefly describe the physical properties of group 1 - the alkali metals.

The alkali metals are soft and silvery. They are less dense than other metals and have low melting and boiling points.

4 Why are the alkali metals so reactive?

Their high reactivity is due largely to the ease with which their outermost single electron can be easily lost in reactions.

5 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of sodium with water, copy and complete the equations for the reaction of rubidium and caesium with water.

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

sodium + water → sodium hydroxide + hydrogen

$Rb + 2H_2O \rightarrow 2RbOH + H_2$

rubidium + water → rubidium hydroxide + hydrogen

$Cs + 2H_2O \rightarrow 2CsOH + H_2$

caesium + water → +

p79

1 Briefly describe the chemical properties of group 2 - the alkaline earths.

The group 2, alkaline earths have similar chemical properties to the group 1, alkali metals. The metals towards the bottom of the group are almost as reactive as the group 1, alkali metals.

2 Briefly describe the physical properties of group 2 - the alkaline earths.

The group 2, alkaline earth metals are soft, silvery-white metals. The alkaline earth metals have relatively low melting and boiling points and are relatively less dense than other metals.

3 Why are the alkaline earths not as reactive as the alkali metals? The alkaline earths have two outermost electrons to lose compared to one outermost electron of the alkali metals. The alkaline earths are thus not as reactive (with the exception of the alkaline earths towards the bottom of the group).

4 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of an alkaline earths with hydrochloric acid, copy and complete the equations for the reaction of barium with hydrochloric acid to form salts:

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

magnesium + hydrochloric acid → magnesium chloride + hydrogen

$Ba + 2HCl \rightarrow BaCl_2 + H_2$

barium + hydrochloric acid → barium chloride + hydrogen

p81

1 Briefly describe the chemical properties of group 17 - the halogens.

The group 17 halogens are reactive and dangerous (Chlorine was used as a poisonous gas during World War I). The halogens react with metals to form salts. The halogens become less reactive the further down the group.

2 Briefly describe the physical properties of group 17 - the halogens.

The halogens are non-metals. Fluorine (F) and chlorine (Cl) are gases at room temperature (25°C), while bromine (Br) is a liquid, and iodine (I) is a solid. The halogens have low melting and boiling points.

3 Why are the halogens the most reactive of the non-metal groups?

The halogens have seven outermost electrons and only need one electron to complete a set of eight outermost electrons. This makes them more reactive than the other non-metal groups.

4 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of an alkali metal with a halogen, copy and complete the equations for the reactions of alkali metals with halogens to form salts:

$2Na + Cl_2 \rightarrow 2NaCl$

sodium + chlorine → sodium chloride

$2K + Br_2 \rightarrow 2KBr$

potassium + bromine → potassium bromide

$2Cs + I_2 \rightarrow 2CsI$

caesium + iodine → caesium iodide

5 Hydrogen, nitrogen, and oxygen also form homonuclear diatomic molecules. What are their formulas?

H_2, N_2, O_2

p83

1 Briefly describe the chemical properties of the transition metals.

The transition metals are less chemically reactive than the group 1 or group 2 metals.

The transition metals can be classed into:

- metals that react rapidly with acids.
- metals that react only with strong acids.
- metals that are unreactive.

2 Briefly describe the physical properties of the transition metals.

Generally, the transition metals are hard, tough, and have a high density. Transition metals have high melting and boiling points. An exception is mercury (Hg) which is a liquid at room temperature (25°C).

3 Why are the transition metals good conductors of electricity?

The transition metals, similar to all metals, are good conductors of heat and electricity. These metals are good conductors because they can easily lose their outer electrons.

4 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of copper sulphate with sodium hydroxide, copy and complete the equations for the reaction of nickel sulphate with sodium hydroxide.

$CuSO_4 + 2NaOH \rightarrow Cu(OH)_2\downarrow + Na_2SO_4$

copper sulphate + sodium hydroxide → copper hydroxide + sodium sulphate

$NiSO_4 + 2NaOH \rightarrow Ni(OH)_2\downarrow + Na_2SO_4$

nickel sulphate + sodium hydroxide → nickel hydroxide + sodium sulphate

p85

1 Briefly describe the chemical properties of group 18 - the noble gases.

The group 18 noble gases are chemically unreactive. The noble gases are odourless, colourless, and tasteless.

2 Briefly describe the physical properties of group 18 - the noble gases.

The noble gases exist as gases at room temperature (25°C), and have low melting points and low boiling points.

3 Why are the noble gases chemically unreactive?

The noble gases have eight outermost electrons and are considered to have a complete set of outermost electrons. The outermost shell is said to be 'full'. This explains why the noble gases are chemically unreactive.

4 The noble gases are described as monatomic. What is meant by monatomic?

Monatomic means that the noble gases exist as single atoms such as Ne and Ar. This may be compared to diatomic molecules such as Cl_2 and H_2.

5 Why are the noble gases used as fillers in light bulbs?

Argon is used in incandescent light bulbs because it doesn't react with the hot filament in the light bulb.

6 Cavendish, in 1875, removed nitrogen and oxygen from a container of air and found the remaining gas to be unreactive:

a) which noble gases were in the container? Argon, Neon, Krypton, Helium, Xenon

b) which gas, left in the container, wasn't a noble gas? Carbon dioxide

p86

1 Galena is the most important ore for lead.

2 **Lead** has been used for thousands of years because it is plentiful, easy to extract, easy to shape, and has a low melting point.

3 Lead is used to make ammunition, ballast for sailboats, scuba diving weights, lead-acid car batteries, solder in electronics, covering for high voltage power cables, sheilding from radiation, bars in stained glass, to balance car wheels, and many other uses.

4 There are 82 protons in the nucleus of an atom of lead.

5 Lead is cheap and plentiful. Why is its use being restricted?

Lead is a poisonous metal. Lead poisoning can damage the brain and kidneys and result in death. Lead is particularly damaging to the nervous system of young children. The poisonous effects of lead has meant that the use of lead in paints has been reduced and lead has been removed from petrol (eg unleaded petrol).

p87

1 What is the chemical symbol for gold? Au

2 Give three reasons explaining why gold is a precious metal.

Gold is a precious metal because of its rarity, brilliant lustre, glossy shine, malleability, and importantly doesn't tarnish.

3 Comment on the following:

'Gold's high density means that most of the Earth's gold sunk to the centre of the Earth because most of the Earth is molten rock. The gold that we mine comes from meteorites that have showered the Earth'.

A theory that most of the Earth's gold has sunk to the centre of the Earth appears reasonable. A theory that the gold we mine, without carrying out an internet search, would depend on evidence that some meteorites would contain gold. There would also need to be some evidence that sufficient numbers of meteorites, containing gold, have struck the Earth.

p90

1 An **element** is a pure substance that cannot be separated into a simpler substance. An element is a sustance that consists only of atoms which have the same number of **protons**.

2 An atom with the atomic number 15 has 15 protons and 15 electrons.

3 An atom with the electron configuration 2,8,13 has an atomic number of 23.

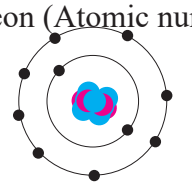
4 Sodium has the symbol Na. If an atom of sodium were to lose an electron to become an ion, the symbol for the sodium ion would be Na^+.

5 The **atomic mass number** of an atom is the average total number of protons and neutrons in the atom.

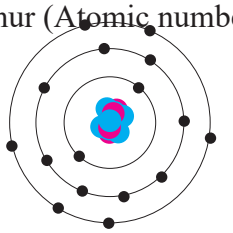
6 **Isotopes** are different atoms of the same element. **Isotopes** are atoms with the same number of protons but **a different number of neutrons**.

7 Draw a sketch of the electron configuration of the atoms of each of the following elements:

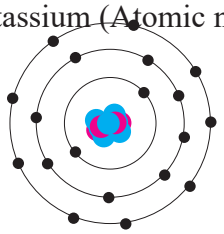
a) Neon (Atomic number = 10)



b) Sulphur (Atomic number = 16)



c) Potassium (Atomic number = 19)



8 Neon has a full electron configuration in its outermost shell therefore is unreactive.

9 Potassium would be expected to be the most reactive of above elements because potassium can easily lose an outer electron. Potassium is in group 1 and can easily lose the outer electron.

10 Find the number of protons, electrons, and average number of neutrons for magnesium.

24.305
Mg
Magnesium
12

a) The number of electrons = 12

b) The number of protons = 12

c) The average number of neutrons = 24.305 - 12 = 12.305

p91

1 Vertical columns are called Groups.

2 Horizontal rows are called Periods.

3 Elements in the same group, column, tend to have similar properties. If Argon, Ar, is used to help reduce unwanted reactions in welding, what is the atomic number of another element that probably could be used for the same purpose?

Any element in Group 8 – Noble Gases – unreactive

4 Briefly describe the chemical properties of group 1 - the alkali metals.

- Most reactive due to the ease of losing the outermost single electron in reactions
- Metals further down the group are more reactive
- React violently with water to form hydroxides

5 Briefly describe the physical properties of group 1 - the alkali metals.

- Soft and silvery
- Less dense
- Have low melting and boiling points

6 Why are the alkali metals so reactive?

Alkali metals are reactive because they lose their outermost electron with ease in a reaction.

7 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of sodium with water, copy and complete the equations for the reaction of rubidium and caesium with water.

$2Na + 2H_2O \rightarrow 2NaOH + H_2$
sodium + water → sodium hydroxide + hydrogen

$Rb + 2H_2O \rightarrow 2RbOH + H_2$
rubidium + water → rubidium hydroxide + hydrogen

$Cs + 2H_2O \rightarrow 2CsOH + H_2$
caesium + water → caesium hydroxide + hydrogen

p92

1 Briefly describe the chemical properties of group 2 - the alkaline earths.

- Have similar properties as Group 1
- Metals towards the bottom of the group are almost as reactive as the Group 1, alkali metals
- Beryllium does not react with water yet the rest do with increasing reactivity further down the Group.

2 Briefly describe the physical properties of group 2 - the alkaline earths.

- Are soft, silvery white metals
- Have relatively low melting and boiling points
- Relatively less dense than other metals

3 Why are the alkaline earths not as reactive as the alkali metals?

Alkali earth metals are less reactive than alkali metals because they have an extra electron in their outermost shell, 2 instead of 1.

4 Elements in the same group, column, tend to have similar reactions. Copy and complete the equation for the reaction of calcium with hydrochloric acid:

$Mg + 2HCl \rightarrow MgCl_2 + H_2$
magnesium + hydrochloric acid → magnesium chloride + hydrogen

$Ca + 2HCl \rightarrow CaCl_2 + H_2$
calcium + hydrochloric acid → magnesium chloride + hydrogen

p92

5 Briefly describe the chemical properties of group 17 - the halogens.

- Are reactive and dangerous (Cl_2 gas used in WW1).
- React with metals to form salts.
- Become less reactive further down the group.

6 Briefly describe the physical properties of group 1 - the halogens.

- Are non-metals.
- Fluorine (F) and Chlorine (Cl) are gases at room temperature.
- Bromine (Br) is a liquid at room temperature.
- Iodine (I) is a solid.
- Have low melting and boiling points.
- Form homonuclear diatomic molecules (2 atoms of the same element) Fluorine (F_2) – Chlorine (Cl_2) – Bromine (Br_2) – Iodine (I_2).

7 Why are the halogens the most reactive of the non-metal groups?

Halogens are the most reactive nonmetals because they can easily gain an electron to complete their outermost shell.

8 Elements in the same group, column, tend to have similar reactions. Copy and complete the equation for the reactions of alkali metals with halogens to form salts:

$2Na + Cl_2 \rightarrow 2NaCl$
sodium + chlorine → sodium chloride

$2K + Br_2 \rightarrow 2KBr$
potassium + bromine → potassium bromide

$Cs + I_2 \rightarrow 2CsI$
caesium + iodine → caesium iodide

9 Fluorine, chlorine, bromine, and iodine form homonuclear diatomic molecules. What are their formulas?

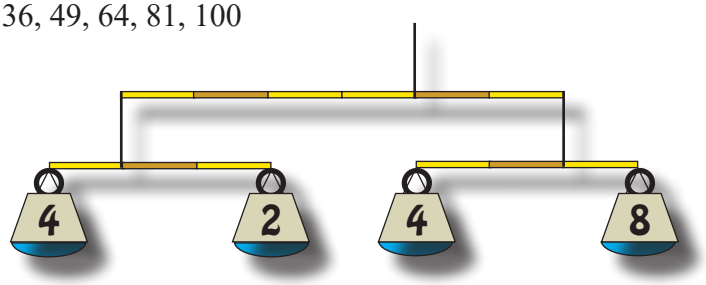
Fluorine = F_2
Chlorine = Cl_2
Bromine = Br_2
Iodine = I_2

p93

1 Assuming no friction, the ball will theoretically bounce for ever. In reality, friction such as air resistance will slow and stop the ball.

2 Fm.
These are the chemical elements whose atomic numbers are perfect squares. 1, 4, 9, 16, 25, 36, 49, 64, 81, 100

3



p94

1 Briefly describe the chemical properties of the transition metals.

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- metals that react only with strong acids.
- metals that are unreactive.

2 Briefly describe the physical properties of the transition metals.

Generally, the transition metals are hard, tough, and have a high density. Transition metals have high melting and boiling points. An exception is mercury (Hg) which is a liquid at room temperature (25°C).

3 Why are the transition metals good conductors of electricity?

The transition metals, similar to all metals, are good conductors of heat and electricity. These metals are good conductors because they can easily lose their outer electrons.

4 Elements in the same group, column, tend to have similar reactions. Given the following equation for the reaction of copper sulphate with sodium hydroxide, copy and complete the equations for the reaction of nickel sulphate with sodium hydroxide.

$$\underset{\text{copper sulphate}}{CuSO_4} + \underset{\text{sodium hydroxide}}{2NaOH} \rightarrow \underset{\text{copper hydroxide}}{Cu(OH)_2\downarrow} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

$$\underset{\text{nickel sulphate}}{NiSO_4} + \underset{\text{sodium hydroxide}}{2NaOH} \rightarrow \underset{\text{nickel hydroxide}}{Ni(OH)_2\downarrow} + \underset{\text{sodium sulphate}}{Na_2SO_4}$$

5 Briefly describe the chemical properties of group 18 - the noble gases.

The group 18 noble gases are chemically unreactive. The noble gases are odourless, colourless, and tasteless.

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The noble gases exist as gases at room temperature (25°C), and have low melting points and low boiling points.

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8 The noble gases are described as monatomic. What is meant by monatomic?

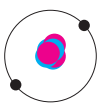
Monatomic means that the noble gases exist as single atoms such as Ne and Ar. This may be compared to diatomic molecules such as Cl_2 and H_2.

9 Why are the noble gases used as fillers in light bulbs?

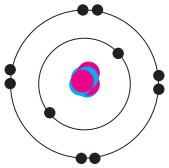
Argon is used in incandescent light bulbs because it doesn't react with the hot filament in the light bulb.

10 Draw a sketch of the electron configuration of the atoms of each of the following elements:

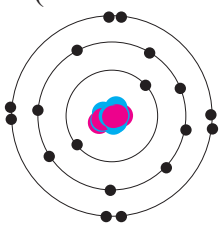
a) Helium (Atomic number = 2)



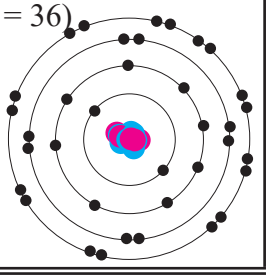
b) Neon (Atomic number = 10)



c) Argon (Atomic number = 18)



d) Krypton (Atomic number = 36)



p95

1 d) 62

2 a) $^{12}C_6$ (99%) and $^{13}C_6$ (1%).

3 c) lost three electrons.

4 a) Calcium

p96

1 d) Chemically unreactive

2 Either a) Chemically reactive or b) Moderatively reactive

3 **a)** $2K + 2H_2O \rightarrow 2KOH + H_2$

potassium + water → potassium hydroxide + hydrogen

b) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

magnesium + hydrochloric acid → magnesium chloride + hydrogen

c) $AgSO_4 + 2NH_4OH \rightarrow Ag(OH)_2\downarrow + (NH_4)_2SO_4$

silver sulphate + ammonium hydroxide → silver hydroxide + ammonium sulphate

p	