GCSE
CHEMISTRY
AQA - COMBINED SCIENCE
MARK SCHEME

C1
ATOMIC STRUCTURE AND THE PERIODIC TABLE
TEST 3
Mark schemes

(a) LiOH (aq)

(b) H₂ (g)

(c) C

(d) A and D

(e) point x at −10 °C

point • at +150 °C

(f) substance B will not reach its boiling point of 190 °C

because the boiling point of water is only 100 °C

there is too much substance B to melt instantly.

allow answers based on thermal conductivity or temperature gradient from the wall of the test tube to the thermometer

2

(a) Flask

(b) Fractional distillation

(c) A – boiling

B – condensing

(d) Octane

(e) Formulation

(f) the fuel is a pure compound
and crude oil is a mixture

or

the fuel is made up of four hydrocarbons

allow crude oil contains a large number of compounds and the fuel contains four

and crude oil could have many more

(g) \( (35 + 37 + 37 / 3) = 36.33 \)

36

allow \( (35 + 48 + 37 + 37 / 4 =) 39(.25) \) for 1 mark

(a) because the mass of an electron is very small

\textit{do not accept has no mass}

(b) 5 / five

(c) +5

(d) 6

(because) mass number = no. protons + no. electrons

allow\ atomic number = 5

(so the number of) neutrons = 11 – 5

allow mass number – number of protons

(e) \( (16 / 31) \times 100 = 51.6 \)

= 52

incorrect sig. figs max 1 mark

(a) any two from:

• hydrogen is in group 1 on Newlands table
• fluorine / chlorine / halogens are in group 1 on Newlands table
• alkali metals are in group 2 on Newlands table

allow converse arguments relating to modern table
allow lithium / sodium / potassium for alkali metals
(b) undiscovered

(c) atomic number

(d) D

E

A

*must be in this order*

(e) has a complete outer shell of electrons

*allow because has a stable arrangement of electrons*

(f) noble gases

(a) Carbon and silicon

(b) Atomic number

(c) Hydrogen / fluorine / chlorine are not in Group 1 of the periodic table
   or
   Hydrogen and fluorine / chlorine are not in the same group of the periodic table

   Lithium / sodium / potassium are in Group 1 of the periodic table

(d) plum pudding model has a single ball of positive charge and nuclear model has positive charges in the centre / nucleus

   plum pudding model has electrons in random positions and nuclear model has electrons in fixed positions

   plum pudding model has no nucleus and the nuclear model has a nucleus

   plum pudding model has no neutrons and the nuclear model has neutrons in the nucleus
(a) **mobile phase** propanone

**stationary phase** paper

(b) any **three** from:

- contains chlorophyll a, b and carotene
- contains Pigment B
- does not contain pheophytin
- contains (at least) one unknown substance
- contains five substances
- contains a substance that does not dissolve in the solvent

(c) \[ R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}} \]

(d) both measurements correct

\[ \text{solvent front} = 9.0 \text{ cm and pigment B distance} = 5.0 \text{ cm} \]

\[ R_i = \frac{5.0}{9.0} \]

\[ = 0.56 \]

*allow ecf from incorrect measurements*

(e) origin line drawn in ink

so it will run **or** dissolve in the solvent **or** split up

spots under solvent **or** solvent above spots / origin line

so they will mix with solvent **or** wash off paper **or** colour the solvent **or** dissolve in the solvent
(a) has 2 electrons in the outer shell

\[
\text{allow energy level for shell}
\]

(b) 3 : 2 : 6 : 18

(c) \[
\frac{9 \times 3}{537} \times 100
\]

= 5.0 (

\text{an answer of 5.0 (\%)} \text{ scores 2 marks}
allow 1.7 (\%)
allow 5.027932.. (\%)

(d) correct formulae

\[
\text{correct balancing of correct formulae}
\]

\[
\text{allow multiples}
\]

\[
\text{allow an answer of}
\]

\[
\text{BeCl}_2 + 2K \rightarrow 2KCl + Be
\]

\[
\text{for 2 marks}
\]

(e) potassium is more reactive

so will displace beryllium

(f) \text{(test)}

\text{place in (simple) electrical circuit}

\text{(result)}

\text{conducts electricity}

\text{(alternative test and result)}

\text{add (dilute) acid}

\text{produces hydrogen gas (with acid)}

(a) most alpha particles went straight through, suggesting lots of empty space

a few alpha particles bounced back, suggesting small central nucleus

with all the positive charge
the plum pudding model does not explain the results because it shows the whole atom as a ball of positive charge with no empty space

(b) the figures show that the radius of an atom is 10 000 times bigger than the nucleus consistent with the nuclear model, which says that the atom has a tiny nucleus at the centre of the atom

(c) all hydrogen atoms have just one proton (in the nucleus)

some hydrogen atoms also have one neutron protons and neutrons have the same relative mass so mass number of these atoms is 2

(d) neutrons are not attracted or repelled by a positive nucleus so the neutrons would all pass through the foil

(a) $1 \times 10^{-10}$ m

(b) 1 / one

allow alkali metals

(c) R and S

because they have the same number of protons allow same atomic number, different mass number

and a different numbers of neutrons
(d) **Level 3 (5–6 marks):**
A relevant and coherent explanation of the trend in reactivity. The response makes logical links between the points raised and considers both the number of energy levels and the distance between the nucleus and the outer energy level.

**Level 2 (3–4 marks):**
Statements that are linked to provide a simple explanation of the trend in reactivity using either the number of energy levels or the distance between the nucleus and the outer energy level.

**Level 1 (1–2 marks):**
Simple statements made about the halogens or the trend in reactivity.

**0 marks:**
No relevant comment

**Indicative content**

Simple statements / descriptions
- have 7 electrons in the outer shell
- need to gain an electron
- form ions with a -1 charge
- halogens further down the group are less reactive (or vice versa)
- halogens further down the group have more shells or energy levels (or vice versa)

Linked statements / explanations
- have 7 electrons in the outer shell so need to gain an electron to have the electronic structure of a noble gas
- halogens further down the group are less reactive because they have more shells or energy levels (or vice versa)
- halogens further down the group have more shells or energy levels so less attractive force on the incoming electron (or vice versa)
- halogens further down the group have more shells or energy levels so more ‘shielding’ against the incoming electron (or vice versa)
- outer electrons of halogens further down group are further away from the attractive force of the nucleus (or vice versa)
- an electron is less easily gained because there are more shells or energy levels (or vice versa)
- an electron is less easily gained because the outer electrons are further from the attractive force of the nucleus (or vice versa)

(a) **elec**tron  
**pro**ton  
**neu**tron  

_This order only_

-all 3 correct = 2 marks

1 or 2 correct = 1 mark
(b)  \( A = \) electron has less mass so is deflected more  
or  
electron deflected towards positive because it is negatively charged  

\[ B = \text{neutron because the neutron's path does not change as not charged} \]

\[ C = \text{proton and proton has greater mass (accept heavier) so is deflected less (than electron)} \]

\[ \text{or} \]

\[ \text{proton is deflected towards negative because it is positively charged} \]

this is because the lower plate is negative  

\[ \text{or} \]

\[ \text{upper plate is positive} \]

(c)  \[
\frac{23}{6.02 \times 10^{23}}
\]

\[ 3.82 \times 10^{-23} \]

\[ \text{answer to 3 significant figures} \]

(d) \[ 2.27 \times 10^{-14} \]