Exampro GCSE Chemistry

C3 Chapter 1 Higher

Name:

Class:

Author:

Date:

Time: 72

Marks: 72

Comments:

Q1. In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

(a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

.....

.....

(1)

(b) Describe how the elements in the modern periodic table are arranged:

(i) in terms of protons

.....

.....

(1)

(ii) in terms of electrons.

.....

.....

(1)

(c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

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(2)

(d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

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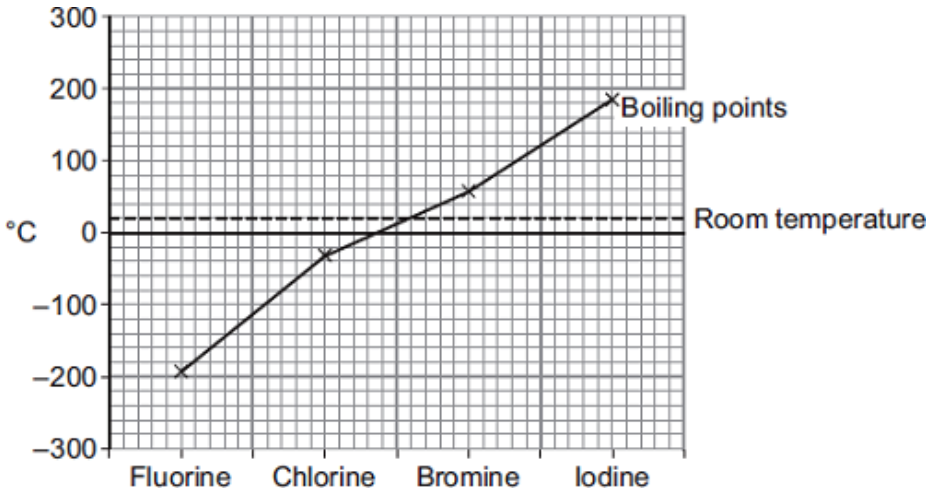
(4)
(Total 9 marks)

Q2. The graph shows the boiling points of the halogens.



(a) Use the graph to help you answer these questions.

(i) Use the correct answer from the box to complete the sentence.

gas	**liquid**	**solid**

At room temperature chlorine is a ..... .

(1)

(ii) Describe the trend in boiling point from fluorine to iodine.

.....

.....

(1)

(b) Chlorine reacts with metals to produce metal chlorides.

(i) When a chlorine atom forms a chloride ion it gains one electron.

What is the charge on a chloride ion?

.....

(1)

(ii) Write a word equation for the reaction between sodium and chlorine.

.....

(1)

(c) In the UK water companies add chlorine to tap water.

Why is chlorine added to tap water?

.....

(1)

(d) Water companies add fluoride to tap water in some parts of the UK.

Fluoride is added to improve dental health.

Suggest **one** reason why some people are against adding fluoride to tap water.

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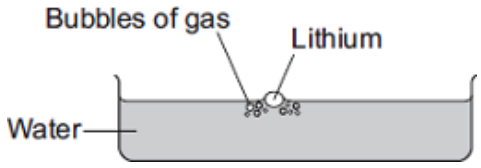
(1)

(Total 6 marks)

Q3. Lithium is in Group 1 of the periodic table.

Lithium reacts with water to produce a gas and an alkaline solution.



(a) (i) Name the gas produced.

.....

(1)

(ii) Which ion causes the solution to be alkaline?

.....

(1)

(b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1 .....

.....

2 .....

.....

(2)
(Total 4 marks)

Q4. Platinum and gold are transition elements. They can both be used to make wedding rings.

By Jeff Belmonte from Cuiabá, Brazil (Flickr) [CC-BY-2.0], via Wikimedia Commons

(a) Platinum and gold are good materials for making wedding rings.

Use your knowledge of the properties of transition elements to suggest why.

.....

.....

.....

.....

(2)

(b) Explain, in terms of electronic structure, why transition elements have similar chemical properties.

.....

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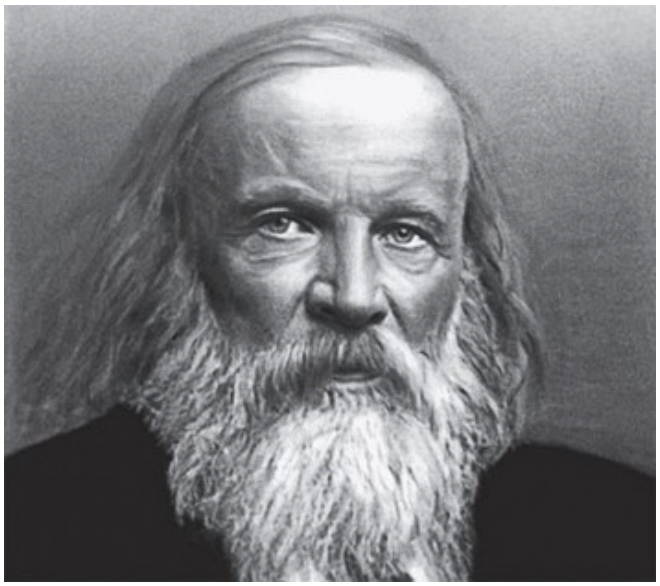
(2)
(Total 4 marks)

Q5. Use the periodic table on the Data Sheet and the information below to help you answer these questions.



Mendeleev was one of the first chemists who classified elements in a systematic way based on atomic weight. He suggested his version of the periodic table in 1869.

He put the elements in order of their atomic weights but reversed the order for some pairs of elements. Then he arranged them in a table so that chemically similar elements were in columns known as Groups. He also left gaps and made predictions.

Part of Mendeleev's table is shown below.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca	#	Ti	V	Cr	Mn
Cu	Zn	#	#	As	Se	Br
Rb	Sr	Y	Zr	Nb	Mo	#
Ag	Cd	In	Sn	Sb	Te	I

The gaps Mendeleev left are shown by #.

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3

(a) Which group of elements in the modern periodic table is missing from Mendeleev's table?

.....

(1)

(b) Mendeleev reversed the order for some pairs of elements. For example, he put tellurium (Te, atomic weight 128) before iodine (I, atomic weight 127), as shown in his table.

Why did he do this?

.....

.....

(1)

(c) In 1869 many chemists did **not** agree with Mendeleev's periodic table.

Suggest **three** reasons why.

.....

.....

.....

.....

.....

.....

.....

(3)

(d) In the 20th century, the arrangement of elements in the periodic table was explained in terms of atomic structure.

Describe the links between atomic structure and the periodic table.

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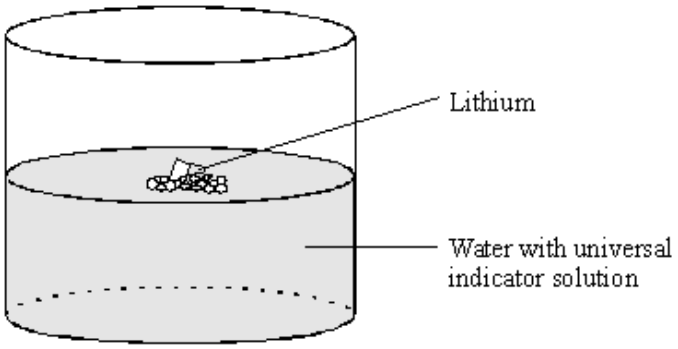
(2)
(Total 7 marks)

Q6. Lithium is a very reactive metal.

(a) Lithium reacts with cold water.



(i) Which **physical** property of lithium is seen during this reaction?

.....

(1)

(ii) Which **chemical** property of lithium will be shown by the universal indicator?

.....

(1)

(b) Complete the sentence by writing in the missing numbers.

Lithium has an atomic number of 3 and a mass number of 7.

This means that an atom of lithium has ..... protons ..... electrons

and ..... neutrons.

(3)

(Total 5 marks)

Q7. (a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

.....

.....

.....

.....

.....

(2)

(b) By the early 20th century protons and electrons had been discovered.

Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

.....

.....

.....

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.....

.....

(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

.....

.....

.....

.....

(2)

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

.....

.....

.....

(1)

(Total 8 marks)

Q8. The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

.....

.....

(1)

(b) Sea water contains bromide ions (Br^-).
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.
Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.

$$2Br^-(aq) + Cl_2(g) \rightarrow Br_2(g) + 2Cl^-(aq)$$

Explain, in terms of electrons, why chlorine is more reactive than bromine.

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.....

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.....

.....

(3)
(Total 4 marks)

Q9. The following article appeared recently in the *Manchester Gazette*.

Sodium Drum Blaze Scare

A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.

A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, “It was fortunate that potassium wasn’t involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous”.

(a) Group 1 metals are stored under oil.

Suggest why.

.....

(1)

(b) Balance the equation which represents the reaction between sodium and water.

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

(1)

(c) Explain why the Group 1 metals are called the *alkali metals*.

.....

.....

(1)

(d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

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.....

.....

(3)
(Total 6 marks)

Q10. Read the information about the development of the periodic table and answer the questions that follow:

Johann Döbereiner was a chemist who realised there was a link between atomic weight and chemical properties. Although it was difficult to measure atomic weights accurately, by 1829 Döbereiner had arranged many elements with similar chemical reactions in groups of three. He noticed that the middle element had an atomic weight that was approximately the average of the other two. These groupings were known as triads. Three of these triads are shown below:

Li 7	S 32	Cl 35.5
Na 23	Se 79	Br 80
K 39	Te 128	I 127

As new elements were discovered, it became difficult to group them in triads, and it was left to others to build on Döbereiner's work. The result was the first periodic table, suggested by Dimitri Mendeleev in 1869.

Our modern periodic table has evolved from Mendeleev's Table. Lithium, sodium and potassium are still together in Group 1, and chlorine, bromine and iodine are in Group 7.

It was many years before chemists understood the nature of the transition elements.

The modern periodic table on the Data Sheet may help you to answer these questions.

(a) Döbereiner suggested that calcium (Ca), strontium (Sr) and barium (Ba) were also a triad.

Use relative atomic masses to explain why.

.....

.....

.....

.....

(1)

(b) Suggest why Döbereiner's ideas were replaced by those of Mendeleev.

.....

.....

(1)

(c) Lithium, sodium and potassium are in Group 1. All these elements react with water.

Describe what you **see** when potassium is added to water.

.....

.....

.....

(2)

(d) In terms of electronic structure, explain why:

(i) elements in the same group of the periodic table have similar chemical properties

.....

.....

(1)

(ii) transition elements have similar properties even though they are not in the same group

.....

.....

.....

.....

(2)

(iii) in Group 1, lithium is **less** reactive than potassium.

.....

.....

.....

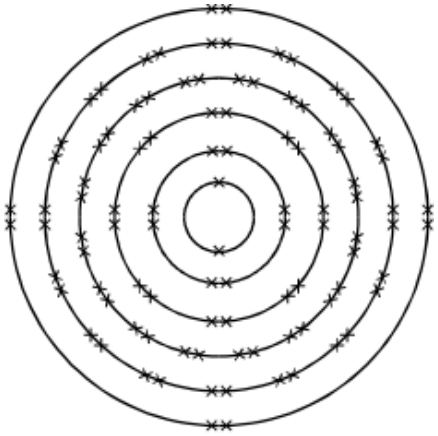
.....

(2)

(Total 9 marks)

Q11. In 1999 scientists at the University of Berkeley claimed to have discovered the element Ununhexium.

The electron arrangement of this element is thought to be as shown in the diagram below.



(a) Which group of the periodic table should this element be placed in?

Group .....

(1)

(b) Give a reason for your answer.

.....

.....

(1)

(Total 2 marks)

Q12. Neodymium (Nd) is a member of the group of elements known as the lanthanides. It is a silvery, white metal. It has a number of uses including making special alloys.

In the reactivity series of metals neodymium is above magnesium but below calcium. Predict how neodymium might react with each of the substances in (a) to (c).

If you think a reaction will take place you should suggest **how vigorous** it might be and **name the products** that might be produced.

(a) How might neodymium react with water?

Reaction .....

.....

Products .....

.....

(b) How might neodymium react with air?

Reaction .....

.....

Products .....

.....

(c) How might neodymium react with dilute hydrochloric acid?

Reaction .....

.....

Products .....

.....

(Total 8 marks)

M1. (a) similar properties

allow same properties

allow correct example of property

ignore answers in terms of atomic structure

1

(b) (i) in order of atomic / *proton* number

allow increasing number (of protons)

1

(ii) elements in same group have same number (*of electrons*) in outer shell **or** *highest energy level*

allow number (of electrons) increases across a period

1

(c) any **two** from:

statements must be comparative

- stronger / harder

ignore higher densities

- less reactive
- higher melting points

ignore boiling point

2

(d) *reactivity increases down group*

allow converse throughout

*for next three marks, outer electron needs to be mentioned once otherwise max = **2***

1

outer electron is further from nucleus

allow more energy levels / shells

allow larger atoms

1

less attraction between outer electron and nucleus

allow more shielding

1

therefore outer electron lost more easily

1

[9]

M2. (a) (i) gas

1

(ii) Increases

1

(b) (i) –1

allow Cl^-

allow –

allow negative

1

(ii) sodium + chlorine → sodium chloride

allow correct symbol equation

1

(c) reduce microbes

accept sterilise

accept prevent diseases

allow disinfect

allow kill bacteria / germs / microbes / micro-organisms

allow to make it safe to drink

ignore get rid of bacteria

1

(d) any **one** from:

- no freedom of choice

  allow unethical

- fluoride in toothpaste

- too much can cause fluorosis

  allow too much can cause damage to teeth

1

[6]

M3. (a) (i) hydrogen

accept H_2

allow H

1

(ii) hydroxide

accept OH^-

allow OH

*do **not** accept lithium hydroxide*

1

(b) any **two** from:

'it' = potassium

potassium:

accept converse for lithium

- reacts / dissolves faster
  allow reacts more vigorously / quickly / violently / explodes
  ignore reacts more
- bubbles / fizzes faster
  allow fizzes more
  allow more gas
- moves faster (on the surface)
  allow moves more
- melts
  allow forms a sphere
- produces (lilac / purple) flame
  allow catches fire / ignites
  *do **not** accept other colours*

2

[4]

M4. (a) any **two** from:

- do not react with water
- do not react with air
  *allow unreactive **or** stay shiny **or** do not tarnish **or** do not corrode*
  *for either of first two points for **1** mark*
  ignore rusts
  ignore durable
- malleable
  ignore hard / strong
- high melting point
  ignore boiling point
  ignore other correct properties

2

(b) (transition elements have) same number / two electrons in outer shell / energy level / fourth shell

ignore references to (metallic) structure / bonding

1

any **one** from:

- because lower energy level / inner shell being filled
- because third energy level can hold up to eighteen electrons

1

[4]

M5. (a) Group O / 8

accept transition elements / metals

or noble / rare / inert gases

apply list principle

1

(b) (chemically) similar elements (now) in the same group / column

accept iodine has properties of Group 7 / halogens

or *iodine does not have group 6 properties*

or *converse for tellurium*

ignore 'it fits the pattern' or any reference to proton / atomic numbers / atomic structure

1

(c) any **three** from:

*ignore not enough evidence / proof **or** Mendeleev not respected*

- (some) boxes had <u>two</u> elements

  allow <u>two</u> correctly identified elements together (in the same box)

- Group 1: copper / silver unreactive (not like the others)

  allow copper / silver not alkali metals / Group 1

- there are non-metals and metals in the same group / box

  accept named examples

- Mendeleev left spaces / gaps

  accept (some chemists thought) there were no more elements to discover

- Medeleev reversed the order (for some elements)

3

(d) any **two** from:

ignore mass number / atomic weight / neutrons throughout

- elements arranged in proton / atomic number order

  allow number of protons / electrons increases across period

- group: elements in same group / column have same number of outer electrons

- elements in same period / row have same number of (electron) shells / energy levels

  allow number of (electron) shells / energy level increase down group

  allow <u>electron</u> rings

  allow orbits

2

[7]

M6. (a) (i) low density

accept floats (on water)

1

(ii) forms an alkaline solution with water

*accept <u>alkali</u> (metal) **or** basic*

*do **not** accept group 1 metal*

1

(b) 3 **or** three (protons)

1

3 **or** three (electrons)

1

4 **or** four (neutrons)

1

[5]

M7. (a) if placed consecutively, then elements would be in wrong group / have wrong properties

allow some elements didn't fit pattern

1

left gaps

1

(b) (elements placed in) atomic / proton number order

1

(elements in) same group have same number of <u>outer</u> electrons

1

any **one** from:

- number of protons = number of electrons
- reactions/(chemical) properties depend on the (outer) electrons
- number of shells gives the period
  allow number of shells increases down the group

1

(c) (i) (transition elements usually) have same / similar number of outer / 4th shell electrons
allow 2 electrons in outer shell

1

(because) inner (3rd) shell / energy level is being filled
ignore shells overlap

1

(ii) 2nd shell / energy level can (only) have maximum of 8 electrons
accept no d-orbitals

or

2nd shell / energy level cannot have 18 electrons

1

[8]

M8. (a) all have seven electrons in their outer shell / energy level

1

(b) *must be comparative in all points or converse*

chlorine atom is smaller than bromine atom

or
chlorine atom has fewer shells than bromine atom

1

outer shell / energy level of chlorine has stronger (electrostatic) attraction to the nucleus than bromine

or
outer shell of chlorine is less shielded from the nucleus than bromine

1

so chlorine more readily gains an extra electron

1

[4]

M9. (a) acts as barrier between sodium and air / oxygen / water (vapour)
accept because they are reactive
ignore oil will not react

1

(b) **2**Na + **2**H_2O → **2**NaOH + H_2

allow multiples / fractions

1

(c) these metals react with water producing an alkaline solution

or

produce solution with pH greater than 7 / high pH

owtte

allow produce OH. ions

***not** these metals are / form alkalis*

ignore 'strong' pH

1

(d) *it = potassium*

*<u>outer</u> electron must be mentioned once for all **3** marks*

bigger atom
or
outer shell electron further from nucleus
or
more shells

or
converse argument for sodium less reactive provided sodium is specified

1

less attraction to nucleus
or
more shielding

***not** less magnetic attraction*

1

outer electron more easily lost

***ignore** potassium reacts more easily*

1

[6]

M10. (a) 40 (Ca) + 137 (Ba) ÷ 2 = 88.5

accept a recognition that the average is near 88
***or** it is the average of the other two*

accept Sr is midway between Ca and Ba

1

(b) eg newly discovered elements / atoms didn't fit (into triads) **or** didn't apply to all elements / atoms **or** lot of exceptions

he = Döbereiner

*ignore Mendeleev left spaces **or** not enough evidence*

1

(c) any **two** from:

- fizzes / bubbles / gas
  hydrogen alone is insufficient
  ignore incorrect name if 'gas' stated
- violent / vigorous / explodes / very fast reaction
  accept container explodes
  ignore strong reaction
- floats / on surface
  ignore sinks
- moves (very quickly)
- melts (into a ball)
- bursts into flame
  accept (bright) light
  ignore colour / glow
- gets smaller / (reacts to) form a solution / dissolves / disappears etc
- steam / gets hot (owtte)
  *ignore alkaline solutions **or** change in colour etc*

2

(d) (i) same number of electrons in outer shell
accept energy level for shell
accept a correct reference to a specific group
eg (all) have one electron in outershell / (all) lose one electron (when they react)

1

(ii) electrons fill an inner / 3rd shell
accept energy level for shell
accept d-level being filled
accept specific reference to 3rd shell
accept descriptions in terms of 3d & 4s etc

1

(usually) same number of outer / 4th shell electrons

1

(iii)

it = lithium

*accept energy level for shell **or** converse reasoning for potassium*

outer shell electron closer to nucleus

accept fewer shells / smaller atom

1

more (electrostatic) attraction (to nucleus) / electrons
less likely to be lost

accept less shielding / isn't much shielding

ignore nucleus has more influence but accept nucleus has more influence over the outer electron(s)

*do **not** accept magnetic / gravitational attraction*

1

[9]

M11. (a) 6 **or** 16

***or** transition metal or F block element or actinide*

1

(b) (elements in group 6 have) six (electrons)
in the outer shell or needs 2 electrons to gain a full shell

accept has 98 electrons

1

[2]

M12. (a) bubble slowly/quickly/vigorously
neodymium hydroxide
hydrogen

(b) oxidise slowly in air
neodymium oxide

(c) violent/very vigorous/rapid bubbles
neodymium chloride
hydrogen

1 mark for each point

[8]