1 In 1869 there were 60 known elements.

Mendeleev arranged the elements in order of their atomic mass (atomic weight).

He realised that elements with similar properties occurred at regular intervals.

(a) Suggest why one of the groups that is on today's periodic table was not in Mendeleev's periodic system.

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(1)

(b) Explain the arrangement of the first 20 elements in today's periodic table.

You should answer in terms of atomic structure.

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(2)

(c) A student put some potassium bromide solution in a test tube.

She added a few drops of chlorine solution and observed the result.

She repeated the process using different potassium halide salts and different halogens.

The table below shows the student's results.

Solution of halogen	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution
Chlorine		Orange colour forms	Brown colour forms
Bromine	No reaction		Brown colour forms
Iodine	No reaction	No reaction	

Give the order of reactivity of the halogens from the results in the table above.

Explain how you used the results to show this order of reactivity.

Order .....

Explanation .....

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(2)

(d) Write a balanced ionic equation for the reaction of chlorine with bromide ions in solution.

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(3)

(e) Explain the order of reactivity of Group 7 elements.

Include information about atomic structure.

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(2)

(Total 10 marks)

2 (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?

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(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.

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(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.

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(1)
(Total 8 marks)

Mark schemes

1

(a) did not appear because they had not been discovered **or** they are unreactive **or** they did not form compounds

1

(b) arranged in order of atomic / proton number

1

elements in the same group have the same number of electrons in the outer shell

1

(c) chlorine>bromine>iodine

table shows that chlorine displaces bromine and iodine

1

and bromine displaces iodine

1

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

correct formulae

1

correct balancing

1

correct state symbol

1

(e) the further down the group, the halogen becomes less reactive because outer electrons are further from the nucleus

1

so less attractive force on an incoming electron

1

[10]

2

(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]