

The Periodic Table

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.1 Atomic Structure and the Periodic Table
Sub-Topic	The Periodic Table
Difficulty Level	Silver Level
Booklet	Question Paper 1

Time Allowed: 59 minutes

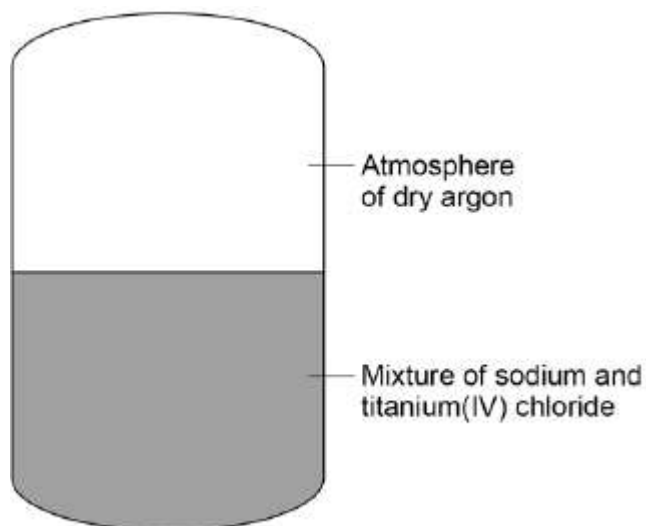
Score: /58

Percentage: /100

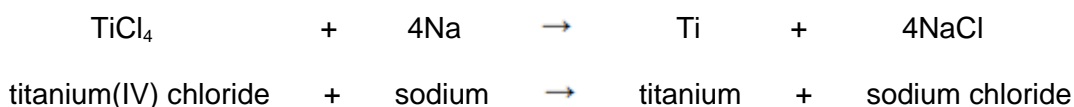
Grade Boundaries:

Q1.Figure 1 shows a reactor used to produce titanium from titanium(IV) chloride.

Figure 1



The chemical equation for the reaction of titanium(IV) chloride with sodium is:



(a) For one reaction:

- 1615 kg titanium(IV) chloride reacted completely with 782 kg sodium
- 1989 kg sodium chloride was produced.

Calculate the mass of titanium produced from this reaction.

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Mass of titanium = kg

(1)

(b) The table below shows the solubility of sodium chloride in 100 cm³ of aqueous solution at different temperatures.

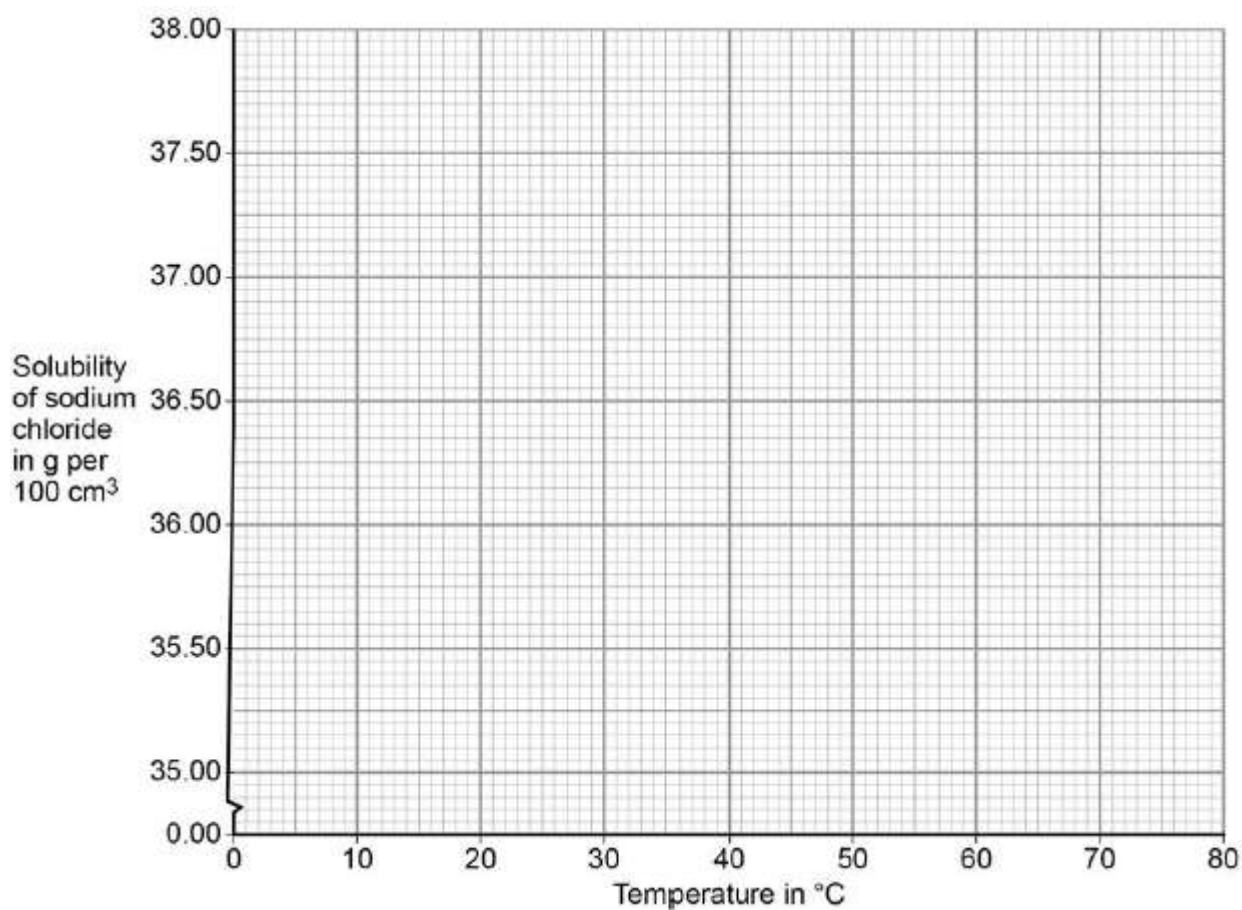
Solubility of sodium chloride in g per 100cm ³	Temperature in °C
35.72	10

35.89	20
36.09	30
37.37	40
36.69	50
37.04	60

On **Figure 2**:

- plot this data on the grid
- draw a line of best fit.

Figure 2



(3)

(c) The product sodium chloride is dissolved in water to separate it from titanium.

At 30 °C the solubility of sodium chloride is 36 kg per 100 dm³.

Calculate the minimum volume of water in dm^3 , at $30\text{ }^\circ\text{C}$, needed to dissolve 1989 kg sodium chloride.

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Volume of water = dm^3

(2)

- (d) Calculate the percentage by mass of titanium in titanium(IV) chloride (TiCl_4).

Give your answer to 3 significant figures.

Relative atomic masses (A_r): Cl = 35.5; Ti = 48

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Percentage of titanium by mass = %

(3)

- (e) Suggest why the reaction is done in an atmosphere of dry argon instead of air containing water vapour.

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(3)

- (f) Explain why titanium conducts electricity.

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(3)
(Total 15 marks)

Q2. This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of

(1)

(ii) The mass number of an atom is the number of

.....

(1)

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

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(2)

(c) Explain why fluorine and chlorine are in the same group of the periodic table.

Give the electronic structures of fluorine and chlorine in your explanation.

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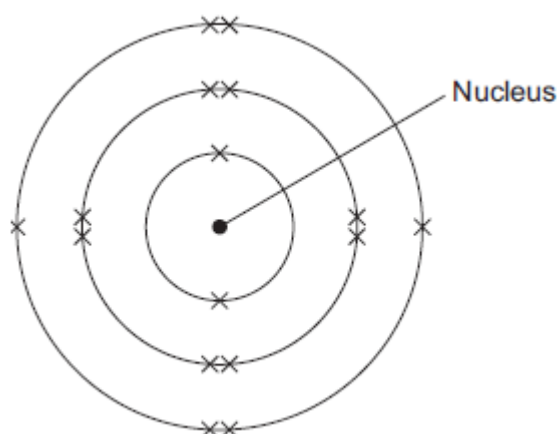
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(2)

- (d) The diagram shows the electronic structure of an atom of a non-metal.



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar	<input type="checkbox"/>
O	<input type="checkbox"/>
S	<input type="checkbox"/>
Si	<input type="checkbox"/>

(1)

- (e) When elements react, their atoms join with other atoms to form compounds.

Complete the sentences.

- (i) Compounds formed when non-metals react with metals consist of

particles called

(1)

(ii) Compounds formed from only non-metals consist of

particles called

(1)

(Total 9 marks)

Q3. In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown below.

Column	1	2	3	4	5	6	7
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

(a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

.....

(1)

(b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

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(1)

- (c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

The modern periodic table places the elements in order of

.....

(1)

- (d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

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(2)

(Total 5 marks)

Q4. This question is about the halogens (Group 7).

- (a) How do the boiling points of the halogens change down the group from fluorine to iodine?

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(1)

- (b) Sodium bromide is produced by reacting sodium with bromine.

Sodium bromide is an ionic compound.

- (i) Write down the symbols of the **two** ions in sodium bromide.

.....

(1)

- (ii) Chlorine reacts with sodium bromide solution to produce bromine and one other product.

Complete the word equation for the reaction.

chlorine + sodium bromide \longrightarrow bromine +

(1)

- (iii) Why does chlorine displace bromine from sodium bromide?

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(1)

- (iv) Use the Chemistry Data Sheet to help you to answer this question.

Suggest which halogen could react with sodium chloride solution to produce chlorine.

.....

(1)

(Total 5 marks)

Q5. The positions of eight elements in the modern periodic table are shown below.

Group 1 2								3 4 5 6 7 0					
Li										N			
									Al				
K						Fe			Cu		As		Br

(a) The **two** metals that react vigorously with water are and (1)

(b) The element used as a catalyst in the Haber process is (1)

(c) The **two** elements with five electrons in their outer shell (highest energy level) are and (1)

(d) Iron has ions with different charges.
The other metal that has ions with different charges is

(1)
(Total 4 marks)

Figure 1

[illegible]

Write the symbol that represents:

(1)

(ii) a transition metal

.....

(1)

(iii) an element with electrons in the same number of energy levels as an atom of argon (Ar)

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(1)

(iv) an element which forms an oxide that dissolves in water to form an acidic solution

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(1)

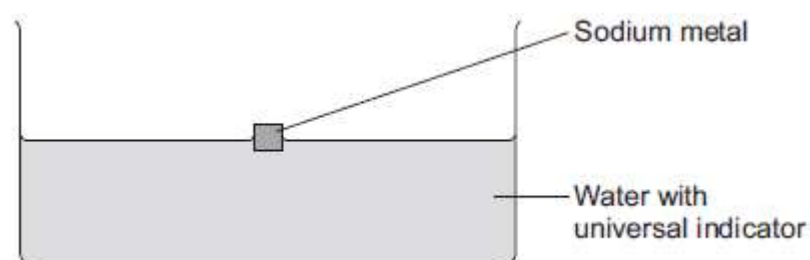
(v) an element that forms a chloride with the formula XCl

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(1)

(b) A teacher put a cube of sodium metal into water containing universal indicator, as shown in **Figure 2**.

Figure 2



The equation for the reaction is:



- (i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1

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2

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3

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(3)

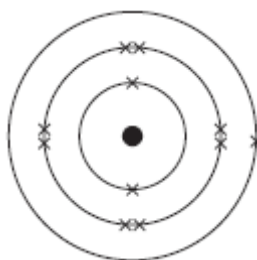
- (ii) Name the ion that made the universal indicator turn purple.

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(1)

- (c) **Figure 3** represents the electronic structure of a sodium atom.

Figure 3



In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)
(Total 11 marks)

Q7.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?

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(1)

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

- (i) in terms of protons

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(1)

- (ii) in terms of electrons.

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(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)