

1. Nov/2022/Paper_11/No.17

The electrical conductivities of two compounds, Y and Z, are shown.

	for Y	for Z
conductivity of the compound in the <u>liquid state</u>	good	does not conduct
conductivity of the mixture obtained by adding the <u>compound to water</u>	good	good

Properties of ionic compounds

1) They do not conduct electricity in solid state but ionic solids

(11) very high m.p and b.p.

(12) soluble in H₂O.

What are compounds Y and Z?

	Y	Z
A	Al ₂ O ₃	SiCl ₄
B	NaCl	Al ₂ O ₃
C	NaCl	SiCl₄
D	SiCl ₄	Al ₂ O ₃

Correct: does not conduct electricity in liquid or solid state.

2. Nov/2022/Paper_11/No.18

Which row describes the relative sizes of the ionic radii of Na⁺, Mg²⁺ and S²⁻?

	smallest	→	largest
A	Na ⁺		Mg ²⁺ S ²⁻
B	Mg ²⁺		Na ⁺ S ²⁻
C	S ²⁻		Na ⁺ Mg ²⁺
D	S ²⁻		Mg ²⁺ Na ⁺

This is movement / change in size of ions across a group. From gp I to VI, there's an increase in atomic charge and hence a decrease in atomic/ionic size. Na⁺ is smaller than Mg²⁺.

From V - VII an extra e⁻ is added to the outer shell to form an ion hence increase in ionic size.

3. Nov/2022/Paper_11/No.19

The oxides BaO, CaO, MgO and SrO all produce alkaline solutions when added to water.

Which oxide produces the saturated solution with the highest pH?

- A** BaO B CaO C MgO D SrO

solubility increases down group II. The most soluble oxide is BaO

4. Nov/2022/Paper_11/No.25

Separate 1.0g samples of Na_2O , MgO , Al_2O_3 , SiO_2 , NaCl , MgCl_2 , Al_2Cl_6 and SiCl_4 are added to separate beakers containing water and stirred.

The number of beakers containing a white solid is Q.

An excess of $\text{NaOH}(\text{aq})$ is then added to each beaker and stirred.

The number of beakers now containing a white solid is R.

Which row is correct?

	Q	R
A	3	2
B	3	3
C	4	3
D	4	4

ionic Na_2O
 ionic MgO
 covalent SiO_2

NaCl - ionic
 MgCl_2 - ionic
 Al_2O_3 - dimer / ionic
 SiCl_4



soluble in water - acidic
 solution \rightarrow add NaOH \rightarrow white ppt

5. Nov/2022/Paper_12/No.17

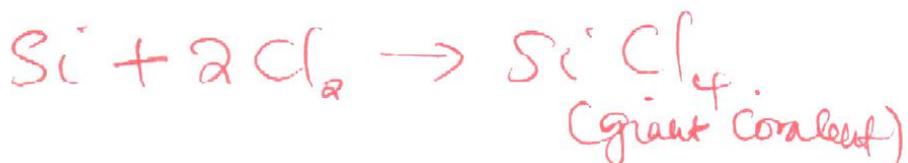
Element X requires strong heating to react with oxygen.

Element X reacts with chlorine to give a covalently-bonded chloride.

What could be the identity of element X?

- A magnesium ~~ionic~~
- B phosphorus \rightarrow does not require strong heating
- C sodium ~~ionic~~
- D silicon**

for covalent bonding, a non-metal element is used in the reaction.



6. Nov/2022/Paper_12/No.18

The melting points of the Period 3 elements sodium to aluminium are shown in the table.

element	Na	Mg	Al
melting point/K	371	923	932

m.p. increases
across the period
for metals, due
to increase in
nuclear charge

Which factor explains the **increase** in melting points from sodium to aluminium?

- A the change in first ionisation energy from sodium to aluminium **X**
- B the increase in electronegativity from sodium to aluminium **X** electronegativity is higher in non-metals.
- C the increase in the A_r of the elements from sodium to aluminium **X**
- D** the increase in the number of outer electrons in each atom from sodium to aluminium

7. Nov/2022/Paper_12/No.25

T is an element in Period 3.

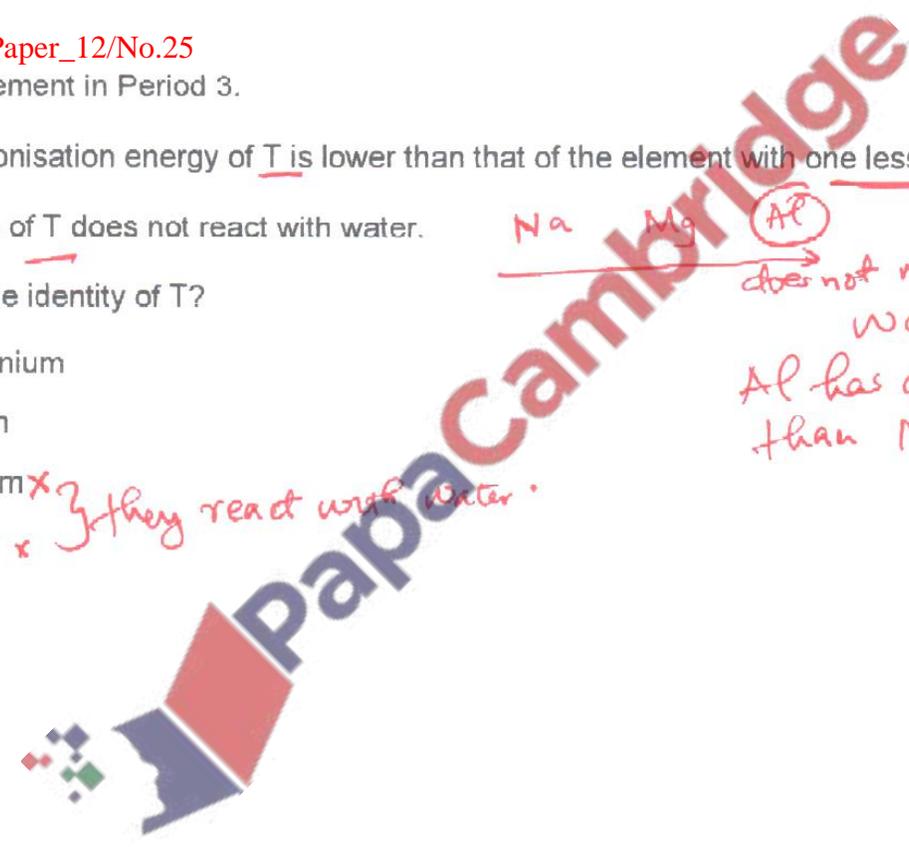
The first ionisation energy of T is lower than that of the element with one less proton.

The oxide of T does not react with water.

Na Mg **Al**
 → does not react with water -
 Al has a lower 1st I.E. than Mg.

What is the identity of T?

- A** aluminium
- B silicon
- C sodium **X** they react with water.
- D sulfur **X**



8. Nov/2022/Paper_21/No.3(a, b)

Some of the common chlorides of Period 3 elements are shown in the list.



(a) From this list, identify:

(i) all the chlorides that have giant ionic structures in the solid state

NaCl and MgCl_2 . [1]

(ii) all the chlorides that react vigorously with water to form strongly acidic solutions

PCl_5 , SiCl_4 and AlCl_3 . [1]

(iii) the chloride that dissolves in water to form a neutral solution

NaCl . [1]

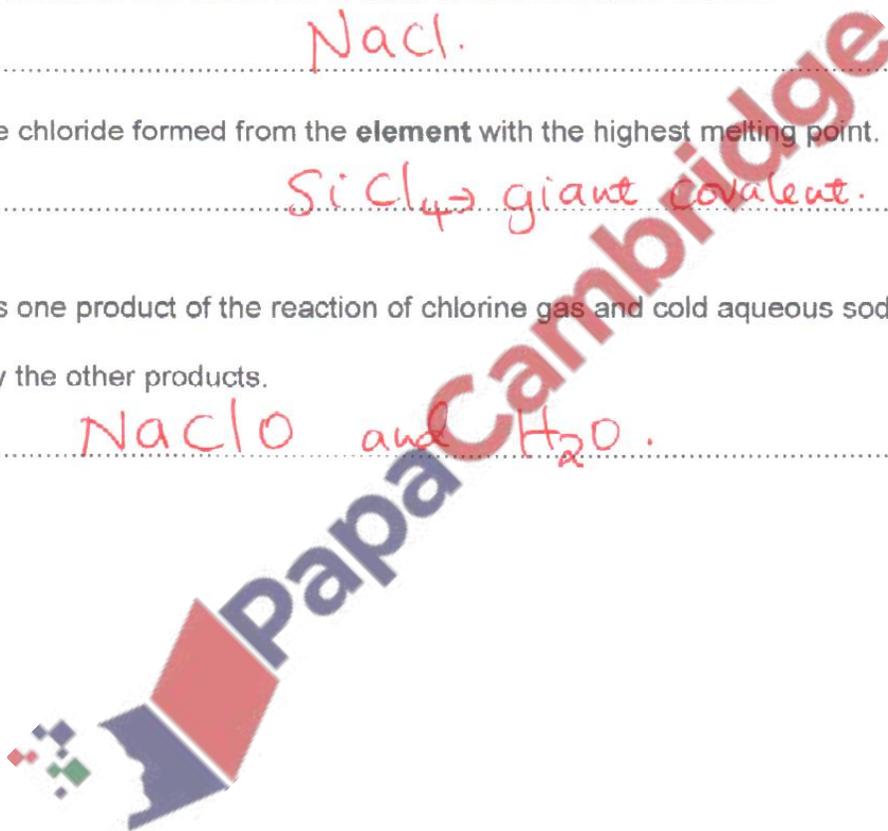
(iv) the chloride formed from the element with the highest melting point.

$\text{SiCl}_4 \rightarrow$ giant covalent. [1]

(b) NaCl is one product of the reaction of chlorine gas and cold aqueous sodium hydroxide.

Identify the other products.

NaClO and H_2O . [1]



The chlorides of some of the Period 3 elements are shown in Table 2.1.

Table 2.1

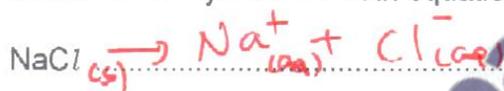
Period 3 chloride	NaCl	AlCl ₃	SiCl ₄	PCl ₅	PCl ₃	SCl ₂
bonding	I	I or C	C	C	C	C
structure	G	G	S	S	S	S
oxidation state of Period 3 element	+1	+3	+4	+5	+3	+2

(a) Complete Table 2.1.

- Identify the bonding shown by each chloride under standard conditions. Use C = covalent, I = ionic, M = metallic.
- Identify the structure shown by each chloride under standard conditions. Use G = giant, S = simple.
- Deduce the oxidation state of the Period 3 element in each chloride.

[4]

(b) Write equations for the reactions of NaCl and PCl₅ with water. Include state symbols in both equations.



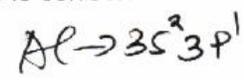
[3]

10. June/2022/Paper_11/No.18

Which statement for the element in Period 3 and Group 13 of the Periodic Table is correct?

- A It has the highest melting point of the elements in its period. *X Si is higher*
- B It has exactly one electron in its shell with principal quantum number 3. *X*
- C** It forms an oxide that reacts with aqueous sodium hydroxide. *✓*
- D It forms a chloride that dissolves in water to give a neutral solution. *not true.*

Amphoteric



11. June/2022/Paper_11/No.19

Carbon monoxide, CO, nitrogen dioxide, NO₂, and sulfur dioxide, SO₂, are all atmospheric pollutants.

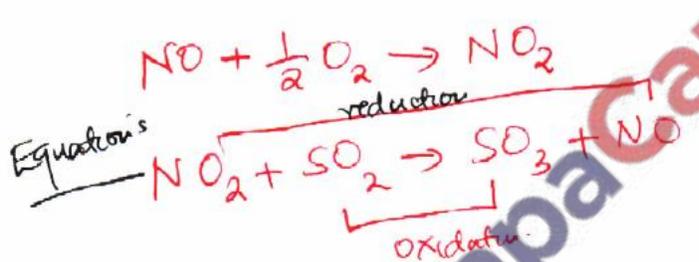
Which reaction occurs in the atmosphere?

- A CO is spontaneously oxidised to CO₂. *X*
- B** NO₂ is reduced to NO by SO₂.
- C NO₂ is reduced to NO by CO. *X*
- D SO₂ is oxidised to SO₃ by CO₂.

in air

CO is not oxidised in the atmosphere

acid.
B Branched ester.
(Methanol and ethanol are substituted)



12. June/2022/Paper_12/No.17

NH₃(aq) is added to separate samples of NaCl(aq), MgCl₂(aq), BaCl₂(aq) and SiCl₄(l). Under the conditions of this experiment, only two samples will produce a white precipitate when NH₃(aq) is added.

What are these two samples?

- A MgCl₂(aq) and BaCl₂(aq)
- B** MgCl₂(aq) and SiCl₄(l)
- C NaCl(aq) and BaCl₂(aq) *X*
- D NaCl(aq) and SiCl₄(l) *X*

used to test for presence of a base.

BaCl does not form acidic solutions

MgCl₂ → forms a slightly acidic solution.

13. June/2022/Paper_12/No.18

Why is the ionic radius of a sulfide ion larger than the ionic radius of a potassium ion?

- A Ionic radius always decreases with increasing atomic number.
- B Positive ions always have smaller radii than negative ions.
- C** The potassium ion has more protons in its nucleus than the sulfide ion.
- D The sulfide ion is doubly charged; the potassium ion is singly charged.

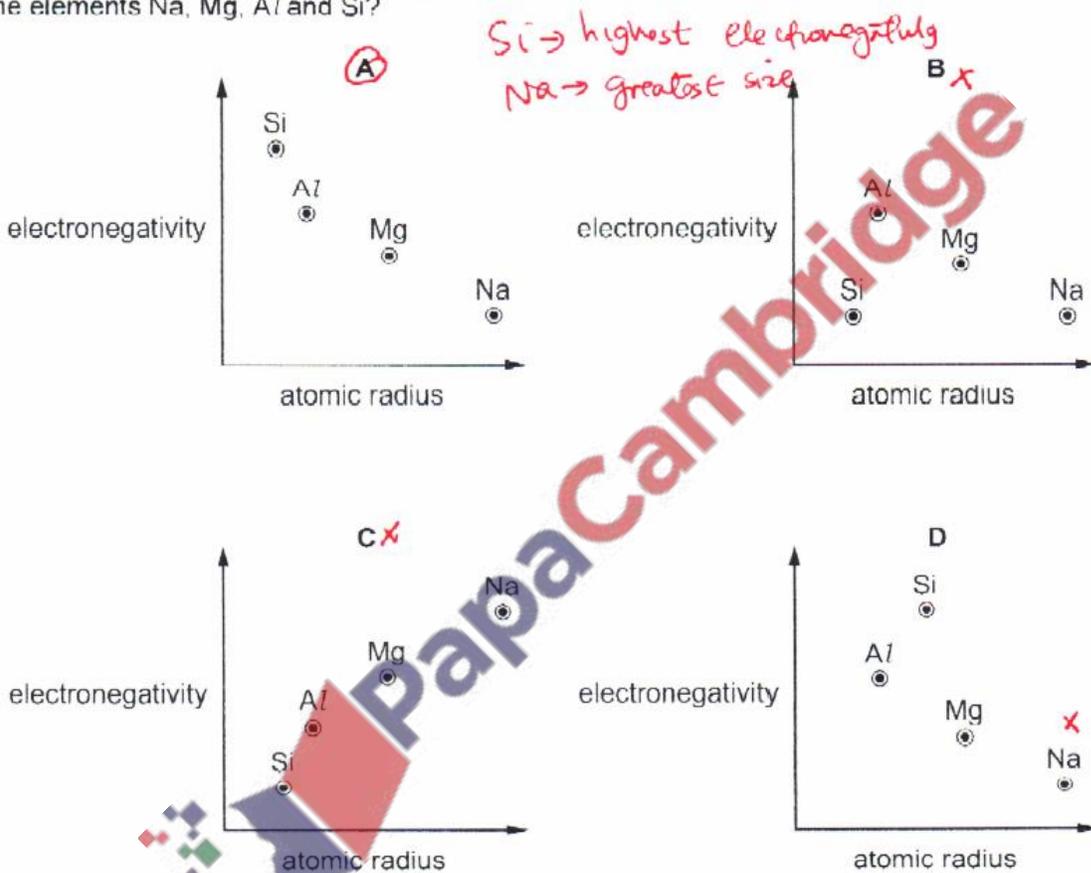
$1s^2 2s^2 2p^6 3s^2 3p^4$

$S^{2-} \rightarrow 16p$ and $18e.$

K^+ has more protons; pulls the outer shells closer to the nucleus. Hence a smaller radius.

14. June/2022/Paper_12/No.19

Which graph correctly shows relative electronegativity plotted against relative atomic radius for the elements Na, Mg, Al and Si?



15. June/2022/Paper_13/No.17

Which ion has the smallest radius?

- A** Al^{3+}
- B Ba^{2+}
- C Mg^{2+}
- D Na^+

Which row is correct?

\rightarrow The smaller the distance btw the shells from the nucleus, the smaller the ionic radius.

Al has the smallest ionic radius since it has more protons.

16. June/2022/Paper_13/No.18

Which row is correct?

	element with the greater fifth ionisation energy	element with an amphoteric oxide
A	aluminium $-2.5-2$	aluminium only \rightarrow amphoteric
B	aluminium	both aluminium and phosphorus
C	phosphorus $-2.5-5$	aluminium only \downarrow not amphoteric
D	phosphorus \times	both aluminium and phosphorus

\rightarrow Ionisation energies increase with increase in nuclear charge.

gains e^- \times $p3^-$, $AE3^+$

17. June/2022/Paper_13/No.19

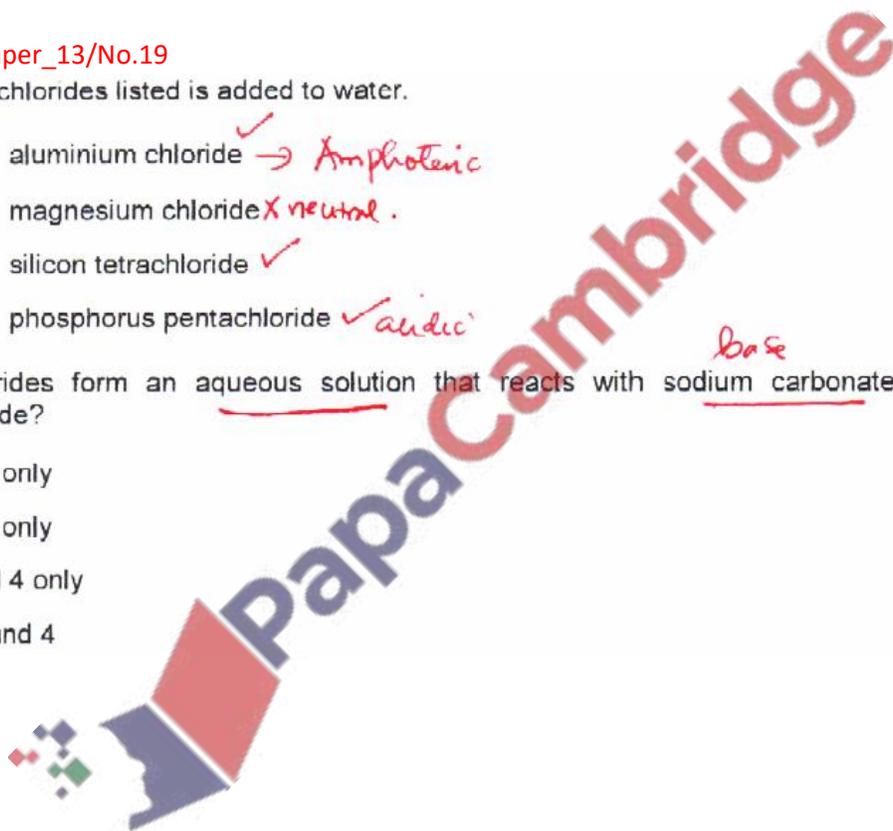
Each of the chlorides listed is added to water.

- aluminium chloride \rightarrow Amphoteric
- magnesium chloride \times neutral.
- silicon tetrachloride \checkmark
- phosphorus pentachloride \checkmark acidic

Which chlorides form an aqueous solution that reacts with sodium carbonate to produce carbon dioxide?

- 1 and 2 only
- 3 and 4 only
- C** 1, 3 and 4 only
- 1, 2, 3 and 4

base



- (c) Across Period 3 there is a general trend for first ionisation energies to increase due to the increase in attraction between the nucleus and the outer electron.

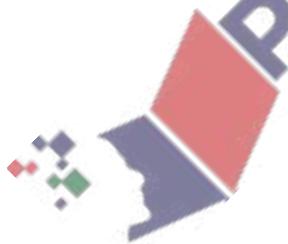
Explain why the first ionisation energy of sulfur is less than the first ionisation energy of phosphorus.

${}^{32}_{16}\text{S} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^4$, $\text{P} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^5$
 - There is a repulsion of two electrons in a 3p orbital in sulfur. [2]

- (d) In an Al^{2+} ion the nuclear attraction for the outer electron is stronger than in an atom of Na.

Compare the electronic structures of Al^{2+} and an atom of Na and explain why the third ionisation energy of aluminium is greater than the first ionisation energy of sodium.

$\text{Al}^{2+} \rightarrow 2 \cdot 8 \cdot 1$ } Though the electron arrangement is
 $\text{Na} \rightarrow 2 \cdot 8 \cdot 1$ } similar, Al^{2+} has a greater
 nuclear charge than Na. [2]



(a) Period 3 elements and their compounds show trends in their physical properties.

(i) On Fig. 2.1 sketch a graph to show the melting points of the first five elements in Period 3.

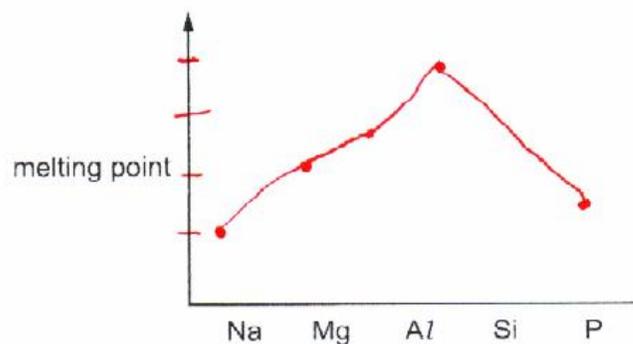


Fig. 2.1

[3]

(ii) Complete Table 2.1 with information for sodium chloride and phosphorus(V) chloride.

Table 2.1

	sodium chloride	phosphorus(V) chloride
state at room temperature	solid	solid
name of change which occurs on addition of water	dissolves	hydrolysis
pH of final solution	7	1-2

[3]