

**2: Particles, atomic structure, ionic bonding and the Periodic Table – Topic questions****Paper 3**

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

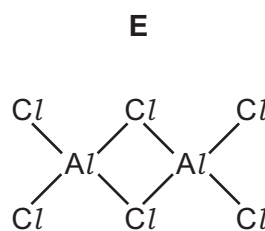
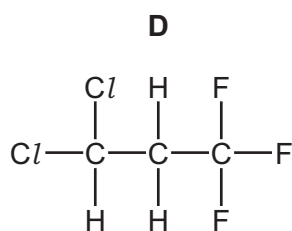
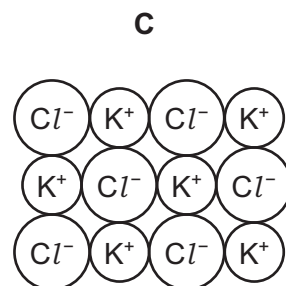
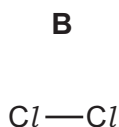
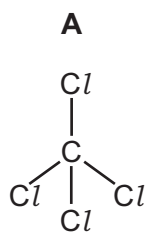
Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	31
1	2016	June	32
4	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

1 The structures of some substances containing chlorine are shown.



(a) Answer the following questions about these substances.

(i) Which substance is a diatomic molecule?

..... [1]

(ii) Which substance represents part of an ionic structure?

..... [1]

(iii) Which substance is an element?

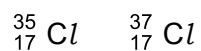
Explain your answer.

..... [2]

(iv) Determine the simplest formula for substance D.

..... [1]

**(b)** The symbols for two isotopes of chlorine are shown.



**(i)** How do these two isotopes differ in their atomic structure?

..... [1]

${}^{35}_{17}$

**(ii)** Determine the number of neutrons present in one atom of the isotope  ${}^{35}_{17}\text{Cl}$ .

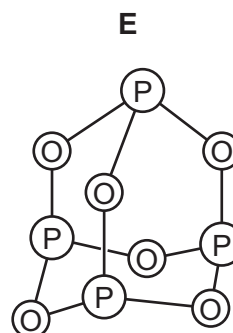
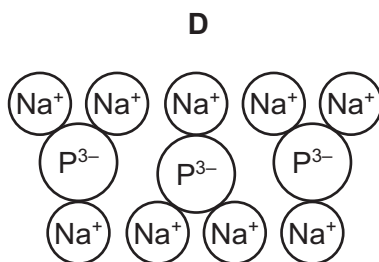
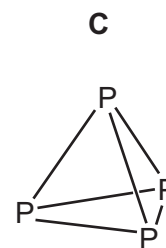
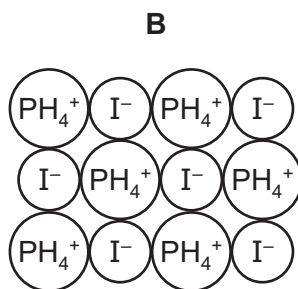
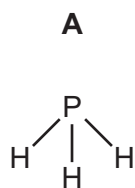
..... [1]

**(iii)** Draw the electronic structure of a chlorine atom. Show all shells and all electrons.

[2]

[Total: 9]

1 The structures of some substances containing phosphorus are shown.



(a) Answer the following questions about these substances.

(i) Which **two** of these substances are ionic?

..... and ..... [1]

(ii) Which **one** of these substances is an element?

Explain your answer.

.....  
 ..... [2]

(iii) Determine the simplest formula for substance **D**.

..... [1]

(b) Phosphorus has one naturally occurring isotope.

$^{31}_{15}\text{P}$

(i) Determine the number of neutrons present in one atom of the isotope  $^{31}_{15}\text{P}$ .

..... [1]

(ii) How many electrons are there in the outer shell of one phosphorus atom?

..... [1]

(iii) Determine the **total** number of electrons present in a phosphorus molecule,  $\text{P}_4$ .

..... [1]

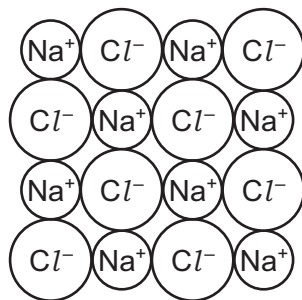
(c) What type of oxide is phosphorus(V) oxide?

Explain your answer.

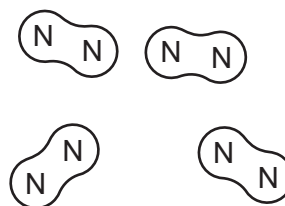
.....  
..... [2]

[Total: 9]

4 The structures of sodium chloride and nitrogen are shown below.



sodium chloride



nitrogen

- (a) Describe the structure and bonding of these two substances and the differences in
- their volatility,
  - their electrical conductivity.

.....

.....

.....

.....

.....

..... [5]

- (b) Ammonia is manufactured by reacting nitrogen with hydrogen using a catalyst.

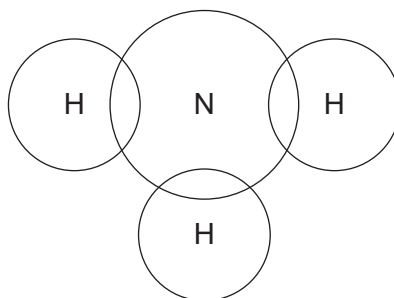
- (i) What is the purpose of the catalyst?

..... [1]

- (ii) Complete the chemical equation for this reaction.

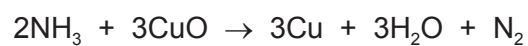


- (iii) Complete the electronic structure of a molecule of ammonia.  
Show only the outer electrons.



[2]

(iv) Ammonia reacts with copper(II) oxide.



Which compound is reduced in this reaction?

Explain your answer.

.....

..... [2]

[Total: 12]

Question	Answer	Marks
1 (a) (i)	B / chlorine / $\text{Cl}_2$ ;	1
1 (a) (ii)	C / $\text{KCl}$ / potassium chloride;	1
1 (a) (iii)	B; has only one type of atom;	1 1
1 (a) (iv)	$\text{C}_3\text{H}_3\text{F}_3\text{Cl}_2$ ;	1
1 (b) (i)	different number of neutrons / different mass numbers / different numbers of nucleons;	1
1 (b) (ii)	18;	1
1 (b) (iii)	7 electrons in the outer shell; first shell has 2 electrons and second shell has 8 electrons;	1 1
		Total: 9
1 (a) (i)	B and D	1
1 (a) (ii)	C; has only one type of atom;	1 1
1 (a) (iii)	$\text{Na}_3\text{P}$ ;	1
1 (b) (i)	16;	1
1 (b) (ii)	5;	1
1 (b) (iii)	60;	1
1 (c)	acidic; because phosphorus is a non-metal / it is a non-metal oxide / it would react with bases / neutralises bases / phosphorus is on the right-hand side of the Periodic Table;	1 1
		Total: 9

*Continues on next page ...*



Question	Answer	Marks
4 (a)	<p>Up for four from:</p> <ul style="list-style-type: none"> <li>• sodium chloride is ionic;</li> <li>• sodium chloride has a giant structure / lattice;</li> <li>• sodium chloride is not volatile / has a high boiling point;</li> <li>• sodium chloride does not conduct (electricity) <u>when solid</u> / conducts <u>when molten</u> / conducts <u>when aqueous</u>;</li> </ul> <p>Up to four from:</p> <ul style="list-style-type: none"> <li>• nitrogen is molecular;</li> <li>• nitrogen has covalent bonds;</li> <li>• nitrogen is volatile / has a low boiling point;</li> <li>• nitrogen does not conduct (electricity);</li> </ul>	5
4 (b) (i)	speeds up (rate of) reaction;	1
4 (b) (ii)	$3\text{H}_2$ ; $2\text{NH}_3$ ;	2
4 (b) (iii)	3 bonding pairs of electrons (between N and H) <u>and</u> no extra electrons on H; 2 non-bonding electrons on N atom;	2
4 (b) (iv)	copper oxide / $\text{CuO}$ ; oxygen removed (from copper oxide) / oxidation number of copper decreases / copper ions gains electrons;	2
		Total: 12