

<b>NAME</b>	<b>INDEX NUMBER</b>
<b>SCHOOL</b>	<b>DATE</b> _____

## STRUCTURE AND BONDING

**1. 1989 Q 6**

The table below gives the distance between atoms (bond lengths) in halogen molecules and the energies required to break the bonds (bond energies) between the atoms.

Molecule	Bond length (nm)	Bond Energy (KJ Mol <sup>-1</sup> )
Cl – Cl	0.20	240
Br – Br	0.23	195
I – I	0.26	150
At – At	0.29	

(i) Predict the energy required to break the At – At bond

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(ii) What is the relationship between bond length and bond energy for the halogen molecules?

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**2. 1989 P1 A Q 8**

A solid compound has a giant Ionic Structure. State and explain whether the compound has electricity in the solid state.

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3. 1989 Q 33c

(c) Using dots (.) and crosses (X) to represent outermost electrons, draw a diagram to show the bonding in  $\text{CCl}_4$ .

4. 1991 P1A Q 21

Using dot (.) and crosses (X) to represent electrons, draw a diagram which shows the bonding in phosphane molecule,  $\text{PH}_3$  (Atomic numbers: p = 15, H = 1) (1 mark)

5. 1993 Q 13

In terms of structure and bonding, explain why graphite conducts electricity while diamond does not (2 marks)

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6. 1993 Q 23c

(a) Study the information given in the table below and answer the questions that follow: -

Formula of compound	NaCl	MgCl <sub>2</sub>	AlCl <sub>3</sub>	SiCl <sub>4</sub>	PCl <sub>3</sub>	SCl <sub>2</sub>
B.P. (°C)	1470	1420	Sublimes at 180°C	60	75	60
M.P. (°C)	800	710		-70	-90	-80

- (i) Give two chlorides that are liquids at room temperature. Give a reason for the answer (2 marks)

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- (ii) Give a possible reason why  $\text{AlCl}_3$  has a much lower melting point than  $\text{MgCl}_2$  although both Al and Mg are metals (1 mark)

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- (iii) Which one of the chlorides would remain in liquid state for the highest temperature range? Show you arrive at your answer (2 marks)

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7. **1994 P1A Q 14**

When an electric current was passed through two molten substances M and N in different containers, the observations in the table below were made.

Molten M	Conducts an electric current and is not decomposed
Molten N	Conducts an electric current and a gas is formed at one of the electrodes

Suggest the type of bonding present in substance M and N

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8. **1994 Q 1 P2**

The table below gives elements represented by letters T, U, V, W, X, Y and their atomic numbers

Element	T	U	V	W	X	Y
Atomic number	12	13	14	15	16	17
Electron arrangement						

Use the information in the table to answer the questions below: -

- (a) Complete the above table giving the electron arrangement of each of the elements

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(b) In which period of the periodic table do these elements belong? Give a reason

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(c) How does the atomic radius v compare with that of X? Explain

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(d) Give the formula of the compound that could be formed between U and W

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(e) What type of bonding will be present in a compound formed between T and Y? Explain

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(f) Arrange the species T,T,T, in increasing order of size

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(g) Which of the ions  $X^{2+}$  and  $X^{2-}$  is the most stable? Explain

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(h) Give the formula of:

(i) An acidic oxide formed when one of the elements in the table is heated in air

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(ii) A basic oxide formed when one of the elements in the table is heated in air

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**9. 1996 Q 5**

a) Using dots (.) and crosses (x) to represent electrons draw diagram to represent`

the bonding in:

(i)  $\text{NH}_3$

(ii)  $\text{NH}_4^+$

(1 mark)

b) State why an ammonia molecule ( $\text{NH}_3$ ) can combine with  $\text{H}^+$  to form  $\text{NH}_4^+$

(Atomic numbers: N=7 and H=1)

(1 mark)

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10. 1996 Q 11

Complete the table below.

Species	Number of neutrons	Electrons
H		

11. 1996 Q 4 P2

Study the table below and answer the questions that follow:

Element	Atomic number	Relative atomic mass	Melting point (°C)
Aluminium	13	27.0	
Calcium	20	40.0	850
Carbon		12.0	3730
Hydrogen		1.0	-259
Magnesium	12	24.3	650
Neon	10		-249
Phosphorous	15	31.0	44.2 (white)
Sodium		23	590 (red)

a) Complete the table by filling in this missing atomic numbers and atomic mass. (2 marks)

b) Write the electron arrangement for the following ions (2 marks)



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c) What is the melting point of hydrogen in degrees Kelvin? (1 mark)  
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d) Which of the allotropes of phosphorous has a higher density? Explain (2 marks)

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 e) The mass numbers of three isotopes of magnesium are 24, 25 and 26.  
 What is the mass number of the most abundant isotope of magnesium? Explain (2  
 marks)

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 f) Give the formula of the compound formed between aluminium and carbon. (1  
 marks)

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g) Explain the difference in the melting points of magnesium and sodium. (2  
 marks)

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**12. 1998 Q 5**

The table below shows some properties of substances C, D and E. Study it and answer the questions that follow.

Substance	M.P (0C)	Solubility in water	Electrical solid state	Conductivity molten state.
E	-39	Insoluble	Good	good
D	1610	Insoluble	Poor	poor
E	801	Soluble	Poor	good

Select substance

a) With a giant molecular structure

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b) That is not likely to be an element

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13. 1998 Q 10

An ion of phosphorous can be represented as  ${}_{15}^{31}\text{P}^{3-}$

Draw a diagram to show the distribution of the electrons and the composition of the nucleus of the ion of phosphorous.

14. 1998 Q 11

Diamond and graphite are allotropes of carbon. In terms of structure and bonding Explain the following.

(a) Diamond is used in drilling through hard rocks

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(b) Graphite is used as a lubricant

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15. 1998 Q 7d

Study the information given in the table below and answer the questions that follow.

The letters do not represent the actual symbols of the elements

(d) What type of bond compound formed  
Give a

Element	Atomic number	Boiling point
S	3	1603
T	13	2743
U	16	718
V	18	87
W	19	1047

would exists in the when U and T react? reason for your answer

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16. 1999 Q 6

What type of bond is formed when lithium and fluorine react? Explain  
(Atomic numbers: Li = 3 and F = 9)

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17. 1999 Q 25

When solid magnesium carbonate was added to a solution of hydrogen chloride in methylbenzene, there was no apparent reaction. On addition of water to the resulting mixture, there was vigorous effervescence. Explain these observations

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18. 1999 Q 3e P2

Study the information in the table below and answer the questions that follow.  
The letters do not represent the symbols of the elements.

Element(C)	Atomic number	Melting point
L	11	97.8
M	13	660
N	14	1440
Q	17	401
R	19	63.7

e) Using dots(.) and crosses (x) to represent outermost electrons show bonding in the compound formed elements N and Q.

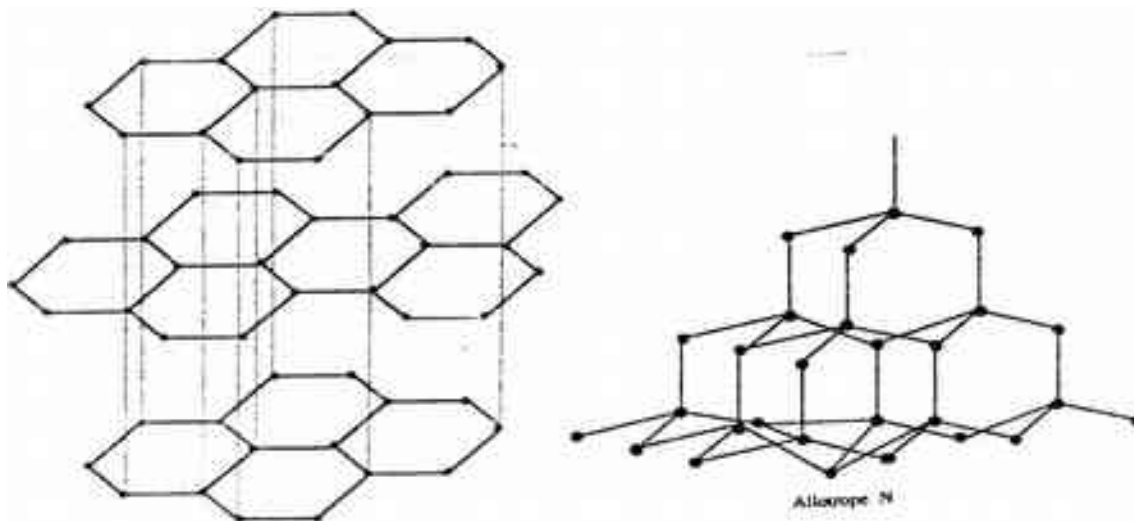
19. 2000 Q 16

Compound Q is a solid with a giant ionic structure. In what form would the compound conduct an electric current

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20. 2000 Q 6a P2

(a) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions that follow



(i) Name allotrope M

M .....

N.....

(ii) Give one use of N

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(iii) Which allotrope conducts electricity? Explain

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**21. 2001 Q 23**

The table below shows the properties of substances K, L, M and N the substances which are likely to be:

Substances	Reaction with oxygen at 25°C	Melting point	Conductivity Solid	Molten
K	Unreactive	Low	Poor	Good
L	Reactive			
M	Unreactive	High	Good	Good
N	Unreactive	Low	Good	Good

- a) Copper metal.....
- b) Magnesium chloride.....

**22. 2002 Q 16**

With reference to iodine, distinguish between covalent bonds and Van Der Waals forces

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23. 2002 Q 20

The table below gives some information about the electrical conductivity and the likely bonding in substances N,P and Q. Complete the table by inserting the missing information the spaces numbered I, II and III

Substance	Likely type of bonding present	Electrical solid	Conductivity
N	Metallic	I.....	Conducts
P	II.....	Does not conduct	Conducts
Q	III .....	Does not conduct	Does not conduct

24. 2003 Q 1b P2

b) i) Element A is the same group of the periodic table as chlorine.  
Write the formula of the compound formed when A reacts with potassium metal.

(1 mark)

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ii) What type of bonding exists in the compound formed in (b) (i) above?  
Give a reason for your answers.

(3 marks)

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25. 2004 Q 6

Both diamond and graphite have giant atomic structures. Explain why diamond is hard while graphite is soft.

(3 marks)

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**26. 2005 Q 4**

Using dots (.) and crosses(x) to represent electrons, show bonding in the compounds formed when the following elements react: (Si = 14, Na = 11 and Cl = 17) (1 mark)

a) Sodium and chlorine (1 mark)

b) Silicon and chlorine (1 mark)

**27. 2005 Q 4c P2**

(c)The table below gives some properties of substances I, II, III, and IV.

Study it and answer the questions that follow

Substance	Electrical conductivity		M.P ( <sup>0</sup> C)	B.P ( <sup>0</sup> C)
	Solid	Molten		
I	Does not conduct	Conducts	801	1420
II	Conducts	Conducts	650	1107
III	Does not conduct	Does not conduct	1700	2200
IV	Does not conduct	Does not conduct	113	440

(i) What type of bonding exists in substances I and II (2 marks)

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(ii) Which substance is likely to be sulphur? Explain (2 marks)

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**28. 2006 Q 20**  
a) Distinguish between a covalent bond and a co-ordinate bond (2 marks)

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b) Draw a diagram to show bonding in an ammonium ion. (1 mark)

**29. 2006 Q 3a,b P2**  
a) Distinguish between isotopes and allotropes. (2 marks)

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b) The chart below is part of the periodic table. Study it and answer the questions that follow. (The letters are not the actual symbols of the elements).

A				B		
C	D				E	

i) Select the element in period three which has the shortest atomic radius. Give a reason for your answer. (2 marks)

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ii) Element F has the electronic structure, 2.8.18.4 on the chart above; indicate the position of element F. (1 mark)

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iii) State one use of the elements of which E is a member. (1 mark)

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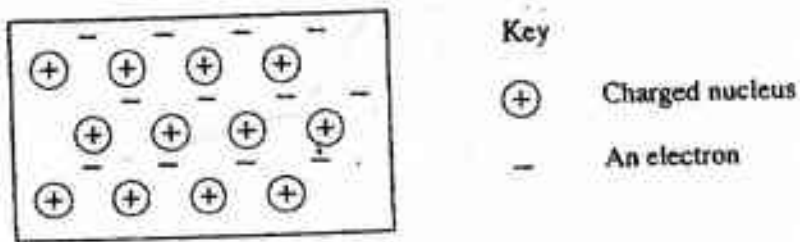
**30. 2007 Q 3b**

b) In terms of structure and bonding, explain why the boiling point of chlorine is lower than that of iodine. (2 marks)

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31. 2007 Q 29

The diagram below is a section of a model of the structure of element T.



- a) State the type of bonding that exists in T. (1 mark)

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- b) In which group of the period table does element T belong? Give a reason. (2 marks)

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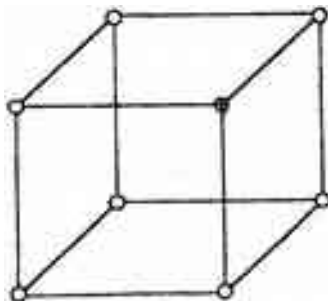
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32. 2007 Q 5a-c P2

- (a) The diagram below represents part of the structure of a sodium chloride crystal. The position of one of the sodium ions in the crystal is shown as  $\oplus$



- (i) On the diagram, mark the position of the other three sodium ions (2 marks)

- (ii) The melting and boiling points of sodium chloride are  $801^{\circ}\text{C}$  and  $1413^{\circ}\text{C}$  respectively. Explain why sodium chloride does not conduct electricity at  $25^{\circ}\text{C}$ , but does so at temperatures between  $801^{\circ}\text{C}$  and  $1413^{\circ}\text{C}$  (2 marks)

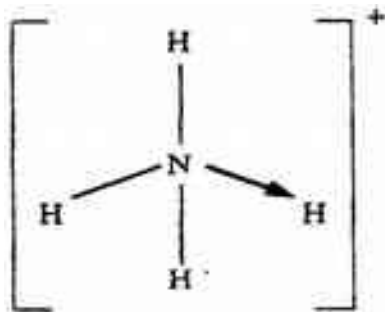


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(b) Give a reason why ammonia gas is highly soluble in water (2 marks)

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(c) The structure of an ammonia ion is shown below:



Name the type of bond represented in the diagram by N → H (1 mark)

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**33. 2008 Q 2b P2**

b) The table below gives information about elements A<sub>1</sub>A<sub>2</sub>A<sub>3</sub>, and A<sub>4</sub>

Element	Atomic Number	Atomic Radius (nm)	Ionic radius (nm)
A <sub>1</sub>	3	0.134	0.074
A <sub>2</sub>	5	0.090	0.012
A <sub>3</sub>	13	0.143	0.050
A <sub>4</sub>	17	0.099	0.181

(i) In which period of the periodic table is element A<sub>2</sub>? Give a reason (2 marks)

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- (ii) Explain why the atomic radius of:
- I  $A_1$  is greater than that of  $A_2$ ;
- .....
- .....
- II  $A_4$  is smaller than its ionic radius (2 marks)
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- (iii) Select the element which is in the same group as  $A_3$  (1 mark)
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- (iv) Using dots (.) and crosses(x) to represent outermost electrons. Draw a diagram to show the bonding in the compound formed when  $A_1$  reacts with  $A_4$  (1 mark)

**34. 2009 Q 6a, c P2**

- (a) Study the table below and complete it.  
( $W^-$  and  $X^{4+}$  are not the actual symbols of the ions)

Ion	Number of Protons	Number of neutrons	Mass Number	Electron Arrangement
$W^-$		20		2.8.8
$X^{4+}$	14		28	

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(c) The atomic numbers of Na and Mg are 11 and 12 respectively. Which of the element has higher ionization energy? Explain (2 marks)

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35. 2009 Q 5

In terms of structure and bonding, explain why the melting point of oxygen is much lower than that of sodium. (3 marks)

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36. 2009 Q 8

Using dots (.) and crosses (X) ,show bonding in:

(a) The compound formed when nitrogen reacts with fluorine.

(Atomic numbers F= 9, N=7)

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(b) Sodium oxide (Atomic numbers Na = 11,O= 8)

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37. 2010 Q 14

Using electrons in the outermost energy level, draw the dot (.) and cross (x) diagram for the molecules H<sub>2</sub>O and C<sub>2</sub>H<sub>4</sub>. (H = 1, C = 6, O = 8)

(2 marks)

i) H<sub>2</sub>O



b) The formula of a complex ion is  $Zn(NH_3)_4^{2+}$ . Name the type of bond that is likely to exist between zinc and ammonia in the complex ion.

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**38. 2010 Q 27**

The atomic numbers of phosphorus, sulphur and potassium are 15, 16 and 19 respectively. The formulae of their ions are  $P^{3-}$ ,  $S^{2-}$  and  $K^+$ . These ions have the same number of electrons.

Write the electron arrangement for the ions. (1 mark)

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a) Arrange the ions in the order of increasing ionic radius starting with the smallest. Give a reason for the order. (2 marks)

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**39. 2010 Q 3 P2**

Use the information in the table below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Atomic number	Melting point ( $^{\circ}C$ )
R	11	97.8
S	12	650.0
T	15	44.0
U	17	-102
V	18	-189
W	19	64.0

a) Give the reasons why the melting point of:

i) S is higher than that of R (1 mark)

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ii) V is lower than that of U (2 marks)

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b) How does the reactivity of W with chlorine compare with that of R with chlorine? Explain, (2 marks)

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c) Write an equation for the reaction between T and excess oxygen (1 mark)

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d) When 1.15g of R was reacted with water, 600cm<sup>3</sup> of gas was produced. Determine the relative atomic mass of R. (Molar gas volume = 24000cm<sup>3</sup>) (3 marks)

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e) Give one use of element V (1 mark)

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**40. 2011 Q 5b(iii-vii) P2**

b) The table below gives the number of electrons, protons and neutrons in particles A, B, C, D, E, F and G.

Particle	Protons	Electrons	Neutrons
A	6	6	6
B	10	10	12
C	12	10	12
D	6	6	8
E	13	10	14

F	17	17	18
G	8	10	8

iii) Write the formula of the compound formed when E combines with G. (1 mark)

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iv) Name the type of bond formed in (iii) above (1 mark)

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v) How does the radii of C and E compare? Give a reason. (2 marks)

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vi) Draw a dot (.) and cross (x) diagram for the compound formed between A and F. (1 mark)

vii) Why would particle B not react with particle D? (1 mark)

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**41. 2011 Q 28**

The diagram below shows the bonding between aluminum chloride and ammonia.



H

Cl

a) Name the types of bonds that exist in the molecule. (1 mark)

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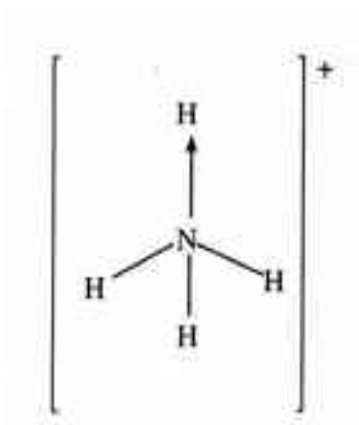
b) How many electrons are used for bonding in the molecule? (1 mark)

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42. 2012 Q7 P1

Ammonium ion has the following structure:



Label on the structure

- (a) Covalent bond; (1 mark)  
(b) Coordinate (dative) bond, (1 mark)