

WJEC P Block Questions.

Examiner
only

10. Aluminium, boron and nitrogen all form chlorides containing three chlorine atoms, XCl_3 .

- (a) Molecules of boron chloride, BCl_3 , and molecules of nitrogen chloride, NCl_3 , have different shapes.

Use VSEPR (valence shell electron pair repulsion) theory to state and explain the shapes of these molecules.

[6]
QWC [2]

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- (b) The boron atom in boron chloride, BCl_3 , is described as being electron deficient. Draw a dot and cross diagram for BCl_3 and use it to show what is meant by the term *electron deficient*. [2]

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- (c) Nitrogen chloride, NCl_3 , is insoluble in cold water whilst the similar compound ammonia, NH_3 , is very soluble. Explain this difference in behaviour. [2]

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- (d) Aluminium chloride, AlCl_3 , forms a dimer that contains both covalent bonds and coordinate bonds. Describe what is meant by the terms *covalent bond* and *coordinate bond*. [2]

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Total [14]



- Q.10 (a)
- BCl_3 is trigonal planar or clear diagram.
 - NCl_3 is pyramidal or clear diagram.
 - BCl_3 has 3 bonded pairs
 - NCl_3 has 3 bonded pairs
 - NCl_3 has a lone pair
 - BCl_3 has no lone pair
 - Electron pairs repel to be as far from each other as possible / position of minimum repulsion.
 - Lone pairs repel more than bonded pairs.

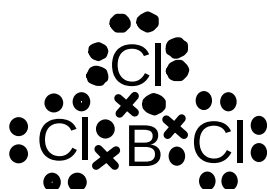
First two points and any other 4 for (1) each up to 6 max

[6]

- *QWC: selection of a form and style of writing appropriate to purpose and to complexity of subject matter.*[1]
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- *QWC: legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning.*[1]

[2]

(b)



accept crosses and dots exchanged (1)

Electron deficient: outer shell of boron has less than 8 electrons / is not full.(1) [2]

- (c) NH_3 can form hydrogen bonds with water molecules (so it dissolves) (1) [2]
 NCl_3 cannot form hydrogen bonding. (1)
- (d)
- Covalent has a pair of shared electrons one from each atom (1)
 - Coordinate has a pair of shared electrons both electrons from same atom (1)

[2]

Total [14]

SECTION B

Examiner
only*Answer all questions in the spaces provided.*

7. Boron, B, has the atomic number 5 and it forms a fluoride, BF_3 .

(a) BF_3 is used to initiate certain types of addition polymerisation of unsaturated compounds.

- (i) Ethene is an example of an unsaturated compound. Describe the bonding between the carbon atoms in ethene. You may wish to draw a labelled diagram. [2]

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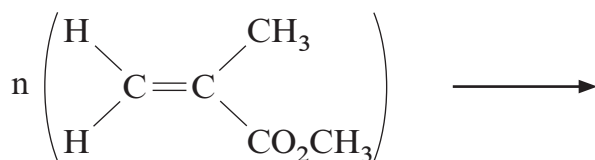
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- (ii) State what is meant by *polymerisation*. [1]

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- (iii) A colourless plastic used to cover lights is made from methyl methacrylate by a process similar to the polymerisation of ethene. Complete the equation by giving the formula of the repeating unit. [1]



- (iv) Addition polymerisation is used to make synthetic rubber. The molecular formula of the monomer used is $\text{C}_4\text{H}_5\text{Cl}$. What is the **empirical** formula of the synthetic rubber polymer? [1]

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- (b) (i) Use the VSEPR theory to deduce the shapes of BF_3 and NH_3 . [2]

Shape of BF_3

Shape of NH_3

- (ii) Explain the difference in the shapes of BF_3 and NH_3 . [2]

QWC [1]

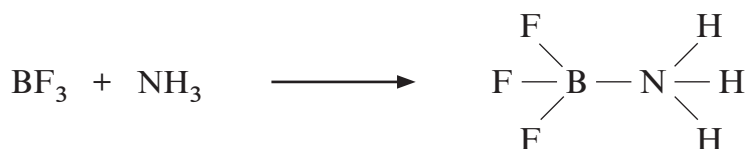
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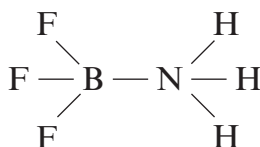
- (c) Boron fluoride reacts with ammonia, NH_3 , to make the compound shown in the following equation.



- (i) Name the type of bond formed between N and B. [1]

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- (ii) Suggest a value for the $\text{F}-\text{B}-\text{F}$ bond angle in this molecule.



Bond angle [1]

- (iii) Explain your answer to part (ii). [1]

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Total [13]



SECTION B

- Q.7 (a) (i) one σ bond/ description of σ bond/ diagram to show overlap of s orbitals (1)
- one π bond/ description of π bond/ diagram to show sideways overlap of p orbitals (1)
- [2]
- (ii) joining of **many/lots of** (small) units or many alkenes / molecules to make a **large/long** unit/ molecule [1]
- (iii)
- $$\text{---} \left(\begin{array}{cc} \text{H} & \text{CH}_3 \\ | & | \\ \text{---C} & \text{---C---} \\ | & | \\ \text{H} & \text{CO}_2\text{CH}_3 \end{array} \right)_n$$
- [1]
- (iv) $\text{C}_4\text{H}_5\text{Cl}$ [1]
- (b) (i) BF_3 is planar triangular/ trigonal planar (1)
- NH_3 is pyramidal/ trigonal pyramid (1) [2]
- (ii) BF_3 has 3 bond pairs (1)
- NH_3 has 3 bond pairs and 1 lone pair (1) [2]
- QWC the information is organised clearly and coherently, using specialist vocabulary where appropriate* [1]
- (c) (i) co-ordinate/ dative covalent/ dative
- no credit for 'covalent' [1]
- (ii) $109\frac{1}{2}^\circ$ (accept any in range 109° - 110°) [1]
- (iii) 4 bond pairs/ bonds (around B)
- no credit for 'tetrahedral' [1]
- Total [13]