

COLLATED QUESTIONS

Lewis structures and shapes (up to six electron pairs about the central atom for molecules and polyatomic ions, including those with multiple bonds), polarity of molecules.

2017:3

(c) Iodine forms a linear I_3^- ion.

- (i) Draw the Lewis structure for the I_3^- ion.
- (ii) Explain why the I_3^- ion has a linear shape.
- (iii) IF_5 has a square pyramidal shape.

Indicate whether the molecule IF_5 is polar or non-polar. Circle your choice.

polar non-polar

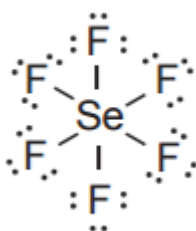
Justify your choice.

2016:1

(c) (i) Complete the following table:

	ICl_4^-	ClF_3
Lewis diagram		
Name of shape		

(ii) The Lewis diagram for SeF_6 is shown below.



Would you expect SeF_6 to be soluble in water?

Yes

No

Explain your answer in terms of the shape and polarity of SeF_6 .

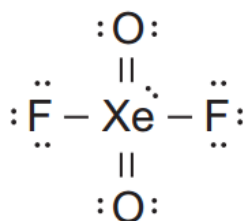
AS91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

2015: 3

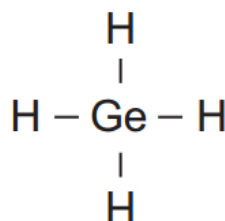
(a) Draw the Lewis diagram and name the shape of

- AsF_5
- SeF_6 .

(b) The Lewis diagrams and shapes for XeO_2F_2 and GeH_4 are shown below.



see-saw



tetrahedral

Compare and contrast the polarities and shapes of these two molecules.

2014: 3

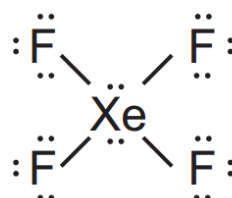
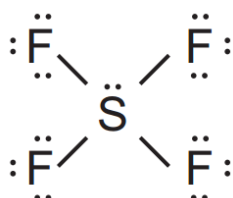
(a) In New Zealand, fluoride for water treatment is supplied as sodium fluorosilicate, Na_2SiF_6 . One of the ions formed in the solution from sodium fluorosilicate is SiF_6^{2-} . Draw the Lewis diagram and name the shape of SiF_6^{2-} .

2013:1

(c) (i) Draw the Lewis diagram and name the shape of

- BF_3
- PCl_6^-

(ii) The Lewis diagrams for SF_4 and XeF_4 are shown below.

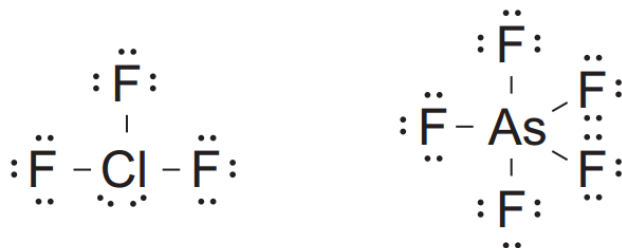


Compare and contrast the polarities and shapes of these two molecules.

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2012: 2 (From expired AS 90780)

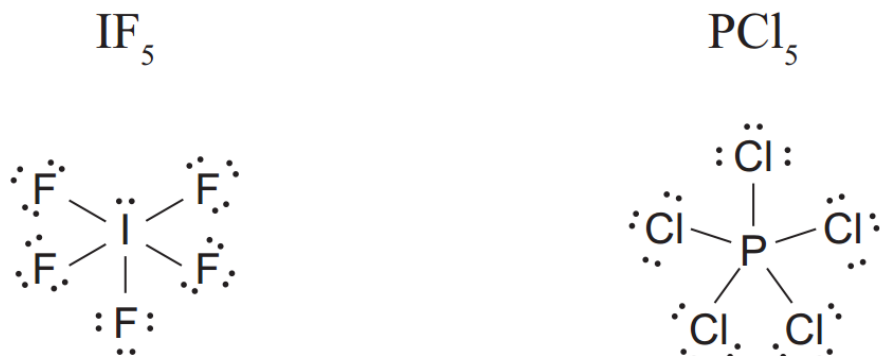
- (a) For the following molecules, draw the Lewis diagram, draw a diagram of the shape, and name the shape.
- SF_6
 - SF_4
- (b) The Lewis diagrams for ClF_3 and AsF_5 are shown below.



Compare and contrast the shape and polarity of these molecules.

2011: 2 (From expired AS 90780)

- (a) Draw Lewis diagrams for IF_3 and NF_3 , and name their shapes.
- (b) The Lewis diagrams for IF_5 and PCl_5 are shown below.



Discuss the polarities of these molecules.

2010: 2 (From expired AS 90780)

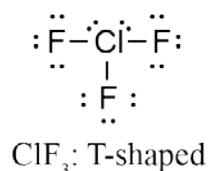
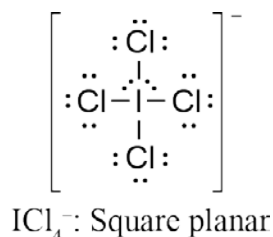
- (a) For the following molecules, draw the Lewis diagram, draw a diagram of the shape, and name the shape.
- SF_4
 - XeF_4
- (b) Discuss the fact that although both SF_4 and XeF_4 have four bonds around the central atom, the molecules have different shapes and polarities.

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Answers

2016: 1

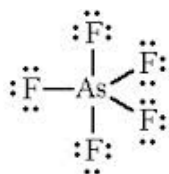
(c) (i)



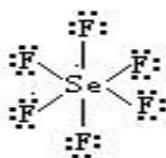
- (ii) No. There is an electronegativity difference between Se and F, so the Se-F bonds are polar covalent. The six bond pairs around the central Se atom arrange themselves as far apart as possible to minimise repulsion, so SeF_6 has an octahedral shape. Since this is a symmetrical shape, the bond dipoles cancel out, so SeF_6 is a non-polar molecule. Water is a polar solvent. Non-polar molecules like SeF_6 are not attracted to polar molecules like water, i.e. the intermolecular attraction between the water molecules and the SeF_6 molecules is insufficient to overcome the attraction between the water molecules. Therefore, SeF_6 is insoluble in water.

2015: 3

(a)



Trigonal bipyramidal



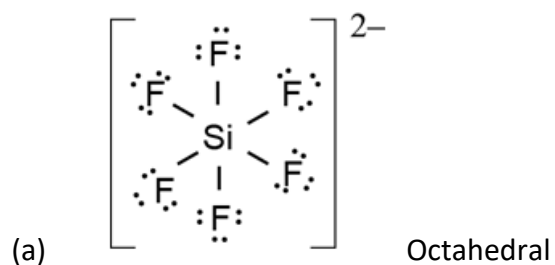
Octahedral

- (b) XeO_2F_2 is polar. It has 5 areas of electron density around the central Xe atom, one of which is a lone pair. Maximum separation for minimum repulsion means that the shape is based on a trigonal bipyramid structure, but is actually see-saw. The $\text{Xe}=\text{O}$ bonds are polar, due to the greater electronegativity of O, and the $\text{Xe}-\text{F}$ bonds even more polar, due to the F atom having the highest electronegativity on the periodic table. The molecule is not symmetrical, and so the dipole moments cannot cancel, making the molecule polar.
- (c) GeH_4 is non-polar. It has 4 areas of electron density around the central Ge atom, all of which are bonded. Maximum separation for minimum repulsion means that the shape is tetrahedral.

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This is a symmetrical structure, thus the bond dipole moments cancel, and therefore the molecule is non-polar.

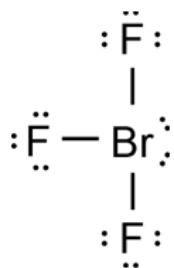
2014:3



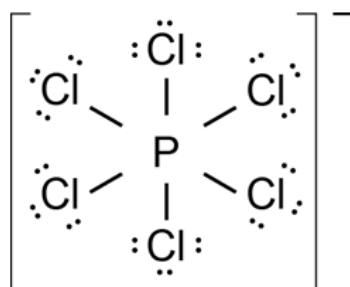
2013: 1

(c) (i)

BrF_3 : T-shaped:



PCl_6^- : Octahedral

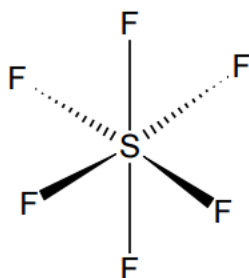
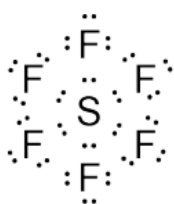


- (ii) There is a difference in electronegativity between S and F, so the S-F bonds are polar covalent. SF_4 has a see-saw shape (distorted tetrahedron) due to the repulsions between four bonding regions and one non-bonding region of charge, which is asymmetric therefore the polarities/dipoles do not cancel. As a result, SF_4 is a polar molecule.

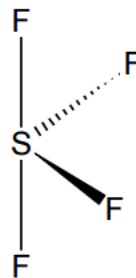
There is a difference in electronegativity between Xe and F, so the Xe-F bonds are polar covalent. XeF_4 has a square planar shape, due to the repulsions between four bonding regions and two non-bonding regions of charge; therefore the polarities/dipoles do cancel. As a result, XeF_4 is a non-polar molecule.

2012: 2 (From expired AS 90780)

(a)



Octahedral



See-saw or saw-horse or distorted tetrahedron

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(b) ClF_3

Shape

- there are 5 regions of electron density around the Cl central atom • these repel to take a trigonal bipyramidal arrangement/ minimise repulsion / to get as far apart as possible
- there are only 3 bonding electron pairs/ 2 lone pairs • thus forming a T-shape arrangement.

Polarity

- the Cl-F bond is polar because of electronegativity difference • the molecule is NOT symmetrical • bond dipoles do not cancel OR charge is not symmetrically distributed over the molecule • so the molecule is polar.

AsF_5

Shape

- has 5 electron pairs around the As central atom • these repel to take a trigonal bipyramidal shape /minimise repulsion / to get as far apart as possible • there are 5 bonding electron pairs/ all electron pairs are bonding • thus forming a trigonal bipyramidal arrangement.

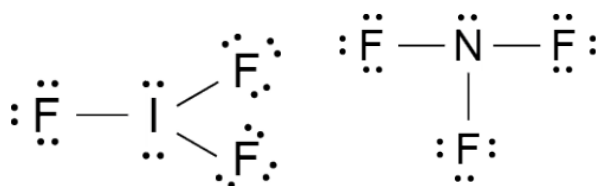
Polarity

- As-F bond is polar because of electronegativity difference • molecule is symmetrical • bond dipoles do cancel • so the molecule is non-polar.

2011: 2 (From expired AS 90780)

(a) IF_3 = T-shape

NF_3 = Trigonal pyramid



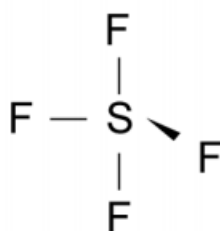
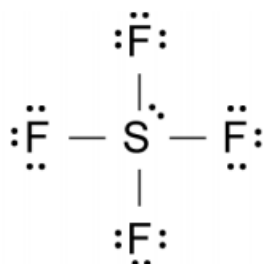
(b) IF_5 • polar IF bond due to difference in electronegativity between I and F • molecule asymmetrical • bond dipoles do not cancel/centre of +ve and –ve charges correspond • molecule is polar.

PCl_5 • polar PCl bond due difference in electronegativity between P and Cl • molecule symmetrical • bond dipoles cancel / centre of +ve and –ve charges correspond • molecule is non-polar.

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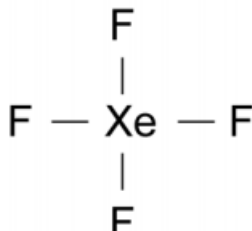
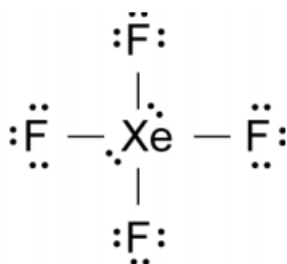
2010: 2 (From expired AS 90780)

(a) SF_4



seesaw / distorted tetrahedron

XeF_4



square planar

(b) XeF_4

Shape • there are 6 electron pairs around the Xe central atom, • these repel to take an octahedral arrangement / minimise repulsion / to get as far apart as possible, • there are only 4 bonding electron pairs / 2 lone pairs, • forming square planar arrangement.

Polarity • the Xe-F bond is polar because of electronegativity difference, • the molecule is symmetrical, • polar bonds (NOT just bonds) cancel / centre of positive and negative charge correspond, • so the molecule is non-polar.

SF_4 Shape • has 5 electron pairs around the S central atom, • these repel to take a trigonal bipyramid shape / minimise repulsion / to get as far apart as possible, • There are only 4 bonding electron pairs / 1 lone pair, • forming see-saw arrangement.

Polarity • S-F bond is polar because of electronegativity difference, • molecule is not symmetrical, • polar bonds (NOT just bonds) do not cancel / centre of +ve and -ve charge do not correspond / polarities reinforce, • molecule is polar.