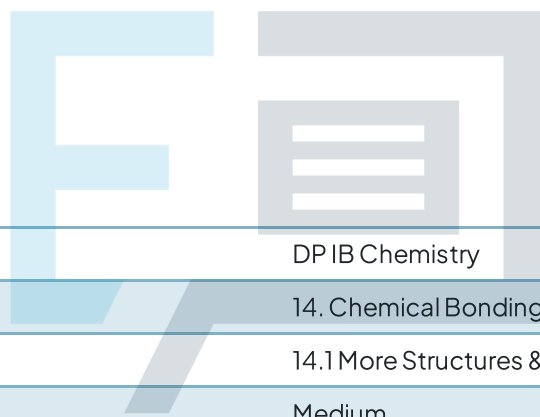




14.1 More Structures & Shapes

Mark Schemes



Course	DP IB Chemistry
Section	14. Chemical Bonding & Structure (HL only)
Topic	14.1 More Structures & Shapes
Difficulty	Medium

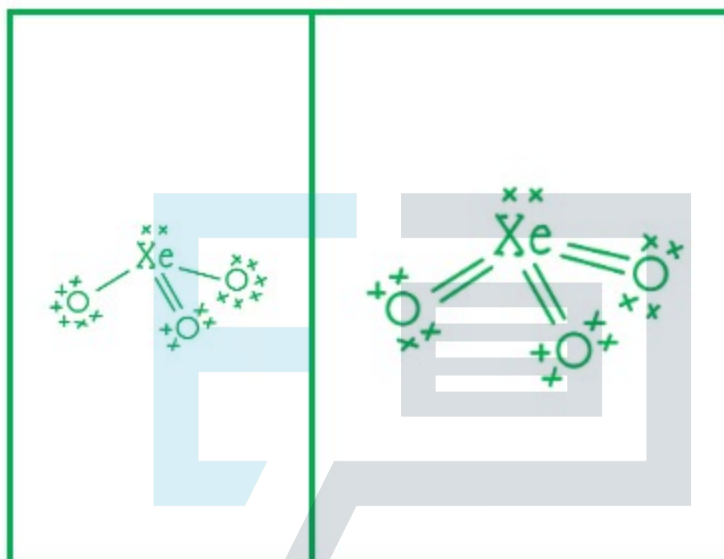
Exam Papers Practice

To be used by all students preparing for DP IB Chemistry HL
Students of other boards may also find this useful

1

The correct answer is **D** because:

- To determine the formal charge on the xenon and oxygen atoms we use the formula:
 - Formal charge (FC) on atom = valence electrons of atom - (1/2 bonding electrons + lone pair electrons)



Xe	$FC = (8) - [1/2(8) + (2)] = +2$	$FC = (8) - [1/2(12) + (2)] = 0$
Left O	$FC = (6) - [1/2(2) + (6)] = -1$	$FC = (6) - [1/2(4) + (4)] = 0$
Central O	$FC = (6) - [1/2(4) + (4)] = 0$	$FC = (6) - [1/2(4) + (4)] = 0$
Right O	$FC = (6) - [1/2(2) + (6)] = -1$	$FC = (6) - [1/2(4) + (4)] = 0$

- Structure on the right is the preferred structure as it has the lowest formal charge
- XeO₃ has 6 bond pairs arranged in 3 double bonds and 1 lone pair
 - 3 bond pairs and 1 lone pair gives a trigonal pyramidal shape



A, B & C are incorrect as	all three statements are correct
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2

The correct answer is **C** because:

- Sulfur has 6 electrons in its outer shell
- It has 4 bonds with chlorine atoms which each contribute an extra electron
- Hence in SCl_4 sulfur has an expanded octet with 10 electrons

A is incorrect as	phosphorus is in group 15 so has 5 electrons in its outer shell. Each chlorine contributes 1 electron giving phosphorus a full outer shell
B is incorrect as	boron is in group 13 so has 3 electrons in its outer shell. Each fluorine contributes an extra electron giving boron 7 electrons. We add an extra electron as the ion has a -1 charge giving a full outer shell
D is incorrect as	nitrogen is in group 15 so has 5 electrons in its outer shell. Each hydrogen contributes an extra electron giving nitrogen 9 electrons. We subtract one as the ion has a +1 charge giving a full outer shell

3

The correct answer is **C** because:

- Phosphorus is in group 15 so has 5 electrons in its outer shell
- Each chlorine atom contributes an electron to phosphorus
- This gives phosphorus a total of 10 electrons arranged in 5 bond pairs
- 5 bond pairs and no lone pairs corresponds to a trigonal bipyramidal shape

A is incorrect as	PCl_3 has 3 bond pairs and 1 lone pair giving it a pyramidal shape
B is incorrect as	SiCl_4 has 4 bond pairs and no lone pairs giving it a tetrahedral shape
D is incorrect as	SF_6 has 6 bond pairs and no lone pairs giving it an octahedral shape

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4

The correct answer is **C** because:

- Each single bond consists of a sigma bond
 - 5 x C-H bonds = 5 sigma bonds
 - 1 x O-H bond = 1 sigma bond
 - 1 x C-O bond = 1 sigma bond
 - 2 x C-C bond = 2 sigma bonds
- Each double bond consists of a sigma and pi bond
 - 1 x C=C = 1 sigma and 1 pi bond
 - 1 x C=O = 1 sigma and 1 pi bond

A, B & D are incorrect as	they contain the incorrect number of sigma and pi bonds
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5

The correct answer is **C** because:

- Br is in group 17 so has 7 electrons in its outer shell
- Each chlorine atom contributes 4 electrons giving 11 electrons in total
- We have to add one electron to account for the negative charge on the ion, giving 12 electrons in total (6 pairs of electrons)
- These are arranged in 4 bond pairs and 2 lone pairs
- This corresponds to a octahedral arrangement of the electron domains but a square planar molecular geometry

A is incorrect as	a tetrahedral molecular geometry corresponds to 4 bond pairs and no lone pairs
B is incorrect as	a tetrahedral electron domain geometry corresponds to 4 electron domains
D is incorrect as	both electron domain geometry and molecular geometry are incorrect for the reasons given above

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