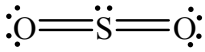
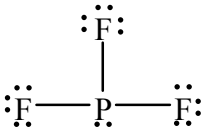
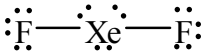
• Complete the following table. **Marks 3**

Molecule	$\underline{S}O_2$	$\underline{P}F_3$	$\underline{Xe}F_2$
Number of non-bonding valence electron pairs about the underlined atom	**1 pair**	**1 pair**	**3 pairs**
Number of valence electron pairs about the underlined atom involved in σ-bonding.	**2 pairs**	**3 pairs**	**2 pairs**
Shape of molecule	**bent**	**trigonal pyramidal**	**linear**

Lewis structures:



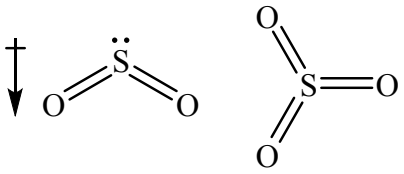




- Which molecule in each of the following pairs has the greater dipole moment? Give reasons for your choice. **3**

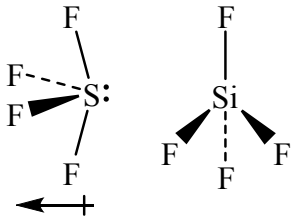
a) SO_2 or SO_3

SO_2 has a larger dipole moment than SO_3.
Both have δ^+ S and δ^- O atoms.
SO_2 is bent leading to the dipole shown.
SO_3 is trigonal planar so that the individual dipoles on the S-O bonds cancel and the molecule has no dipole moment.



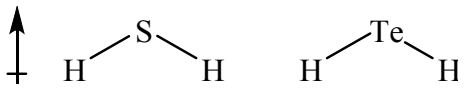
b) SiF_4 or SF_4

SF_4 has a larger dipole moment than SiF_4.
Both have δ^- F with δ^+ Si and S respectively.
The unsymmetrical 'see-saw' structure of SF_4 leads to an overall dipole, as shown.
SiF_4 is tetrahedral so that the individual dipoles on the Si-F bonds cancel and the molecule has no dipole moment.



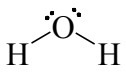
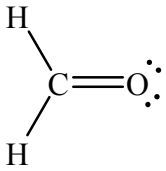
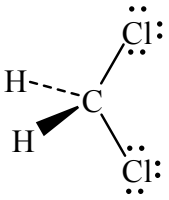
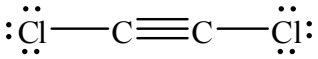
c) H_2S or H_2Te

H_2S has a larger dipole moment than H_2Te.
Both have δ^+ H with δ^- S and Te respectively and are bent leading to overall dipoles, as shown.
S is more electronegative than Te so the partial negative charge on S is considerably bigger leading to a larger dipole moment.



- Complete the following table.

Marks 6

Formula	Lewis structure	Molecular shape	Is the molecule *polar* or *non-polar*?
e.g. H_2O		bent (angular)	polar
CH_2O		**sp^2 hybridized C: trigonal planar**	**polar**
CH_2Cl_2		**sp^3 hybridized C: tetrahedral**	**polar**
C_2Cl_2		***sp* hybridized C: linear**	**non-polar**

- Explain, with reference to the distribution of electronic energy levels, why crystalline SiO_2 (quartz) is transparent while crystalline Fe is opaque.

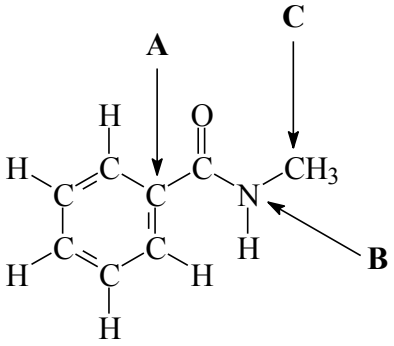
2

SiO_2 has no energy states separated by the energy of the photons in visible light, so it does not absorb light in the visible wavelength range and transmits it instead.

Crystalline Fe has many energy states separated by the energies of all the photons in visible light, so it absorbs light across the entire visible wavelength range.

Marks 3

- The structure of *N*-methylbenzamide is shown below. Complete the table concerning the atoms **A**, **B** and **C** indicated by the arrows.



Selected atom	Number of electron lone pairs about the selected atom	Number of σ-bonds associated with the selected atom	Geometry of bonds about the selected atom
A	**0**	**3**	**trigonal planar**
B	**1**	**3**	**trigonal pyramidal**
C	**0**	**4**	**tetrahedral**