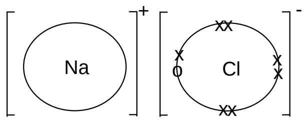
Answers to Topic 3 exercises

Topic 3 Exercise 1

1.



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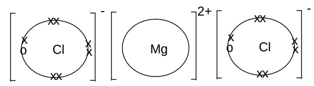

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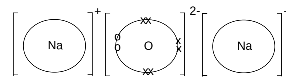

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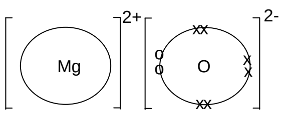

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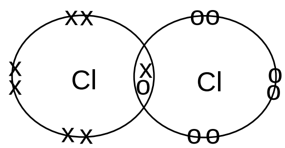

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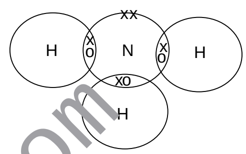

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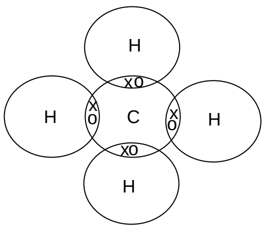

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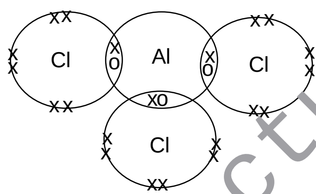

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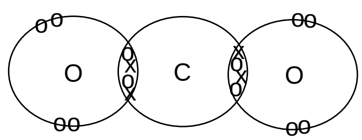

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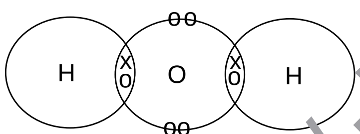

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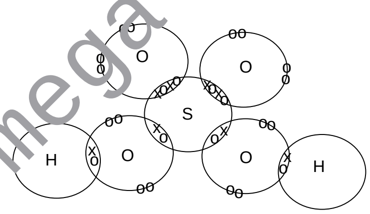

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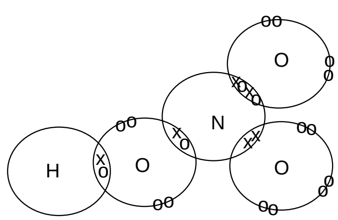

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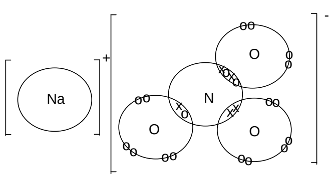

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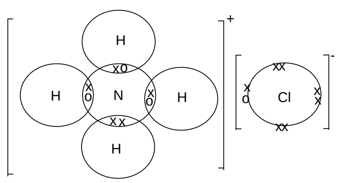

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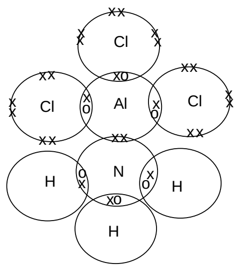


Topic 3 Exercise 2

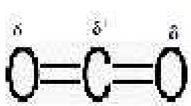
1. ionic – large difference in electronegativity
2. polar covalent – significant but not very large difference in electronegativity
3. covalent – no difference in electronegativity, both atoms electronegative
4. metallic - both atoms electropositive
5. polar covalent - significant but not very large difference in electronegativity
6. ionic – large difference in electronegativity
7. metallic – both atoms electropositive
8. mostly ionic – fairly large difference in electronegativity
9. polar covalent – significant but not very large difference in electronegativity
10. covalent – almost no difference in electronegativity

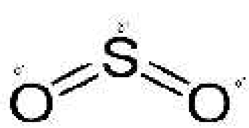
Topic 3 Exercise 3

1. linear, 180^{o}	2. trigonal planar, 120^{o}	3. tetrahedral, 109^{o}
4. trigonal pyramidal, 107^{o}	5. bent, 104^{o}	6. bent, 118^{o}
7. linear, 180^{o}	8. bent, 118^{o}	9. trigonal planar, 120^{o}
10. octahedral, 90^{o}	11. square planar, 90^{o}	
12. trigonal bipyramidal, 120^{o}/90^{o}		13. tetrahedral, 109^{o}
14. octahedral, 90^{o}	15. tetrahedral, 109^{o}	16. trigonal planar, 120^{o}
17. bent, 118^{o}	18. tetrahedral, 109^{o}	19. trigonal pyramidal, 107^{o}
20. trigonal planar, 120^{o}	21. trigonal pyramidal, 107^{o}	

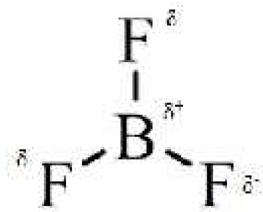
Topic 3 Exercise 4

1. The relative ability of an atom to attract a bonded pair of electrons
2.
   a) Cl – Cl no dipole
   b) H – O $\delta^+ - \delta^-$
   c) B – F $\delta^+ - \delta^-$
   d) N – F $\delta^+ - \delta^-$
   e) N – O $\delta^+ - \delta^-$
   f) H – Cl $\delta^+ - \delta^-$
   g) H – N $\delta^+ - \delta^-$
   h) B – H $\delta^+ - \delta^-$

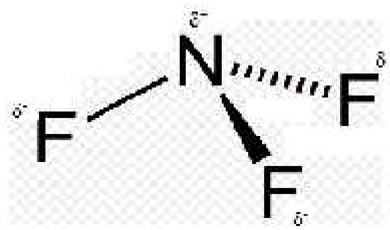
3.
   a)
   
   no overall dipole

   b)
   
   overall dipole

   c)


no overall dipole

d)

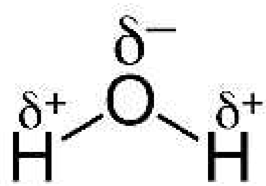

overall dipole

e) Cl-Cl no overall dipole

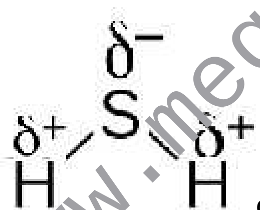
f)

$\overset{\delta+}{H}-\overset{\delta-}{Cl}$ overall dipole

g)


overall dipole

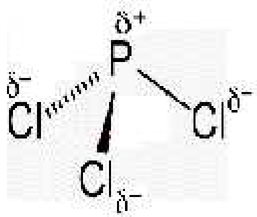
h)


overall dipole

i)

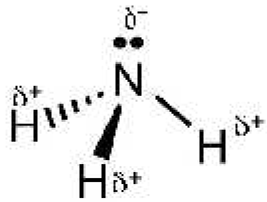

no overall dipole

j)



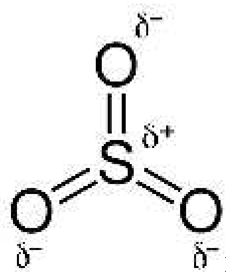
overall dipole

k)



overall dipole

l)



no overall dipole

4. a) Van der Waal's forces only
   b) Van der Waal's forces and dipole-dipole bonding
   c) Van der Waal's forces only
   d) Van der Waal's forces and dipole-dipole bonding
   e) Van der Waal's forces only
   f) Van der Waal's forces and dipole-dipole bonding
   g) Van der Waal's forces and dipole-dipole bonding
   h) Van der Waal's forces and hydrogen bonding
   i) Van der Waal's forces only
   j) Van der Waal's forces and dipole-dipole bonding
   k) Van der Waal's forces and hydrogen bonding
   l) Van der Waal's forces only

Topic 3 Exercise 5

1. both are metals
   Mg^{2+} ions are smaller than Na^{+} ions and have a higher charge
   so the attraction to the delocalised electrons will be stronger
   and more energy will be required to separate them
   so Mg will have a higher melting point
2. both are metals
   Na^{+} ions are smaller than K^{+} ions

so the attraction to the delocalised electrons will be stronger
and more energy will be required to separate them
so Na will have a higher melting point

3. both are ionic
Cl^- ions are smaller than Br^- ions
so the attraction to the Na^+ ions will be stronger
and more energy will be required to separate them
so NaCl will have a higher melting point

4. both are ionic
Mg^{2+} ions are smaller than Na^+ ions and have a higher charge
O^{2-} ions have a higher charge than Cl^- ions
so the attraction between Mg^{2+} and O^{2-} will be stronger
than the attraction between Na^+ and Cl^-
and more energy will be required to separate them
so MgO will have a higher melting point

5. both are giant covalent
C is a smaller atom than Si
So the covalent bonds between C atoms are stronger than those between Si atoms
And more energy will be needed to break them
So C will have a higher melting point

6. both are simple atomic
Ar atoms have more electrons than Ne atoms and a bigger surface area
So the Van der Waal's forces between Ar atoms will be stronger
than those between Ne atoms
And more energy will be required to separate them
So Ar will have a higher melting point

7. both are simple molecular
Cl_2 molecules have more electrons than F_2 molecules and a bigger surface area
So the Van der Waal's forces between Cl_2 molecules will be stronger
than those between F_2 molecules
And more energy will be required to separate them
So Cl_2 will have a higher melting point

8. both are simple molecular
NH_3 has hydrogen bonding between its molecules
Which is stronger than the dipole-dipole bonding/van der Waal's forces
in between molecules of PH_3
so more energy is needed to separate them
so NH_3 has a higher melting point

9. NaCl is ionic, HCl is simple molecular
ionic bonds between Na^+ and Cl^- are stronger
than intermolecular forces between HCl molecules
so more energy is needed to separate them
and NaCl has a higher melting point

10. SiO_2 is giant covalent, CO_2 is simple molecular
the covalent bonds between Si and O atoms
are stronger than the intermolecular forces in between CO_2 molecules

so more energy is needed to separate them
and SiO_2 has a higher melting point

Topic 3 Exercise 6

1. giant lattice of Mg^{2+} ions
attracted to a sea of delocalised electrons
this attraction is strong
so a lot of energy is required to separate the Mg^{2+} ions from the electron sea
so Mg has a high melting point
electrons are free to move
when a potential difference is applied
so Mg conducts electricity
2. giant covalent structure
every C atom is attached to 4 others
in a tetrahedral arrangement
the covalent bonds between C atoms are strong
so a lot of energy is required to separated C atoms from each other
so diamond has a high melting point
there are no free electrons and no ions
so diamond cannot conduct electricity
3. giant covalent structure
every Si atom is attached to 4 O atoms, and every O atom to 2 Si atoms
in a tetrahedral arrangement
the covalent bonds between Si and O atoms are strong
so a lot of energy is required to separate them
so SiO_2 has a high melting point
there are no free electrons and no ions
so SiO_2 cannot conduct electricity
4. giant ionic lattice containing Mg^{2+} ions and O^{2-} ions
the attraction between Mg^{2+} and O^{2-} ions is very strong
so a lot of energy is needed to separate them
so MgO has a high melting point
in the solid state the ions cannot move
so MgO cannot conduct electricity in the solid state
but in the molten state the ions can move
so MgO can conduct electricity in the molten state
5. CO_2 is a simple molecular structure
each C atom is attached to 2 O atoms with double covalent bonds
the molecules are held together by weak Van der Waal's forces
so not much energy is required to separate them
so CO_2 has a low melting point
there are no ions and no free electrons
so CO_2 cannot conduct electricity
6. giant covalent structure
every C atom is bonded to three others

in a trigonal planar arrangement
to form a hexagonal plane of carbon atoms
the fourth electron on each carbon atom is delocalised
the planes are held together by Van Der Waal's forces
which are fairly strong due to the infinite size of the layers
so a lot of energy is needed to separate them
and even more energy to separate the C atoms in the same layer from each other
so graphite has a high melting point
the delocalised electrons can flow freely within the same layer
so graphite conducts electricity (although poorly perpendicular to the layers)

7. giant ionic lattice containing Na^+ and NO_2^- ions
each NO_3^- ion contains N attached to three O atoms with a single bond, a double bond and a dative bond. The ion is planar.
The attraction between the ions is strong
So a lot of energy is required to separate them
So $NaNO_3$ has a high melting point
The ions are not free to move in the solid state
So $NaNO_3$ does not conduct electricity

8. water has a simple molecular structure
each O atom attached to 2 H atoms, and each H atoms to one O
two lone pairs on O give the molecule a bent shape
there is hydrogen bonding between the molecules
which is relatively strong
and requires quite a lot of energy to break
so water has a fairly high melting point
despite the small size of the molecules
there are no ions and no free electrons
so water does not conduct electricity

9. sulphur dioxide has a simple molecular structure
each S atom is attached to 2 O atoms and each O atom to one S
by double covalent bonds
one lone pair on S gives the molecule a bent shape
there is dipole-dipole bonding between the molecules
which is relatively weak
and requires little energy to break
so water has a fairly low melting point
there are no ions and no free electrons
so sulphur dioxide does not conduct electricity

10. He has a simple atomic structure
there are very weak Van der Waal's forces between the atoms
which require very little energy to break
so He has a very low melting point
there are no ions and no free electrons

so He does not conduct electricity