Answer all the questions below as fully as you can then check your answers

1. If electrons are said to be delocalised, what does this mean?
2. What type of electrons are usually involved in delocalisation within organic molecules?
3. What is resonance?
4. Draw Kekulé structures to show the two resonance structures for a benzene molecule.
5. The nitrate ion (NO_3^-) can be drawn as three resonance structures, draw Lewis structures to show the position of all lone pairs and delocalised electrons in the three resonance structures for the nitrate ion.
6. The ozone (O_3) molecule can be drawn as two resonance structures, draw Lewis structures to show the position of all lone pairs and delocalised electrons in the two resonance structures for the ozone molecule.

Answers

1. If electrons are said to be delocalised, what does this mean?

   In a covalent bond the 2 shared electrons are held between the two atomic nuclei involved in forming the bond, that is the electrons are localised

   Delocalised electrons are electrons which are not associated with one particular bond but instead are free to move throughout the whole molecule.

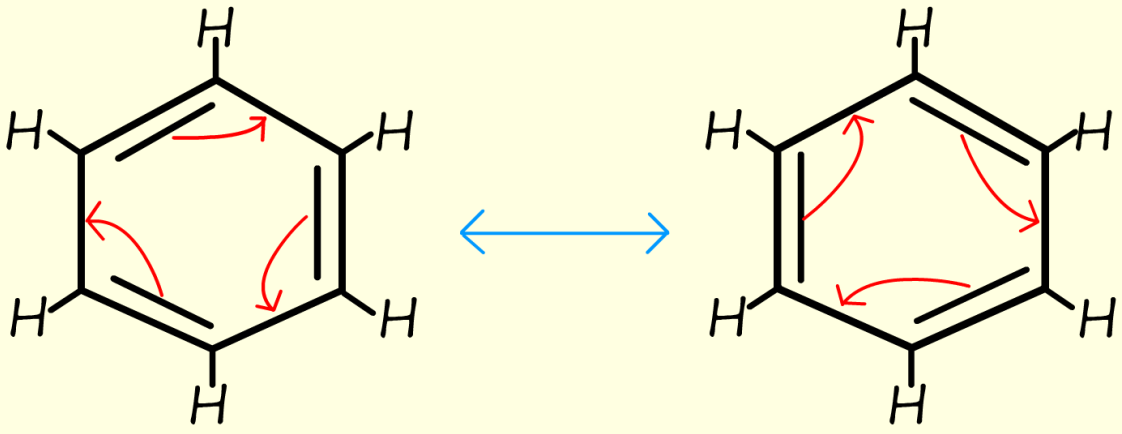
2. What type of electrons are usually involved in delocalisation within organic molecules?

   In covalent molecules it is usually the pi(π) electrons which are associated with delocalisation.

3. What is resonance?

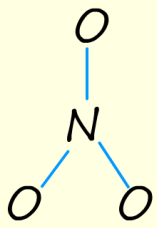
   Resonance is a way of trying describe the movement of delocalised electrons within a molecule or ion. We often draw various resonance structures to show the delocalised electrons, with the actual structure of the molecule or ion being a combination of all the individual resonance structures.

4. Draw Kekulé structures to show the two resonance structures for a benzene molecule.

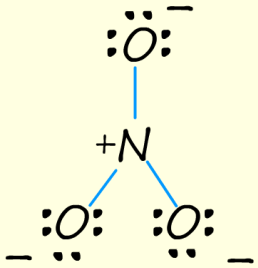


5. The nitrate ion (NO_3^-) can be drawn as three resonance structures, draw Lewis structures to show the position of all lone pairs and delocalised electrons in the three resonance structures for the nitrate ion.

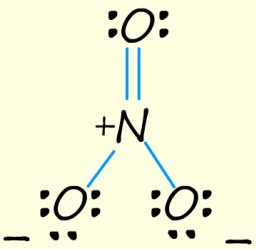
In the nitrate ion the central atom will be nitrogen - it has 5 valency electrons Oxygen is in group 6 and has 6 valency electrons, so in total from the three oxygen atoms we have 18 electrons, also charge of -1 will contribute 1 extra electron, this gives a total of 24 valency electrons. Possible structures for nitrate ion are shown below:



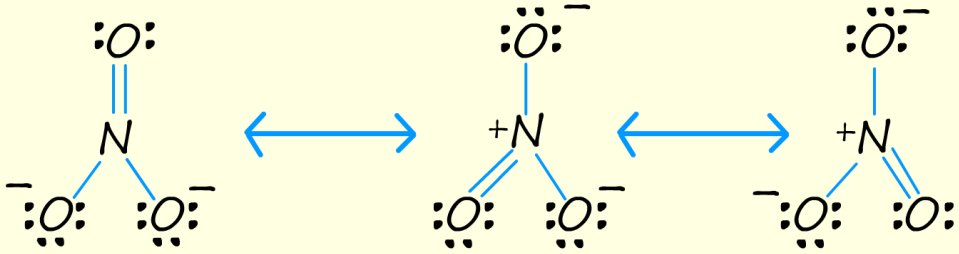
1. Basic outline of the structure. Now try and fit 24 valency electrons into the molecule. Recall that nitrogen, the central atom usually makes 3 bonds and has a lone pair.



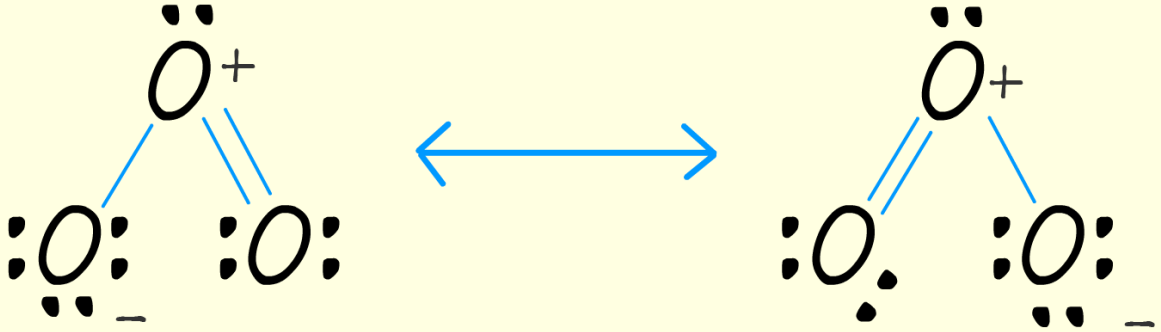
This structure has 24 valency electrons, molecule has a charge of 2- while the nitrate ion has a charge of -1. So form a N=O as shown in the next structure



This molecular ion has a charge of -1 and is one possible resonance structure for the nitrate ion.



6. The ozone (O_3) molecule can be drawn as two resonance structures, draw Lewis structures to show the position of all lone pairs and delocalised electrons



There are 18 valency electrons in an ozone molecule, 6 from each oxygen atom. In trying to draw the structures I started with an assumption that oxygen normally makes 2 bonds but if I draw double bonds (O=O) for all the oxygen atoms the central atom will end up making 4 bonds. Analysis shows that a;; the bond lengths in ozone are the same length, intermediate between O-O and O=O bond lengths. The above arrangement in each resonance also gives each oxygen atom an octet of electrons.