FUNDAMENTALS OF CHEMISTRY 1A (CHEM1001) - June 2010

2010-J-2

- ammonia

  PCl_3

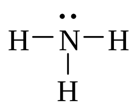
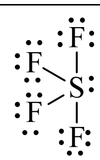
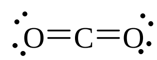
  potassium hydrogencarbonate

  $Ca_3(PO_4)_2$

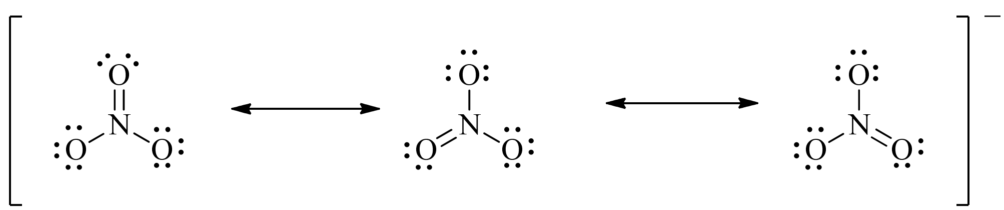
- 7.2×10^{23} atoms

2010-J-3

-

3	4	4
1	1	0
		
trigonal pyramidal	"see-saw"	linear

- When two or more Lewis structures can be drawn for a molecule, the true structure is none of the structures that is drawn, but a type of average made up of all the resonance contributors. Some structures may contribute more than others.



e.g. In NO_3^-, the ion does not contain 1 double and 2 single bonds, but is an average of the three structures shown. All of the N-O bonds are exactly the same length and the energy of the true structure is lower than the theoretical energy for any one of the given structures. This energy difference is known as resonance stabilisation energy.

2010-J-4

- Titanium is inert. It will not corrode nor dissolve and poison the patient.
  Titanium is a light-weight metal with a similar density to bone.
  Titanium is strong and will not break, so is suitable for supporting the patient's weight.

- 6.15×10^{-19} J
  814 nm

2010-J-5

- 3.0×10^{-3} mol

  0.020 M

2010-J-6

$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

8.58 L

2010-J-7

- H_2O_2
- 1.2 atm

2010-J-8

- towards reactants

  14.0

2010-J-9

- 8.8 kJ
- –2220 kJ mol^{-1}

2010-J-10

- 1.3×10^{-3} M

  It remains the same. As the name implies, it is constant and is unaffected by increases in amounts of reactants or products. (It is dependent on temperature.)

  1.8×10^{-3} M

2010-J-11

- red: $MnO_2 + 4H^+ + 2e^- \rightarrow Mn^{2+} + 2H_2O$

  ox: $2Cl^- \rightarrow Cl_2 + 2e^-$

  over all: $MnO_2 + 2Cl^- + 4H^+ \rightarrow Mn^{2+} + 2H_2O + Cl_2$

  Cl^- is oxidised
- 2.95 g

2010-J-12

- 1.22 V
- The boiling points in F_2, Cl_2 and Br_2 are determined by the size of the dispersion forces between molecules. The bigger the atoms, the more polarisable their electron clouds and the greater the dispersion forces. Hence boiling points are in order $Br_2 > Cl_2 > F_2$.

  Dispersion forces also operate in HF, HCl and HBr, but here the dipole formed between the halogen atom and the hydrogen also needs to be considered. F is a very small and very electronegative atom. The H–F bond is therefore highly polarised and H-bonds form in this liquid. These are much stronger than dispersion forces and so HF has an anomalously high b.p. Cl and Br are not as electronegative as F: the dispersion forces in HCl and HBr are more significant than the dipole-dipole forces as can be evidenced by the order of boiling points HF > HBr > HCl.

  The values given tell us that the total of the dispersion forces in Br_2 is greater than the H-bonds in HF. Similar comparisons can be made between other members of the 2 series.

2010-J-13

- Fuel cells use H_2(g) and O_2(g) as the reactants.
  Disadvantages: H_2 is highly flammable and a severe explosion hazard should the car be involved in a crash. It's likely cars would need to be heavier to prevent rupture of tanks. There are also handling difficulties as it's a gas.
  Advantages: The only product of a fuel cell is water, so they are non-polluting. High efficiency.

  Aluminium air battery uses Al(s) and O_2 as reactants.
  Advantages: The fuel (Al) is not explosive and can easily be replaced when it is exhausted. Aluminium is very light metal and 3 electrons lost in its oxidation to Al^{3+}, so a lot of energy generated per g of fuel. Aluminium is very plentiful and cheap. Steady voltage as [Al] and [O_2] don't vary.
  Disadvantages: The $Al(OH)_3$ product needs to be recycled. Conversion back to Al metal involves large amounts of electricity and associated CO_2 output.