CHEM1001 Worksheet 3 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

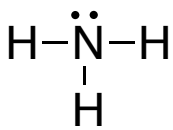
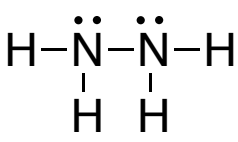
Model 1: Ionic Bonding

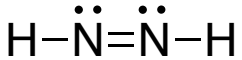
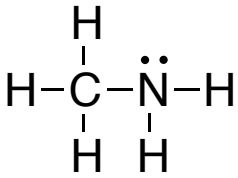
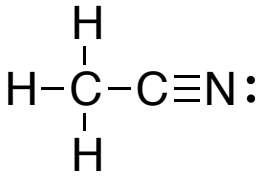
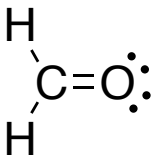
1. +2
2. -2
3. -3.
4. Iodine – 7 valence electrons so gains 1 electron to form I^-.
   Sodium – 1 valence electron so loses 1 electron to form Na^+.
   Oxygen – 6 valence electrons so gains 2 electrons to form O^{2-}.
   Aluminium – 3 valence so loses 3 electrons to form Al^{3+}.
   Nitrogen – 5 valence electrons so gains 3 electrons to form N^{3-}.
   Sulfur – 6 valence electrons so gains 2 electrons to form S^{2-}.
   Bromine – 7 valence electrons so gains 1 electron to form Br^-.
   Magnesium – 2 valence electrons so loses 2 electrons to form Mg^{2+}.
5. Sodium: sodium iodide NaI, sodium oxide Na_2O, sodium nitride Na_3N, sodium sulfide Na_2S, sodium bromide NaBr
   Aluminium: aluminium iodide AlI_3, aluminium oxide Al_2O_3, aluminium nitride AlN, aluminium sulfide Al_2S_3, aluminium bromide $AlBr_3$.
   Magnesium: magnesium iodide MgI_2, magnesium oxide MgO, magnesium nitride Mg_3N_2, magnesium sulfide MgS, magnesium bromide $MgBr_2$.
6. (i) NaOH (ii) $NaNO_3$ (iii) Na_2SO_4 (iv) Na_3PO_4
   (v) $Mg(OH)_2$ (vi) $Mg(NO_3)_2$ (vii) NH_4OH (viii) $(NH_4)_2SO_4$

Model 2: Covalent bonding

1. Bonding = red. Non-bonding = blue.

2. Hydrogen = 1, carbon = 4, nitrogen = 3, oxygen = 2, fluorine = 1, silicon = 4, phosphorus = 3, sulfur = 2, chlorine = 1
3. Hydrogen = 1, carbon = 4, nitrogen = 3, oxygen = 2, fluorine = 1, silicon = 4, phosphorus = 3, sulfur = 2, chlorine = 1
4. Each atom has 8 valence electrons.
5. See below.

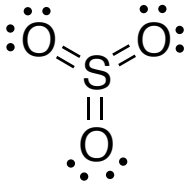
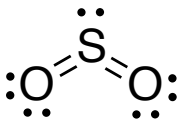
	
NH_3	N_2H_4

	
N_2H_2	CH_3NH_2
	
CH_3CN	CH_2O

6. S has 10 valence electrons in SCl_4 from 4 bonds and 1 lone pair.
   S has 12 valence electrons in H_2SO_4 from 6 bonds (2 double bonds and 2 single bonds).

7. (a) Total = 6 (S) + 4 × 7 (Cl) = 34.
8. (b) Total = 4 × 2 (S-Cl bonds) + 4 × 3 × 2 (Cl lone pairs) + 2 (S lone pair) = 34.
   Yes, the totals match, as they must. The molecule must use all the electrons available: no more or less.

9. See below.

	
SO_3	SO_2

Model 3: Ionic or Covalent?

1. (a) Ionic (b) Ionic (c) Ionic
   (d) Covalent (e) Covalent (f) Covalent

2. (a) Na_2O (b) MgO (c) Al_2O_3
   (d) SiO_2
   (e) P_2O_3 (P_2O_5 is also possible in which P has expanded its octet. Actually this oxide is more common for phosphrous.)
   (f) SO (SO_2 and SO_3 are also possible in which S has expanded its octet. Actually these oxides are the common ones for sulfur.)