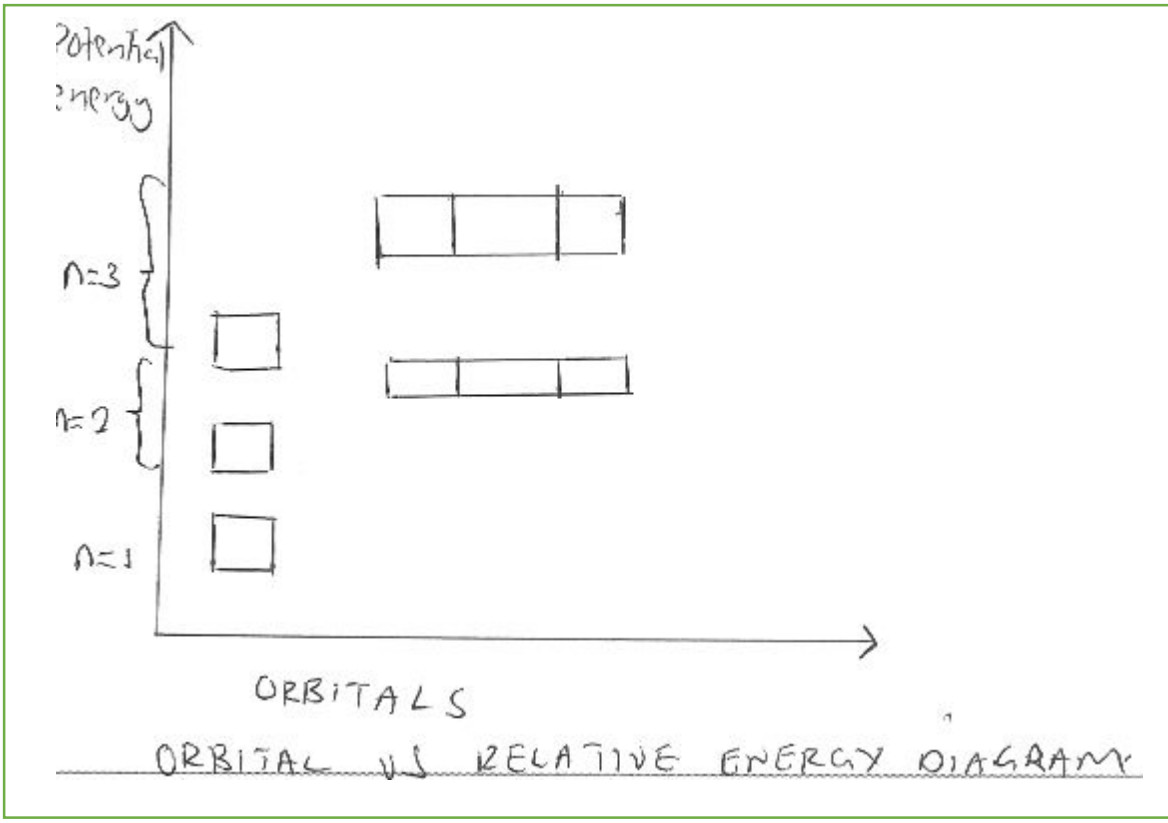
CHE 1501: OCT/NOV 2015

1. (a) $Mg(HCO_3)_2$ **(2)**

(b) Isotopes are atoms of the same element with different numbers of neutrons. **(2)** S^- and S^{2-} are not isotopes, they are ions of the same element sulphur, which have the same number of neutrons but different numbers of electrons only. **(1)**

(c) $1s^22s^22p^63s^23p^6$ **(2)** it is isoelectronic with argon **(2)**

(d)



n=3 **(1/2)**;

l= 0,1,2 **(1/2)**;

m_l= -2, -1, 0, +1, +2 **(1/2)**;

m_s= +1/2, -1/2 **(1/2)**

2. (a) $2Cr(OH)_3$ (s) + $6ClO^-$ (aq) + $2H^+$(aq) → $2CrO_4^{2-}$(aq) + $3Cl_2$ (g)

(i) ClO^- **(2)**

(ii) Cr **(2)**

(iii) CrO_4^{2-} **(2)**

(iv) $2Cr(OH)3 + 6ClO^- \longrightarrow 2CrO_4^{2-} + 2H_2O + 2OH^- + 3Cl_2$ **(2)**

3. (a)$LiSO_4$ does not react with NaOH because it is a neutral salt **(1)**

$AgNO_3$(aq) + NaOH (aq) ⟶ AgOH (s) + $NaNO_3$ (aq) **(2)**

Precipitation reaction (**1**)

(b)

	C	H	O
Mass in 100g	38.7	9.7	51.6
No. of moles	38.7/12.001 =3.225	9.7/1.008 =9.7	51.6/16 =3.225
Simplest whole number ratio	1	3	1

(5)

Empirical Formula: CH_3O **(1)**

(c) 10.0g of p-aminophenol = $\frac{10}{109.13}$= 0.092 mol **(1)**

15.0g of acetic anhydride= $\frac{15.0}{102.10}$= 0.147mol **(1)**

Mole ratio= 1:1

Therefore p-aminophenol is the limiting reagent **(1)**

Therefore 0.092mol of paracetamol will be produced. **(1)**

Mass of paracetamol produced= $0.092 * 151.17 = 13.91g$ **(1)**

Theoretical Yield= 13.91g **(1)**

% yield= $\frac{experimental\ yield}{theoretical\ yield}$

$= \frac{10.8 \times 100\%}{13.91} = 77.6\%$ **(2)**

4. (a) Hydride Ion- H^-

   Hydrogen cation – H^+

   Hydrogen atom – H……..**(1)**

   $H^+ < H < H^-$ **(1)**

   (b) $N < O < F$ **(2)**

   (c) electronegativity is the measure of an atom's ability to attract the shared electrons to itself when bonded to another atom in a molecule **(2)**

   (d) The polarity of the substance, and its ability to form hydrogen bonds with water **(2)**

   (e) A- Coordinate covalent **(1)**

   B- Polar covalent **(1)**

   C- Non polar covalent **(1)**

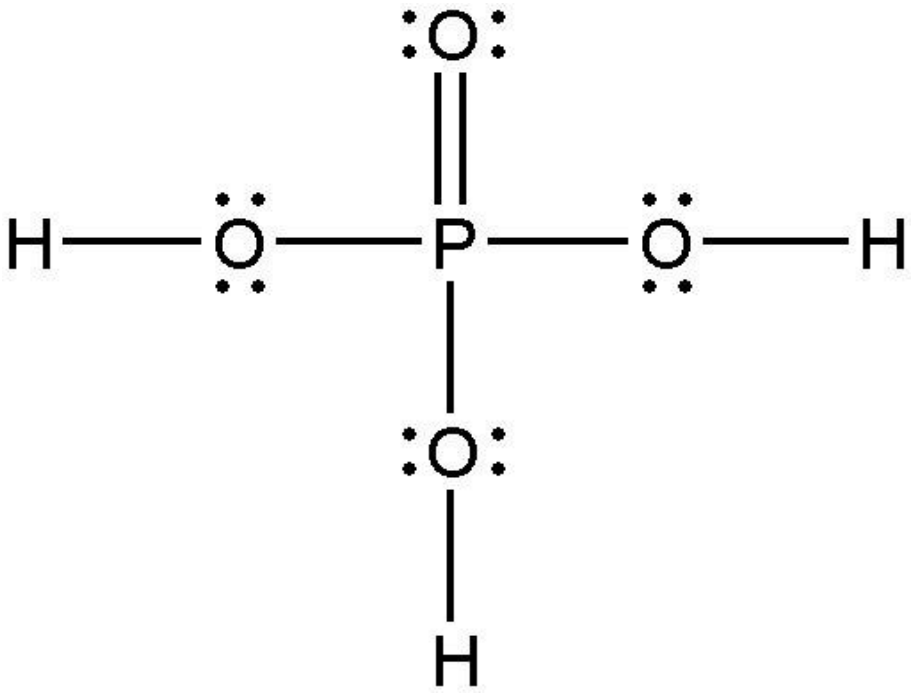
   D- Ionic **(1)**

   (f) 1mol of CO_2-occupies 22.4l at stp **(1)**

   Density of $CO_2 = \frac{m}{v} = \frac{44g}{22.4l} = 2g/l$ **(2)**

$CO_{2\ is}$ denser than air hence it would be the lower layer. **(1)**

5. (a)



3 marks for diagram including all lone pairs

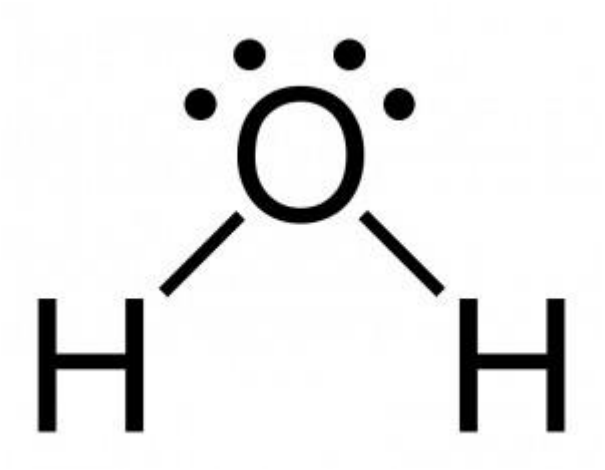
2 marks for showing bond polarity (P → O)

Formal charge of Phosphorus**= 5**- $(0+\frac{10}{2})= 0$ **(1)**

Formal charge on oxygen in single bonds= 6- $(4+\frac{4}{2}) = 0$ $(^{\mathbf{1}}/_{\mathbf{2}})$

Formal charge on oxygen in double bonds= 6- $(4+\frac{4}{2}) = 0$ **(1/2)**

(b)



- Be is a group II element with 2 bond pairs and no lone pairs of electrons around it, hence the linear shape. (2)
- O has 2 lone pairs and 2 bond pairs of electrons, hence the bent shape (2)

6. Rate of reaction is the change in concentration of a reagent per unit time (2)

Factors affecting rate of reaction: temperature, concentration, pressure, catalyst, and surface area of a solid (3)

The rate of disappearance of reactants is only equal to the rate of disappearance of the products only when dynamic equilibrium is reached. (1) However, changes in temperature, concentration or pressure may shift the position of equilibrium either to the right or to the left (1)

(b) The forward reaction is exothermic so it is favoured by low temperature (3)

(ii) the reaction is favoured by high pressure because pressure is inversely proportional to volume, therefore as the pressure increases, the reaction favouring fewer molecules takes place (3)

(iii) K= $\frac{[NH3]}{[N2][H2]}3$ (2)

(c) It speeds up the rate of reaction **(1),** i.e. it speeds up the rate at which equilibrium is reached **(1**), by lowering the activation energy of the reaction **(2).**

7. $HSO_3^- + CN^- \rightarrow HCN^- + SO_3^{2-}$

HSO_3^- acid

CN^- base

HCN- conjugate acid

SO_3^{2-} conjugate base…….. (**2 MARKS**)

Bronsted Lowry Theory (**1)**

(b) They are fully dissociated in solution to give H^+ and OH^- ions respectively (**2)**

(c) NH_4^+; H_3O^+; HXO_3 (**3)**

(d) SO_2 reacts with more oxygen to give SO_3 **(1)**

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3$ **(2)**

SO_3 reacts with rain water to form acid rain

$SO_3 + H_2O \rightarrow H_2SO_4$ **(2)**

H_2SO_4 is the acid rain