# CH1011 Tutorial 8 Answers

1. Identify the acids and the bases in the following processes.

$NH_4^+ + OH^- \rightarrow H_2O + NH_3$
acid base acid base
$HSO_4^- + H_2O \rightarrow H_3O^+ + SO_4^{2-}$
acid base acid base

2. Define a Bronsted-Lowry base and give an example of a strong Bronsted-Lowry base.

A Bronsted-Lowry base is a *proton acceptor - a substance that accepts an $H^+$ ion.*

strong base **CaO** $CaO(s) + H_2O(l) \rightarrow 2OH^-(aq) + Ca^{2+}(aq)$
here $O^{2-}$ accepts $H^+$ from $H_2O$

3. Calculate the pH and pOH of a 0.000290 mol $dm^{-3}$ solution of HCl.
Is this solution acidic, basic or neutral?

pH $= -\log_{10}[H^+] = -\log_{10}(0.00029)$
$= 3.54$
pOH = 14 –pH = 10.46

The solution is acidic.

4. $CO_2$ is the gas that determines to a large extent the pH of rainwater. Calculate the concentration (mmol/L) of $CO_2$ inside a raindrop that is at equilibrium with air that contains a concentration of 370ppm $CO_2$ at 25°C at sea-level. $K_H SO_2 = 3.30 \times 10^{-2}$ mol $dm^{-3}$ $atm^{-1}$ at 25°C.

$\%_i = ppmv_i \times 10^{-4}$ $p_i = (\%_i / 100)\ p_{atm}$
$\%_{CO2} = 370\ ppmv \times 10^{-4}$ $p_{SO2} = (370 \times 10^{-4} / 100) \times 1\ atm = 3.70 \times 10^{-4}$ atm

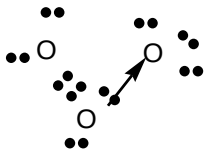
$[CO_{2(aq)}] = p_{CO2} K_H = 3.70 \times 10^{-4}$ atm $\times 3.30 \times 10^{-2}$ mol $dm^{-3}$ $atm^{-1}$
$= 1.22 \times 10^{-5}$ mol $dm^{-3}$
**$= 1.22 \times 10^{-2}$ mmol/L**

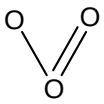
5. Describe the **mechanism** for the formation of **ozone** in the stratosphere.
   - Draw **Lewis dot** and **VSEPR structures** for ozone.
   - Why is the presence of ozone in the stratosphere regarded as essential for the success of most life-forms on the planet and yet it is harmful to many of the same life-forms in the lower troposphere?

The mechanism for the formation of ozone in the stratosphere:

| The formation of $O_3$ , | | | produces 350 kT / d |
|---|---|---|---|
| | UV-C $h\nu$, $\lambda$ < 245 nm | | $\Delta$H, kJ/mol |
| 1) $O_2$ | $\rightarrow$ | $2O$ | 495 - $E_{h\nu}$ |
| 2) $O + O_2$ | $\rightarrow$ | $O_3^*$ | -105 |
| 3) $O_3^* + M$ | $\rightarrow$ | $O_3 + M$ | (M = third body : $N_2$, $O_2$, absorbs excess energy) |

This reaction occurs in a region of the stratosphere (15 -35 km) which is called the ozone layer.
The concentration of ozone is not high (9 - 11ppm) in this layer and so ozone is still a trace gas but the absorption of radiation both in the formation and destruction of ozone is vital as it acts as a radiation shield for life on the planet. The net energy change associated with the reaction is exothermic and so there is a heating effect in this region of the atmosphere.

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Ozone in the stratosphere is a radiation shield which prevents UV-B and UV-C photons from impacting on the Earths surface. UV-C in particular is harmful to DNA and causes damage which results in mutagenic and carcinogenic effects.
Ozone in the troposphere acts as a poison as it is a very powerful oxidant and destroys cellular organisms (used for disinfecting water) as well as irritating the lungs and eyes of humans.