Concentration of species in solution

We need to think about the relative concentrations of species in solution for acids and bases and salts.

For example: KNO_3

What species are present in solution excluding water?

K^+, NO_3^-, H_3O^+, OH^- $KNO_3 \rightarrow K^+ + NO_3^-$

$K^+ = NO_3^- > H_3O^+ = OH^-$

For example:

$Ca(NO_3)_2$

What species are present in solution excluding water?

Ca^{2+}, NO_3^-, H_3O^+, OH^- $Ca(NO_3)_2 \rightarrow Ca^{2+} + 2\ NO_3^-$

$NO_3^- > Ca^{2+} > H_3O^+ = OH^-$

Concentration of species in solution

Neutral species have the same concentration of H_3O^+ and OH^- in solution (1×10^{-7}). Weak acids and bases have different concentrations of H_3O^+ and OH^- in solution.

For example: HF
What species are present in solution excluding water?

$HF + H_2O \rightleftharpoons F^- + H_3O^+$

HF, F^-, H_3O^+, OH^-

What are the relative concentrations of these species?

$HF > F^- = H_3O^+ > OH^-$

Try: CH_3COOH, CH_3NH_2

Concentration of species in solution

Acidic and basic salts (conjugate base of a weak acid or the conjugate acid of a weak base) change the ratio of H_3O^+ and OH^- in solution because of their reaction with water after they dissolve in water.

Try: Na_2CO_3

For example: HCOONa

What species are present in solution excluding water?

$HCOONa \rightarrow HCOO^- + Na^+$

$HCOO^- + H_2O \rightleftharpoons HCOOH + OH^-$

$HCOO^-$, Na^+, OH^-, $HCOOH$, H_3O^+

What are the relative concentrations of these species?

$Na^+ > HCOO^- > OH^- = HCOOH > H_3O^+$

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(b) For each of the following 0.100 mol L^{-1} solutions, list all species in order of **decreasing** concentration.

Do not include water.

(i) HCl

$H_3O^+ = Cl^- > OH^-$

(ii) CH_3NH_2

$CH_3NH_2 > OH^- = CH_3NH_3^+ > H_3O^+$

(iii) NH_4Cl

$Cl^- > NH_4^+ > NH_3 = H_3O^+ > OH^-$

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QUESTION ONE

When chlorine gas is added to water, the equation for the reaction is:

$$Cl_2(g) + H_2O(\ell) \rightleftharpoons HCl(aq) + HOCl(aq)$$

(a) (i) Write an equation for the reaction of the weak acid, hypochlorous acid, HOCl, with water.

(ii) List all the species present when HOCl reacts with water, in order of decreasing concentration.

Order of decreasing concentration:

Justify your order.

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Q	Evidence		
	Achievement	**Achievement with Merit**	**Achievement with Excellence**
	• Equation correct. OR FOUR species correctly identified. • Recognises HOCl partially dissociates. OR One correct justification.	• ALL species and order correct AND partial explanation to support the order of the species.	• ALL species and order correct AND complete justification.