# Salts & Solubility

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YALE UNIVERSITY
CHEMISTRY 161
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www.mioy.org/chem161

# What is a salt?

A salt is an ionic compound: metal + nonmetal

Some salts are **soluble** in water (*aqueous*, *aq* = dissolves in water).

Some salts are **insoluble** in water (precipitate, solid, *s*).

MEMORIZE THIS CHART:

*You should be able to quickly identify the ions that comprise a salt!*

| | | *Exceptions* |
|---|---|---|
| **SOLUBLE** | Group 1 cations | |
| | $NH_4^+$ | |
| | $NO_3^-$ | |
| | $CH_3COO^-$ | |
| | $Cl^-$, $Br^-$, $I^-$ | $Ag^+$, $Hg_2^{2+}$, $Pb^{2+}$, $Cu^+$ |
| | $SO_4^{2-}$ | $Hg_2^{2+}$, $Pb^{2+}$, $Ba^{2+}$, $Ca^{2+}$, $Sr^{2+}$, |
| **INSOLUBLE** | $OH^-$ | Group 1 cations, $Ba^{2+}$, $Ca^{2+}$, $Sr^{2+}$, $NH_4^+$ |
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| | $CO_3^{2-}$, $PO_4^{3-}$, $F^-$ | Group 1 cations, $NH_4^+$ |

# Determine if each of the following salts are soluble or insoluble.

1. $KNO_3$:
2. $PbSO_4$ :
3. KOH :
4. $MgSO_4$ :
5. $FePO_4$ :
6. $Pb(NO_3)_2$ :
7. $Pb(SO_4)_2$ :
8. $FeCl_2$ :
9. ZnS :
10. $Cd(OH)_2$ :
11. $MgCO_3$ :
12. $NH_4Cl$ :
13. $CaBr_2$ :
14. $Hg_2I$ :
15. $CuCH_3COO$ :

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2. Sodium Chloride :
3. Barium Nitrate :
4. Ammonium Bromide :
5. Magnesium Hydroxide :
6. Barium Sulfate :
7. Barium Hydroxide :
8. Lanthanum Nitrate :
9. Sodium Acetate :
10. Lead(II) Hydroxide :
11. Lead(IV) Sulfate :
12. Calcium Phosphate :
13. Iron(II) Sulfide :
14. Lithium Fluoride :
15. Aluminum Carbonate :

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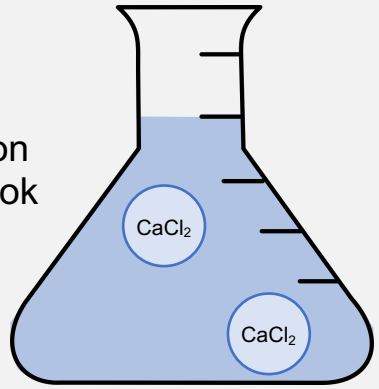

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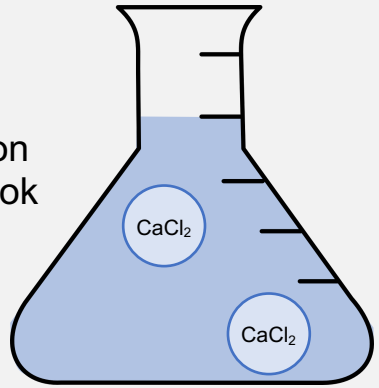


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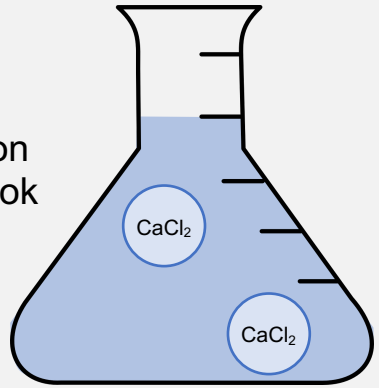


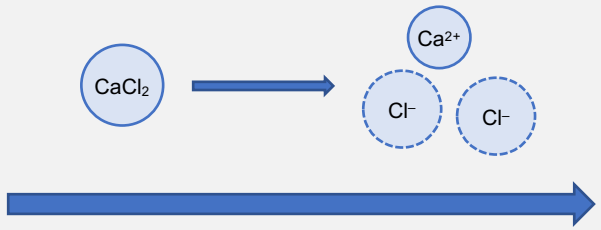


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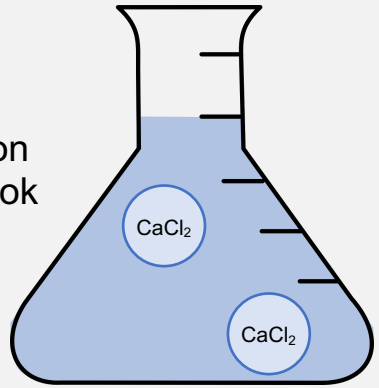


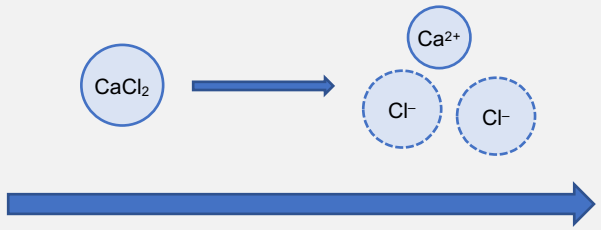


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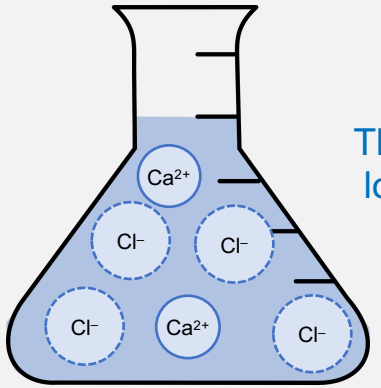


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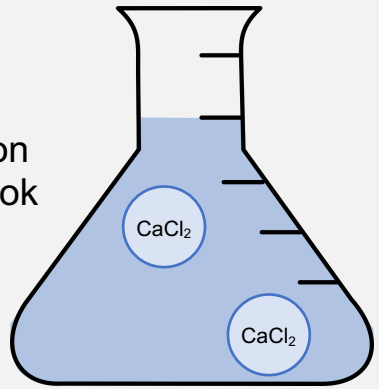


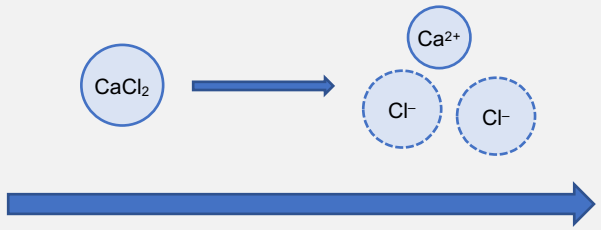


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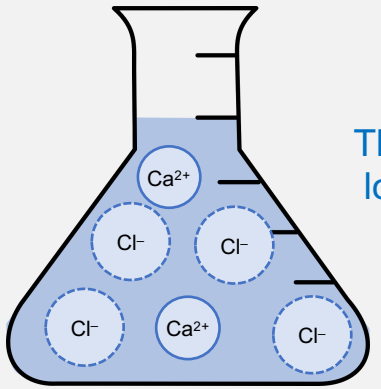


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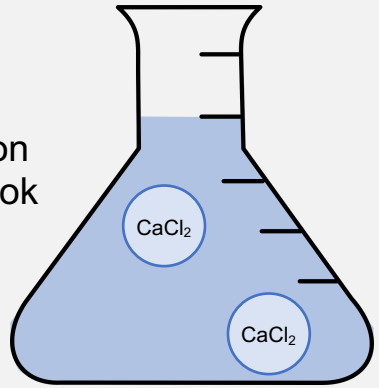


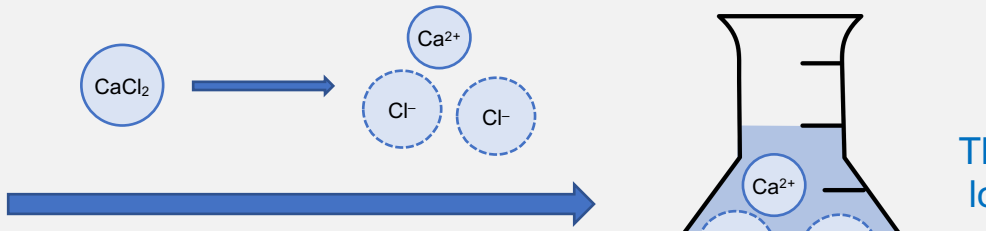


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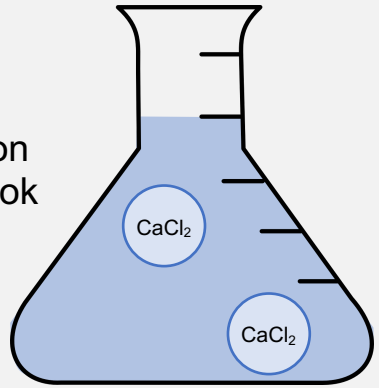


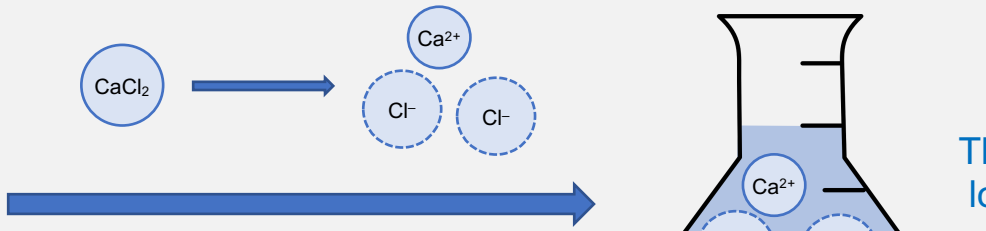


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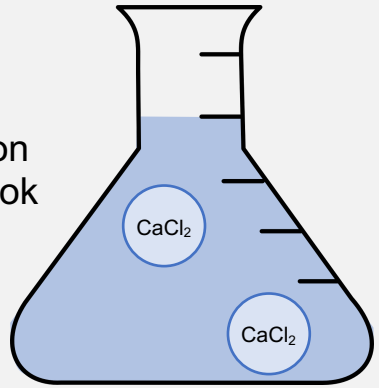


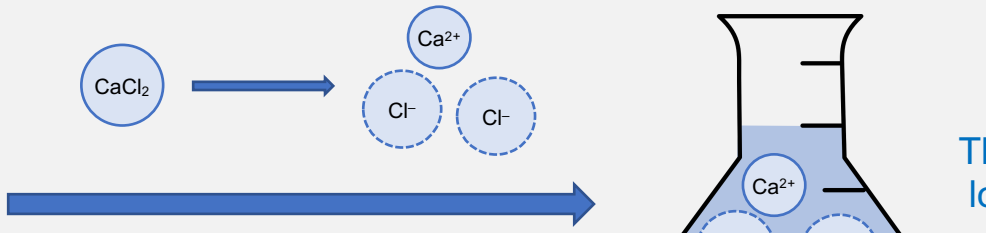


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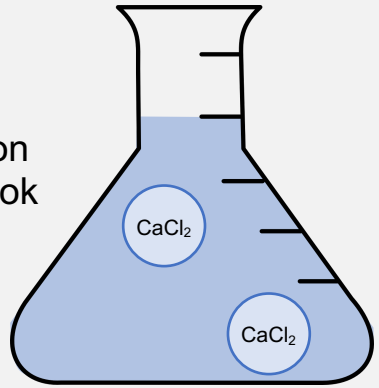


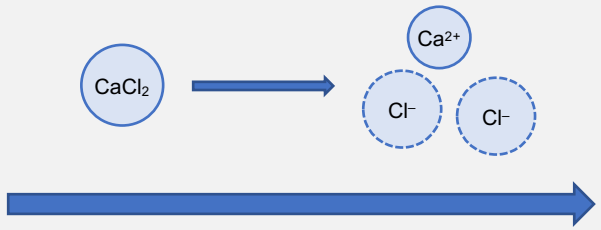


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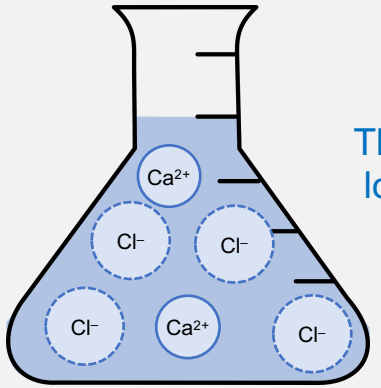


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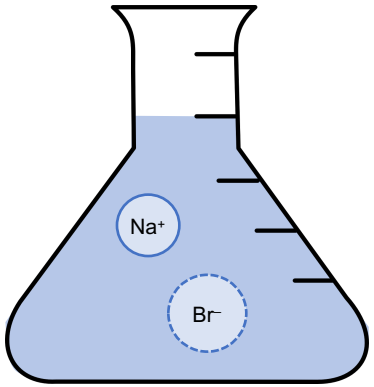
1 molecule $NaBr = 1Na^+ + 1Br^-$

1 mol $NaBr$ = 1 mol $Na^+$ + 1 mol $Br^-$




1 molecule $Na_2SO_4 = 2Na^+ + 1SO_4^{2-}$

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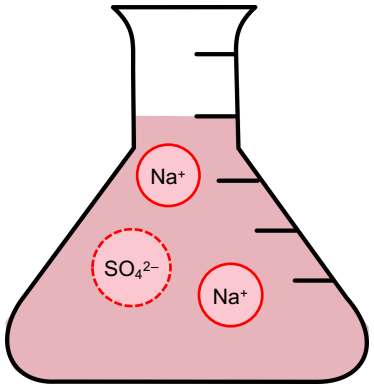
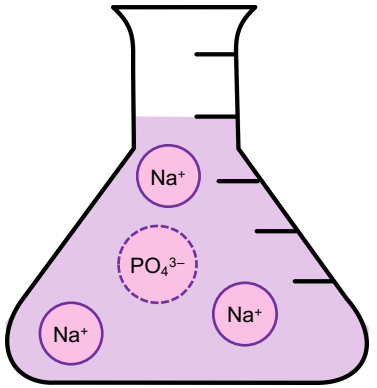



1 molecule $Na_3PO_4 = 3Na^+ + 1PO_4^{3-}$

1 mol $Na_3PO_4$ = 3 mol $Na^+$ + 1 mol $PO_4^{3-}$



# Which of the following has the greatest concentration of dissolved ions in solution?

**$NaBr$ $Na_2SO_4$ $Na_3PO_4$**

These are all soluble salts!

We can represent the dissociation of each salt into its ions:

1 molecule $NaBr = 1Na^+ + 1Br^-$

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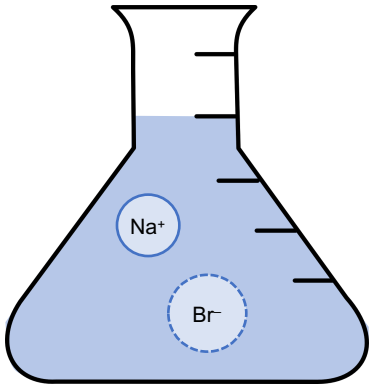


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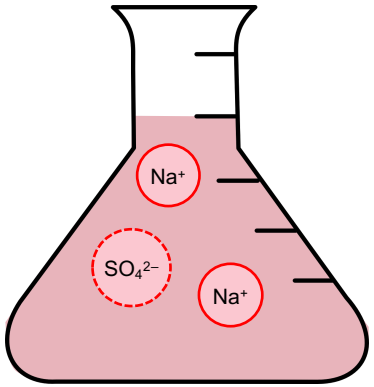


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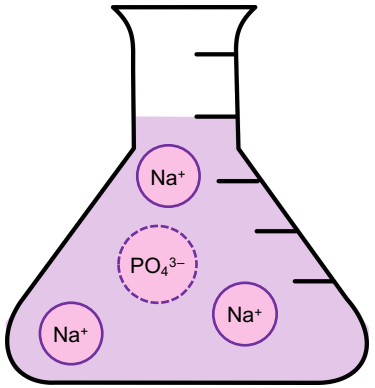


Now it's easier to understand that a solution of $Na_3PO_4$ would have the highest concentration of dissolved ions (4 ions).

# Which of the following has the greatest concentration of dissolved ions in solution?

**0.25 M NaBr** **0.25 M $Na_2SO_4$** **0.25 M $Na_3PO_4$**

These are all soluble salts!

We can represent the dissociation of each salt into its ions:

1 molecule NaBr = $1Na^+ + 1Br^-$

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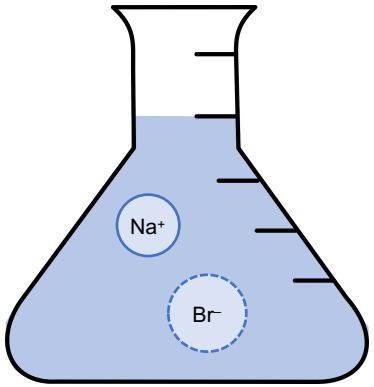


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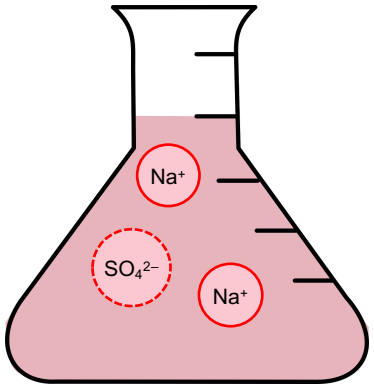


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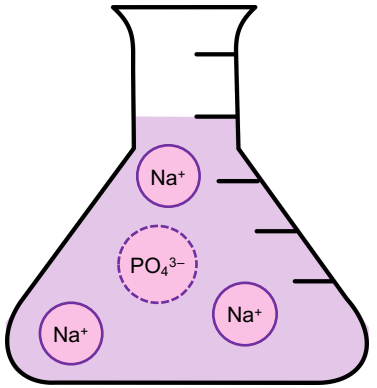

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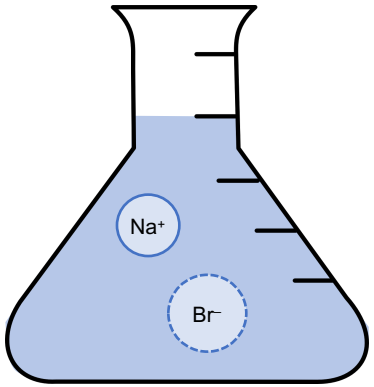


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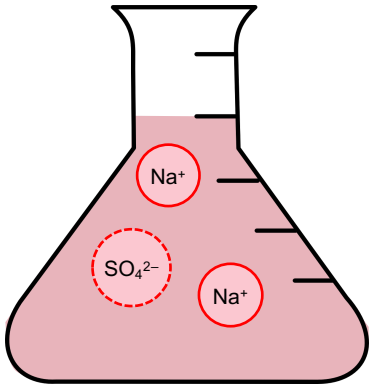


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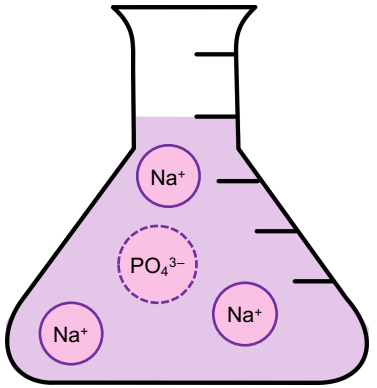


Understand that the concentration of *ions* would be:

1 NaBr : 2 ions

1 $Na_2SO_4$ : 3 ions

1 $Na_3PO_4$ : 4 ions

# Which of the following has the greatest concentration of dissolved ions in solution?

**0.25 M NaBr** **0.25 M $Na_2SO_4$** **0.25 M $Na_3PO_4$**

These are all soluble salts!

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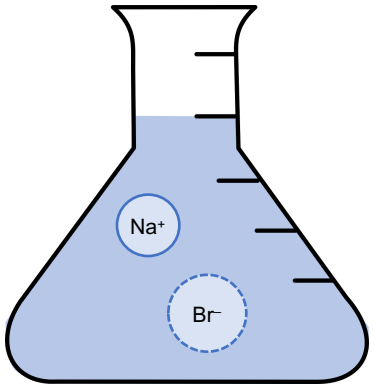


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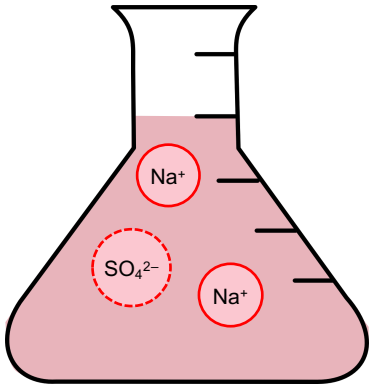


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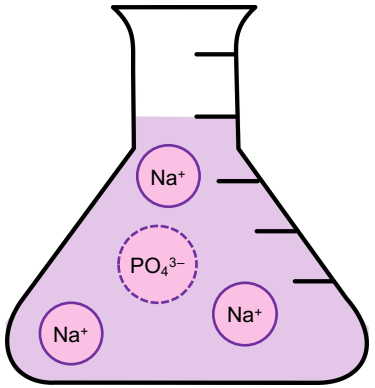


Understand that the concentration of *ions* would be:

1 NaBr : 2 ions

$[\text{ions}] = 2 \times 0.25\ \text{M} = 0.50\ \text{M}$

1 $Na_2SO_4$ : 3 ions

$[\text{ions}] = 3 \times 0.25\ \text{M} = 0.75\ \text{M}$

1 $Na_3PO_4$ : 4 ions

$[\text{ions}] = 4 \times 0.25\ \text{M} = 1.00\ \text{M}$

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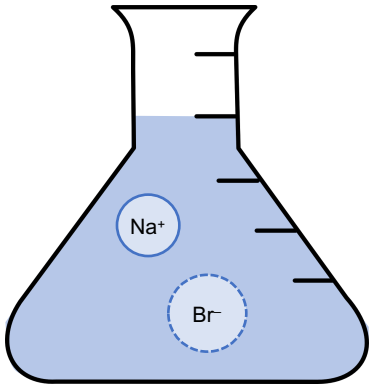


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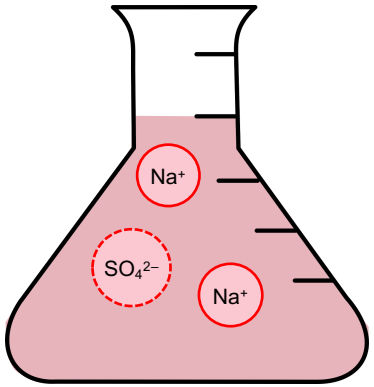


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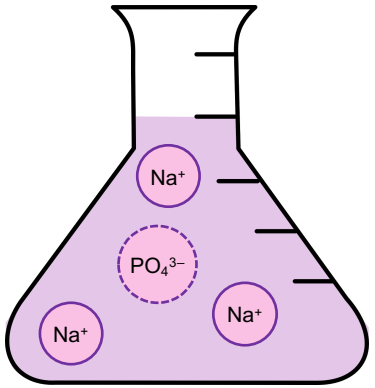


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