0.10 M NaNO₂

Strong or weak electrolyte?
If a salt: of what acid and base?
Spectator ions?
Predominate molecule or ion in solution?
Strong or weak – acid or base?
Acidic, basic, or neutral?
Reaction that determines the pH?
Kₐ = Kₗ/Kₜ or Kₜ = Kₗ/Kₐ?

\[
\text{NO}_2^- + \text{H}_2\text{O} \leftrightharpoons \text{HNO}_2 + \text{OH}^- \\
\text{initial} \quad 0.10 \quad 0 \quad 0 \\
\text{change} \quad -x \quad +x \quad +x \\
\text{equil.} \quad 0.10 -x \quad x \quad x
\]

\[
K_b = \frac{[\text{HNO}_2][\text{OH}^-]}{[\text{NO}_2^-]} = \frac{x^2}{0.10 - x} \quad \text{(neglect}\ x) \\
[\text{OH}^-] = x = 1.19 \times 10^{-6} \text{ M} \quad \text{pOH} = 5.925 \\
pH = pK_w - \text{pOH} = 8.075 = 8.08
\]

Kₐ = 7.1 \times 10^{-4} for nitrous acid

0.10 M H₂SO₃

Strong or weak electrolyte?
If a salt: of what acid and base?
Spectator ions?
Predominate molecule or ion in solution?
Strong or weak – acid or base?
Acidic, basic, or neutral?
Reaction that determines the pH?
Kₐ = Kₗ/Kₜ or Kₜ = Kₗ/Kₐ?

\[
\text{H}_2\text{SO}_3 \leftrightharpoons \text{HSO}_3^- + \text{H}^+ \\
\text{initial} \quad 0.10 \quad 0 \quad 0 \\
\text{change} \quad -x \quad +x \quad +x \\
\text{equilibrium} \quad 0.10 -x \quad x \quad x
\]

\[
K_a = \frac{[\text{H}^+][\text{HSO}_3^-]}{[\text{H}_2\text{SO}_3]} = 7.1 \times 10^{-4} = \frac{x^2}{0.10 - x} \quad \text{(successive approx. start by neglecting} \ x) \\
[\text{H}^+] = x = 8.43 \times 10^{-3} \text{ M} : \ 0.10 - x = 0.0916 \\
[\text{H}^+] = x = 8.06 \times 10^{-3} \text{ M} : \ 0.10 - x = 0.0919 \\
[\text{H}^+] = x = 8.08 \times 10^{-3} \text{ M} : \ 0.10 - x = 0.0919 \\
pH = pK_a = 2.093 = 2.09
\]

Kₐ = 7.1 \times 10^{-4} for sulfurous acid
0.10 M KNO₃

Strong or weak electrolyte? Strong (salt)
If a salt: of what acid and base? HNO₃ (strong) and KOH (strong)
Spectator ions? K⁺, NO₃⁻
Predominate molecule or ion in solution? H₂O that affects the pH
Strong or weak – acid or base? ineffective, negligible
Acidic, basic, or neutral? neutral
Reaction that determines the pH? H₂O ⇌ H⁺ + OH⁻ (all aq)

0.100 M NH₄NO₃

Strong or weak electrolyte? Strong (salt)
If a salt: of what acid and base? HNO₃ (strong) NH₃ (weak)
Spectator ions? NO₃⁻
Predominate molecule or ion in solution? NH₄⁺ that affects the pH
Strong or weak – acid or base? weak acid (conjugate acid of weak base)
Acidic, basic, or neutral? acidic
Reaction that determines the pH? NH₄⁺ ⇌ H⁺ + NH₃ (all aq)
Kₐ = Kw/Kₐ = 5.69x10⁻¹⁰

Kₖ = 1.76x10⁻⁵

Solve for pH?

\[
\begin{align*}
\text{NH}_4^+ & \rightleftharpoons H^+ + \text{NH}_3 \\
\text{initial} & : 0.100 \quad 0 \quad 0 \\
\text{change} & : -x \quad +x \quad +x \\
\text{equilibrium} & : 0.100 - x \quad x \quad x
\end{align*}
\]

\[
\frac{[H^+] [\text{NH}_3]}{[\text{NH}_4^+]} = 5.69 \times 10^{-10} = \frac{x^2}{0.100 - x}
\]

\[x = 7.543 \times 10^{-6} \, \text{M} \quad \text{or} \quad 0.100 - x = 0.1000\]

\[\text{pH} = 5.1224 = 5.122\]