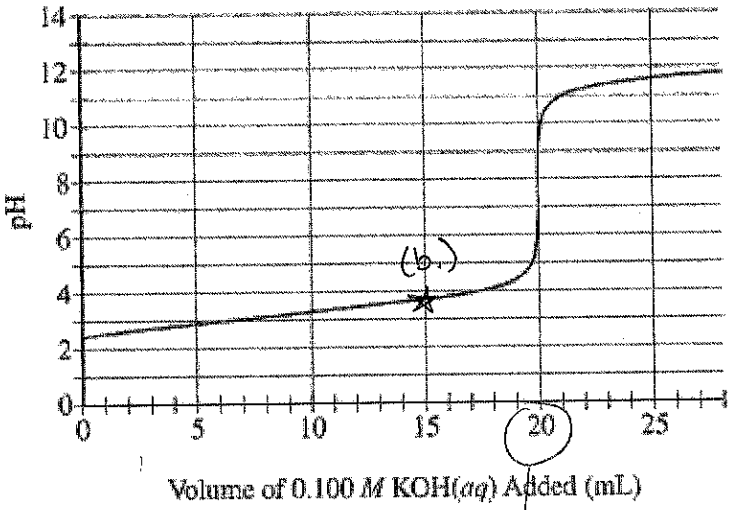
FR Practice #6 (2018 #2, shortened, 3 points)

6. To produce an aqueous solution of HNO_2, a student bubbles $N_2O_3(g)$ into distilled water. Assume that the reaction goes to completion and that HNO_2 is the only species produced. To determine the concentration of $HNO_2(aq)$ in the resulting solution, the student titrates a 100. mL sample of the solution with 0.100 M KOH(aq). The neutralization reaction is represented below.

$$HNO_2(aq) + OH^-(aq) \rightarrow NO_2^-(aq) + H_2O(l)$$

The following titration curve shows the change in pH of the solution during the titration.



a. Use the titration curve and the information above to

   i. determine the initial concentration of the $HNO_2(aq)$ solution (1 point)

   ii. estimate the value of the pK_a for $HNO_2(aq)$ (1 point)

b. During the titration, after a volume of 15 mL of 0.100 M KOH(aq) has been added, which species, $HNO_2(aq)$ or $NO_2^-(aq)$, is present at a higher concentration in the solution? Justify your answer. (1 point)

a.) (i) $M_a V_a = M_b V_b$

$M_a(100.\,mL) = (0.100\,M)(20.0\,mL)$

$M_a = \frac{0.100 \times 20.0}{100.} = \boxed{0.020\,M\ HNO_2}$

(ii) $pK_a \approx 3.4$ (No justification required! pK_a = pH @ ½ eq. pt)

b.) $[NO_2^-]$ is greater, b/c the titration is past the ½-equivalence point (but b4 the eq. pt), so more conjugate base will be present than acid.