See all pages for work

1.The correct choice was B. ✓

2. The correct choice was C. ✓

3.The correct choice was C. ✓

4.The correct choice was A. ✓

5.The correct choice was B. ✓

6.The correct choice was A. ✓

7.~~The correct choice was~~ C. (E) Right answer is 400 mL

8. pH = pK$_a$ = 6.4

9. 0.4 moles of sodium bicarbonate should be added. (OK – I get 0.416 mole)

10. pH = 8.6 (OK – I got 8.56)

11. pH = 9.15 after pH before = 9.16

12. ~~pH = pK$_a$ = 4.74~~ Weak base solution is formed. $K_b = 5.6 \times 10^{-10}$ $[CH_3COO^-] = 0.066M$ pH = 8.2

13. 1 mole or 132 grams.

14. (A) pH = 9.62 (B) 10 : 1

You need 2 moles of $NH_4^+$

$$2 \text{ moles } NH_4 \times \frac{1 \text{ mol } (NH_4)_2SO_4}{2\ NH_4} = 1 \text{ mole } (NH_4)_2SO_4$$

$$pH = pK_a + \log \frac{A^-}{HA}$$

# TTC Buffers

(1) $pH = pK_a + \log \frac{A^-}{HA}$ $pH = (-\log 1.80 \times 10^{-5}) + \log \frac{0.500 \text{ mol acetate}}{0.500 \text{ mol acetic acid}}$

ratio is 1, so log = 0

$pH = 4.74$

(2) $(0.500L)(0.200M) = 0.100$ mol acetic acid (HA)

$pH = pK_a + \log \frac{A^-}{HA}$ $5.00 = (-\log 1.8 \times 10^{-5}) + \log \frac{x}{0.100}$ (x = acetate) solve for x

$x = 0.182$ moles $NaC_2H_3O_2$ $(A^-)$

(3) $pH = pK_a + \log \frac{NO_2^-}{HNO_2}$ solve for ratio $\frac{NO_2^-}{HNO_2} = 1.42$

$5.00 = (-\log 4.0 \times 10^{-4}) + \log \frac{NO_2^-}{HNO_2}$

Since molarities are the same, find correct volume ratio

(4) Buffer has to be WEAK ACID/Base conjugate pair. $H_2SO_4$ is a strong acid

(5) $CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$

| | $CH_3COOH$ | $OH^-$ | $CH_3COO^-$ | $H_2O$ |
|---|---|---|---|---|
| I | 1 mole | 0.25 mol | 0 | 0 |
| C | −0.25 | −0.25 | +0.25 | 0 |
| E | 0.75 mol HA | 0 | 0.25 mol $A^-$ | |

← BUFFER use $pH = pK_a + \log \frac{A^-}{HA}$

(6). C and D are NOT buffers. A and B are buffers, but solutions in A have more moles of weak acid & weak base, so they will be more resistant to pH change.

(7) $HA + OH^- \rightarrow H_2O + A^-$

| | $HA$ | $OH^-$ | $H_2O$ | $A^-$ |
|---|---|---|---|---|
| | 0.050 moles | x | 0 | 0 |
| | −x | −x | — | +x |
| | 0.050 − x | 0 | | x |

← BUFFER

$pH = pK_a + \log \frac{A^-}{HA}$

$8.00 = (-\log 4.0 \times 10^{-8}) + \log \frac{x}{0.05 - x}$

solve for x!

$x = 0.04$ mol $OH^-$ / NaOH

volume needed → 400 mL

# TTC Buffers

(8) $H_2CO_3$ HA
$HCO_3^-$ $A^-$

$$pH = pK_a + \log\frac{A^-}{HA}$$

$$pH = (-\log 4.2\times10^{-7}) + \log\frac{1.00}{1.00}$$

$$pH = 6.4$$

(9) $$pH = pK_a + \log\frac{A^-}{HA}$$

$$7.00 = (-\log 4.2\times10^{-7}) + \log\frac{x}{0.100}$$ ← moles $H_2CO_3$

solve for $x = 0.400$ mol $HCO_3^-$ / $NaHCO_3$

(10) Use $pH = pK_a + \log\frac{A^-}{HA}$

OR $pOH = pK_b + \log\frac{HA}{A^-}$

0.05M HA → $NH_4^+$  $K_a = 5.6\times10^{-10}$
0.01M $A^-$ → $NH_3$  $K_b = 1.8\times10^{-5}$

(11) BEFORE
0.01 mol HCN (HA)
0.07 mol $CN^-$ ($A^-$)

$$pH = (-\log 4.79\times10^{-10}) + \log\frac{0.07}{0.10}$$

$$pH = 9.32 + {}^-0.15$$

$$= 9.17 \text{ (or so)}$$

AFTER adding 0.001 mol $H^+$
0.07 mol $CN^-$ − 0.001 = 0.069 mol $CN^-$ left
0.10 mol HCN + 0.001 = 0.101 mol HCN

$$pH = (-\log 4.79\times10^{-10}) + \log\frac{0.069}{0.101}$$

$$= 9.32 + {}^-0.16$$

$$= 9.16 \text{ (or so)}$$

(12) $CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$

| | $CH_3COOH$ | $OH^-$ | $CH_3COO^-$ | $H_2O$ |
|---|---|---|---|---|
| I | 0.005 moles | 0.005 | 0 | 0 |
| C | −0.005 | −0.005 | +0.005 | |
| E | 0 | 0 | 0.005 | |

☹! Not a buffer; Solution is a WEAK BASE

(cont'd next page)

(12) after adding $OH^-$, solution contains

0.005 moles $CH_3COO^-$ in 75 mL

$[CH_3COO^-] = 0.066\text{ M}$  $K_b = \frac{1\times10^{-14}}{K_a} = 5.6\times10^{-10}$

$5.6\times10^{-10} = \frac{x^2}{(0.066-x)}$ ← ignore x

$[x] = [OH^-] = 1.56\times10^{-6}\text{ M}$  pH = 8.20

(13) $NH_4^+$ (HA)
$NH_3$ ($A^-$)
moles $NH_3$: 0.50

$pH = pK_a + \log\frac{A^-}{HA}$

$8.65 = (-\log 5.6\times10^{-10}) + \log\frac{0.50}{x}$

$x = 2\text{ moles }NH_4^+ \times \frac{(NH_4)_2SO_4}{2\,NH_4} = 1\text{ mole }(NH_4)_2SO_4$

(132 grams)

(14) $\frac{HCO_3^-}{CO_3^{2-}}\left(\frac{HA}{A^-}\right) = 5.00$ → $\frac{A^-}{HA}$

OR USE $pOH = pK_b + \log\frac{HA}{A^-}$

(A) $pH = (-\log 4.8\times10^{-11}) + \log\left(\frac{1}{5}\right)$
$= 10.3 + -0.70$
$= 9.6$ (or so)

(B) $9.30 = 10.30 + \log\frac{A^-}{HA}$

$0.1 = \frac{A^-}{HA}$  so $\frac{HA}{A^-} = 10$