

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.  $\text{pH} = \text{pK}_a = 6.4$

9. 0.4 moles of sodium bicarbonate should be added.

(now OK - I get 0.416 mole)

10.  $\text{pH} = 8.6$

(OK - I get 8.56)

11.  $\text{pH} = 9.15$

after pH before = 9.16

12.  ~~$\text{pH} = \text{pK}_a = 4.74$~~

Weak base solution is formed.

$K_b = 5.6 \times 10^{-10}$   $[\text{CH}_3\text{COO}^-] = 0.066 \text{ M}$

~~$\text{pH} = 8.2$~~   
 $\text{pH} = 8.2$

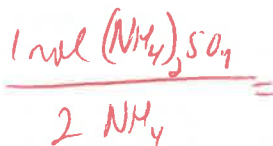
13. 1 mole or 132 grams.

14. (A)  $\text{pH} = 9.62$

(B) 10 : 1

You need 2 moles of  $\text{NH}_4^+$

2 moles  $\text{NH}_4^+ \times$



1 mole  $(\text{NH}_4)_2\text{SO}_4$

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

## TTC buffers

ratio is 1, so  $\log = 0$

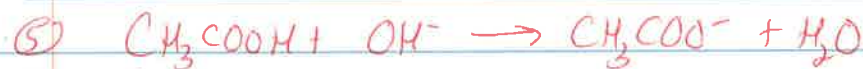
(1)  $pH = pK_a + \log \frac{A^-}{HA}$   $pH = (-\log 1.80 \times 10^{-5}) + \log \frac{0.500 \text{ ml acetate}}{0.500 \text{ ml acetic acid}}$   
 $pH = 4.74$

(2)  $(0.500 \text{ L})(0.200 \text{ M}) = 0.100 \text{ mol acetic acid (HA)}$   $\frac{x}{0.100}$  solve  
 $pH = pK_a + \log \frac{A^-}{HA}$   $5.00 = (-\log 1.8 \times 10^{-5}) + \log \frac{x}{0.100}$  solve

$x = 0.182 \text{ moles NaC}_2\text{H}_3\text{O}_2 (A^-)$

(3)  $pH = pK_a + \log \frac{NO_2^-}{HNO_2}$  solve for ratio  $\frac{NO_2^-}{HNO_2} = 1.42$  Since molarities are the same, find correct volume ratio  
 $5.00 = (-\log 4.0 \times 10^{-4}) + \log \frac{NO_2^-}{HNO_2}$  correct volume ratio

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



I 1 mole 0.25 mol 0 0

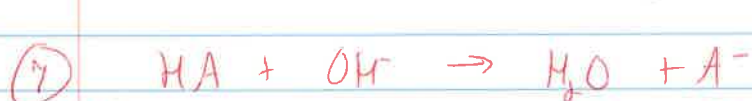
C -0.25 -0.25 +0.25 0

E 0.75 ml HA 0 0.25 ml  $A^-$

← 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.



0.050 moles x 0 0

-x -x - +x

0.050 - x 0 x ← BUFFER

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

$8.00 = (-\log 4.0 \times 10^{-5}) + \log \frac{x}{0.05-x}$

solve for x!

$x = 0.04 \text{ mol } OH^- / NaOH$

volume needed → 400 mL

# TTC Buffers

⑧

$H_2CO_3$	HA	$pH = pK_a + \log \frac{A^-}{HA}$
$HCO_3^-$	$A^-$	

$$pH = (-\log 4.2 \times 10^{-7}) + \log \frac{1.00}{1.00}$$

$$pH = 6.4$$

⑨

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

$$7.00 = (-\log 4.2 \times 10^{-7}) + \log \frac{x}{0.100} \quad \leftarrow \text{mole } H_2CO_3$$

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

⑩ Use

$pH = pK_a + \log \frac{A^-}{HA}$	$0.05M HA \rightarrow NH_4^+$	$K_a = 5.6 \times 10^{-10}$
OR	$0.01M A^- \rightarrow NH_3$	$K_b = 1.8 \times 10^{-5}$
$pOH = pK_b + \log \frac{HA}{A^-}$		

⑪ ~~BEFORE~~

$0.01$ mole HCN (HA)	$pH = (-\log 4.79 \times 10^{-10}) + \log \frac{0.07}{0.10}$
$0.07$ mole $CN^-$ ( $A^-$ )	

$$pH = 9.32 + (-0.15)$$

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

~~AFTER~~ adding  $0.001$  mole  $H^+$

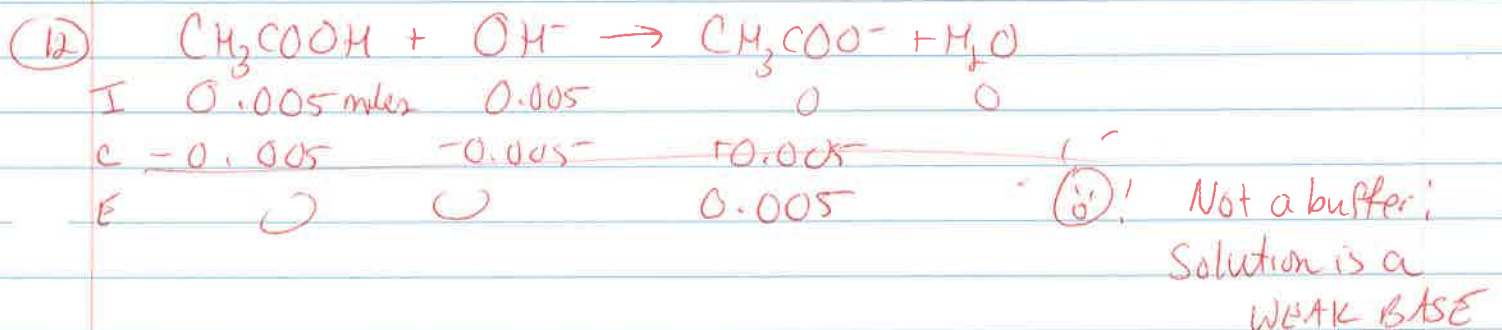
$$0.07 \text{ mole } CN^- - 0.001 = 0.069 \text{ mole } CN^- \text{ left}$$

$$0.10 \text{ mole HCN} + 0.001 = 0.101 \text{ mole HCN}$$

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

$$= 9.32 + (-0.16)$$

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



(cont'd next page)

(12) After adding  $\text{OH}^-$ , solution contains

0.005 moles  $\text{CH}_3\text{COO}^-$  in 75 mL

$$[\text{CH}_3\text{COO}^-] = 0.0666 \text{ M} \quad K_b = \frac{1 \times 10^{-14}}{K_a} = \frac{5.6}{1.8 \times 10^{-5}} \times 10^{-10}$$

$$\frac{5.6}{1.8 \times 10^{-5}} \times 10^{-10} = \frac{x^2}{(0.0666 - x)} \leftarrow \text{ignore } x$$

$$[x] = [\text{OH}^-] = 1.56 \times 10^{-4} \text{ M} \quad \text{pH} = 8.20$$

(13)  $\text{NH}_4^+$  (HA)  
 $\text{NH}_3$  ( $\text{A}^-$ )

moles  $\text{NH}_3$ : 0.50

$$\text{pH} = \text{p}K_a + \log \frac{\text{A}^-}{\text{HA}}$$

~~$$\text{pH} = \text{p}K_a + \log \frac{\text{A}^-}{\text{HA}}$$~~

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

$$x = 2 \text{ moles } \text{NH}_4^+ \times \frac{(\text{NH}_4)_2\text{SO}_4}{2 \text{ NH}_4} = 1 \text{ mole } (\text{NH}_4)_2\text{SO}_4$$

(132 grams)

(14)  $\frac{\text{HCO}_3^-}{\text{CO}_3^{2-}} \left( \frac{\text{HA}}{\text{A}^-} \right) = 5.00$

$$\begin{aligned} \text{(A)} \quad \text{pH} &= (-\log 4.8 \times 10^{-11}) + \log \left( \frac{1}{5} \right) \\ &= 10.3 + -0.70 \\ &= 9.6 \text{ (or so)} \end{aligned}$$

OR USE  $\frac{\text{HA}}{\text{A}^-}$   
 $\text{pOH} = \text{p}K_b + \log \frac{\text{HA}}{\text{A}^-}$

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

$$0.1 = \frac{\text{A}^-}{\text{HA}}$$

SO  $\frac{\text{HA}}{\text{A}^-} = \frac{10}{1}$