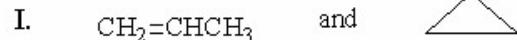


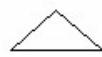
CHMB41 FSG Week 3 – Acid and Bases

1. If  $\text{H}_2\text{O}$  has a  $\text{pK}_a$  value of 15.7 and  $\text{HF}$  has a  $\text{pK}_a$  value of 3.2, which is a stronger base,  $\text{HO}^-$  or  $\text{F}^-$ ? Explain.
  2. Which of the following is the strongest acid?
    - A)  $\text{CH}_3\text{OH}$
    - B)  $\text{CH}_3\text{OH}_2^+$
    - C)  $\text{H}_2\text{N}^-$
    - D)  $\text{CH}_3\text{NH}_2$
    - E)  $\text{CH}_3\text{NH}_3^+$
  3. Which of the following pairs are resonance structures?

A) I

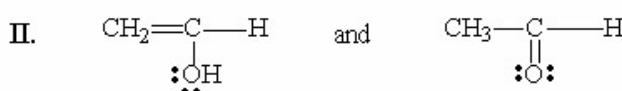


and

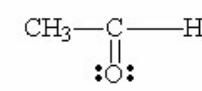


B) II

C) III

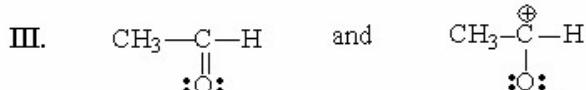


and

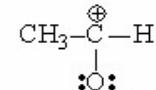


D) IV

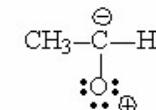
E) V



and

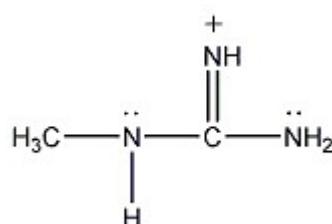


IV. CH<sub>3</sub>—C≡H and

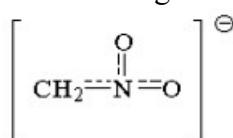


V.  $\text{CH}_2-\ddot{\text{O}}-\text{CH}_2$  and

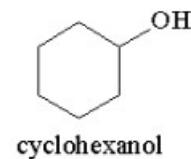
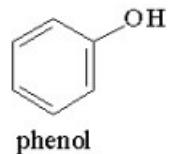
4. Draw the important resonance contributing forms for the structure shown below.



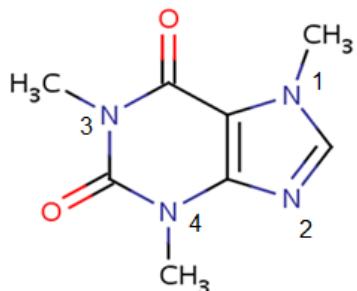
5. Draw four resonance contributors for the following structure and indicate which is the most important contributor. Explain. 



6. Why is phenol a stronger acid than cyclohexanol?

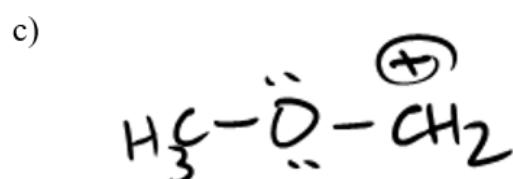
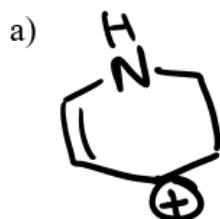


7. Which is the most basic N in the caffeine molecule?



- A) 1
- B) 2
- C) 3
- D) 4

8. Draw the most stable resonance contributor for the structures shown:

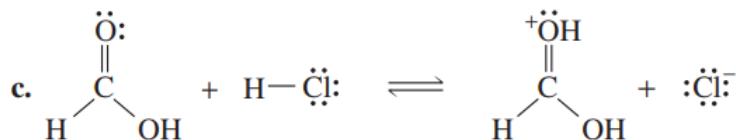


9. Which is a stronger base?

- |                                                          |                                                      |                                                                   |
|----------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------|
| a. $\text{HS}^-$ or $\text{HO}^-$                        | c. $\text{CH}_3\text{OH}$ or $\text{CH}_3\text{O}^-$ | e. $\text{CH}_3\text{COO}^-$ or $\text{CF}_3\text{COO}^-$         |
| b. $\text{CH}_3\text{O}^-$ or $\text{CH}_3\text{NH}_2^-$ | d. $\text{Cl}^-$ or $\text{Br}^-$                    | f. $\text{CH}_3\text{CHClCOO}^-$ or $\text{CH}_3\text{CHBrCOO}^-$ |

CHMB41 FSG Week 3 – Acid and Bases

10. Draw curved arrows to show where the electrons start and where they end in the following reactions:



11. a. Rank the following alcohols from strongest to weakest acid:



$K_a = 5.75 \times 10^{-13}$



$K_a = 1.29 \times 10^{-13}$



$K_a = 4.90 \times 10^{-13}$

b. Explain the relative acidities.

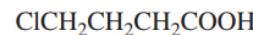
12. a. Rank the following carboxylic acids from strongest to weakest acid:



$K_a = 1.52 \times 10^{-5}$



$K_a = 1.39 \times 10^{-3}$



$K_a = 2.96 \times 10^{-5}$



$K_a = 8.9 \times 10^{-5}$

- b. How does the presence of an electronegative substituent such as Cl affect the acidity of a carboxylic acid?  
 c. How does the location of the substituent affect the acidity of the carboxylic acid?

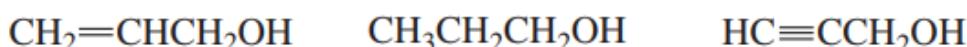
CHMB41 FSG Week 3 – Acid and Bases



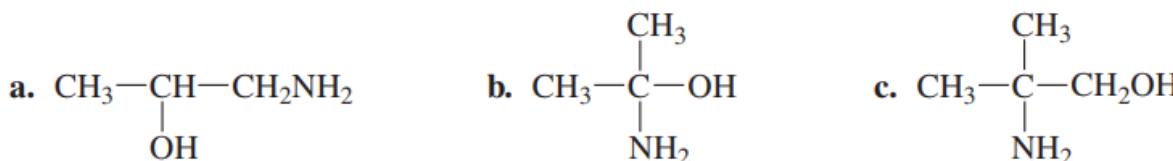
14. For each of the following compounds, draw the form that predominates at pH = 3, pH = 6, pH = 10, and pH = 14:

- a.  $\text{CH}_3\text{COOH}$       b.  $\text{CH}_3\text{CH}_2\overset{+}{\text{NH}_3}$       c.  $\text{CF}_3\text{CH}_2\text{OH}$   
 $pK_a = 4.8$        $pK_a = 11.0$        $pK_a = 12.4$

15. a. Rank the following alcohols from strongest to weakest acid.  
b. Explain the relative acidities.



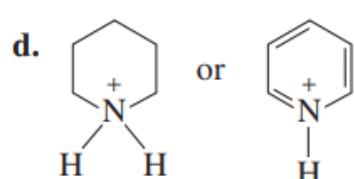
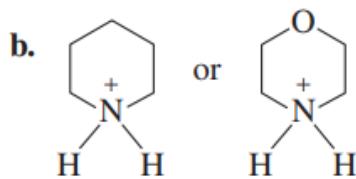
16. For each compound, indicate the atom that is most apt to be protonated.



17. Tenormin, a member of the group of drugs known as beta-blockers, is used to treat high blood pressure and improve survival after a heart attack. It works by slowing down the heart to reduce its workload. Which atom in Tenormin is the most basic?

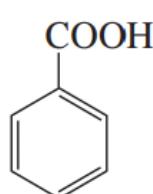


18. Which is a stronger acid?

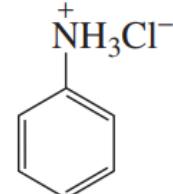


19. Given that  $\text{C}_6\text{H}_{11}\text{COOH}$  has a  $\text{pK}_a = 4.8$  and  $\text{C}_6\text{H}_{11}\text{NH}_3^+$  has a  $\text{pK}_a = 10.7$ , what pH would you make the water layer to cause both compounds to dissolve in it?

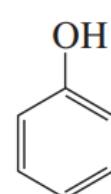
20. How could you separate a mixture of the following compounds? The reagents available to you are water, ether, 1.0 M HCl, and 1.0 M NaOH.



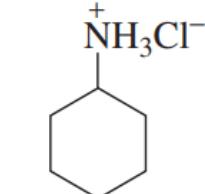
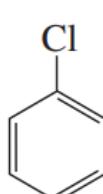
$\text{pK}_a = 4.17$



$\text{pK}_a = 4.60$



$\text{pK}_a = 9.95$



$\text{pK}_a = 10.66$