

1. Categorize the following acids/bases pairs as Arrhenius, Brønsted–Lowry and/or Lewis pairs. [☆]

- HCl bubbled in water;
- BF_3 in a diethyl ether solution;
- Boric acid ($\text{B}(\text{OH})_3$) dissolved in water;
- Fe(III) center coordinating acetylacetonate ligands.

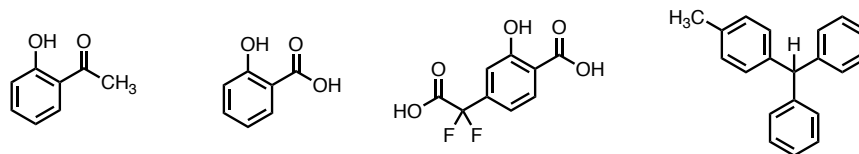
2. Qualitatively predict the position of the following equilibria. [☆]

- $\text{HCl} + \text{Et}_3\text{N} \rightarrow \text{Et}_3\text{NH}^+ + \text{Cl}^-$
- $\text{Et}_3\text{N} \cdot \text{HCl} + \text{Me}_2\text{NH} \rightarrow \text{Et}_3\text{N} + \text{Me}_2\text{NH} \cdot \text{HCl}$
- $\text{H}_2\text{SO}_4 + \text{NaBr} \rightarrow \text{HBr} + \text{NaHSO}_4$
- $\text{CH}_3\text{CO}_2\text{H} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CO}_2^- + \text{H}_3\text{O}^+$
- $\text{Pyridine} + \text{CF}_3\text{CO}_2\text{H} \rightarrow \text{CF}_3\text{CO}_2^- + \text{pyridine} \cdot \text{H}^+$

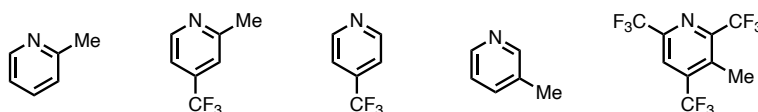
3. Indicate the acid and base reactants and define their conjugate base and acid. [☆]

- $\text{NaHCO}_3 + \text{CF}_3\text{CO}_2\text{H} \rightarrow \text{CF}_3\text{CO}_2\text{Na} + \text{CO}_2 + \text{H}_2\text{O}$
- $\text{H}_3\text{PO}_4 + \text{LiOH} \rightarrow \text{LiH}_2\text{PO}_4 + \text{H}_2\text{O}$
- $2\text{HCl} + \text{Cs}_2\text{CO}_3 \rightarrow \text{CsCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
- $\text{Ba}(\text{OH})_2 + \text{HF} \rightarrow \text{BaF} + \text{H}_2\text{O}$

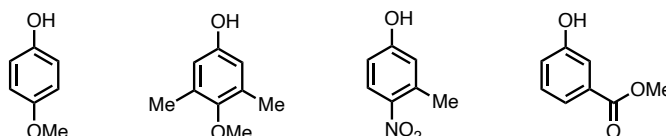
4. Indicate the proton with the lowest pKa in the following molecules. [☆☆]



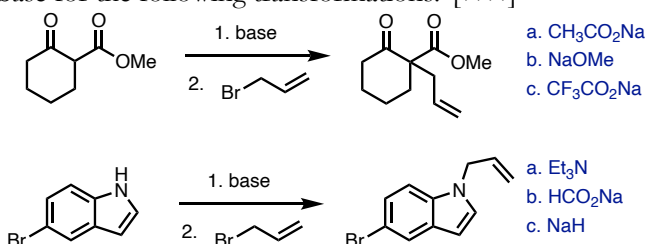
5. Order the following molecules according to increased basicity. [☆☆]



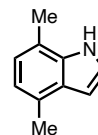
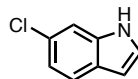
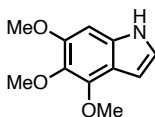
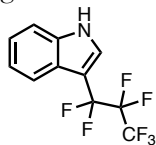
6. Order the following phenols according to increased acidity. [☆☆]



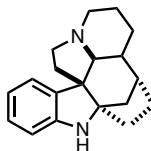
7. What is the most suitable base for the following transformations? [☆☆]



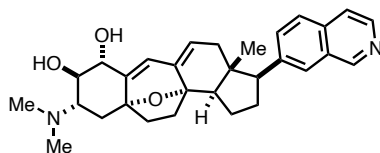
8. Order the following indoles according to increasing acidity. [☆☆]



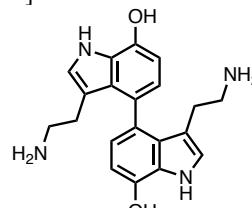
9. Indicate the most basic atom for each of the following natural products. [☆☆]



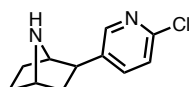
Aspidofractinine



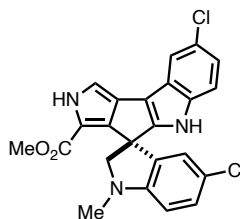
Cortistatine A



Dendridine A

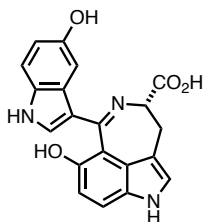


Epibatidine

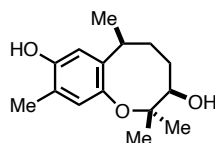


Spiroindimicin B

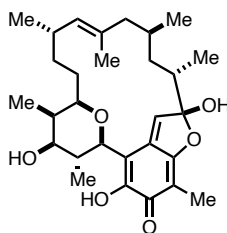
10. Indicate the most acidic atom in each of the following natural products. [☆☆]



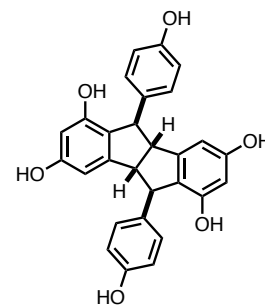
Hyrtiazepine



Hellannuol A

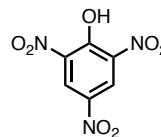
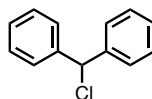
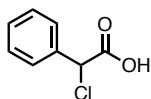
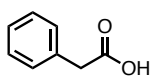


Kendomycin

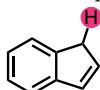


Pallidol

11. Order these molecules from the least acid to the most acidic. [☆☆]



12. Explain the pK_a of the following molecules in comparison to other alkanes. [☆☆]

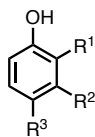


$pK_a = 20$



$pK_a = 46$

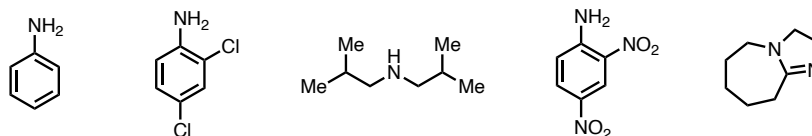
13. Describe the variation of acidity of the following phenol: [☆☆]



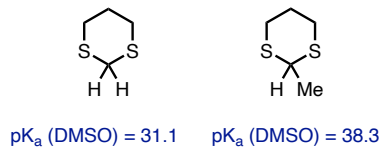
When:

- R¹ is bromo;
- R² is dimethylamino;
- R¹ is nitro;
- R³ is methoxy and R² is cyano.

14. Order the following N-containing compounds according to increasing basicity. [☆☆]



15. Hypothesize the reason of the substantial pK_a difference between the two compounds: [☆☆☆]



16. Explain the anomalous pK_a values: [☆☆☆]

