

Acids And Bases

A. Introduction

B. Log Scales To Measure Proton Dissociation From Organic Molecules Equilibria That Generate Protons

a *constant*, because an equilibrium
variable, therefore
is not a good parameter
will not change

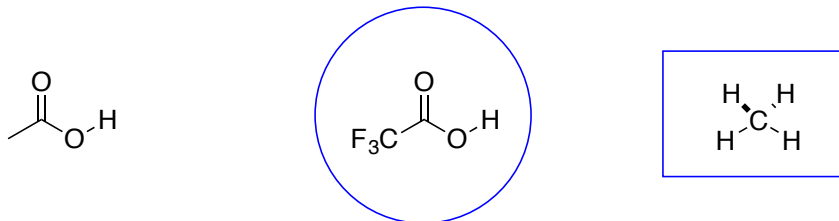
This *is* effectively the same as the statement:

may be represented as:

for *all* organic
a *small* fraction
a *strong* acid
is *high*.

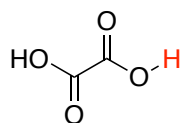
weak acid.

therefore a significantly stronger acid than methane.



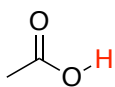
does

10^{60} 10^6 10 1 10^{-6} 10^{-60}



$K_a = 5.4 \times 10^{-2}$

1



1.8×10^{-5}

4



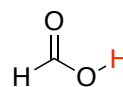
1.1×10^{-7}

5



1.0×10^{-14}

6



1.8×10^{-4}

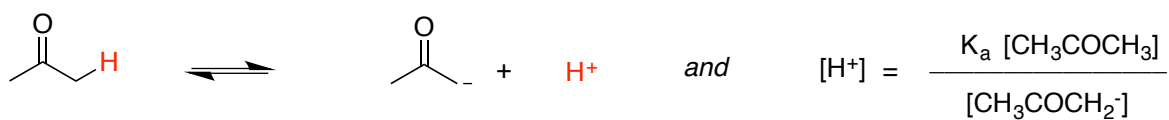
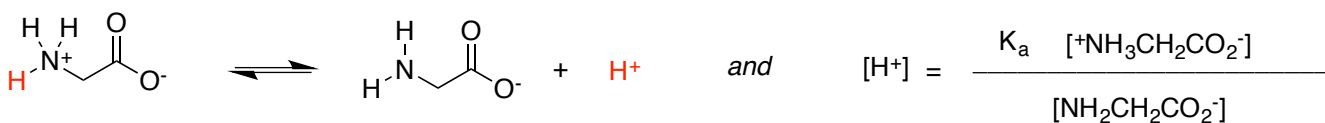
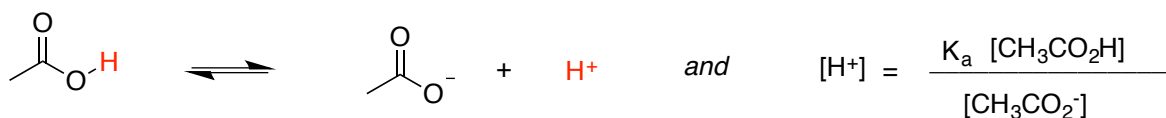
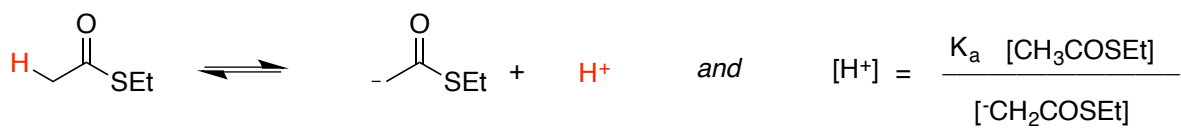
3



6.6×10^{-4}

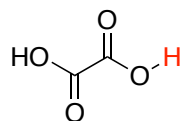
2

1 would be a strong acid.



Simplifying The Scale: pKa

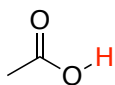
are less than the absolute differences



$$K_a = 5.4 \times 10^{-2}$$

$$\log K_a = -1.27$$

$$-\log K_a = 1.27$$



$$1.8 \times 10^{-5}$$

$$\log K_a = -4.74$$

$$-\log K_a = 4.74$$



$$1.1 \times 10^{-7}$$

$$\log K_a = -6.95$$

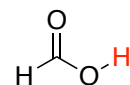
$$-\log K_a = 6.95$$



$$1.0 \times 10^{-14}$$

$$\log K_a = -14$$

$$-\log K_a = 14$$



$$1.8 \times 10^{-4}$$

$$\log K_a = -3.74$$

$$-\log K_a = 3.74$$



$$6.6 \times 10^{-4}$$

$$\log K_a = -3.18$$

$$-\log K_a = 3.18$$

called the pKa value.

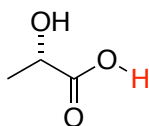
only a small amount of the compound

are positive for

larger K_a

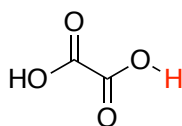
less

smaller pKa values.



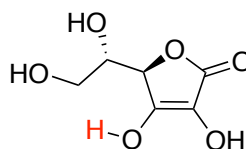
lactic acid
 $pK_a = 3.86$

2



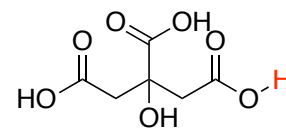
oxalic acid
4.19

4



ascorbic acid
4.10

3



citric acid
3.08

1

10 times easier

10,000,000,000 times easier to

NH_4^+ <i>ammonium</i> $pK_a = 9.2$ <u>2</u>	NH_3 <i>ammonia</i> 38 <u>4</u>	H_3O^+ <i>hydroxonium</i> -1.7 <u>1</u>	H_2O <i>water</i> 14.0 <u>3</u>
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more

less likely that water will dissociate into hydroxide and a proton

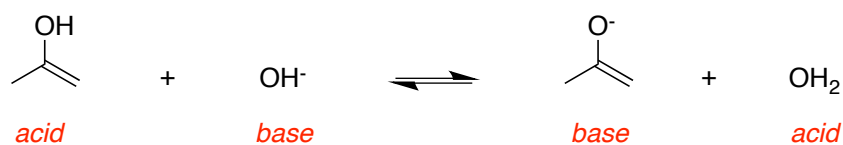
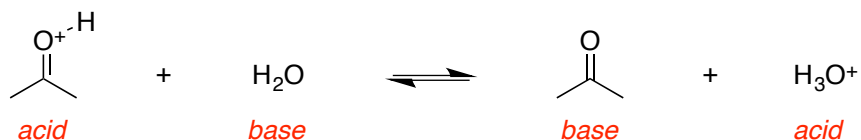
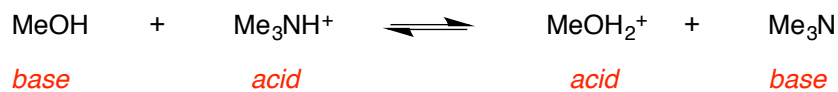
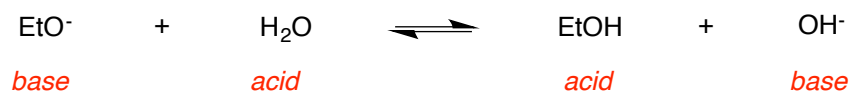
C. Acid-Base Equilibria

starting materials

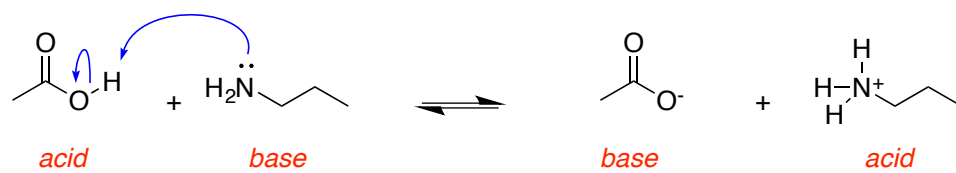
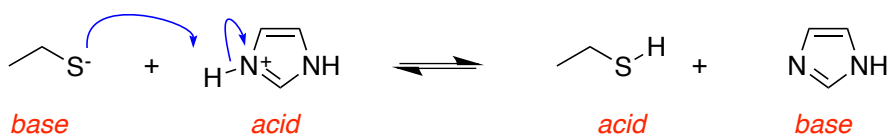
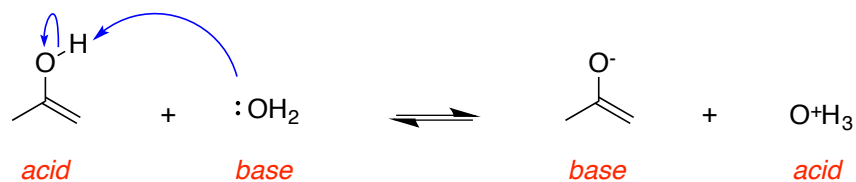
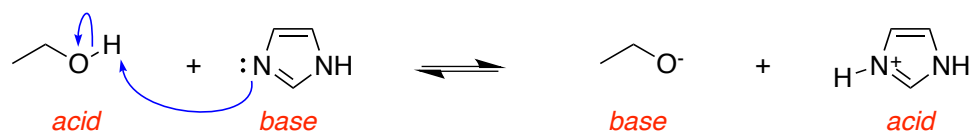


side with the weakest acid because

higher pK_a values



It is possible for

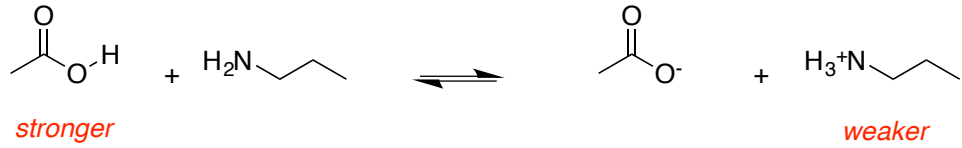


called its conjugate base.

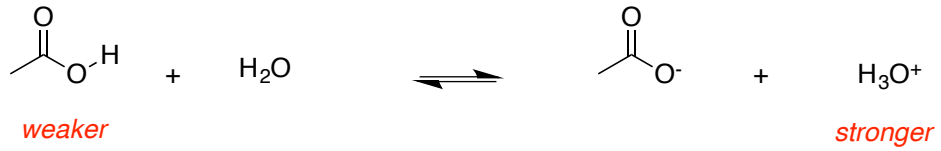
formed by protonating a base.

acid of ammonia.

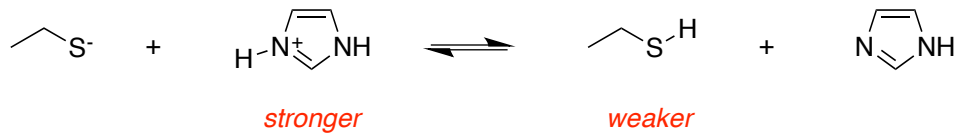
acid of water.



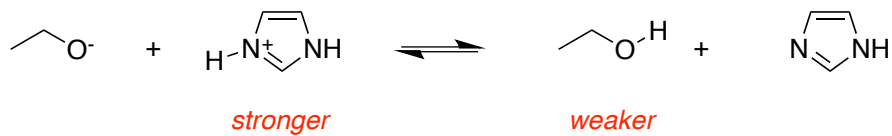
favors products



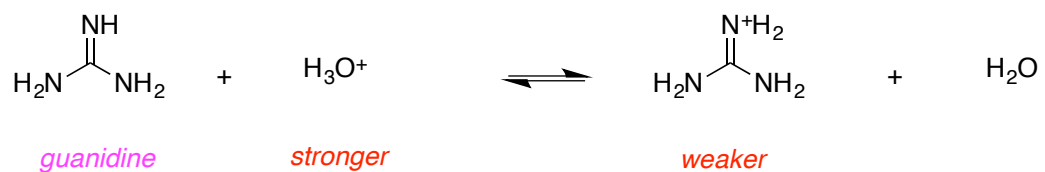
favors starting materials



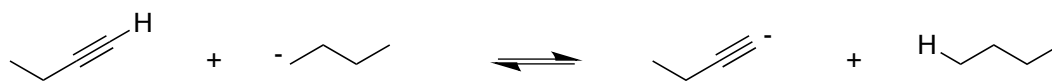
favors products



favors products



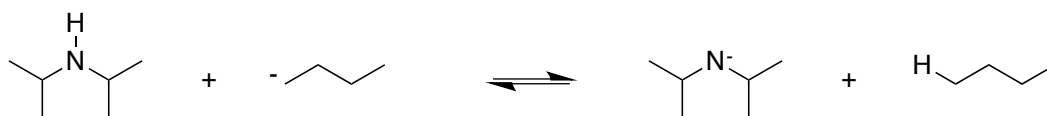
favors products



stronger

weaker

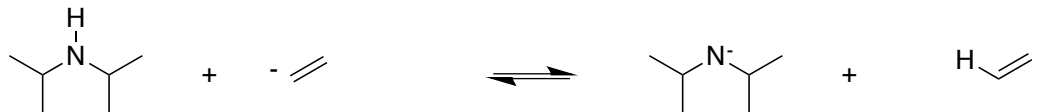
favors products



stronger

weaker

favors products



stronger

weaker

favors products

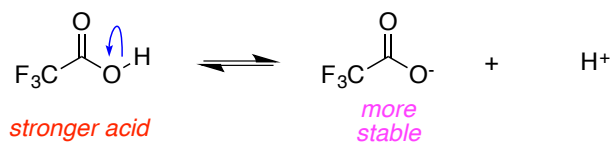
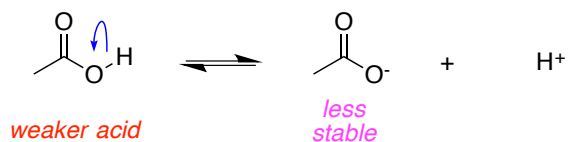


weaker

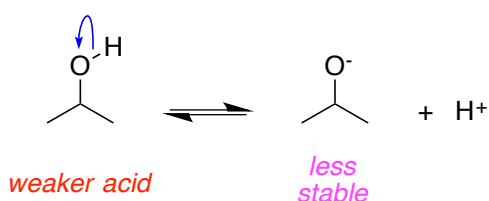
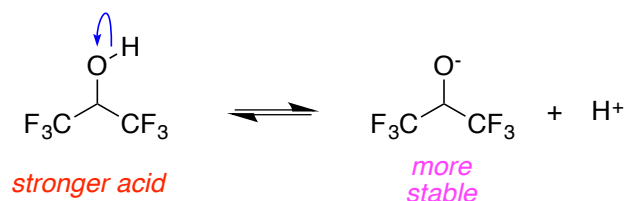
stronger

favors starting materials

D. Predicting Relative pK_a Values

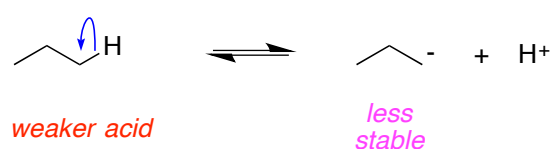
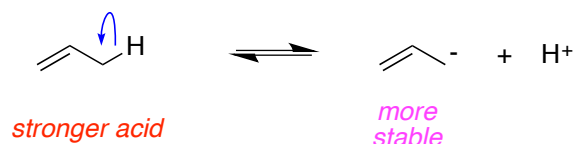


Ethanoic acid is a weaker stabilized by electronegativity

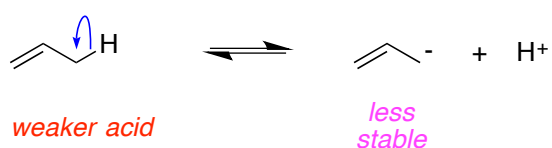
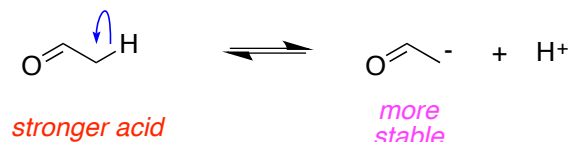


1,1,1,3,3,3-Hexafluoropropan-2-ol has a lower pK_a stronger acid.

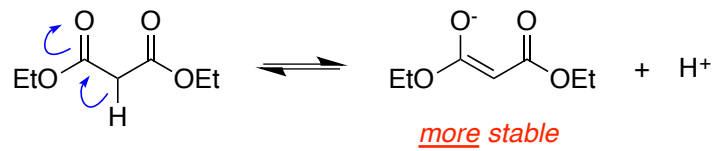
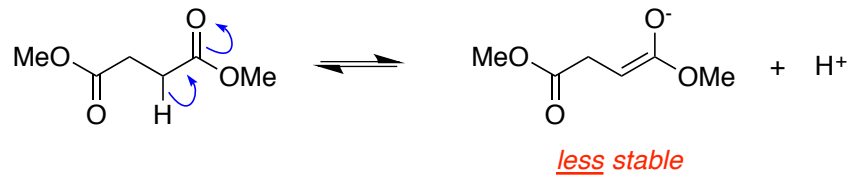
more stable than that from propan-2-ol because of electronegativity effects.



Allyl anions are more stable resonance effects, stronger acid than propane.

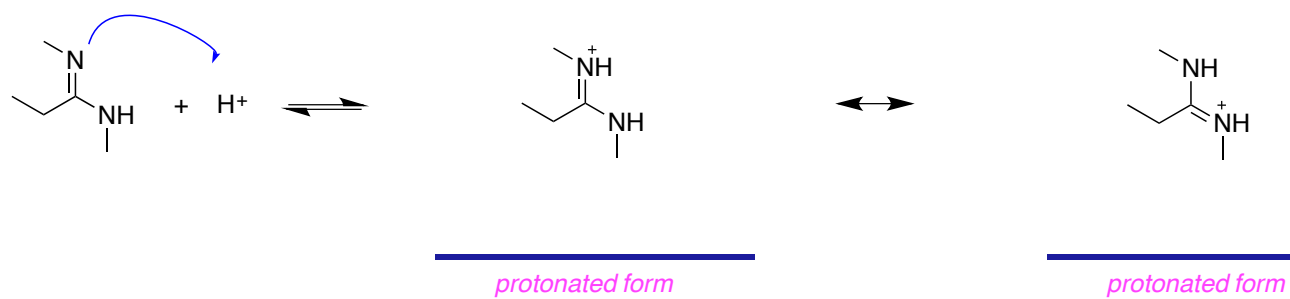
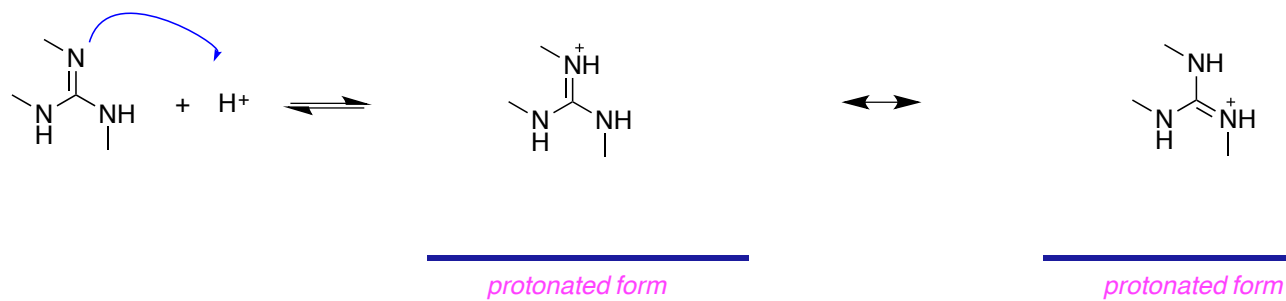
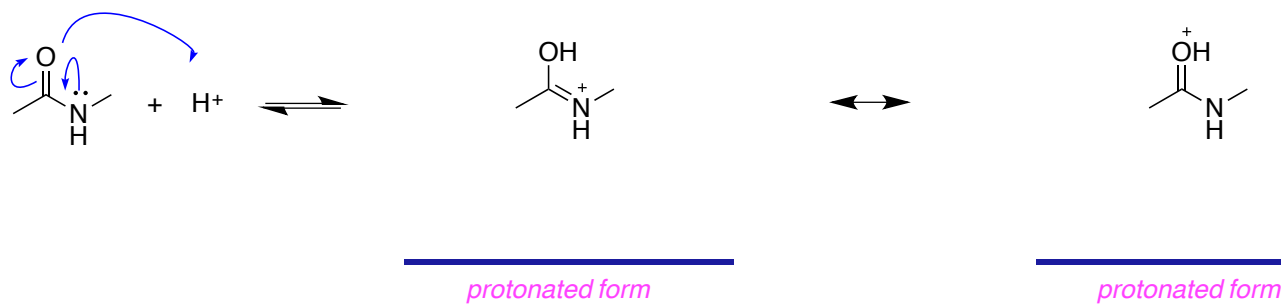
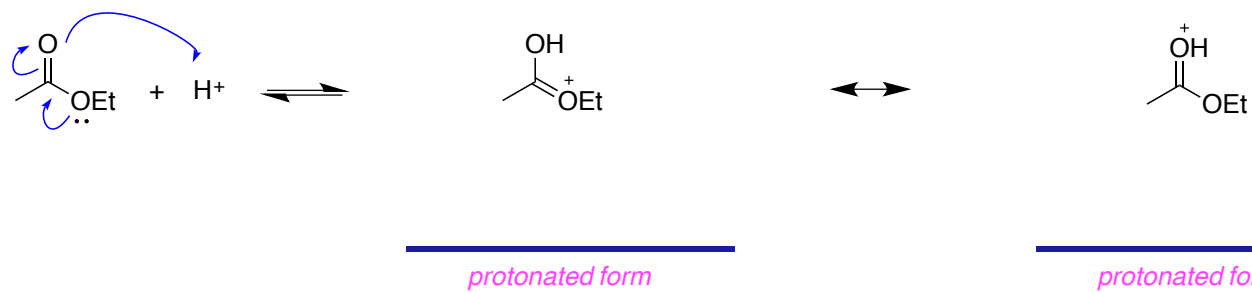


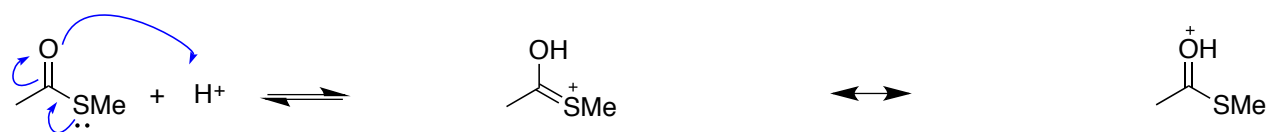
more stable than allyl anions due to electronegativity effects, so ethanal has a lower pK_a



higher pK_a
resonance effects.

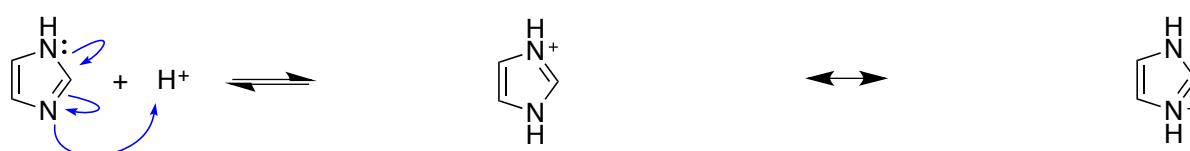
E. Predicting Sites Of Protonation





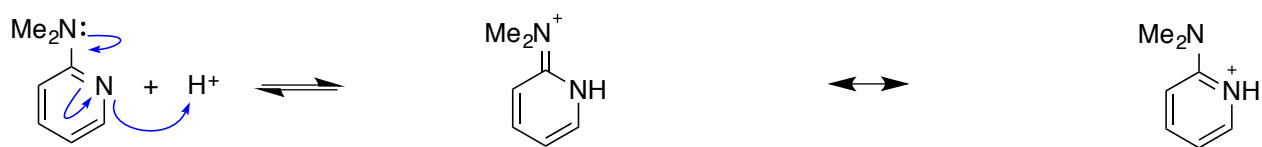
protonated form

protonated form



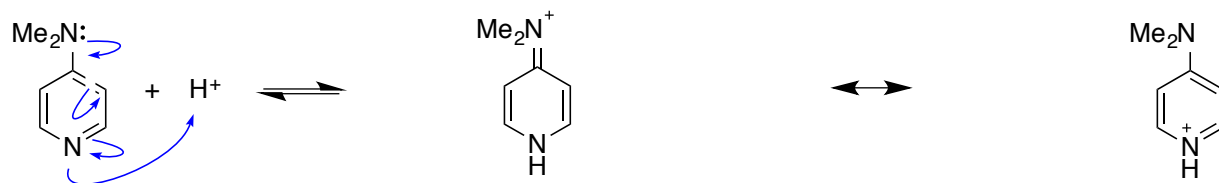
protonated form

protonated form



protonated form

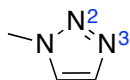
protonated form



protonated form

protonated form

selectively at N^3 .



explanation:

because of resonance effect, electrons

can move from one N to another

F. Lewis Acids And Bases

All acids *do not*

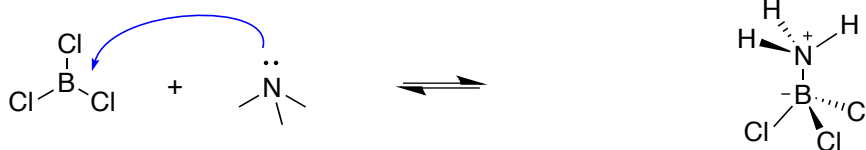
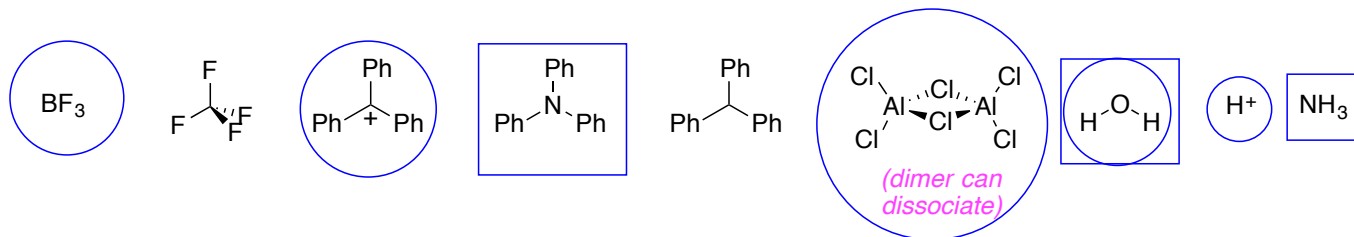
eg *an empty p-orbital*.

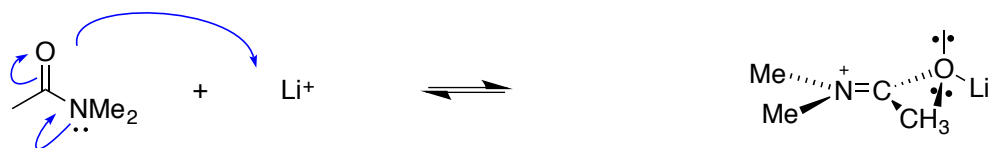
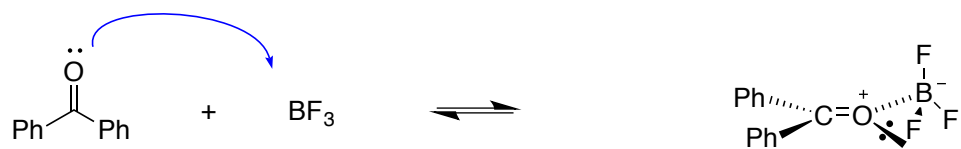
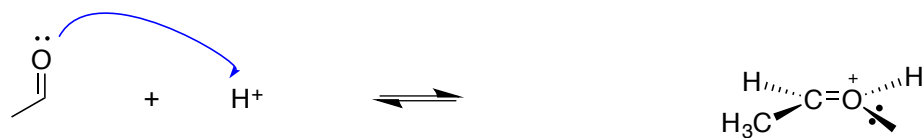
Lewis *acids*

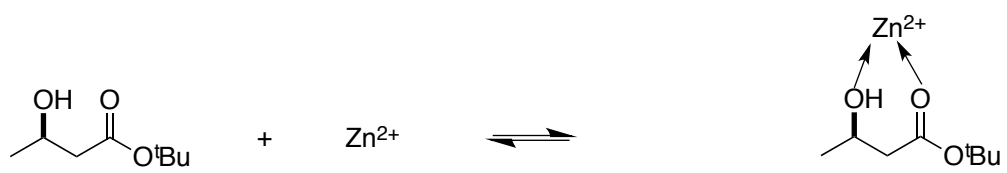
acids because they have 6 electrons in their valence shell and *an empty*

can fit the definition of a Lewis acid.

Protons *do* fit







two phosphorus atoms are sp^3 hybridized.

