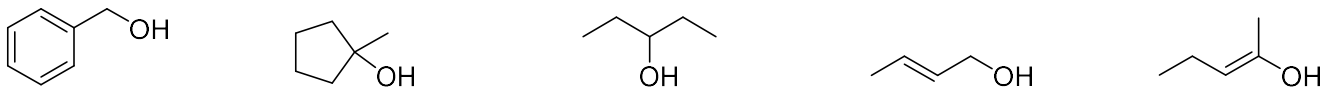
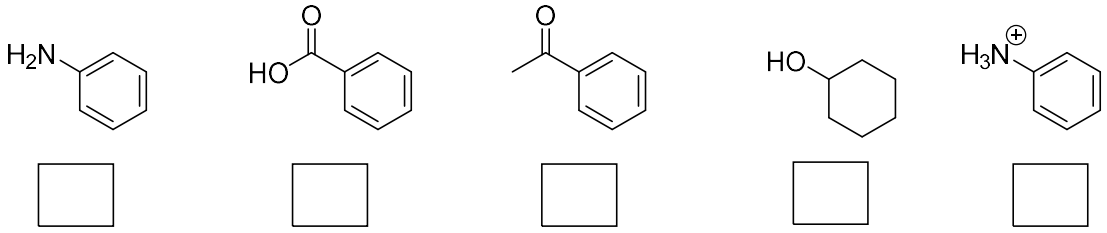
Chapter 12 Worksheet – Alcohols

12A. FUNdamentals

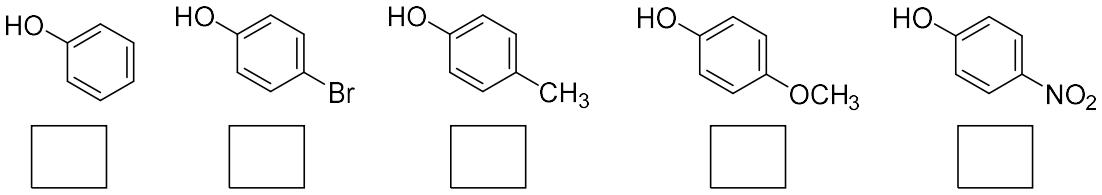
(a) Classify each alcohol by substitution pattern (**primary 1°, secondary 2°, or tertiary 3°)** and whether it is **alkyl, allyl, vinyl, or benzylic**.



(b) Identify the **most acidic H** on each molecule, then list **its approximate pKa** in the box provided.

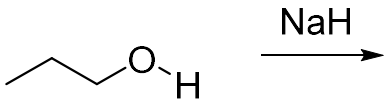


(c) Draw the conjugate base of each phenol then rank by relative acidity in the boxes below, where 1 = most acidic.



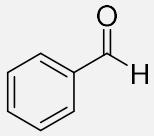
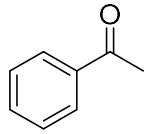
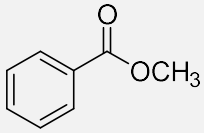
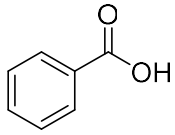
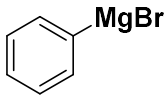
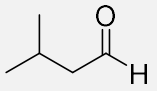
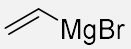
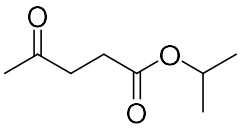
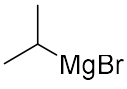
Conjugate bases:

(d) Draw the arrow-pushing mechanism and products in this reaction:



12B. CARBONYL REACTIONS:

- Draw the product of each reaction: **starting material + reagent → Product.**

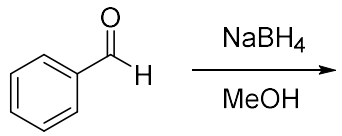
	Starting Material	Reagents *& translation* *know this mechanism	Alternate reagents (same product)	Draw the Product look out for NR! (no reaction)
1	 **benzaldehyde** (almond extract)	***(a) $NaBH_4$, MeOH** *sodium boro**hydride** in methanol*	• H_2 with Pt, Pd, or Ni *hydrogen gas with platinum, palladium, or nickel* • 1. $LiAlH_4$ 2. H_2O	
2	 **Acetophenone**	*** (b) 1. $LiAlH_4$ 2. H_2O** *lithium aluminum **hydride** followed by water*	• $NaBH_4$, MeOH • H_2 with Pt, Pd, or Ni	
3	 **Methyl benzoate**	*** (c) 1. CH_3MgBr 2. H_2O** ***Methyl** magnesium bromide followed by water*	1. MeMgBr - abbreviation 2. H_2O	
4	 **Benzoic Acid**	*** (d)** **1.**  **2. H_2O** ***Phenyl** magnesium bromide followed by water*	1. PhMgBr - abbreviation 2. H_2O	
5	 **3-methylbutanal**	***(e)** **1.**  **(1 mol)** **2. H_2O** ***vinyl** magnesium bromide (1 molar equivalent) followed by water*	n/a	
6	 **Isopropyl 4-oxo-pentanoate**	***(f)** **1. xs**  **2. H_2O** *Excess **isopropyl** magnesium bromide followed by water*	1. *i*-PrMgBr - abbreviation 2. H_2O	

Pro-tip: See the REVIEW OF REACTIONS for Chapter 12 on pg. 546 of the Klein text (3rd ed)

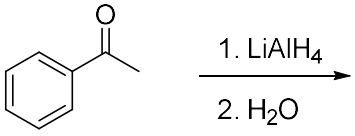
12B. CARBONYL REACTION MECHANISMS

- Draw the arrow-pushing mechanism for the reactions, including all charged intermediates and product.
- Mix & Match (Mechanism Bootcamp): draw the mechanism for each starting material (1-6) and reagent from the 12B reactions (previous page)

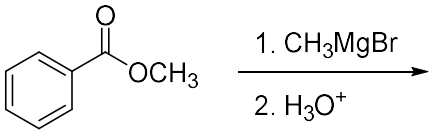
(1a)



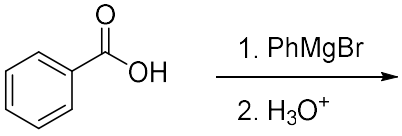
(2b)



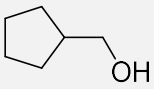
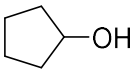
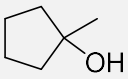
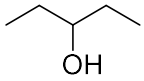
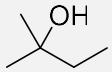
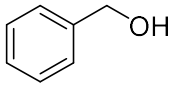
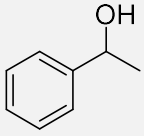
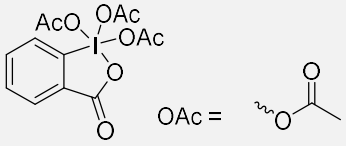
(3c)



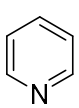
(4d)

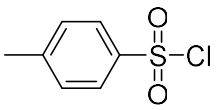


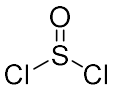
12C. ALCOHOL REACTIONS: Draw the <u>product of each reaction</u>: **starting material + reagent → Product.**

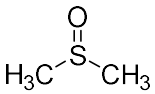
	Starting Material	Reagents *& translation* *know this mechanism	Alternate reagents (same product)	Draw the Product
7		***(g) NaH** *Sodium hydride*	Na *Sodium metal*	
8		***(h) TsCl, py** *Tosyl chloride in pyridine*	n/a	
9		***(i) HBr** *Hydrobromic acid*	• PBr_3 *Phosphorus tribromide* • 1. TsCl, py 2. NaBr *Tosyl chloride in pyridine, followed by sodium bromide*	
10		***(j) $SOCl_2$, py** *Thionyl chloride in pyridine*	HCl, $ZnCl_2$ Alcohols of 8 carbons or less react with *Hydrochloric acid with zinc chloride*	
11		***(k) conc. H_2SO_4, Δ** *Concentrated sulfuric acid with heat*	1. TsCl, py 2. NaOEt *Tosyl chloride with pyridine followed by sodium ethoxide*	
12		**(l) $Na_2Cr_2O_7$, H_2SO_4, H_2O** *Sodium dichromate in aqueous sulfuric acid*	• Chromic Acid (H_2CrO_4) • CrO_3, H_3O^+	
13		**(m) DMP, CH_2Cl_2**  **Dess-Martin Periodinane** (DMP) *in methylene chloride solvent*	• PCC, CH_2Cl_2 *Pyridinium chlorochromate in methylene chloride solvent* • 1. DMSO, $(COCl)_2$ 2. Et_3N *Dimethylsulfoxide & oxalyl chloride followed by triethylamine*	

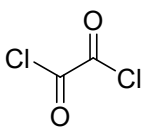
Structures & abbreviations that didn't fit above…

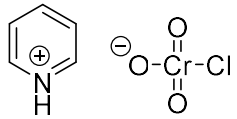

pyridine (py)


***para*-toluenesulfonic chloride** (tosyl chloride, TsCl)


thionyl chloride ($SOCl_2$)


dimethyl sulfoxide (DMSO)

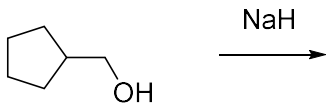

oxalyl chloride ($(COCl)_2$)


pyridinium chlorochromate (PCC)

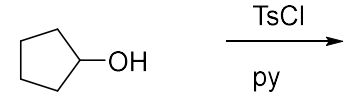
12C. ALCOHOL MECHANISMS

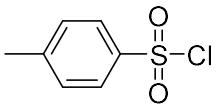
- Draw the arrow-pushing mechanism for the reactions, including all charged intermediates and product.
- Mix & Match (Mechanism Bootcamp): draw the mechanism for each starting material (7-3) and reagents (g-k) from the 12B reactions (previous page)

(7g)

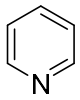


(8h)





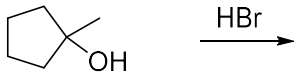
***para*-toluenesulfonic chloride**
(tosyl chloride, TsCl)



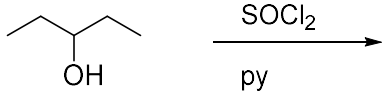
pyridine

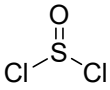
(py)

(9i)



(10j)



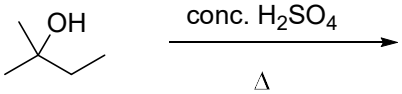


thionyl chloride
($SOCl_2$)

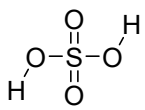
pyridine

(py)

(11k)

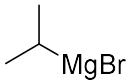
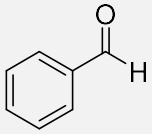
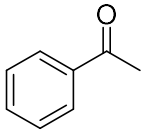
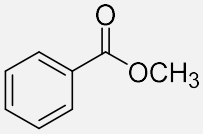
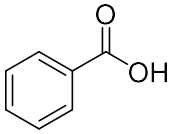
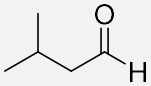
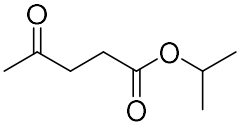


* H_2O is present in this concentrated *solution*

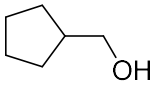
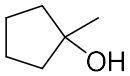
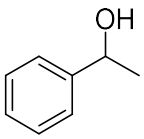


sulfuric acid
H_2SO_4

BONUS: Mix & Match with Reaction Bootcamp!

React each carbonyl compound with each reagent and draw the product in the box		**(a) $NaBH_4$, MeOH**	**(b) 1. $LiAlH_4$ 2. H_2O**	**(f) 1. xs**  **2. H_2O**
1	 **benzaldehyde** (almond extract)			
2	 **Acetophenone**			
3	 **Methyl benzoate**			
4	 **Benzoic Acid**			
5	 **3-methylbutanal**			
6	 **Isopropyl 4-oxo-pentanoate**			

BONUS: Mix & Match with Reaction Bootcamp!

React each alcohol with each reagent and draw the product in the box	**7.** 	**9.** 	**13.** 
(g) NaH			
(h) TsCl, py			
(i) HBr			
(j) $SOCl_2$, py			
(k) conc. H_2SO_4, Δ			
(l) $Na_2Cr_2O_7$, H_2SO_4, H_2O			
(m) DMP, CH_2Cl_2			