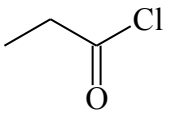
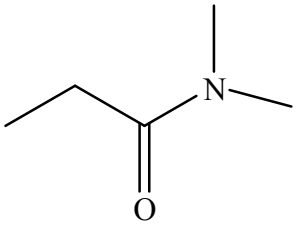
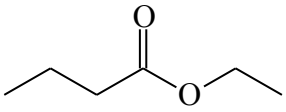
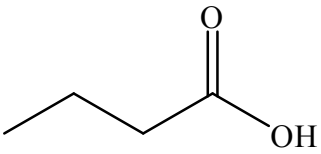
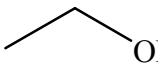
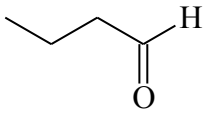
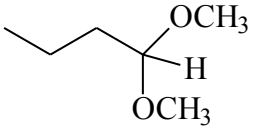
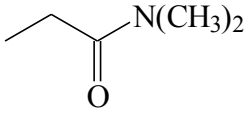
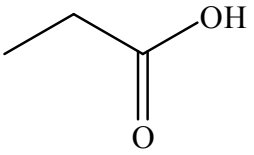
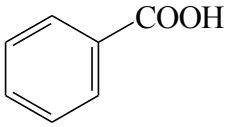
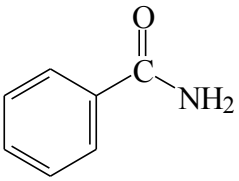
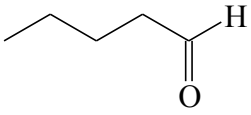
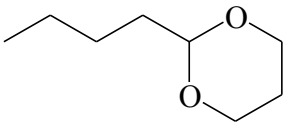
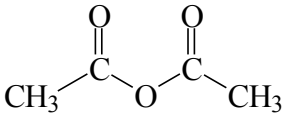
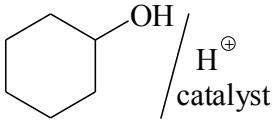
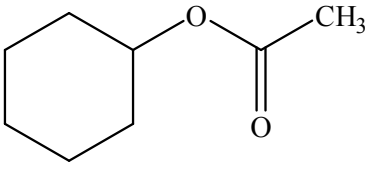
Marks 13

- Complete the following table.

STARTING MATERIAL NAME (where required)	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	excess $(CH_3)_2NH$	 + $(CH_3)_2NH^+Cl^-$
 Name:	3 M HCl / heat	 + 
	**excess CH_3OH H^+ / heat**	

- Complete the following table. Make sure you complete the name of the starting material where indicated.

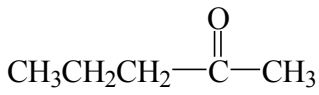
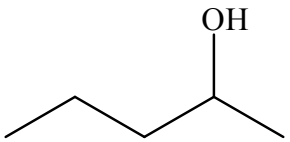
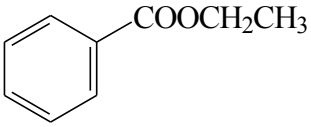
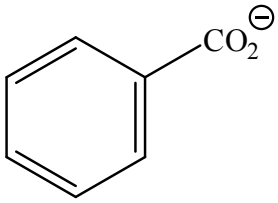
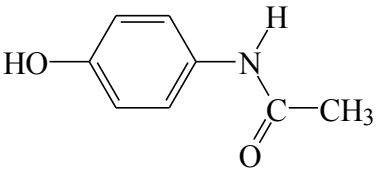
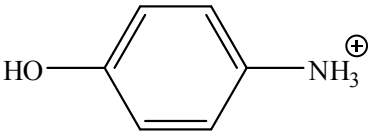
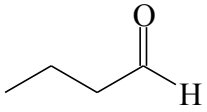
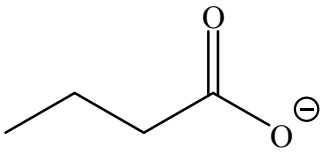
Marks 13

STARTING MATERIAL NAME (where required)	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	conc. HCl / heat	 + $(CH_3)_2NH^+Cl^-$
	**1. $SOCl_2$ / heat** **2. excess NH_3**	
 **Name: pentanal**	**$HOCH_2CH_2CH_2OH$** **H_2SO_4 (catalyst)** **heat**	
		 + CH_3COOH

1

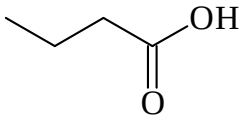
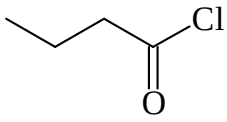
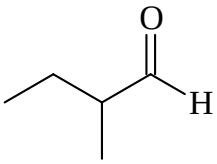
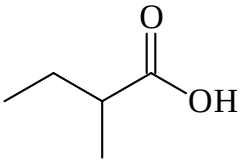
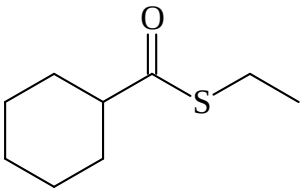
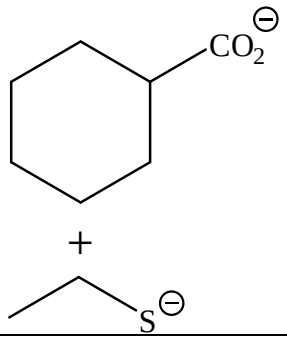
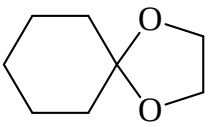
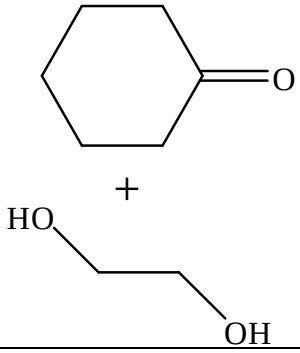
- Complete the following table. Make sure you complete the name of the starting material where indicated.

Marks 5

STARTING MATERIAL NAME (where required)	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
 **Name: 2-pentanone**	1. $LiAlH_4$ / dry ether 2. $H^{\oplus}$ / H_2O	
	3 M NaOH / heat	 + CH_3CH_2COOH
	conc. HCl / heat	 + CH_3COOH
	$[Ag(NH_3)_2]^{\oplus}$ / dil. $OH^{\ominus}$	

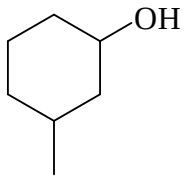
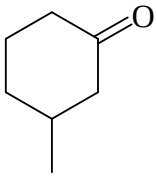
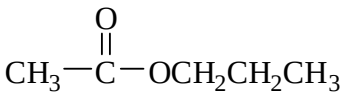
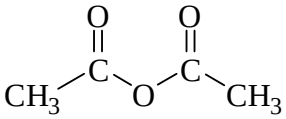
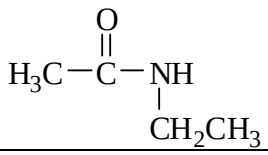
- Complete the following table. Make sure you complete the name of the starting material where indicated.

Marks 8

STARTING MATERIAL NAME (where required)	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
 **Name: butanoic acid (or butyric acid)**	**$SOCl_2$**	
 **Name: 2-methylbutyraldehyde (or 2-methylbutanal)**	**$Cr_2O_7^{2-}$ / H^+**	
	3 M NaOH / heat	
	1 M HCl / heat	

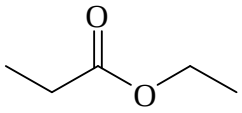
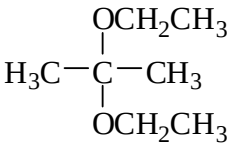
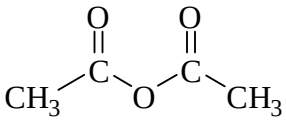
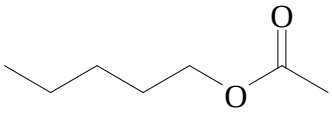
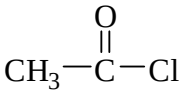
Marks 8

- Complete the following table. Make sure you complete the name of the starting material or major product where indicated.

STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
CH_3CH_2CHO	**1. $NaBH_4$** **2. H^+ / H_2O**	$CH_3CH_2CH_2OH$
	**$Cr_2O_7^{2-}$ / H^+**	 **Name: 3-methylcyclohexanone**
 **Name: propyl acetate**	3 M NaOH / heat	$CH_3CO_2^-$ + $CH_3CH_2CH_2OH$
	excess $CH_3CH_2NH_2$	$CH_3CO_2^-$ + 

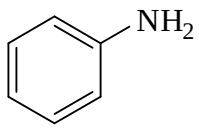
Marks 5

- Complete the following table. Make sure you indicate any relevant stereochemistry.

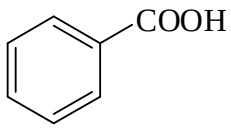
STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
CH_3CH_2COOH	1. $SOCl_2$ 2. CH_3CH_2OH	
	dilute $H^{\oplus}$	 + CH_3CH_2OH
$CH_3CH_2CH_2CH_2CH_2OH$	 conc. H_2SO_4 catalyst	 + CH_3COOH
	H_2O	CH_3COOH

- Aniline, benzoic acid and benzamide are all insoluble in water, but soluble in ether. Explain how, by using simple laboratory reagents and equipment, each compound could be separated and recovered from a mixture of all three.

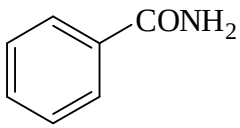
Marks
5



aniline



benzoic acid

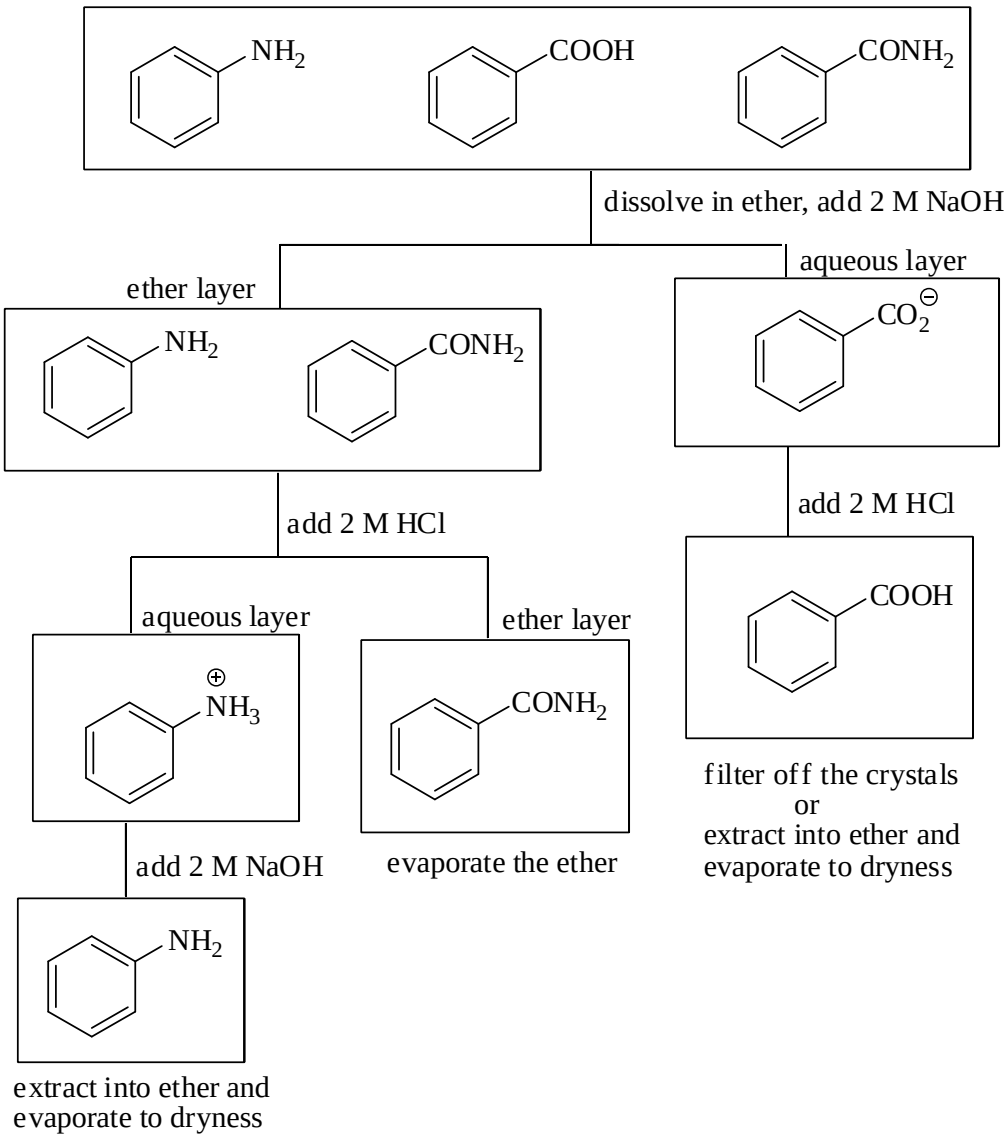


benzamide

All of the compounds are neutral and will dissolve in an organic solvent like ether.

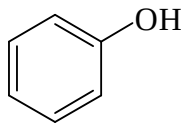
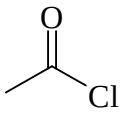
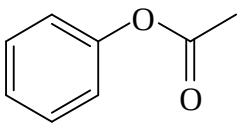
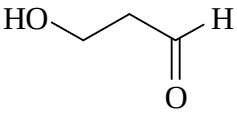
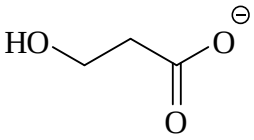
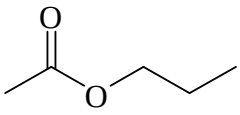
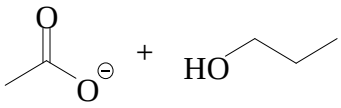
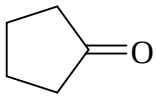
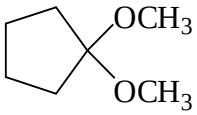
Benzoic acid is a weak acid and will react with a strong base to form an anion which will dissolve in water.

Aniline is a weak base (whereas benzamide is a *very* weak base) and will be deprotonated by reaction with a strong acid to form a water soluble cation.



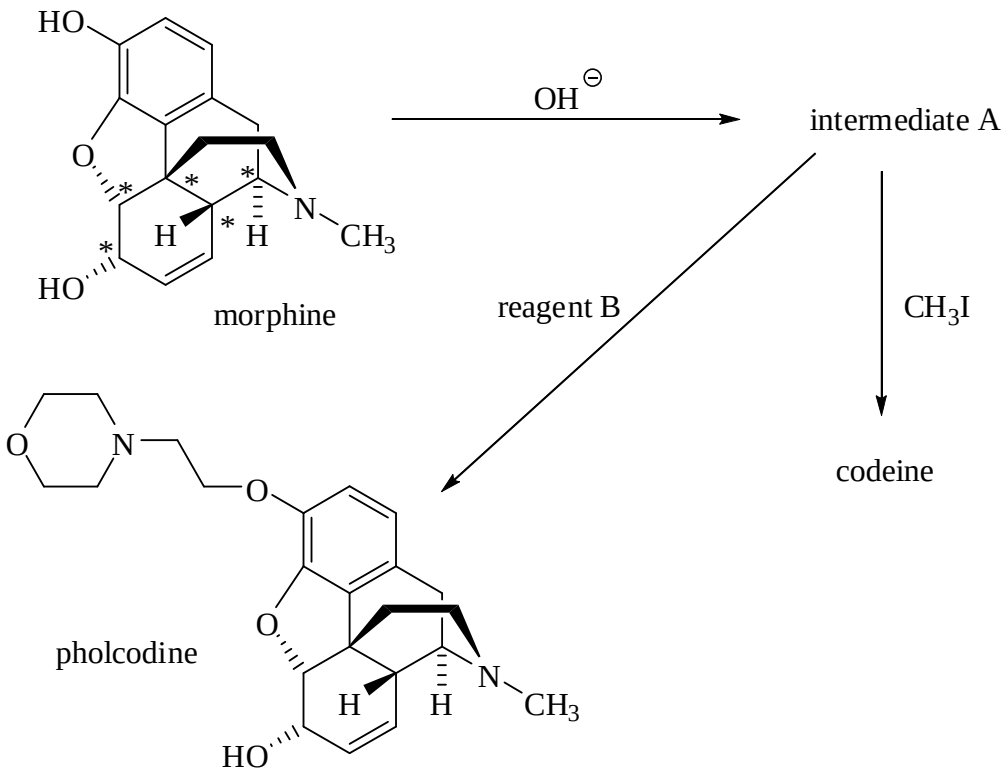
Marks 6

- Complete the following table. Make sure you complete the name of the starting material or major product where indicated.

STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
		 **Name: phenyl acetate**
	$[Ag(NH_3)_2]^{\oplus}$ / $OH^{\ominus}$	
	3 M NaOH / heat	
 **Name: cyclopentanone**	excess CH_3OH / $H^{\oplus}$ cat. heat	

Marks 7

- Morphine is the principal active agent in opium and is a highly potent analgesic drug. Its structure and conversion into codeine (a moderate analgesic) and pholcodine (a cough suppressant) are shown below.



Give the molecular formula of morphine. **$C_{17}H_{19}O_3N$**

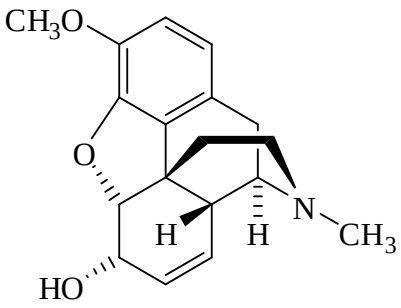
How many stereogenic (chiral) centres are there in morphine? **5 (* on picture)**

Identify the functional groups present in morphine.

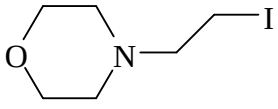
phenol, amine, alcohol, ether, alkene

Draw the structures of codeine and reagent B.

codeine

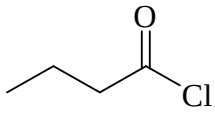
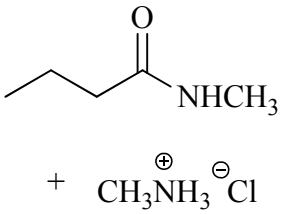
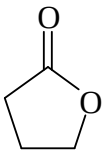
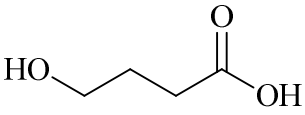
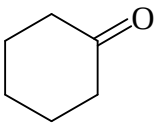
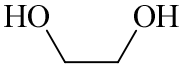


reagent B



Marks 6

- Complete the following table. Make sure you complete the name of the starting material where indicated.

STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	excess CH_3NH_2	 + $CH_3\overset{\oplus}{N}H_3\ \overset{\ominus}{Cl}$
	$H^{\oplus}$ / H_2O / heat	
 **Name: cyclohexanone**	 + $H^{\oplus}$ catalyst