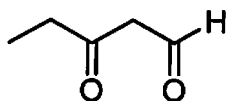


Name: _____

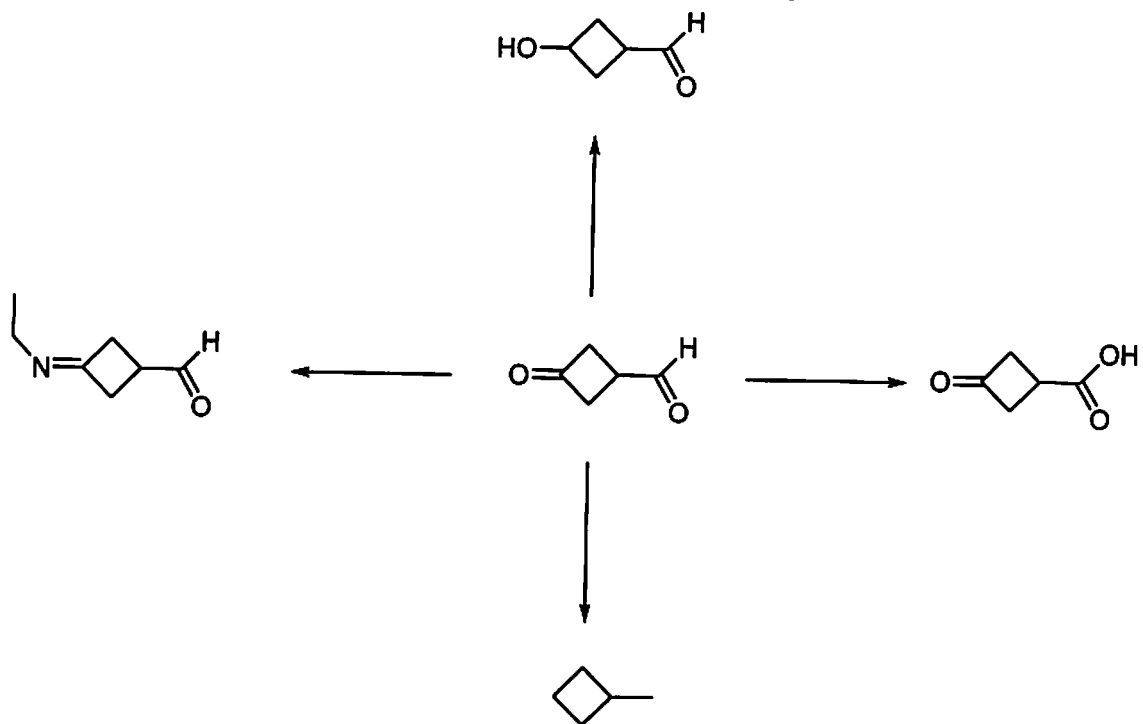
If you do not want your graded exam placed in the box outside my office, then check here
1-10) are True or False (10pts)

- 1) Ketones will undergo nucleophilic addition reactions.
- 2) Aniline ($C_6H_5-NH_2$) can be prepared by nitrating Benzene (using HNO_3/H_2SO_4), followed by subsequent reduction of the Nitro group.
- 3) Amines are basic and nucleophilic because of the lone pair of electrons on the Nitrogen.
- 4) Aldehydes will undergo nucleophilic addition reactions.
- 5) Nitronium means NO_2^+ and Nitrosonium means NO^+ .
- 6) Protecting groups should be easy to put on, inert to the desired reaction conditions, and also easy to remove.
- 7) Nitrogen inversion involves the Nitrogen atom changing its hybridization.
- 8) The famous chemists Hofmann and Saytzeff were biologically related as father and son.
- 9) Ammonium salts have increased water solubility since they are ionic.
- 10) The hydrate of an aldehyde has the same number of Oxygen atoms as an acetal of a ketone.

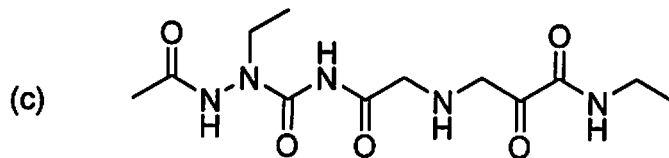
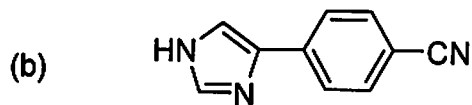
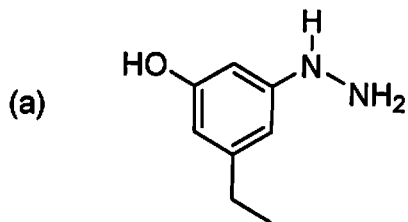
11) Name the following compound in IUPAC acceptable terms. (2pts)



12) (8pts) Provide the reagents used in the following reactions.

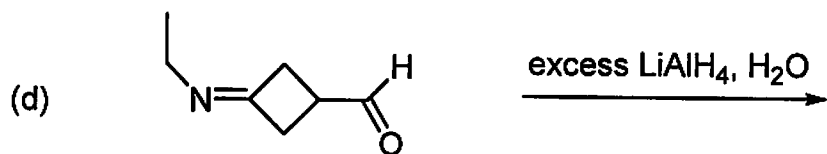
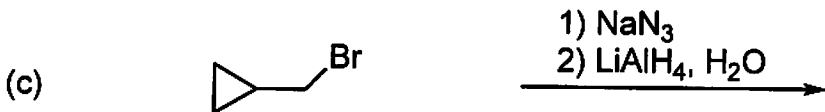
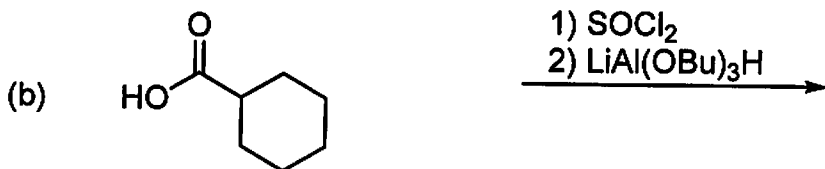


13) (3pts) Circle the *most basic atom* in each of the following species.



14) Draw a line angle (stick figure) diagram for N-ethylbutan-2-amine.
(2pts)

15) Provide the products for following reactions. (8pts)



16) (2pts) What is the definition of a CONDENSATION reaction?

17) (4pts) Write the mechanism (*i.e. curly arrows*) for the reaction of:



18) (2pts) What is the name of the above mechanism?

19) (2+1+1+1=5pts) a) Name the general class of organic compound (functional group) that each of these species belong to.

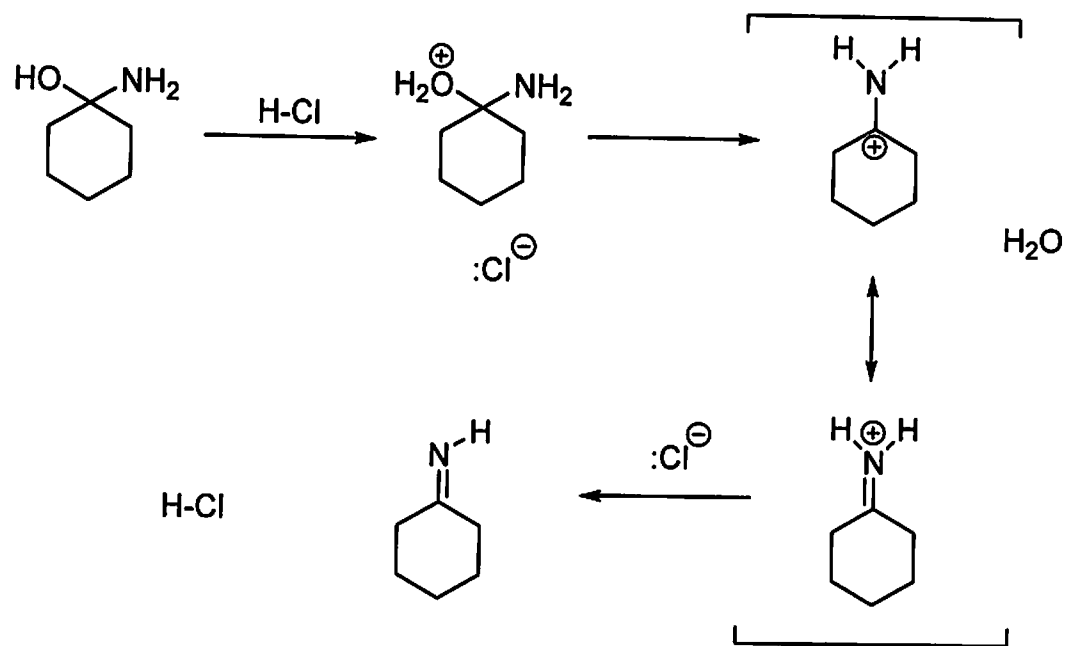


b) How many lone pairs, **in total**, are on the two functional groups above?

c) Indicate which above functional group is prepared by reaction of a primary amine with NaNO_2 (sodium nitrite) and hydrochloric acid.

d) Indicate which above functional group reacts with a Grignard reagent (RMgBr) followed by acid hydrolysis to yield a ketone product.

20) Draw in the curly arrows for the following mechanism (4pts).



*****Bonus question (up to 3pts)*****

Normally Nitrogens are more basic than Oxygens, but explain why Furan is more basic than Pyrrole.

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122	lithium 3 Li 6.941	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	helium 2 He 4.0026
francium 87 Fr 223	radium 88 Ra 226	cesium 55 Cs 132.91	aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	neon 10 Ne 20.180	
		barium 56 Ba 137.33	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	argon 18 Ar 39.948	
		potassium 19 K 39.098	zinc 30 Zn 65.39	cadmium 48 Cd 112.41	mercury 80 Hg 200.59	indium 49 In 114.82	potassium 19 K 39.098	
		calcium 20 Ca 40.078	nickel 28 Ni 58.693	palladium 46 Pd 106.42	uranium 92 U 238.03	tin 50 Sn 118.71	calcium 20 Ca 40.078	
		scandium 21 Sc 44.956	copper 29 Cu 63.546	gold 79 Au 196.97	uranium 92 U 238.03	lead 82 Pb 207.2	uranium 92 U 238.03	
		titanium 22 Ti 47.887	zinc 30 Zn 65.39	mercury 80 Hg 200.59	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		vanadium 23 V 50.942	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		chromium 24 Cr 51.996	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		manganese 25 Mn 54.938	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		iron 26 Fe 55.845	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		cobalt 27 Co 58.933	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		nickel 28 Ni 58.693	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		copper 29 Cu 63.546	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		zinc 30 Zn 65.39	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		gallium 31 Ga 69.723	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		germanium 32 Ge 72.61	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		arsenic 33 As 74.922	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		selenium 34 Se 78.96	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		indium 49 In 114.82	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		tin 50 Sn 118.71	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		lead 82 Pb 207.2	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	
		uranium 92 U 238.03	nickel 28 Ni 58.693	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	uranium 92 U 238.03	

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm 144.91	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dyprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac 227	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np 237	plutonium 94 Pu 244	americium 95 Am 243	curium 96 Cm 247	berkelium 97 Bk 247	californium 98 Cf 251	einsteinium 99 Es 252	fermium 100 Fm 257	mendelevium 101 Md 258	nobelium 102 No 259

** Actinide series

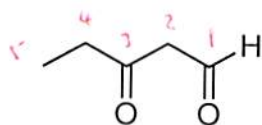
Name: _____

NITROGEN

If you do not want your graded exam placed in the box outside my office, then check here
1-10) are True or False (10pts)

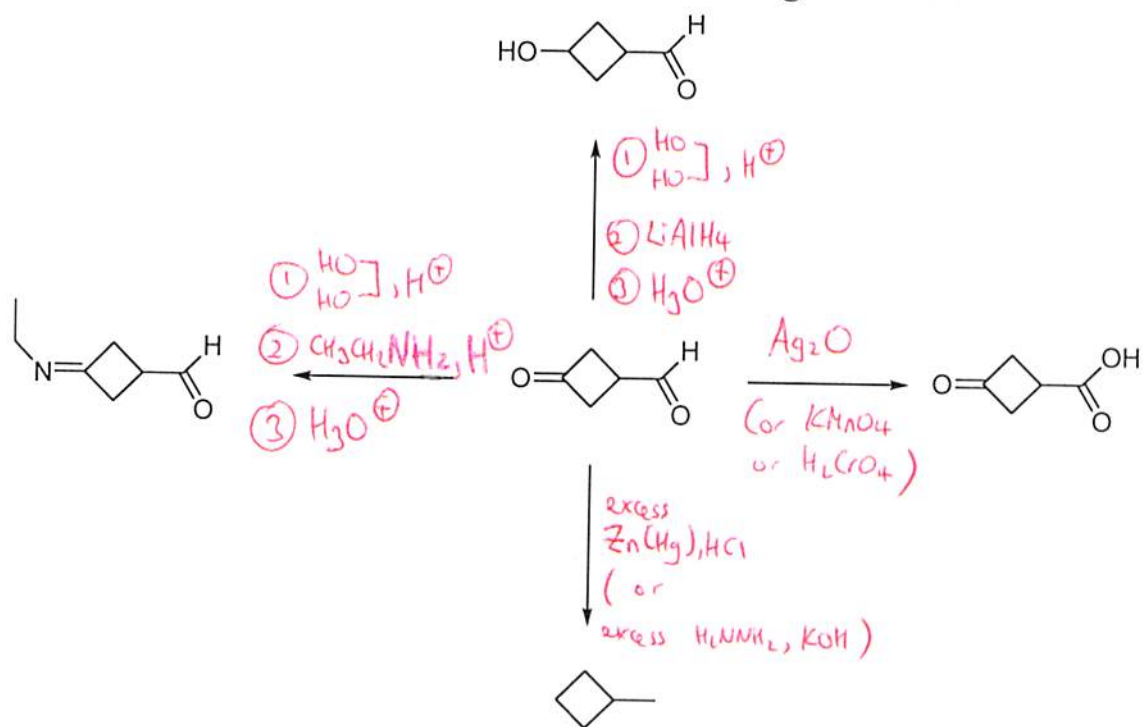
- 1) Ketones will undergo nucleophilic addition reactions. True
- 2) Aniline ($C_6H_5-NH_2$) can be prepared by nitrating Benzene (using HNO_3/H_2SO_4), followed by subsequent reduction of the Nitro group. True
- 3) Amines are basic and nucleophilic because of the lone pair of electrons on the Nitrogen. True
- 4) Aldehydes will undergo nucleophilic addition reactions. True
- 5) Nitronium means NO_2^+ and Nitrosonium means NO^+ . True
- 6) Protecting groups should be easy to put on, inert to the desired reaction conditions, and also easy to remove. True
- 7) Nitrogen inversion involves the Nitrogen atom changing its hybridization. True
- 8) The famous chemists Hofmann and Saytzeff were biologically related as father and son. False
- 9) Ammonium salts have increased water solubility since they are ionic. True
- 10) The hydrate of an aldehyde has the same number of Oxygen atoms as an acetal of a ketone. True

11) Name the following compound in IUPAC acceptable terms. (2pts)

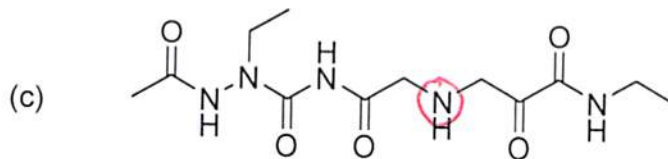
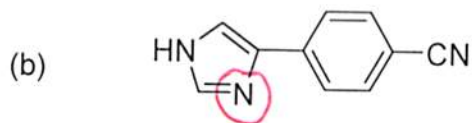
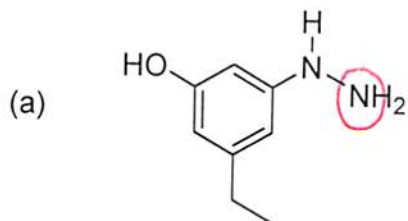


3-oxopentanal

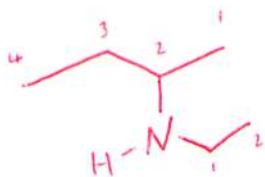
12) (8pts) Provide the reagents used in the following reactions.



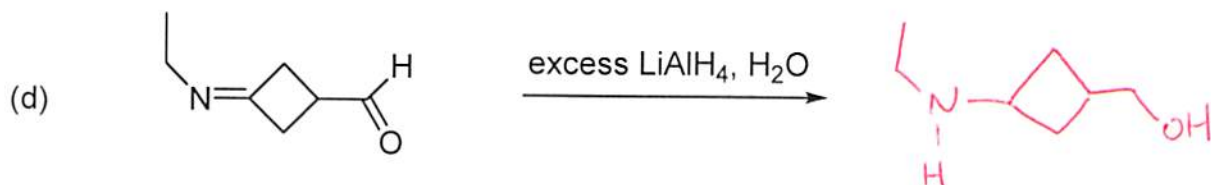
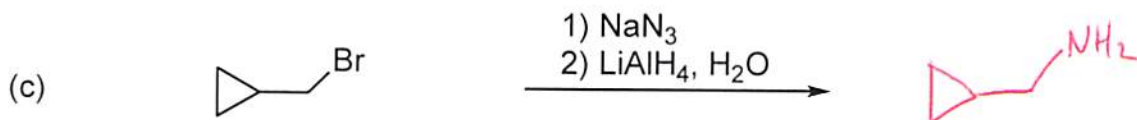
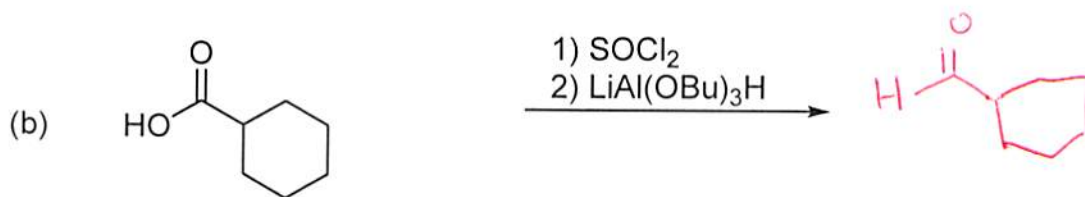
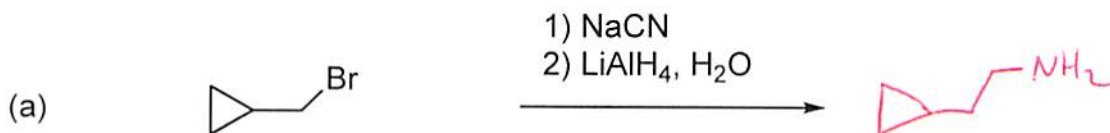
13) (3pts) Circle the *most basic atom* in each of the following species.



14) Draw a line angle (stick figure) diagram for N-ethylbutan-2-amine.
(2pts)



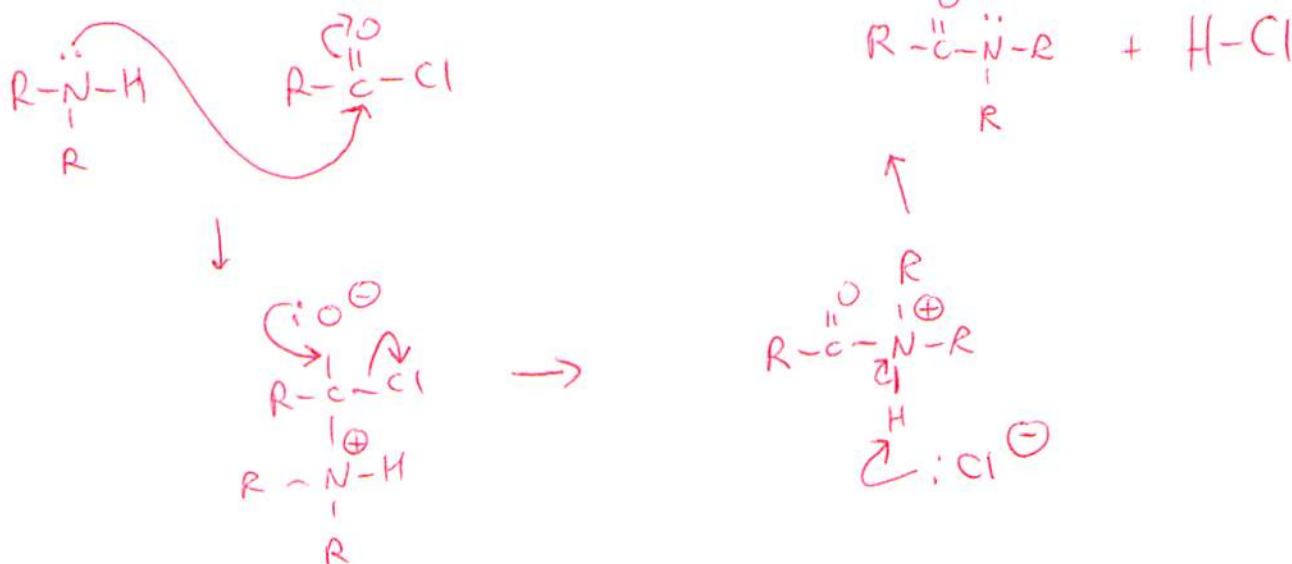
15) Provide the products for following reactions. (8pts)



16) (2pts) What is the definition of a CONDENSATION reaction?

A reaction where two (or more) molecules add together but also includes the expulsion of a small molecule (usually water).

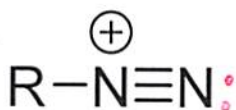
17) (4pts) Write the mechanism (i.e. curly arrows) for the reaction of:



18) (2pts) What is the name of the above mechanism.

Nucleophilic Acyl Substitution.

19) (2+1+1+1=5pts) a) Name the general class of organic compound (functional group) that each of these species belong to.



Diagonium Cation



Nitrile

b) How many lone pairs, **in total**, are on the two functional groups above?

$$1+1 = 2$$

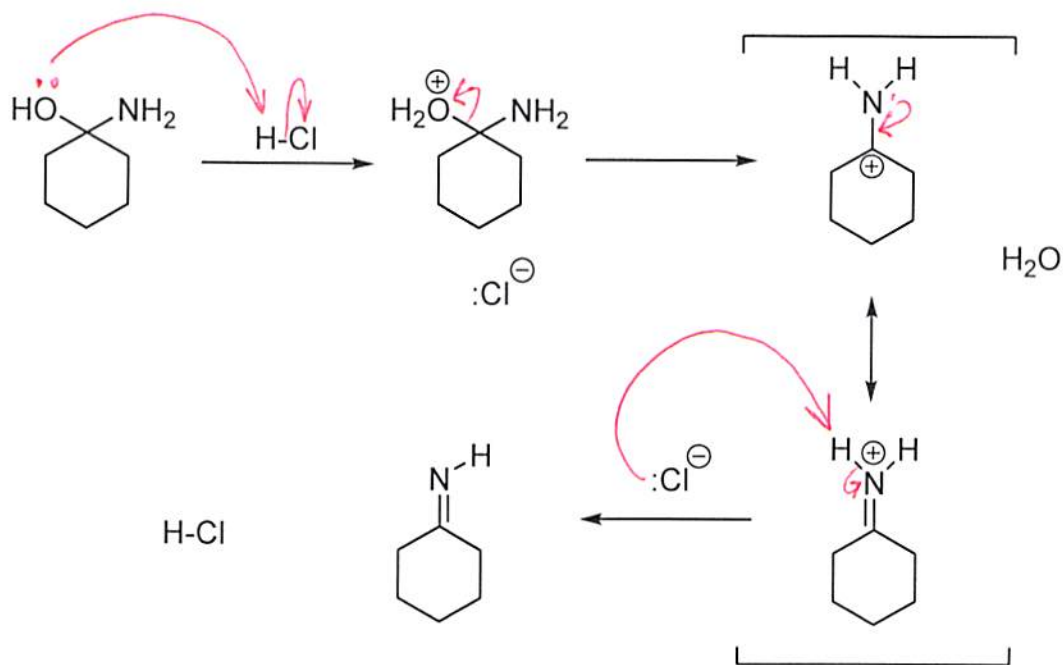
c) Indicate which above functional group is prepared by reaction of a primary amine with NaNO_2 (sodium nitrite) and hydrochloric acid.

Diagonium Cation

d) Indicate which above functional group reacts with a Grignard reagent (RMgBr) followed by acid hydrolysis to yield a ketone product.

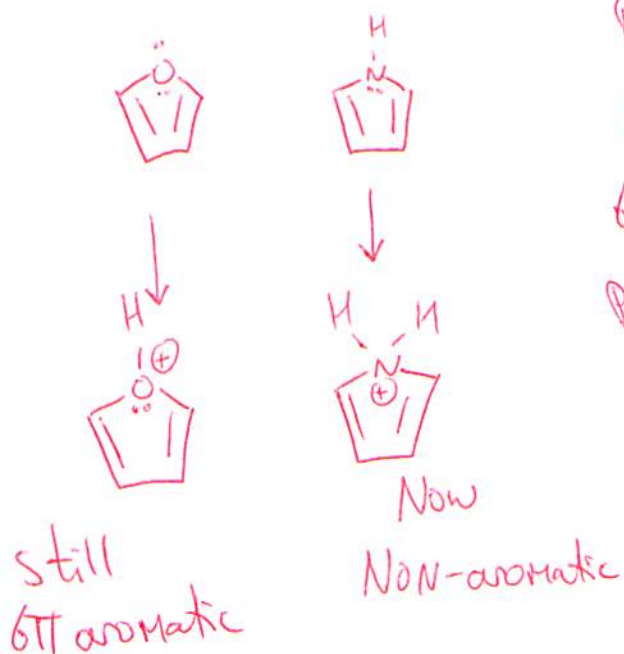
Nitrile

20) Draw in the curly arrows for the following mechanism (4pts).



Bonus question (up to 3pts)

Normally Nitrogens are more basic than Oxygens, but explain why Furan is more basic than Pyrrole.



Both are $\delta\pi$ aromatic systems.
 Upon protonation, furan produces a $\delta\pi$ aromatic system, whereas the protonated pyrrole is now non-aromatic.
 Furan can act as a base and still maintain its aromaticity.