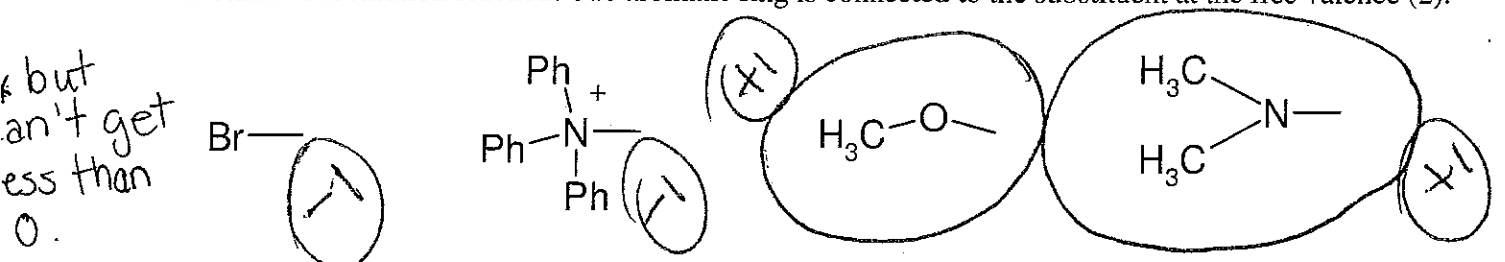
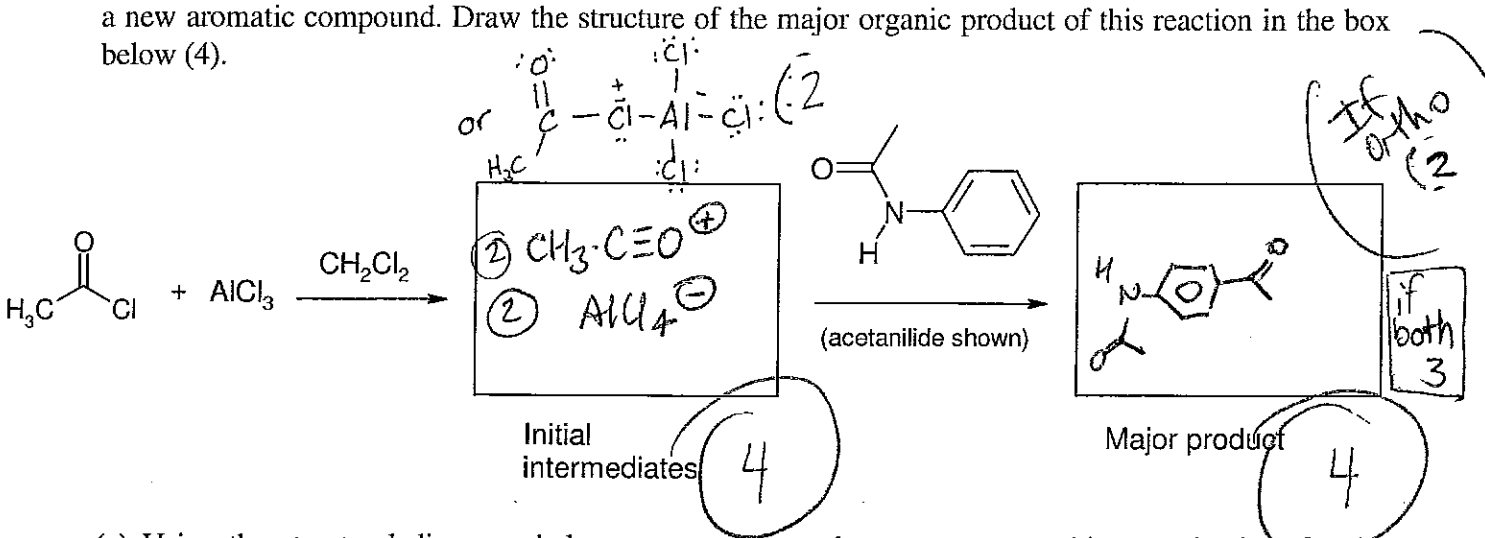
Part I

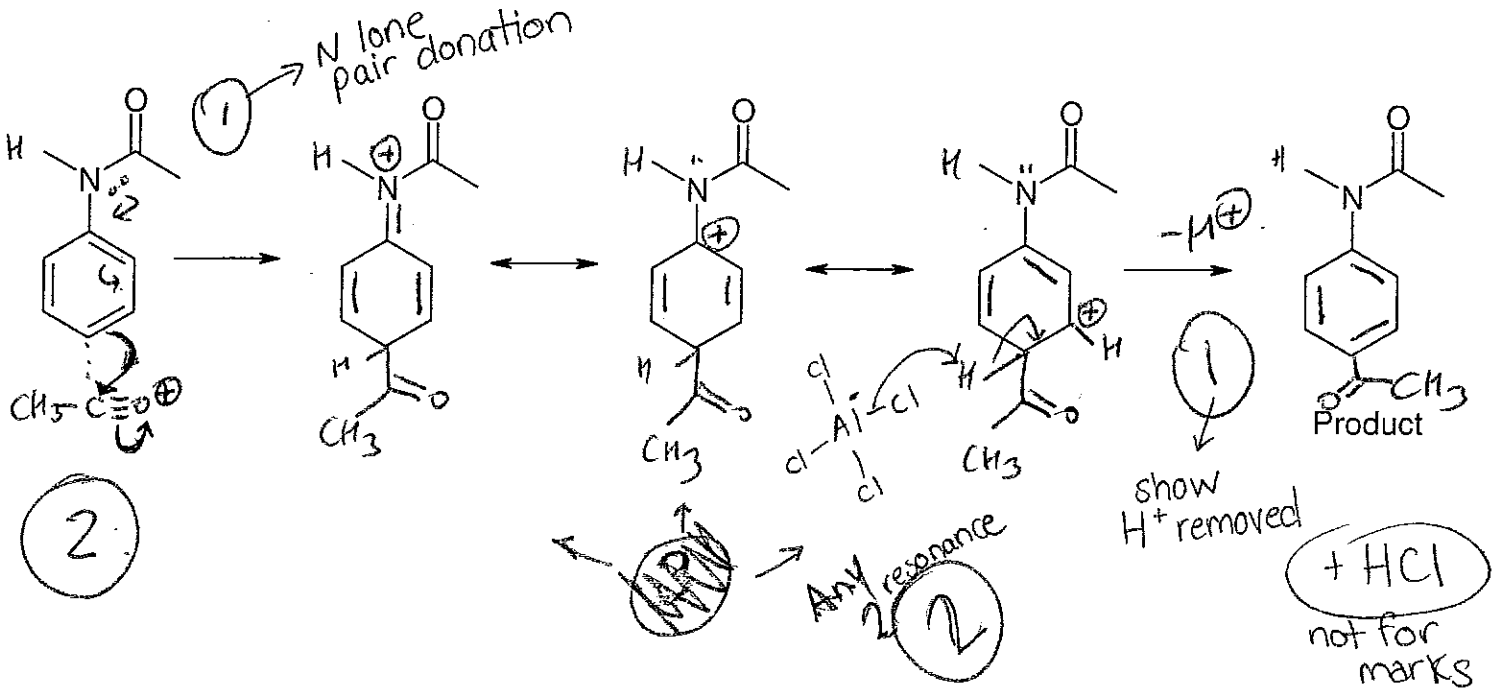
1. (a) Circle the substituent(s) that would be ***activating*** and ***ortho/para*** directing in an electrophilic aromatic substitution reaction. The aromatic ring is connected to the substituent at the free valence (2).



(b) Acetyl chloride (ethanoyl chloride) reacts with aluminium chloride in dichloromethane solvent to give a coloured solution. In the box below, sketch the structure on the initial intermediates that are formed in this reaction (4). The addition of acetanilide results in loss of this colour and the formation of a new aromatic compound. Draw the structure of the major organic product of this reaction in the box below (4).



(c) Using the structural diagrams below, propose a step-by-step arrow-pushing mechanism for the reaction of the initial intermediates with acetanilide to explain the formation of the product you indicated above. INCLUDE THE RESONANCE FORMS OF ANY FURTHER INTERMEDIATES Full Lewis structures are required (6).

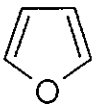


2

2. (a) Is the heterocycle furan shown below aromatic, YES or NO. CIRCLE your choice and provide two reasons for your choice neatly in point form below (4).

Any 2 / 1 each

2

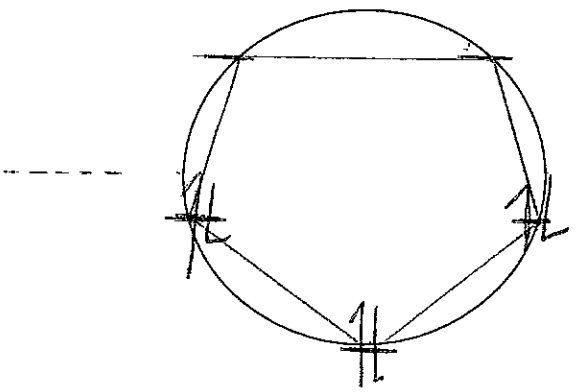


1. - Continuous array of P orbitals in a ring
   - Planar (sp^2 hybrid O)
2. - $4n+2$ π e's
   - cyclic / ring

(b) How many π-type Molecular Orbitals (MOs) does it have (2)? 5 — 2

(c) What is the hybridization of the oxygen atom in furan (2)? sp2 — 2

(d) Use a Frost Circle diagram (polygon in a circle) to corroborate your answer to the above. Indicate the position(s) of the MOs and fill in the appropriate number of electrons (6).

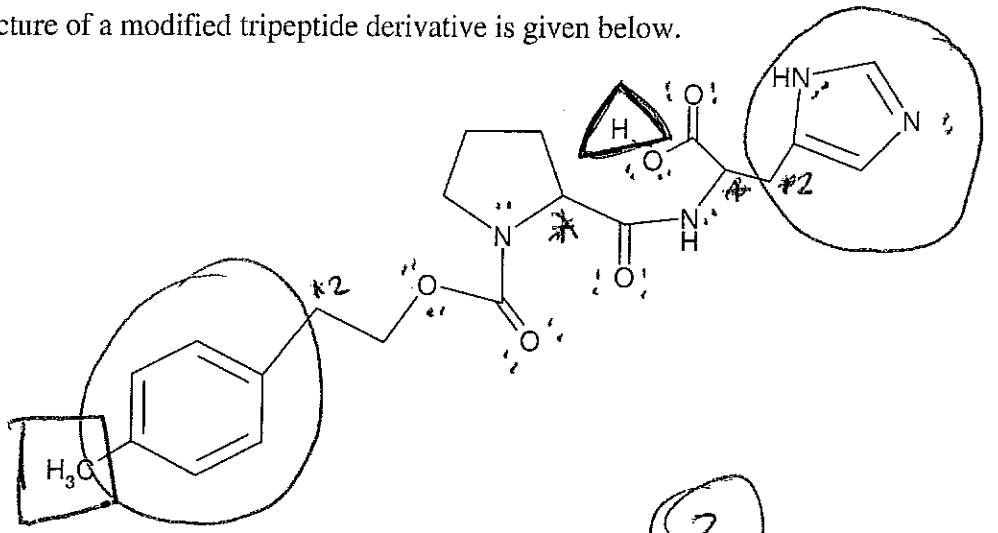


Frost Circle

Position of M.O.'s — 3

Filling in electrons — 3

3. The structure of a modified tripeptide derivative is given below.



(a) Complete the Lewis structure of this compound (2).

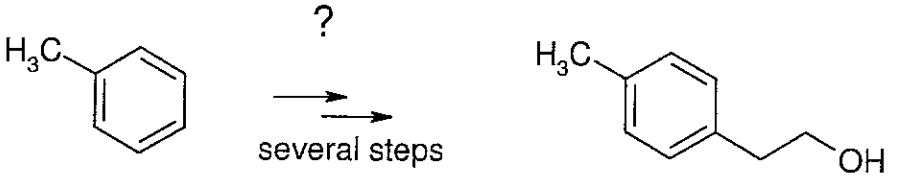
(b) Circle the aromatic rings directly on the structure above (2).

(c) How many stereogenic centres are present in this compound (2)? 2 *

(d) Place a box around the position that would be most susceptible to bromination using bromine in the presence of light at low temperature (2). 1 mark for #2

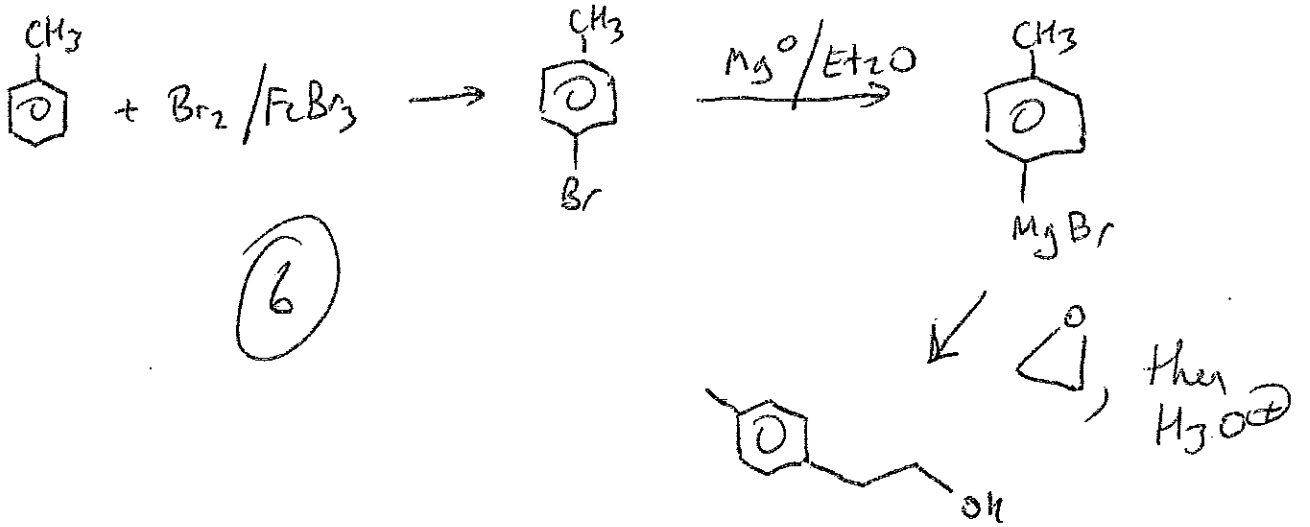
(e) Place a triangle around the most acidic proton in this structure (2).

(f) The left hand portion of this compound, 2-(4'methyl)phenylethanol, can be readily synthesized from toluene. Propose a logical synthesis of 2-(4'methyl)phenylethanol in the space below (6).

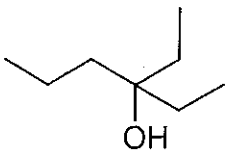


toluene

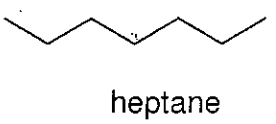
2-(4'-methyl)phenylethanol



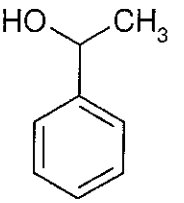
4. Propose syntheses for any **TWO** of the following three target molecules. You may use benzene or bromobenzene and/or any alcohol having 4-carbons or less, any halide having 4-carbons or less, as well as any inorganic reagents that you may require (12).



3-ethyl-3-hexanol



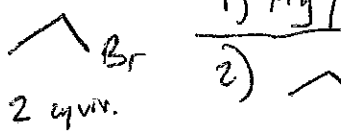
heptane

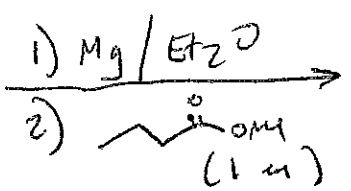


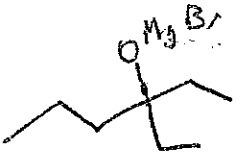
1-phenylethanol

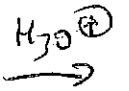
Answer 1:

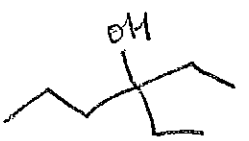
(A)

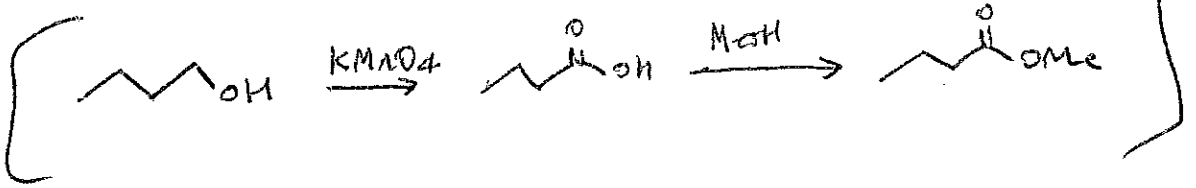








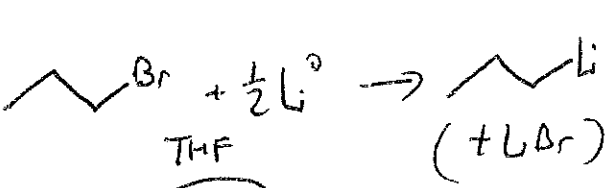


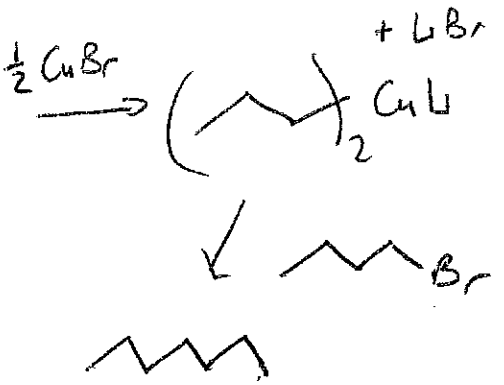


6

Answer 2:

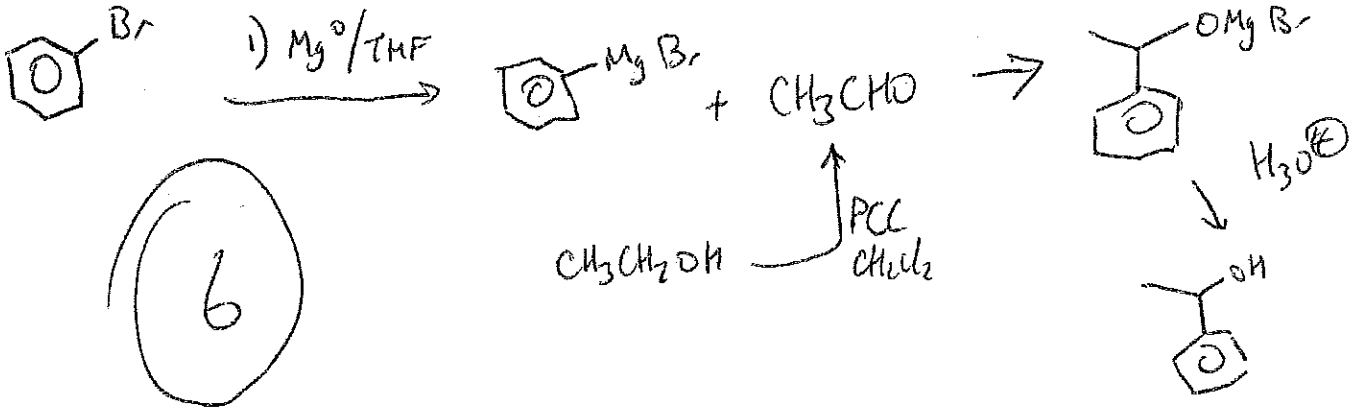
(B)





6

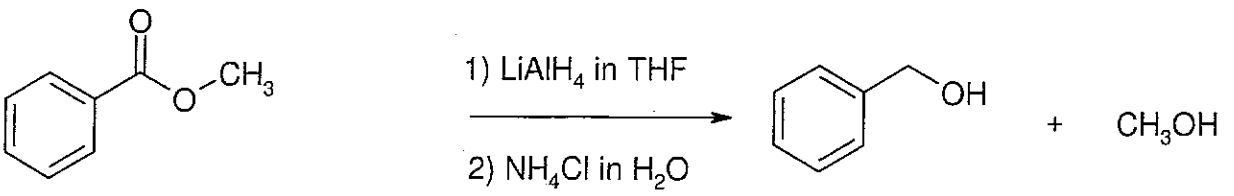
(C)



6

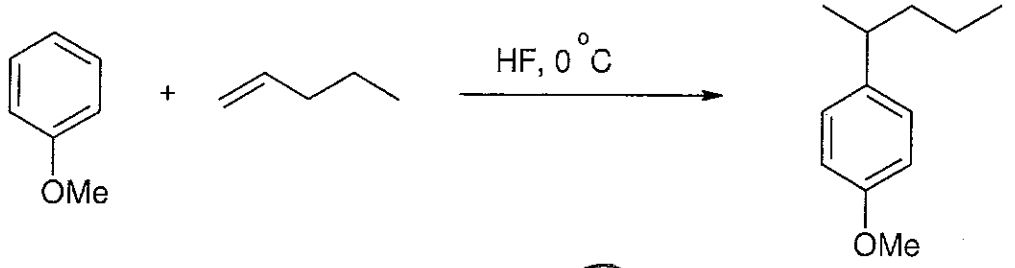
5) Mechanisms. Provide a complete, step-by-step arrow-pushing mechanism to explain **ONE** of the following two reactions (12).

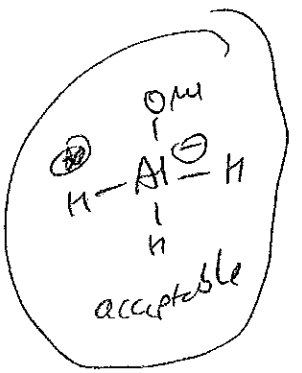
a)



OR

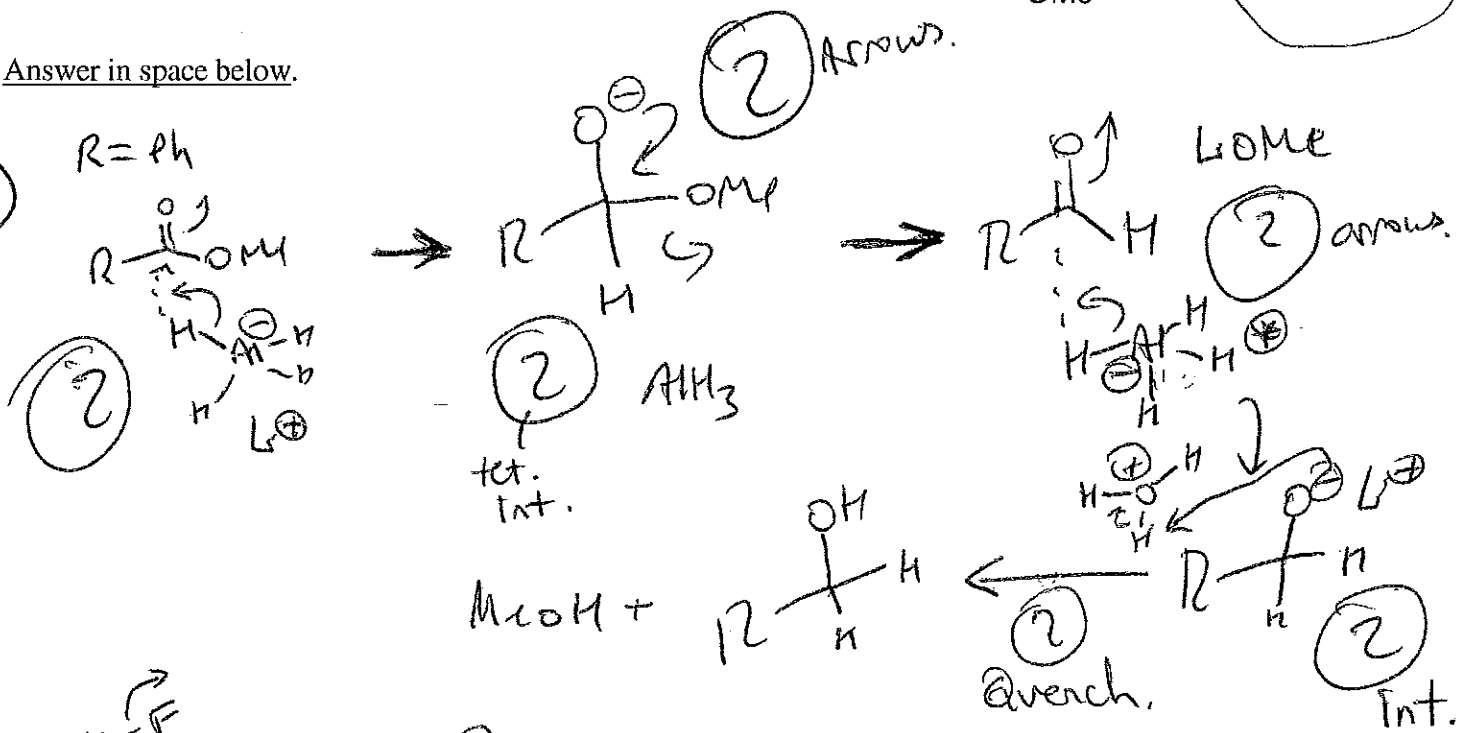
b)





Answer in space below.

a)



b)