Chemistry 2542
Summer 2010; Final Exam

This exam has 7 problems on 9 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) Key

Scores:

Problem 1: 25

Problem 2: 25

Problem 3: 25

Problem 4: 30

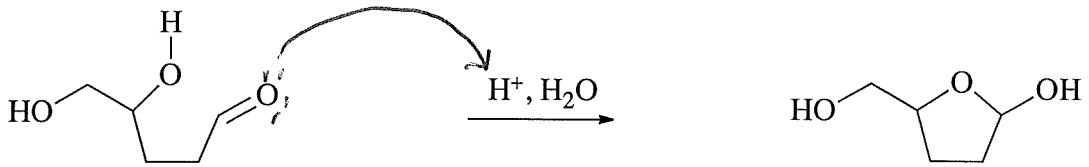
Problem 5: 40

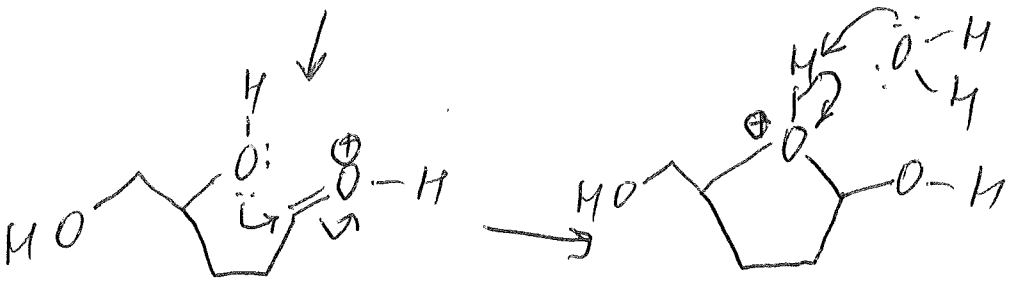
Problem 6: 30

Problem 7: 25

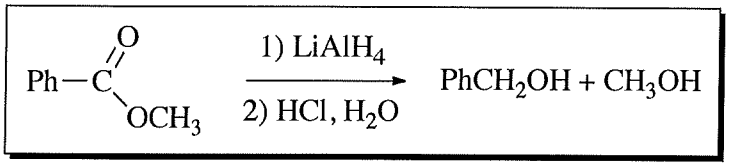
Total: 200

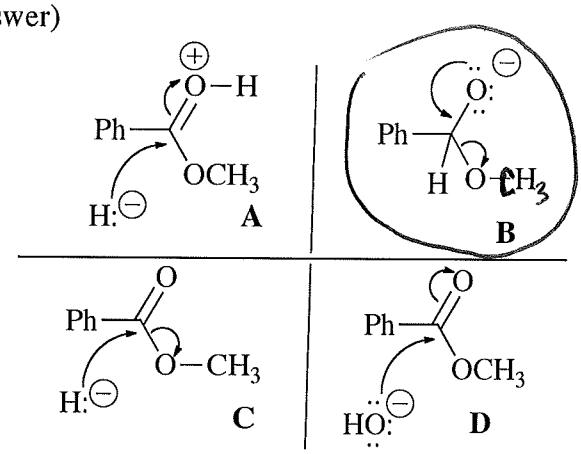
1. 25 pts (a) (15 pts) Using **curved arrows** and showing the structure of the **intermediates**, write the **mechanism** that accounts for the product in the following reaction:



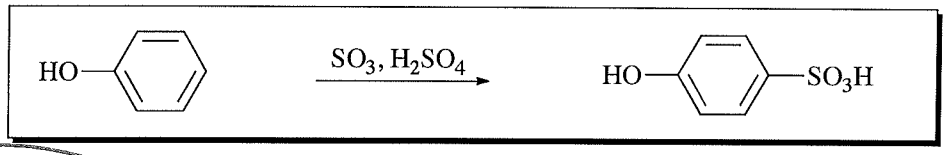


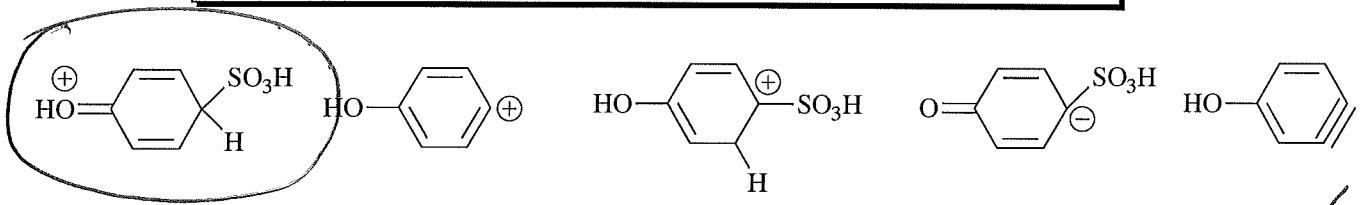
(b) (5 pts) Which one of the following four schemes (**A-D**) represents an important step in the mechanism of the reaction in the box (circle the correct answer)





(c) (5 pts) Circle the structure of the **intermediate** product for the reaction in the box:

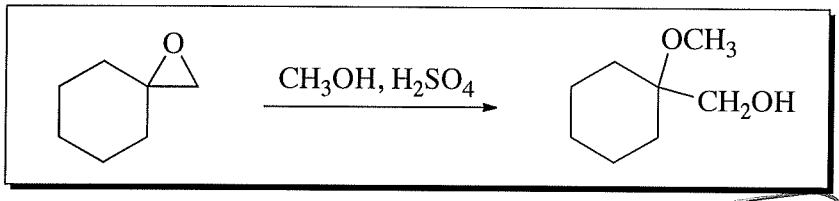


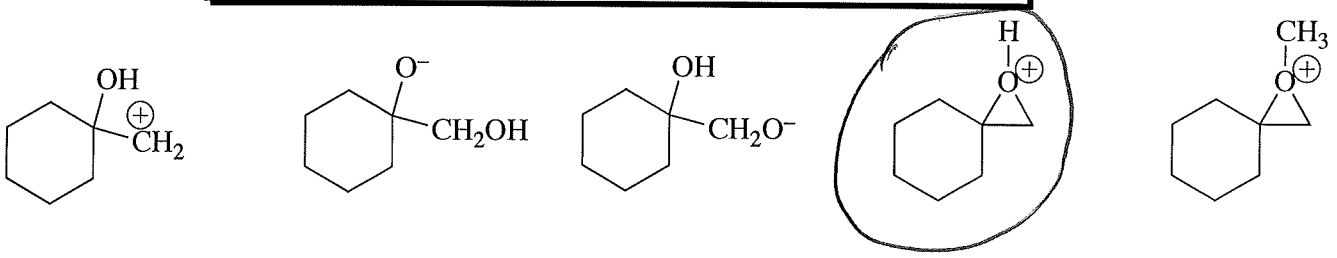


25 pts

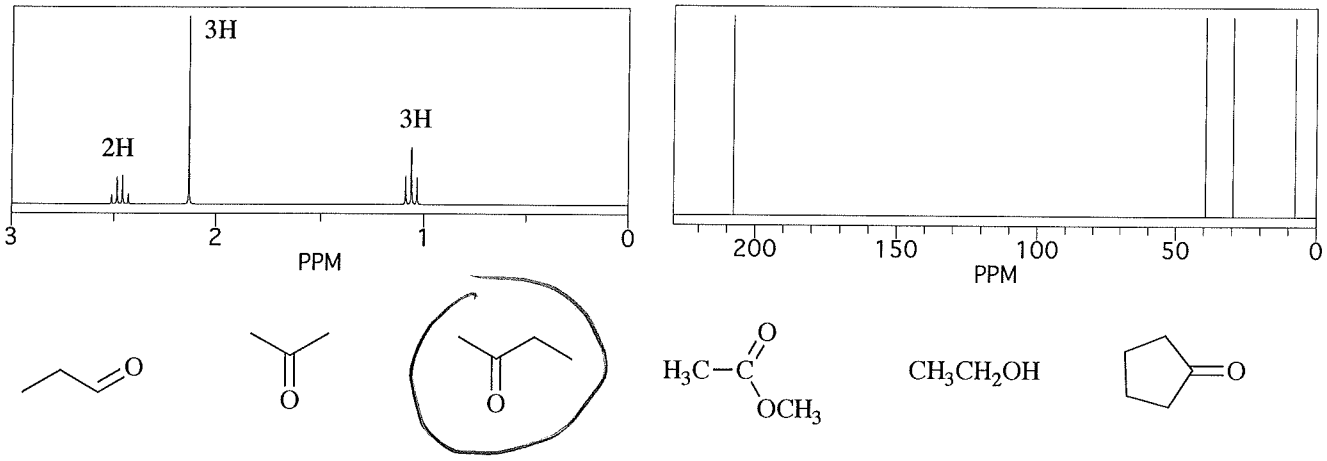
2. (**25 pts**) Answer the following questions:

(a) (**5 pts**) Circle the structure of the **intermediate** product for the reaction in the box:

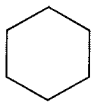
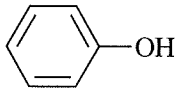


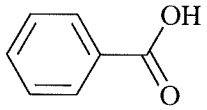


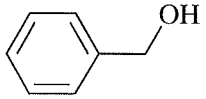
(b) (**10 pts**) Circle the structure of the compound that gives these ^{1}H and ^{13}C NMR spectra:



(c) (**10 pts**) Rank the following substances in order of increasing acidity. Put A, B, C, D, or E into the boxes (2 pts each).

A) CH_3NH_2 B)  C) 

D) 

E) 

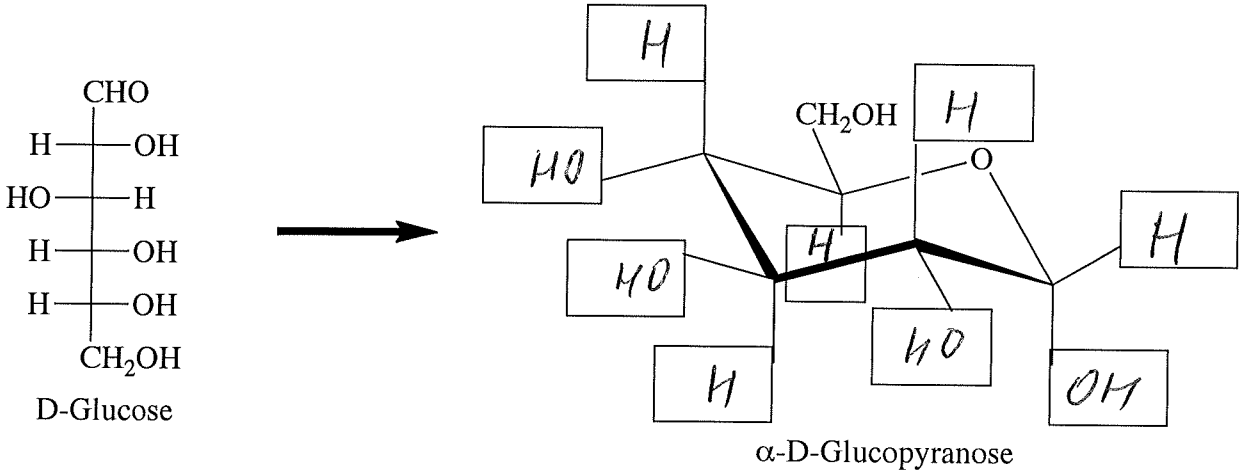
B	<	A	<	E	<	C	<	D

least acidic

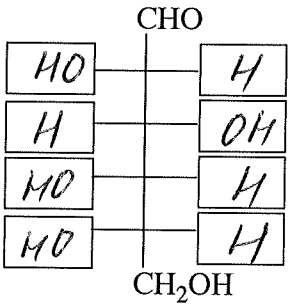
most acidic

25 pts

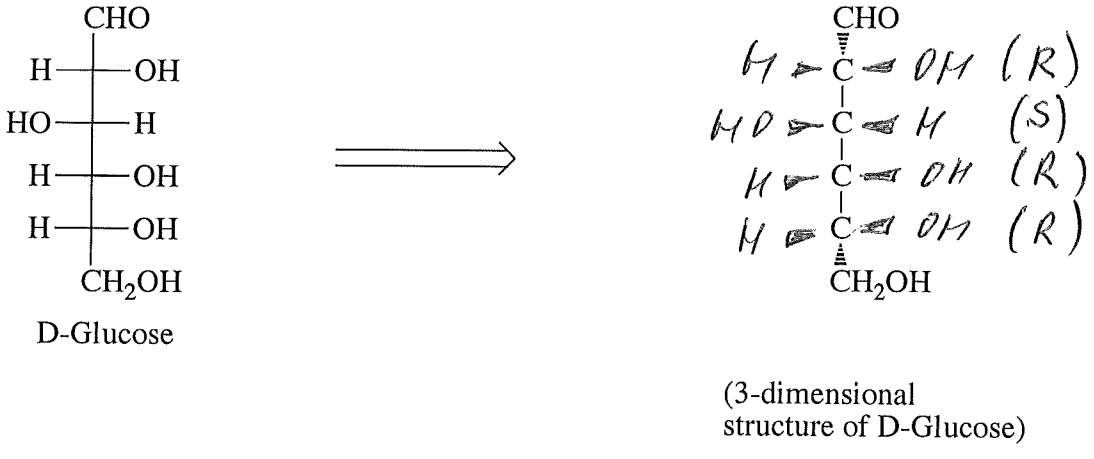
3. (**25 pts**) **(a)** Finish drawing of the cyclic structure of D-glucose in the form of **α–D-glucopyranose**. [place missing -**H** and -**OH** substituents in each box (9 pts; 1 pt each)



(b) Finish drawing of the Fischer projection of **L-glucose:** (8 pts; 1 pt each box)

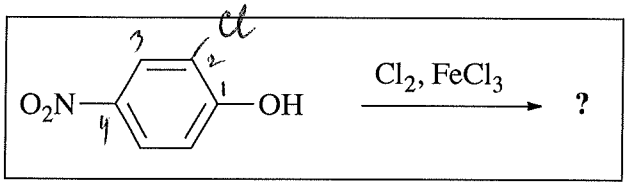


(c) Convert the Fischer projection of **D-glucose** into three-dimensional representation (finish provided drawing) and assign *R* or *S* stereochemistry to each chirality center (8 pts; 2 pt each carbon):



25 pts

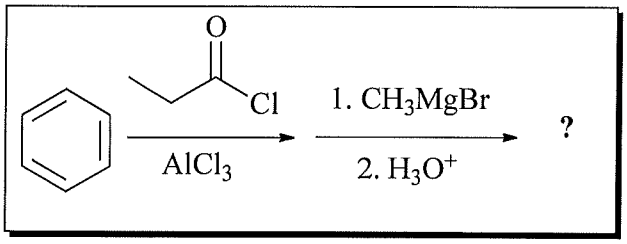
4. (**30 pts**) Circle the name of the **major product** for each the following reactions (5 pts each):

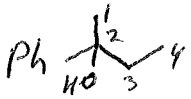


2-chloro-4-methylaniline 2-chloro-4-nitrotoluene

2-chloro-4-nitrophenol *p*-chlorotoluene

2-chloro-4-nitro-1-hydroxyphenol

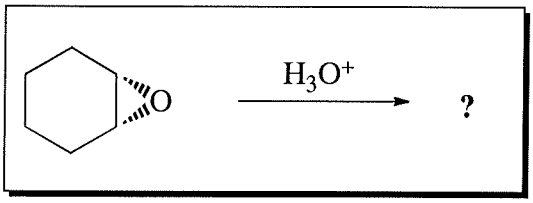




3-chloro-2-isopropylphenol 1-phenyl-2-butanol

2-phenyl-2-butanol 1-phenyl-1-propanone

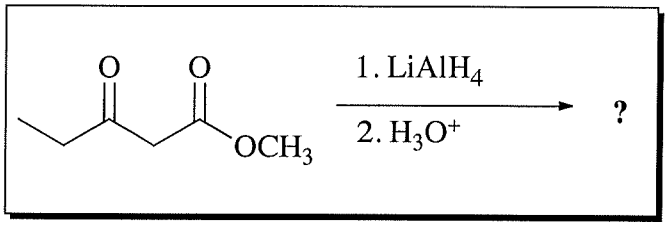
1-phenyl-1-propanol propylbenzene

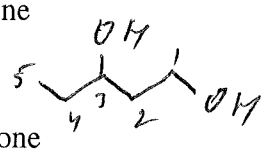


cyclohexanol *trans*-1,2-cyclohexanediol

1,2-epoxycyclohexane *cis*-1,2-cyclohexanediol

cyclohexanone 2-hydroxycyclohexanone

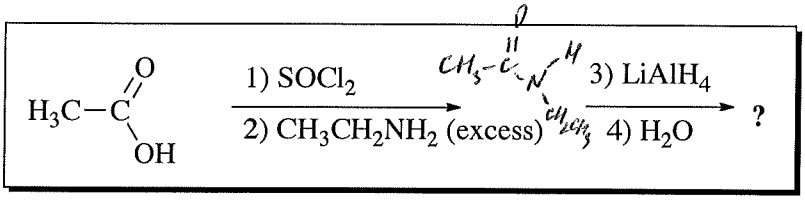




1,3-pentanediol 3-pentanone

1-methoxy-1,3-pentanediol

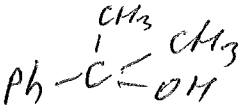
methyl 3-hydroxypentanoate

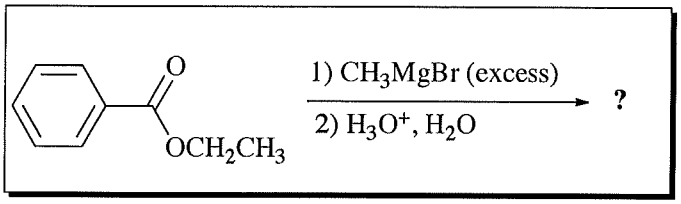


N,*N*-diethylacetamide diethylamine

N-ethylpropylamine ethanol

2-(*N*,*N*-diethylamino)-1-ethanol





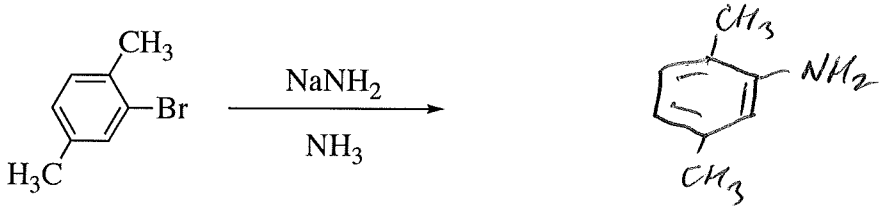
3-phenyl-3-pentanol 2-phenyl-2-propanol

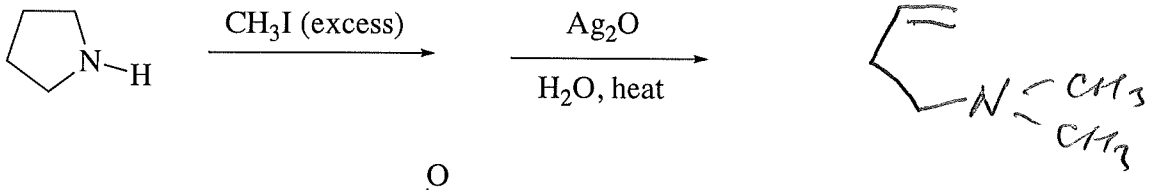
1-ethyl-1-phenylethanol 1-benzyl-1-ethanol

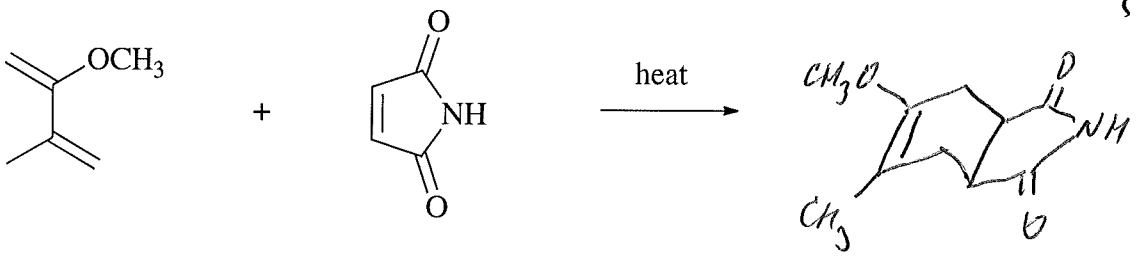
2-phenyl-2-butanol 1-phenyl-2-butanone

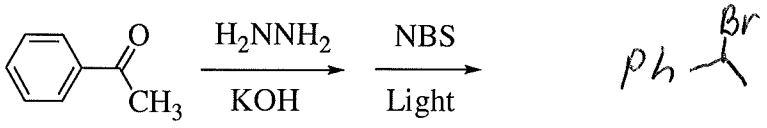
30 pts

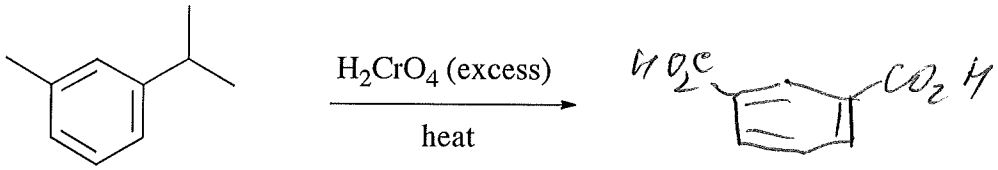
5. (**40 pts**) Draw the structure of the main product for each the following reactions (5 pts each):

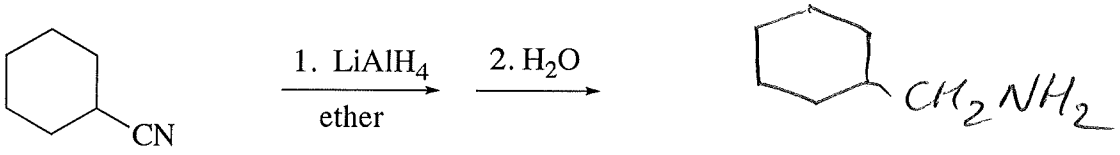


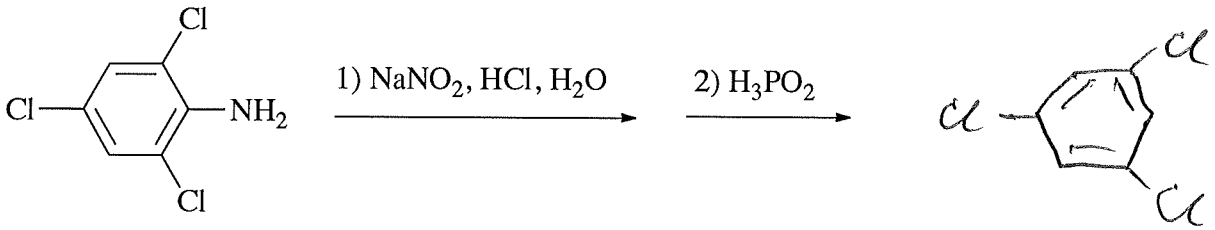






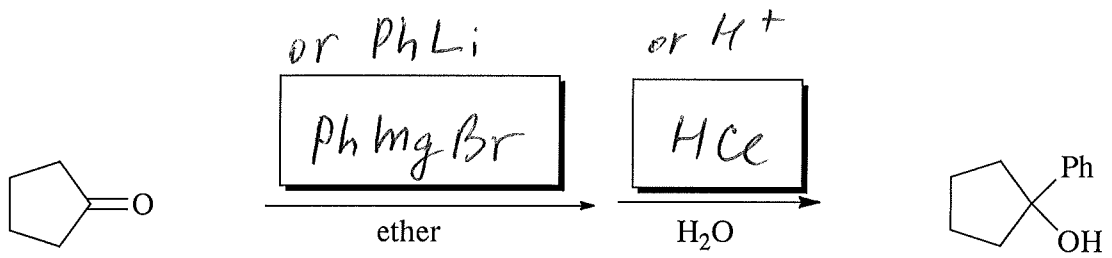


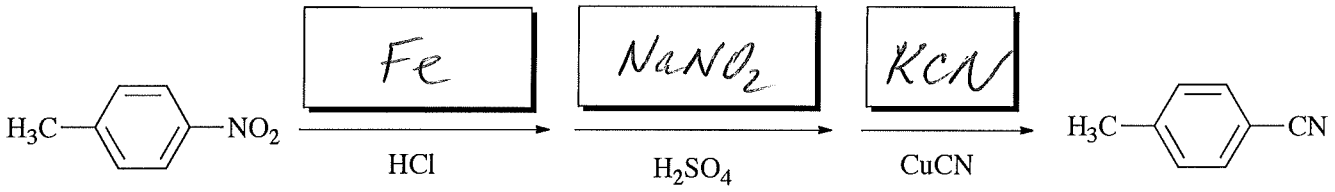


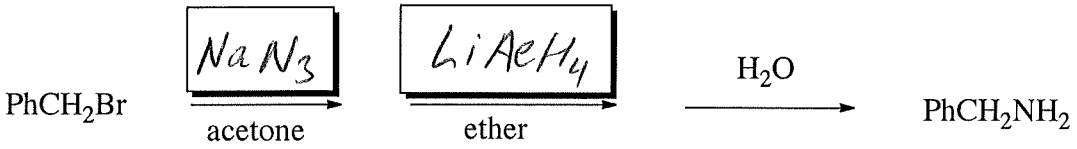


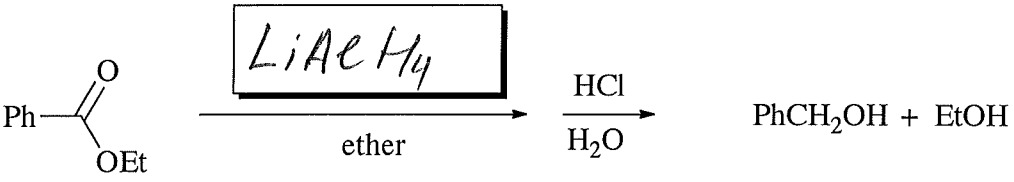
40 pts

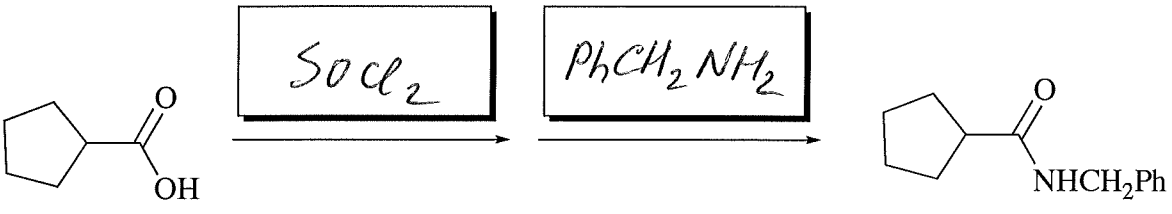
6. (**30 pts**) Place in each box the molecule of a reagent that is required to perform each of the following reactions (3 pts each box):







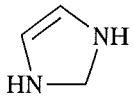
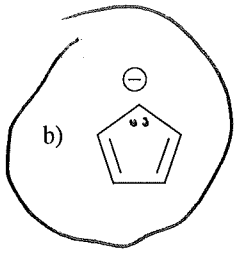
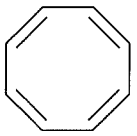
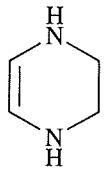
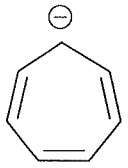




30 pts

7. (**25 pts**) For each of the following questions **circle** the item that is the correct answer (5 pts each):

(a) Which one of the following compounds is aromatic?

a)  b)  c)  d)  e)  f) 

(b) Which one of the following compounds is the strongest **base**?

aniline ethane ethanol *o*-ethylphenol phenol *p*-nitroaniline ethylamine

(c) Which one of the following compounds is more reactive then benzene towards nitration?

nitrobenzene benzonitrile benzoic acid phenol bromobenzene benzenesulfonic acid

(d) Which one of the listed compounds is characterized by the following spectroscopic data:
IR: important absorptions at 3298 cm^{-1} (medium intensity, broad) and 1668 cm^{-1} (strong intensity).
^{13}C NMR: two signals are observed at 163 ppm and 25 ppm.

HCOOH CH_3COCH_3 $HCON(CH_3)_2$ CH_3CHO $HCONHCH_3$ CH_3CN CH_3CH_2OH

(e) How many **stereoisomers** (including enantiomers) has a molecule of *aldotetrose* in the *open chain* form?

$CH_2(OH)-\overset{*}{C}H(OH)-\overset{*}{C}H(OH)-CH(=O)$ $2^2=4$

one two three four five six seven eight nine ten sixteen thirty two sixty four