CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE (CHEMISTRY, INDUSTRIAL CHEMISTRY, BIO, MATHEMATICS) BACHELOR OF EDUCATION (SCIENCE)

CHEM 332: ORGANIC CHEMISTRY III

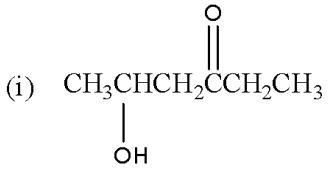
STREAMS: **TIME: 2 HOURS**

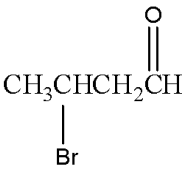
DAY/DATE: WEDNESDAY 18/12/2024 **11.30 A.M – 1.30 P.M**

INSTRUCTIONS:
Answer question **One** (Compulsory) and any other **Two** questions

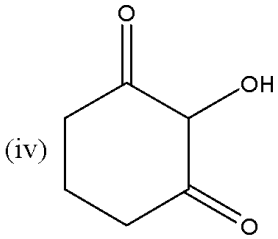
QUESTION ONE [30 MARKS]

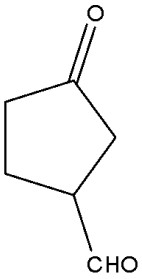
(a) Write the IUPAC name of each of the following organic compounds **(3 marks)**

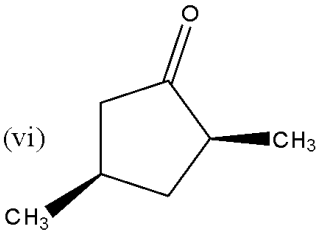
(i) 

(ii) 

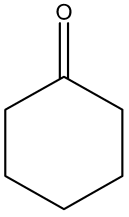
(iii) $CH_3CO(CH_2)_4CH_3$

(iv) 

(v) 

(vi) 

(b) Write structures for the major organic product(s) formed when cyclohexanone is reacted with the following reagents. **(6 marks)**



Cyclohexanone

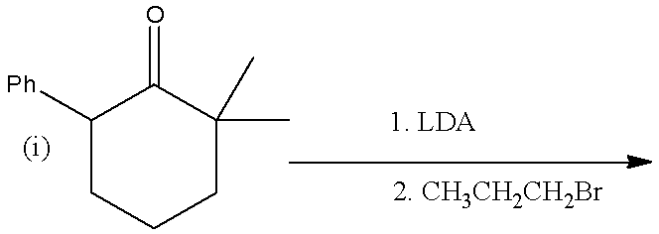
(i) CH_3NH_2, H_3O^+ (ii) excess CH_3OH, H_3O^+ (iii) NH_2OH, H_3O^+

(iv) $PhNHNH_2$, H_3O^+ (v) PhMgBr then H_3O^+ (vi) NaCN, HCN then H_3O^+

(c) Discuss the physical properties of aldehydes and ketones. (**3 marks**)

(d) Write the major organic product(s) of the following reactions. (**6 marks**)

(i)



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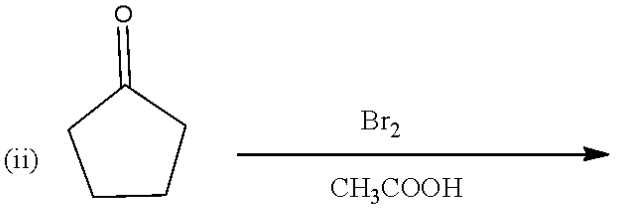

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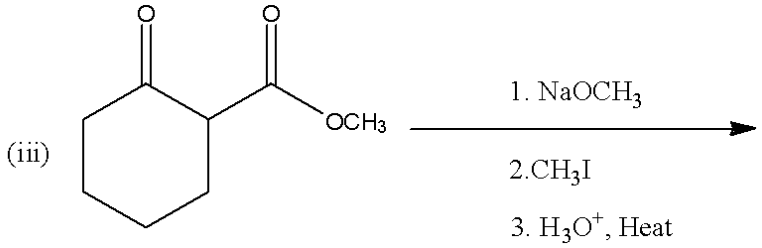
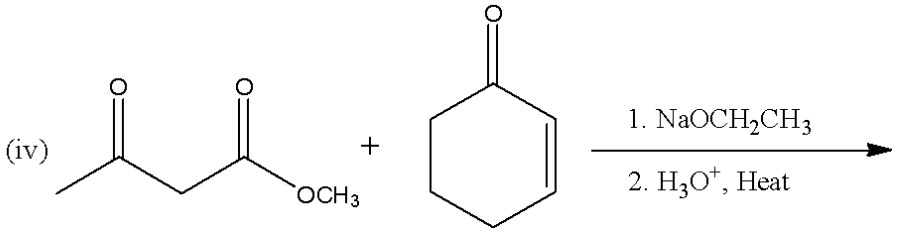
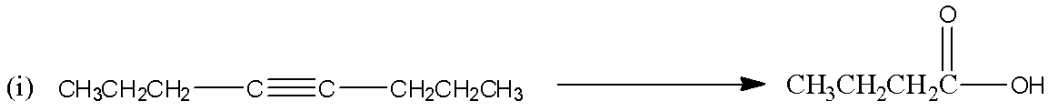
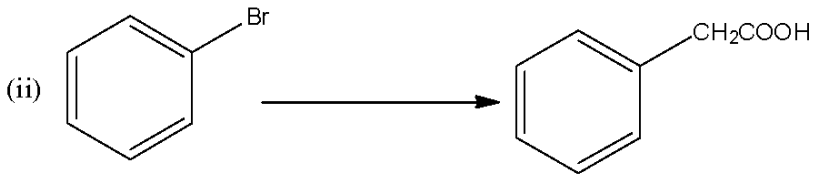


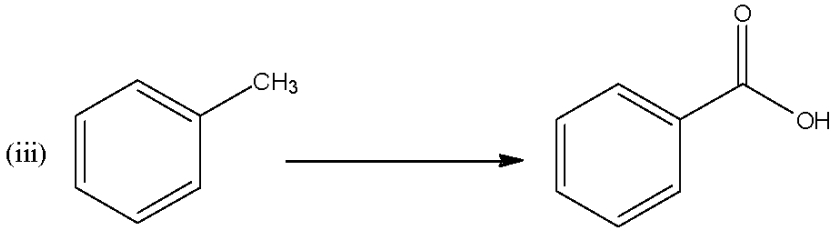
(iv)

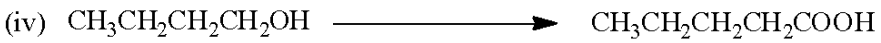


(e) Provide the reagents that are required to effect each of the following transformations. (**6 marks**)

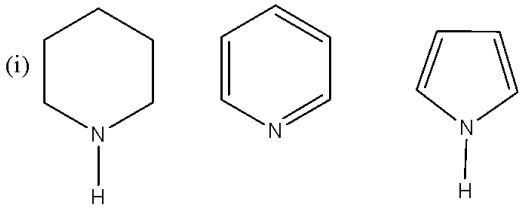
(i) 

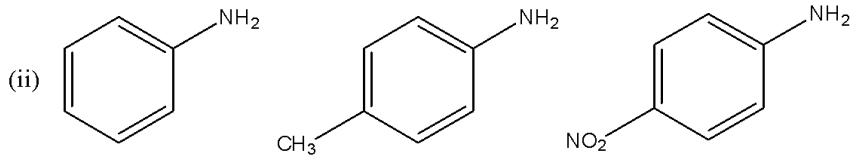
(ii) 

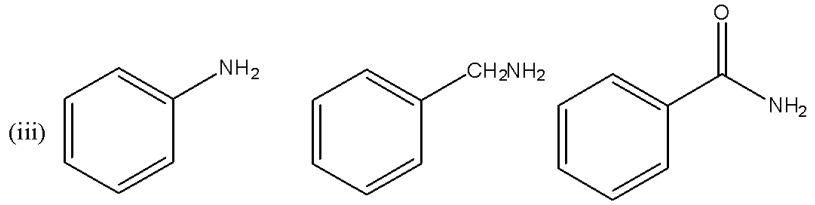
(iii) 

(iv) 

(f) Rank the amines in each set in order of increasing basicity. Justify your order in each case. **(6 marks)**

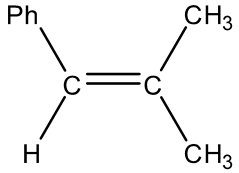
(i) 

(ii) 

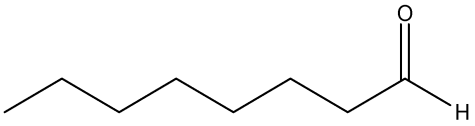
(iii) 

QUESTION TWO [20 MARKS]

(a) Show how the Wittig reaction can be used to synthesize the following alkene, starting with an alkyl halide and a ketone or an aldehyde. (**2 marks**)



(b) Design a reasonable synthesis of octanal from each of the following compounds. (**6 marks**)

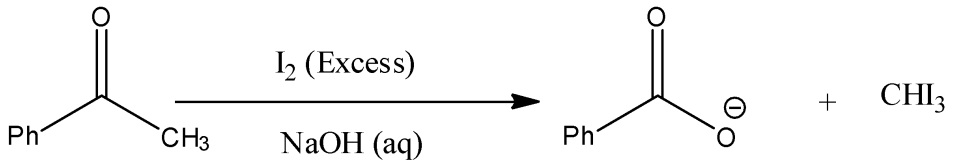


octanal

(i) octan-1-ol (ii) non-1-ene (iii) oct-1-yne

(iv) 1-bromoheptane (v) octanoic acid (vi) ethyl octanoate

(c) Write the stepwise mechanism of the following reaction (**3 marks**)

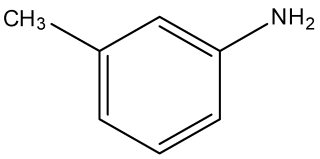


(d) Draw the structures of the following compounds (**3 marks**)

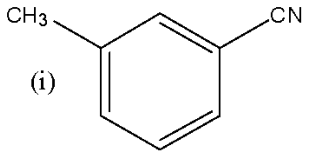
(i) *tert*-butylamine (ii) N-ethyl-N-methylhexan-3-amine (iii) N-methylpyrrolidine

(iv) N,N-diethylaniline (v) N-methyl-N-propylcyclopentanamine (vi) N,4-diethylhexan-3-amine

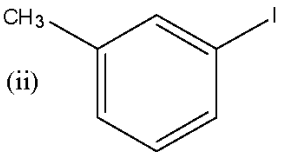
(e) Design a reasonable synthesis for conversion of *m*-toluidine to the following compounds. (**6 marks**)



m-toluidine



(i)



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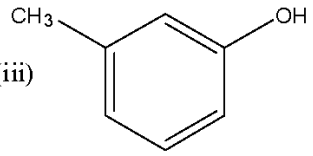

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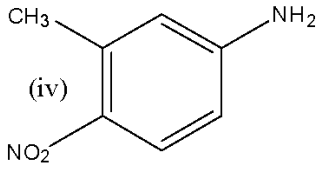

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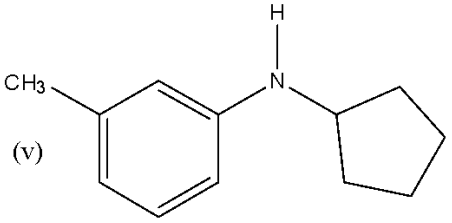

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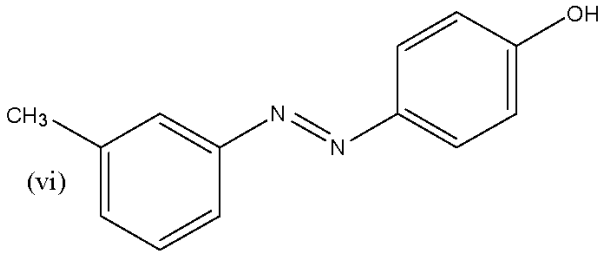
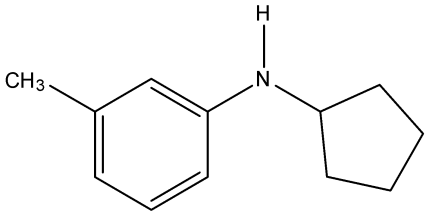


(vi)

QUESTION THREE [20 MARKS]

(a) Design a reasonable synthesis of the following amine using reductive amination.

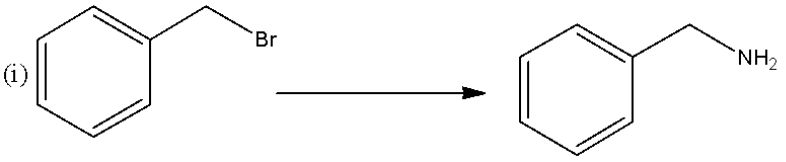
(**2 marks**)

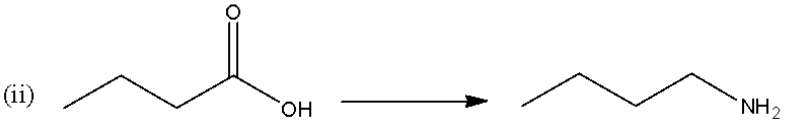


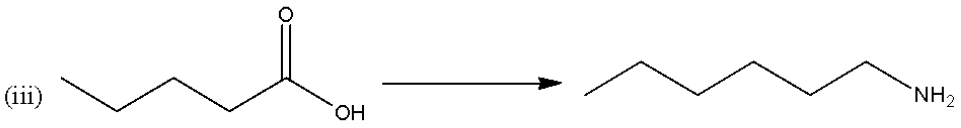
(b) Discuss the physical properties of amides. (**2 marks**)

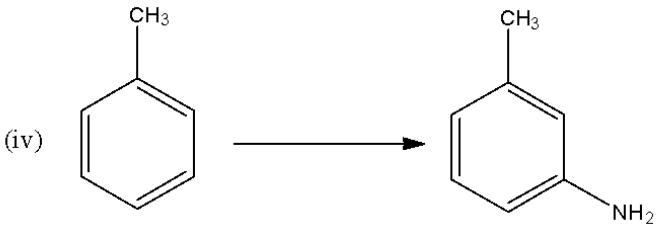
(c) Provide the reagents that are required to effect each of the following transformations.

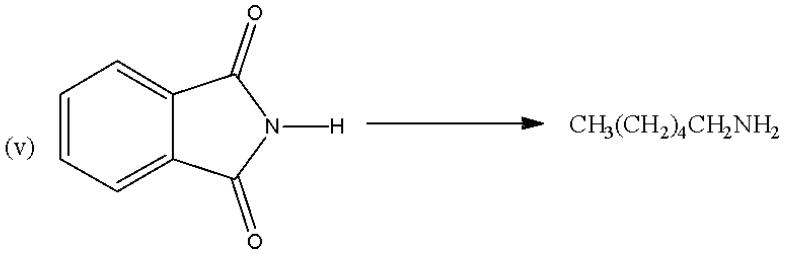
(**10 marks**)

(i) 

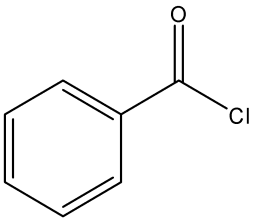
(ii) 

(iii) 

(iv) 

(v) 

(d) Write the structure of the major organic product(s) of the reaction of n benzoyl chloride with each of the following reagents. **(6 marks)**



benzoyl chloride

(i) ethanol (ii) sodium acetate (iii) anisole and aluminum chloride

(iv) excess CH_3MgBr, then dilute acid (v) $LiAlH(O\text{-}t\text{-}Bu)_3$ (vi) aniline

QUESTION FOUR [20 MARKS]

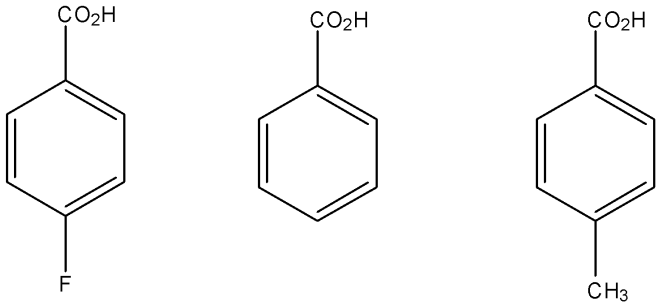
(a) Draw the structures of the following carboxylic acids **(3 marks)**

(i) 4-aminopentanoic acid (ii) *trans*-2-methylcyclohexanecarboxylic acid

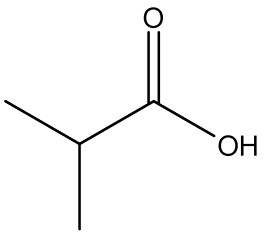
(iii) 4-oxoheptanoic acid (iv) 3-chloroheptanedioic acid

(v) 3,4-dimethylhex-3-enoic acid (vi) 3-methylphthalic acid

(b) Arrange the following compounds in order of increasing acidity and explain the basis for the chosen order. **(3 marks)**

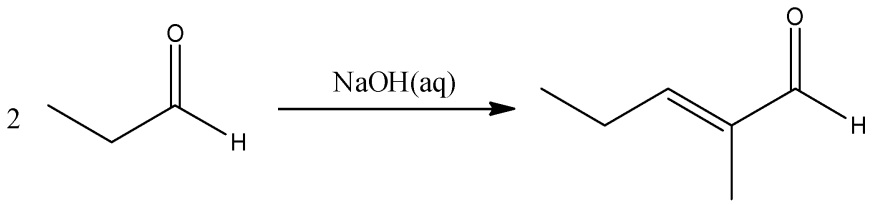


(c) Design a malonic ester synthesis for 2-methylpropanoic acid. **(4 marks)**

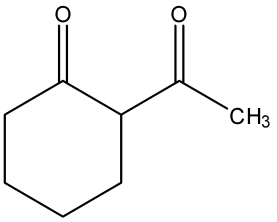


2-methylpropanoic acid

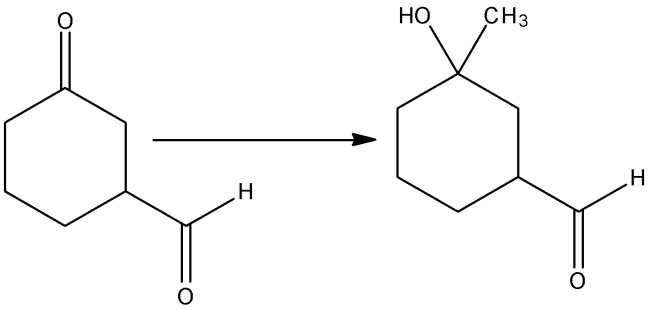
(d) Write the stepwise mechanism of the following reaction. **(4 marks)**



(e) Design a Stork enamine synthesis for the following compound starting with cyclohexanone and any other reagents of your choice. **(3 marks)**



(f) Write the stepwise reaction for the following reaction **(3 marks)**


O
H
O
HO
CH3
H
O
