NATIONAL UNIVERSITY OF LESOTHO

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF PHARMACY

B. PHARM (HONOURS) EXAMINATION

PHA 3409 – PHARMACEUTICAL ORGANIC CHEMISTRY

JANUARY 2024 TIME: 3 HOURS TOTAL: 100 MARKS

INSTRUCTIONS:

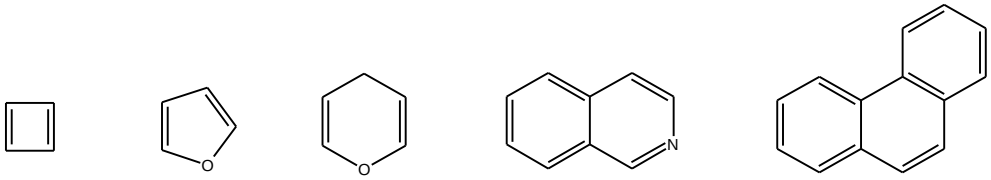
- **THIS PAPER CONSISTS OF 8 QUESTIONS**
- **ANSWER ALL QUESTIONS**
- **START EACH QUESTION ON A NEW PAGE**
- **MARKS ARE SHOWN IN PARENTHESIS AT THE END OF EACH QUESTION**

Question 1 **[15 marks]**

a. Explain why it is important to study aromatic chemistry in pharmacy? [2]

b. Mention two characteristics of polycyclic aromatic hydrocarbons (2), and give an example of any polycyclic aromatic hydrocarbon (1). [3]

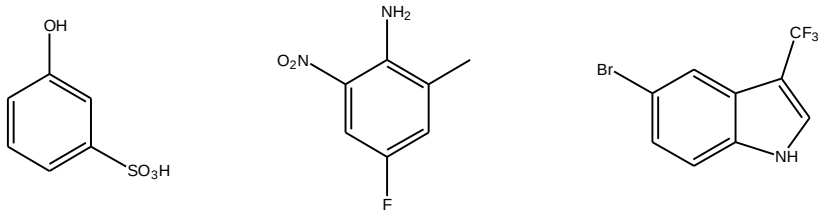
c. Indicate whether or not the following molecules are aromatic (5) and justify your answer for each molecule (5). [10]



i ii iii iv v

Question 2 **[15 marks]**

a. Give IUPAC names of the following aromatic compounds [6]



i ii iii

b. Draw chemical structures of the following compounds [4]

i. 4-methylthiazole

ii. 2,4-diaminobenzoic acid

c. Show a detailed mechanism of nitration of benzene [5]

Question 3 **[15 marks]**

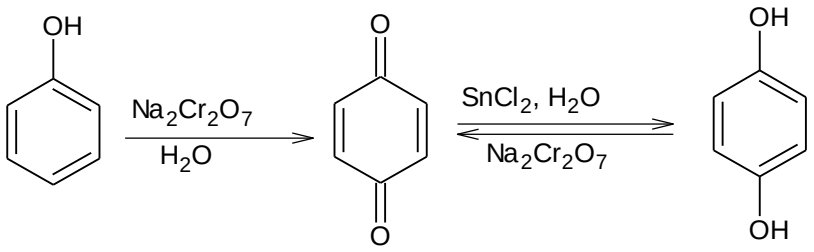
a. Describe structurally sulfonic acid (1) and compare it with sulphuric acid (1). [2]

b. Mention any 3 pharmaceutical products that are derivatives of sulfonic acid. [3]

c. Describe how you would synthesize propylphenol using phenol as one of the starting reagents. Show a detailed mechanism of this reaction and show all possible products. [5]

d. Explain why the reaction above gives multiple products [2]

e. Interpret the reaction below [3]



Question 4 **[15 marks]**

a. You are a pharmaceutical chemistry student at NUL tasked to synthesize a series of new compounds using aniline as your starting material. Assuming that you have nitrobenzene in the lab, and that the available budget is not enough to purchase commercial aniline, schematically show how you would synthesize aniline from nitrobenzene. [4]

i. Justify why you chose the above method of synthesis [2]

ii. Now that you have your starting material aniline, show how you would produce 2,4,5-tribromoaniline [3]

iii. Explain why 2,4,5-tribromoaniline is the major product in the bromination of aniline [1]

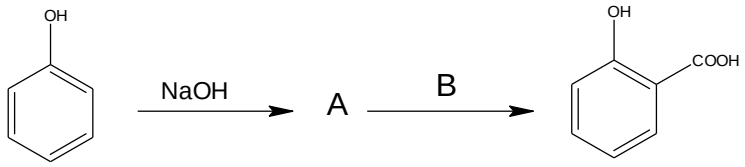
iv. Which other method of synthesis would be suitable for producing primary amines? [1]

v. Schematically outline the synthetic method mentioned above. [4]

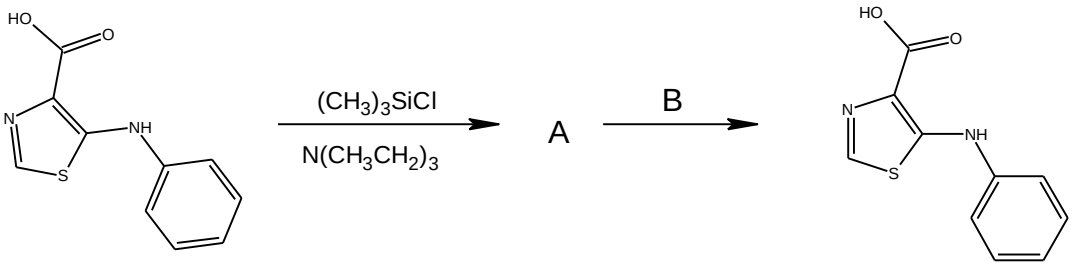
Question 5 **[10 marks]**

Show the missing products and/or reactants (A and B) in the following reactions.

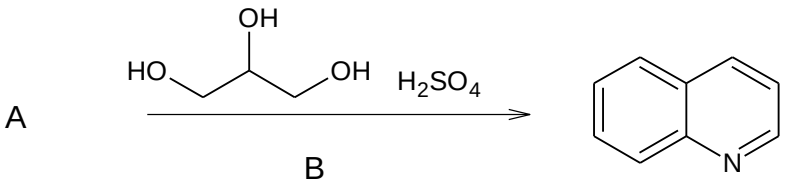
a. [2]



b. [4]



c. [4]



Question 6 **[10 marks]**

a. Describe Harworth synthesis. [1]

b. Outline (schematically or in words) how you would carry out the synthesis of naphthalene using the Harwoth synthesis [7]

c. Mention any 2 characteristics of naphthalene. [2]

Question 7 **[10 marks]**

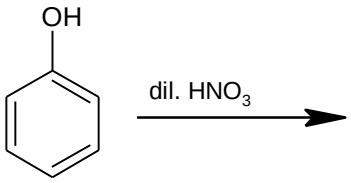
a. Define the term heterocyclic molecule (1) and give an example of an NSAID that contains a heterocyclic structure (1). Draw the structure of the heterocycle that is present in the drug mentioned above (1). [3]

b. Pyrrole is a heterocyclic aromatic compound. With the aid of an orbital diagram, briefly explain why pyrrole is aromatic (2) and draw all resonance structures of pyrrole (5). [7]

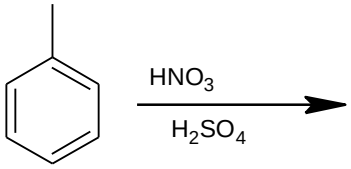
Question 8 **[10 marks]**

Provide the structures of product(s) of the following reactions.

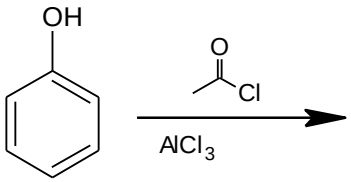
a.



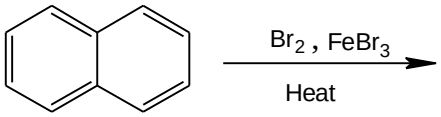
b.



c.



d.



e.