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# UNIVERSITY OF RUHUNA – FACULTY OF ALLIED HEALTH SCIENCES

## DEPARTMENT OF PHARMACY

## FIRST BPHARM PART II EXAMINATION – SEPTEMBER/OCTOBER 2020

## PH 1213 PHARMACEUTICAL CHEMISTRY II (SEQ)–OLD SYLLABUS

**TIME: THREE HOURS**

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**INSTRUCTIONS**

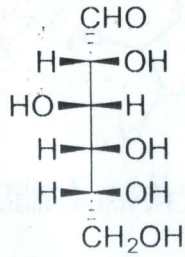
- There are **six** questions in parts **A** and **B** in this paper.
- Answer **all** questions.
- No paper should be removed from the examination hall.
- Do not use any correction fluid.
- Use illustrations where necessary.



## PART A

**01**. Answer **all** parts

1.1 The structure of D-glucose is shown below in its wedge-line formula.




Draw the following structures pertaining to D-glucose.

1.1.1 Fischer projection formulae of both D and L glucose. (***10 marks***)

1.1.2 Haworth formulae of α and β-pyranose forms. (***10 marks***)

1.1.3 Chair conformation of α and β-glucopyranose. (***10 marks***)

1.2 Properties of α-amino acids depend on their side chains.

1.2.1 Classify the following amino acids into *non-polar* and *polar* groups. (***10 marks***)

Ala, Cys, Gly, Met, Pro, Val

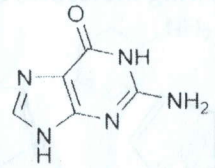
1.2.2 Draw the chemical structures of any three of the above amino acids. (***15 marks***)

1.3 What are the four levels of protein structure? (***15 marks***)

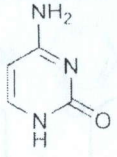
1.4

1.4.1 Give trivial names the following two molecules **A** and **B**.

**A**




**B**




1.4.2 Show how pairing occurs between these two molecules **A** and **B** in a DNA double helix. (***20 marks***)

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1.5

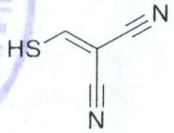
1.5.1 What are the two components that should be combined to make a triglyceride? (*05 marks*)

1.5.2 Draw the structures for any ω-3 and ω-6 fatty acids. (*05 marks*)

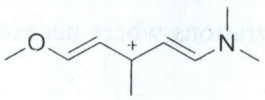
**02.** Answer **all** parts.

2.1 Draw all contributing resonance structures with the maximum number of complete octets and the minimum number of atoms with a formal charge for the following two molecules. Indicate the most contributing resonance structures. (*30 marks*)

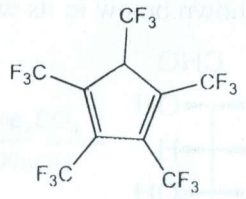
2.1.1



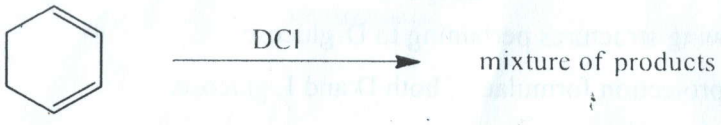

2.1.2




2.2 Based on the argument of aromaticity would you expect the following compound to be either a strong acid or a strong base? (*25 marks*)




2.3 The addition of one equivalent of DCl to 1,3-cyclohexadiene gives a mixture of products.




Draw the structures of the products and accounts for the mixture of products giving a mechanism for the reaction. (*25 marks*)

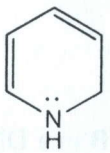
2.4 Friedel-Crafts acylation of *tert*-butyl benzene is highly **regioselective** and provides the para isomer as the major product. Draw the mechanism for the reaction of *tert*-butyl benzene with propanoyl chloride and $AlCl_3$ giving the major product. (*20 marks*)

**03.** Answer **all** parts.

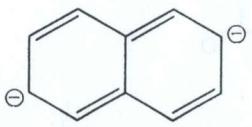
3.1

3.1.1 Define aromaticity in terms of the Hückel rule. (*10 marks*)

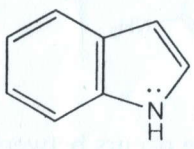
3.1.2 Using the Hückel rule, determine whether the following molecules are aromatic or not. (*30 marks*)



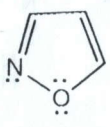

3.1.2.1




3.1.2.2




3.1.2.3




3.1.2.4

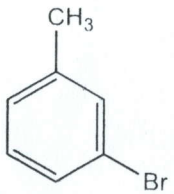
3.2 The orientation of electrophilic aromatic substitution on a disubstituted benzene ring is usually controlled by the more powerful activator of the two groups already on the ring.

3.2.1 Name and draw the structures(s) of the major product(s) of electrophilic chlorination of *m*-nitrophenol, and *p*-chloronitrobenzene. (***20 marks***)

3.2.2 Give a brief explanation for your answers in 3.2.1 (***10 marks***)

3.3 Propose a synthesis of each of the following compounds from toluene. Note that direct bromination of toluene with $Br_2$/Fe is not possible as the ortho and para products in the mixture cannot be separated by distillation in a reasonable purity. Their boiling points are too close together (182 and 185 $^0$C respectively). (***30 marks***)

3.3.1 


3.3.2 


**04**. Answer **all** parts

4.1 Show the structures of species **X** and **Y** in the following acid-base reactions. (***10 marks***)

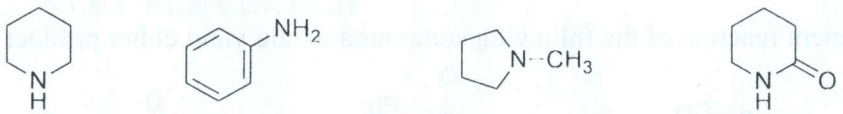
4.1.1 


4.1.2 


4.2

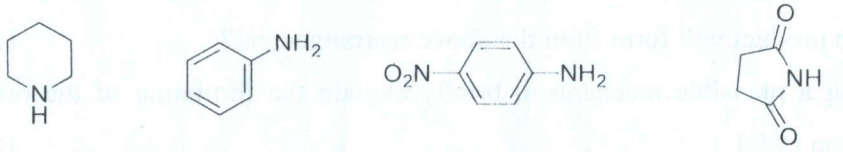
4.2.1 Indicate the order of decreasing acid strength of the following compounds.

(***10 marks***)

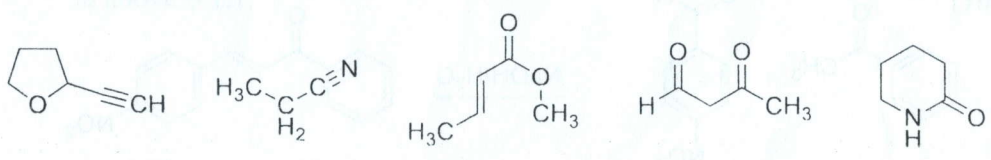



4.2.2 Indicate the order of decreasing base strength of the following compounds.

(***10 marks***)

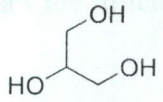


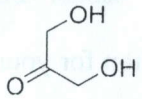

4.3 Give the structure(s) of the most favored conjugate base and the resonance structure(s) of each of the following molecules. (***20 marks***)



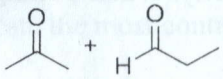
## PART B

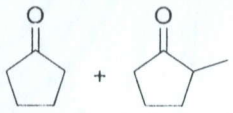
4.4 Write down the products formed when the following two molecules react with aqueous periodic acid ($HIO_4$). ***(20 marks)***

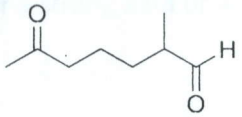
4.4.1 


4.4.2 

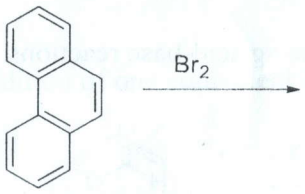

4.5 Draw the structure of an alkene that would yield each of the following products upon ozonolysis. ***(15 marks)***

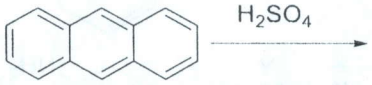
4.5.1 


4.5.2 


4.5.3 


4.6 Predict the major product formed in each of the following reactions. ***(15 marks)***

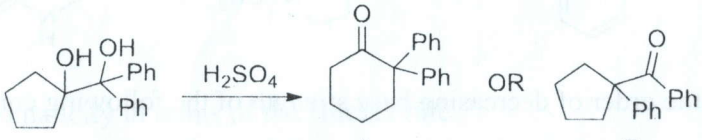
4.6.1 


4.6.2 


4.6.3 


**05.** Answer **all** parts

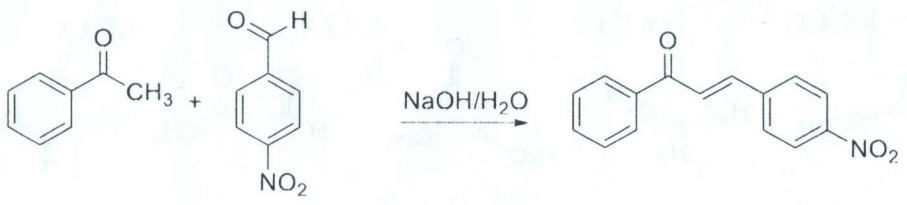
5.1 A rearrangement reaction of the following compound would yield either product **A** or **B**.



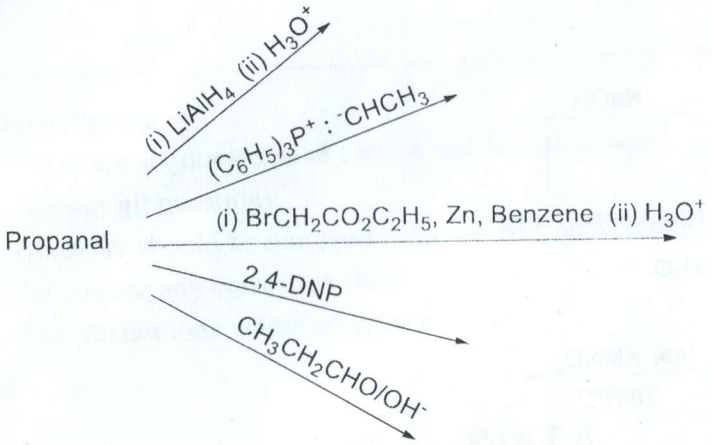

5.1.1 Which product will form from the above rearrangement? ***(10 marks)***

5.1.2 Giving a plausible mechanism, briefly explain the formation of the product you mention in 5.1.1. ***(20 marks)***

5.2 Write a mechanism that accounts for the formation of the following product. ***(20 marks)***

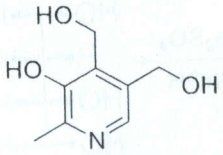


5.3 Write the structural formulae for the products formed when **propanal** reacts with each of the following reagents. (***50 marks***)




**06.** Answer **all** parts

6.1 Vitamin $B_6$ has the following chemical structure.




6.1.1 Identify the heterocyclic nucleus present. (***05 marks***)

6.1.2 Briefly explain the orbital structure of the identified heterocycle above in 6.1.1. (***25 marks***)

6.1.3 Compare the basicity of pyrrole with the heterocycle you identified in 6.1.1 (***10 marks***)

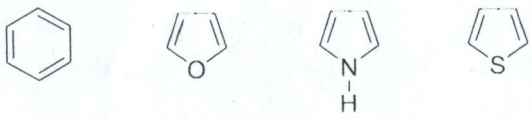
6.1.4 What product/s would you obtain when the identified heterocycle in 6.1.1 reacts with each of the following reagents? (***10 marks***)

6.1.4.1. $C_6H_5Li$/Toluene

6.1.4.2. $H_2O_2/CH_3COOH$

6.2

6.2.1 Arrange the following compounds in the order of decreasing aromaticity. (***10 marks***)




6.2.2 Briefly explain the reason for the reduced aromaticity of the least stable compound in above 6.2.1. (***10 marks***)

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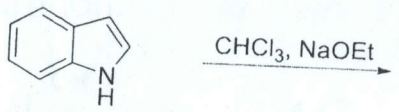
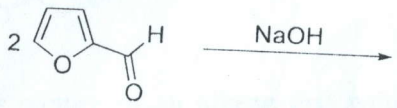
6.3 Predict the product expected from each of the following reactions. ***(30 marks)***

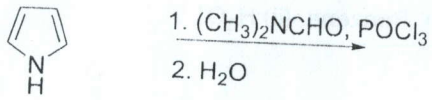
6.3.1.




6.3.2.

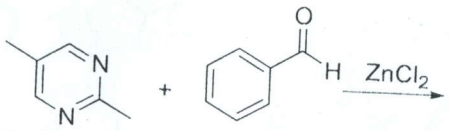



6.3.3.

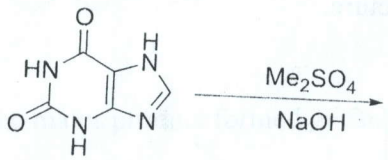



6.3.4.


6.3.5.




6.3.6.

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