

CHM 172

Practical 5: PRE PRACTICAL EXERCISE

Surname		Initials	
Student number			Signature:
Name of your tutor:			Date:

Question 1

Calculate the % atom economy and the % carbon efficiency green chemistry metrics in the table below for the three salicylic acid synthetic routes.

The three routes are found on page 1 of the Aspirin Manufacture document:

Refer to the Green chemistry metrics on page 5-6. The molar masses of the compounds are presented in Table 4 page 7 of the Aspirin Manufacture document.

	Route 1: Salicylic acid from phenol	Route 2 Salicylic acid from salicin	Route 3 Salicylic acid from oil of wintergreen
<i>% Atom economy</i>			
<i>% Carbon efficiency</i>			
Why are we unable to calculate reaction mass efficiency for the above reactions from the given reaction equations?			
Of the three metrics (% atom economy, % carbon efficiency or % mass efficiency) which metric do you consider the most important in deciding the route to take?			
Refer to the calculated % atom economy for all three routes, which route of making salicylic acid do you consider the least green? Briefly explain your choice.			

Question 2

Refer to the procedure for the synthesis of **aspirin from salicylic acid and acetic anhydride in the laboratory on page 3 of the information document**. In the table below, three inputs and three outputs of aspirin synthesis are listed. The three processes that requires energy during the synthesis of aspirin are also listed.

Indicate the impact (environmental, social or economic) that each input, each output and energy will have during aspirin synthesis. Briefly explain each impact.

Use methanol in row 1 as an example.

Refer to the table below as guidance:

ENVIRONMENTAL IMPACT	ECONOMIC IMPACT	SOCIAL IMPACT
Over extraction of raw materials	Demand and supply	Job creation
Land pollution	Profits	Longevity of life
Air and water pollution	Prices of chemicals and drugs	Quality of life
Land degradation	Employment	Drug dependency and abuse
Global warming and climate change	Tax contribution	Human rights

Table of inputs, outputs and energy used during aspirin synthesis.			
	List	Impact	Explain the impact
Example	Methanol	Environmental Social Economic	Methanol exposure may affect animals, birds and fish, leading to their death. Methanol can cause low growth rate in plants. Methanol can be an alternative to conventional transportation fuels because it is cheap to produce and has a lower risk of flammability compared to gasoline.
Inputs	Salicylic acid		
	Acetic anhydride		
	Sulfuric acid		

Outputs	Aspirin		
	Water		
	Acetic acid		
Energy	Weighing Heating Boiling		

Question 3

Briefly define sustainability. [1]				
Briefly define systems thinking. [1]				
Tick (✓) the factors that are important in the choice of the drug synthesis route. [1] Do not tick if NOT important.	<input type="checkbox"/>	Source of raw materials	<input type="checkbox"/>	Solvents
	<input type="checkbox"/>	Energy used	<input type="checkbox"/>	Catalysts
	<input type="checkbox"/>	Amounts of reactants used	<input type="checkbox"/>	Amounts products formed
	<input type="checkbox"/>	Waste management	<input type="checkbox"/>	Byproducts

Question 4

What kind of engineer will you be? _____ . As this engineer, what could you contribute to make a drug synthesis route more sustainable? [2]

Question 5

Do you give consent for your submission to be used for research purposes? Yes or No.

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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If your answer is **yes**, your submissions will be used as data to evaluate how effective this teaching design is. Your anonymity will be protected and codes will be assigned to all documents received.

You will not be penalized or be disadvantaged in anyway if your answer is **No**.

The University of Pretoria Ethics Board has approved this research.