



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017**

COURSE NAME : FUNDAMENTALS OF GREEN CHEMISTRY
COURSE CODE : DAU 32103
PROGRAMME CODE : DAU
EXAMINATION DATE : DECEMBER 2016 / JANUARY 2017
DURATION : 3 HOURS
INSTRUCTION : SECTION A: ANSWER ALL QUESTIONS
SECTION B: ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

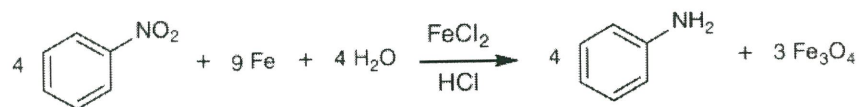
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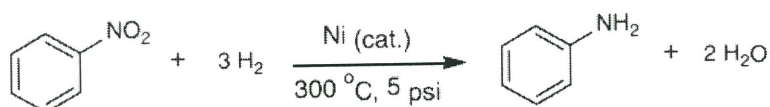
SECTION A

- Q1 (a) Differentiate between atom economy and E factor. (2 marks)
- (b) Given below two chemical reactions for the hydrogenation of nitrobenzene.

Traditional Béchamp Process:



Nickel Catalyzed Hydrogenation Process:



- (i) Calculate the atom economy of each reaction.
(Given atomic mass in g/mol: C = 12, H = 1, N = 14, O = 16, Fe = 56) (10 marks)
- (ii) Interpret the results obtained in **Q1b(i)** for each reaction in green chemistry context. (5 marks)
- (c) The product and waste tonnages of four chemical industry productions are shown below;

Industry	Product tonnage (kg)	Waste tonnage (kg)	E factor
Oil refining	10^7	10^6	
Bulk chemicals	10^5	1.5×10^5	
Fine chemicals	10^3	1.025×10^4	
Pharmaceuticals	10^2	5.0×10^3	

- (i) Calculate the E factor for production of each chemical industry. (4 marks)
- (ii) Interpret the results obtained in **Q1c(i)** from green chemistry point of view. (4 marks)

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SECTION B

- Q2** Chemical disaster is an accident or event that can lead to tremendous destruction to the environment, equipment, plant and people. There are various consequences of the chemical disaster such as chemical toxic gas release and dispersion. Discuss any chemical disaster that had been occurred. Your discussion should include the followings;
- (i) The background of the company. (5 marks)
 - (ii) The event chronology and the cause of the disaster. (10 marks)
 - (iii) Explain how the disaster was handled. (5 marks)
 - (iv) The effects of the disaster to the environment. (5 marks)
- Q3** (a) (i) Define the terms catalyst and catalysis. (2 marks)
- (ii) Differentiate between homogenous and heterogenous catalyst. (4 marks)
- (iii) Discuss the advantages of using catalyst in chemical reactions in green chemistry context. (4 marks)
- (b) (i) State the green chemistry principle that associated with the use of solvent and explain the green chemistry aims in this principle. (4 marks)
- (ii) Describe the advantages and disadvantages of using organic solvent. (4 marks)
- (iii) Define green solvents and state three (3) characteristics of green solvent. (4 marks)
- (iv) Water is one of the green solvents. The use of water as solvent is the best solution in green chemistry. Explain. (3 marks)
- Q4** (a) (i) Explain the five layers of earth's atmosphere and gas composition. (5 marks)
- (ii) Explain the terms of greenhouse gases. Give three (3) examples of greenhouse gases. (5 marks)

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(iii) Discuss the phenomenon of greenhouse effect. (5 marks)

(b) “Countries that are currently highly dependent on fossil fuel should focus all their efforts toward harnessing renewable energy sources. Although the cost of production is still high, more effort would bring down the value”. Based from this statement, answer the following questions.

(i) Define renewable energy. (2 marks)

(ii) Discuss the types of renewable energy that can be used as alternatives for fossil fuel energy. (8 marks)

Q5 (a) (i) State any four water quality parameters that are measured in water quality sampling programs. (4 marks)

(ii) The measurement of oxygen consumed by the organic matter in water samples are carried out by biological and chemical analysis methods. Differentiate between the two methods. (4 marks)

(iii) Explain the importance of measuring hardness in water samples. (5 marks)

(b) (i) Define the air pollution index (API) and state the index pollutants components that are being measured in the air monitoring program. (4 marks)

(ii) Air pollution index was collected at various locations hourly. The average data obtained for each location are as below. Analyze and interpret the data for each location. Your answer may include the possible causes that might contribute to the data obtained.

Location	API
A	80
B	250
C	30

(8 marks)



– END OF QUESTIONS –