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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016**

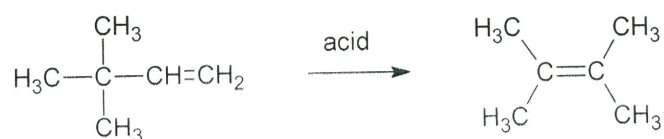
COURSE NAME	:	FUNDAMENTALS OF GREEN CHEMISTRY
COURSE CODE	:	DAU 32103
PROGRAMME	:	3 DAU
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	SECTION A) ANSWER ALL QUESTIONS SECTION B) ANSWER TWO (2) QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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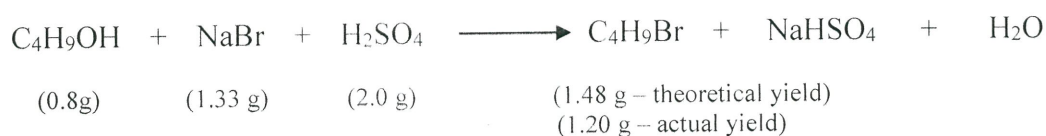
SECTION A

- Q1** (a) Define the following terms.
- (i) Atom economy (1 mark)
- (ii) E-factor (1 mark)
- (b) Differentiate the following terms
- (i) green chemistry and environmental chemistry. (2 mark)
- (ii) atom economy (intrinsic) and atom economy (experimental). (2 mark)
- (c) State **two (2)** principles of green chemistry and explain each of the principles. (4 marks)
- (d) Given below three chemical reactions. Given the molar mass in g/mol : C(12), H(1), O(16), N(14), Na(23), Cl(35.5)

Reaction 1: Hydrogen productionReaction 2: Synthesis of 2,3 - dimethyl-2-buteneReaction 3: Hydrazine (N₂H₄) production

- (i) Determine the atom economy of each reaction. (9 marks)
- (ii) Discuss the results of the atom economy of each reaction. The discussion should state the interpretation of the results in green chemistry point of view. (6 marks)

Q2 The following chemical reaction is the synthesis of 1-Bromobutane, C₄H₉Br. The amount of chemicals used and the amount of product are indicated in the bracket. The theoretical and actual yield of 1-Bromobutane are 1.48 g and 1.20 g respectively. Given molar mass in g/mol : C₄H₉OH (74), NaBr (103), H₂SO₄ (98), C₄H₉Br (137), NaHSO₄ (120) and H₂O (18).



- (i) Identify all the reactants and by products of the above reaction. (6 marks)
- (ii) Calculate the atom economy (intrinsic) and atom economy (experimental). (8 marks)
- (iii) Determine the % yield of 1-Bromobutane. (3 marks)
- (iv) Determine the E-factor of the above reaction if the amount of waste is calculated by subtracting the actual yield of product from the total amount of reactants. Discuss on the value obtained. (8 marks)

SECTION B

Q3 Accidents in chemical process industries constitute major threat to property and population because of the magnitude. 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. Some of the worst disasters of toxic releases have occurred in toxic chemicals like ammonia, chlorine and cyclohexane etc. The various past chemical accidents occurred are well known such as Bhopal tragedy, Fukushima Nuclear disaster, KYSHTYM disaster and Jilin Chemical Plant explosion.

Discuss any industrial disaster that had been occurred. Your discussion should include the followings;

- (a) The background of the company. (5 marks)
- (b) The event chronology and the cause of the disaster. (10 marks)
- (c) Explain how the disaster are handled. (5 marks)
- (d) The effects of the disaster to the environment and others. (5 marks)

- Q4**
- (a) (i) Define the terms catalyst and catalysis. (2 marks)
 - (ii) Explain the term biocatalysis and give **one (1)** example of bio catalyst. (2 marks)
 - (iii) Explain and draw a schematic representation of enzyme-catalysed reaction. (10 marks)
 - (b) (i) State the green chemistry principle that associated with the use of solvent and explain. (4 marks)

- (ii) Define green solvents and give **three (3)** characteristics of green solvent. (4 marks)
- (iii) Water is one of the green solvents. The use of water as solvent is the best solution in Green Chemistry. Explain. (3 marks)
- Q5**
- (a) Explain the terms of greenhouse gases. Give **three (3)** examples of greenhouse gases. (5 marks)
- (b) Explain the phenomenon of greenhouse effect. (5 marks)
- (c) A material balance for the accumulation of CO_2 in the environment consists of CO_2 generation due to natural causes and human activities.
- (i) State the formula for the depletion of CO_2 due to its absorption in the natural sinks. (5 marks)
- (ii) Interpret the formula in the perspective of Green Chemistry. (5 marks)
- (iii) The various sinks for CO_2 absorption have been depleting because of deforestation. Explain your answer. (5 marks)

- END OF QUESTIONS -