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EXTERNAL MODERATOR: MR N STOLZ

INSTRUCTIONS:

1. **ALL** questions should be attempted.

2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.

4. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.

5. This examination question paper, together with all associated diagrams **MUST BE HANDED IN TOGETHER WITH YOUR SCRIPT.**

Student Number:
QUESTION 1 - RENEWABLE ENERGY STORAGE

1.1. Name 4 forms of renewable energy storage? (4)

1.2. What are the main drivers or motivation for shifting from conventional to renewable energy sources (mention 4 with examples)? (8)

1.3. Describe two scenarios that help with the implementation of renewable energy sources as alternative to conventional energy sources. (3)

TOTAL /20/

QUESTION 2 - INDUSTRIAL SYMBIOSIS

2.1. What is Industrial Symbiosis? Describe two examples of industrial symbiosis. (6)

2.2. What are the challenges in implementing industrial symbiosis (name three)? (6)

TOTAL /12/
QUESTION 3 - GREEN ENGINEERING, RESOURCE AND ENERGY EFFICIENCY, AND GREEN TECHNOLOGIES

3.1 What is Chemical Leasing? (4)

3.2 Give two examples illustrating Chemical Leasing. (4)

3.3 How can private enterprises, government (policy level, law enforcement), and the general public influence a shift towards green technologies? (12)

TOTAL /20/

QUESTION 4 - VINASSE BENEFICIATION

4.1 What is vinasse (origin, composition, disposal issues)? (5)

4.2 What are possible disposal methods for vinasse? (8)

4.3 What business opportunities are there for the upcycling of vinasse? Discuss advantages and disadvantages (1 each for each product). Give a flow scheme for the production of these products, starting from molasses. (12)

TOTAL /25/
QUESTION 5 - BIOMASS FRACTIONATION

Ionic liquids have demonstrated their potential in biomass fractionation.

5.1 What is biomass fractionation, and which products are obtained? Give 2 general examples for industrial processes, and state the products they produce. 

(5)

5.2 Provide the definition for an ionic liquid. 

(3)

5.3 How can ionic liquids be used in biomass fractionation? 

(5)

5.4 Describe, on a molecular level, how do some ionic liquids interact with biomass fractions, e.g. cellulose. What are the main characteristics that an ionic liquid needs to possess to be able to dissolve cellulose? 

(5)

5.5 Mention 5 challenges that retard the implementation of ionic liquid technology into industry. 

(5)

TOTAL /23/