



Philadelphia University
Faculty of Engineering

Student Name:
Student Number:

Dept. of Alternative Energy Technology
Midterm Exam, Second Semester: 2021/2022

Course Title: Bioenergy and Waste Management	Date: 15/5/2022
Course No: (615446)	Time Allowed: 75 Minutes
Lecturer: Dr. Mohammad Abu-Naser	No. of Pages: 4

Question 1: (6Mark)

Objectives: This question is related to Basic Concepts

a) Write the equation of photosynthesis in words and in chemical symbols

Words:

Carbon Dioxide + Water → Glucose + Oxygen

Chemical symbols:



b) Connect the term on the left column with its appropriate definition on the right column

Bioenergy	All the living matter, composed primarily from carbon and hydrogen
Biomass	The end product when biomass is converted directly into a liquid fuel
Biofuel	Energy derived from materials which are alive, or were recently living, or from the waste of animals.

Question 2:

(6Mark)

Objectives: This question is related to Biomass Sources

Sort the following biomass sources in the following table under the correct biomass source category

“Corn, Cassava, rice, bagasse, soybean, sweet potato, sweet beet, wood residues, wheat straw, rapeseed, Jatropha, Sugarcane”

Sugar-Based	Starch-Based	Cellulose-Based	Oil-Based
Sweet beet Sugarcane	Corn Cassava Rice Sweet potato	Wood residues Bagasse Wheat straw	Soybean Rapeseed Jatropha

Question 3:

(6Mark)

Objectives: This question is related to Theory of Ethanol Production

a) Write the equation of fermentation in words and in chemical symbols

Words:

Glocuse → Ethanol + Carbon Dioxide

Chemical symbols:



b) Calculate the theoretical ethanol yield from 1 kg of corn which has 25 percent moisture and contains 75 percent starch on a dry basis.

One kg of corn contains: 1kg-0.25kg = 0.75 kg dry mass

Starch content of 1 kg of corn is: 0.75*0.75 = 0.5625 kg

Theoretical Ethanol yield from 1 kg of corn is: 0.5625 kg * 1.111 * 0.511

= 0.319 kg ethanol/kg corn

Question 4:

(6Mark)

Objectives: This question is related to Technologies of Ethanol Production

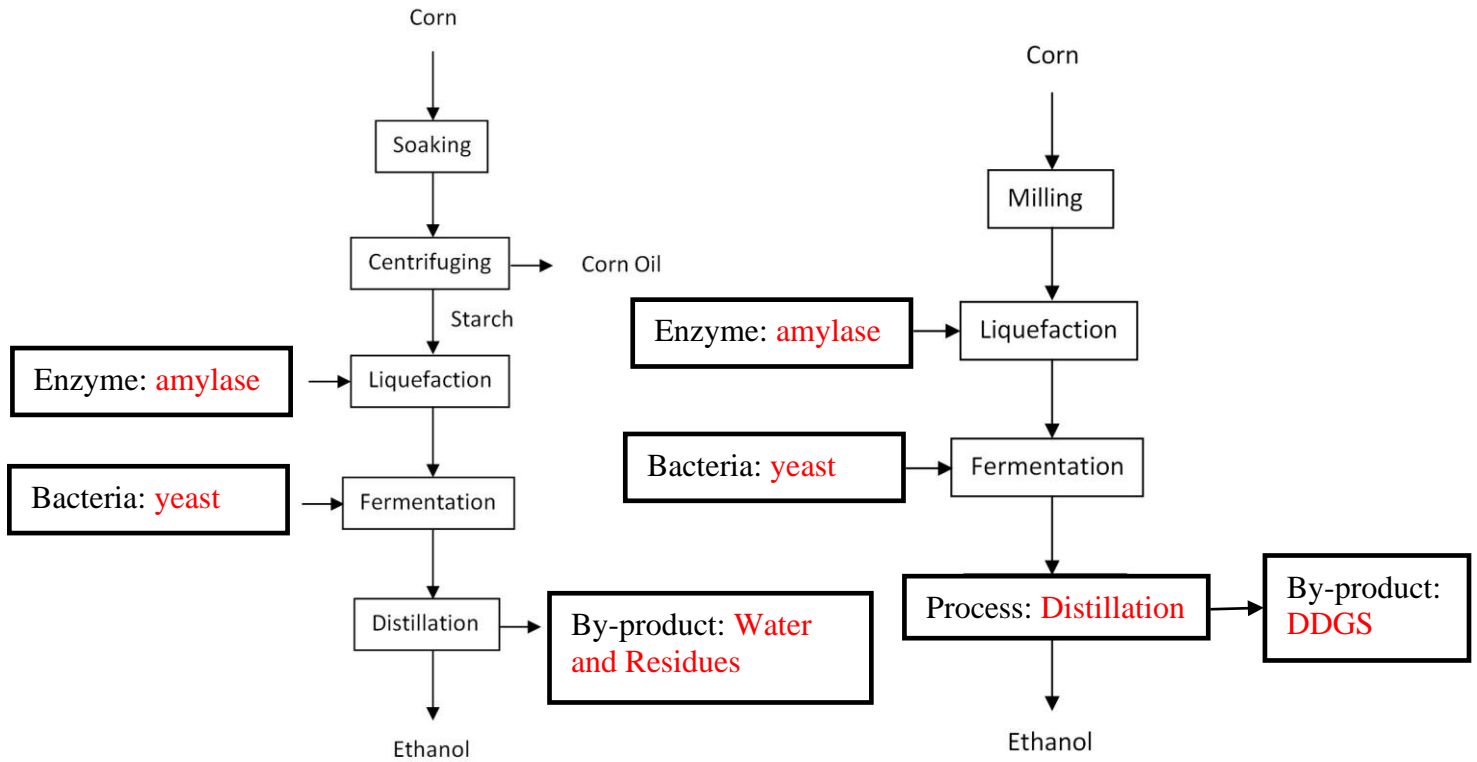
a) Write down the three steps of ethanol production from sugar-based biomass in the correct order

1. Squeezing
2. Fermentation
3. Distillation

b) For the following two ethanol production technologies, fill in the boxes with the correct technology, enzyme, bacteria, process, and by-product

Technology: **Wet Milling**

Technology: **Dry Milling**



Question 5:

(6Mark)

Objectives: This question is related to Biodiesel Production

a) Mention the main advantages/disadvantages of biodiesel compared to diesel

Advantages of biodiesel:

- Renewable
- Better lubricity

Disadvantages of biodiesel:

- Poor cold climate performance
- Higher cost

b) Write the chemical equation of the transesterification process in words



c) What are the main two purposes the transesterification process achieves in terms of fuel properties?

- Reduce Viscosity
- Increase Cetane Number