

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS - 2020

FOOD TECHNOLOGY - SECOND YEAR DEGREE

FT 214 INTRODUCTION TO FOOD CHEMISTRY

FRIDAY 26<sup>TH</sup> JUNE, 2020– 8:20 A.M.

**TIME ALLOWED: 3 HOURS**

**INFORMATION FOR CANDIDATES:**

1. You have 10 minutes to read the paper. You must not begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS**
3. All answers must be written in the answer books provided.
4. Write your name and number clearly on the front page. Do it now.
5. Calculators are permitted in the examination room. Notes and textbooks are not allowed.
6. Show all workings and calculations in the answer book.

**MARKING SCHEME**

QUESTION 1	[5 MARKS]
QUESTION 2	[30 MARKS]
QUESTION 3	[15 MARKS]
QUESTION 4	[19 MARKS]
QUESTION 5	[4 MARKS]
QUESTION 6	[27 MARKS]

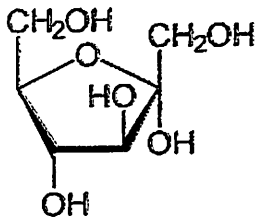
**ANSWER ALL QUESTIONS**

1. Write **TRUE** or **FALSE** for each sentence.

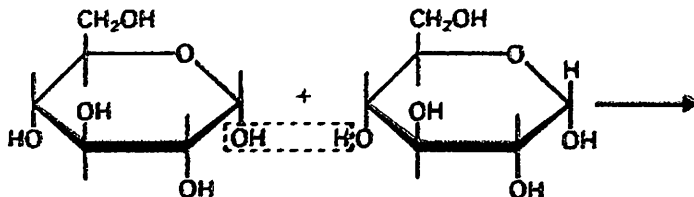
- (a) The shape formed by the arrangement of electrons around the nucleus of a carbon atom is called tetrahedron. [½ mark]
- (b) D-Ribose has three chiral carbons so will have a total of eight isomers. [½ mark]
- (c) The covalent bond found in lipid monomers is called ester bond whereas that which is found in carbohydrate monomers is called peptide bond. [½ mark]
- (d) Additional bonds that occur between certain atoms or functional groups of adjacent macromolecule/polymer are called INTRAMOLECULAR BONDS. [½ mark]
- (e) Equatorial position is where the substituent groups lie in the periphery of a sugar ring. [½ mark]
- (f) Native starch granule is a birefringent material due to its highly ordered crystalline structures created by packing of amylopectin and amylose into double helix. [½ mark]
- (g) Most amino acids exist as zwitterions in the physiological environment in nature with a net charge of +1. [½ mark]
- (h) Proteins with  $\alpha$ -helix structures are less soluble in water than those that have  $\beta$ -pleated sheets due to extensive network of hydrogen bonds in  $\alpha$ -helices. [½ mark]
- (i) The partial double bond character of peptide bond is due to the resonance structures caused by the delocalization of electrons purposely to stabilize the peptide bond. [½ mark]
- (j) Denatured protein gets adsorbed onto aqueous-metal interface and cause fouling of heat-exchangers. [½ mark]

(Total = 5 marks)

2. (a) Describe the THREE main classes of carbohydrate. [3 marks]
- (b) The  $\alpha$ -D-fructofuranose structure is shown. Explain how this systematic name is derived. [2 marks]



- (c) Draw the correct chair conformation of D-glucose and explain why glucose exists in this conformation. [6 marks]
- (d) (i) Maltose is a disaccharide formed from condensation reaction. Complete the reaction below. Also show the glycoside linkage in the disaccharide and its reducing and non-reducing ends. [4 marks]

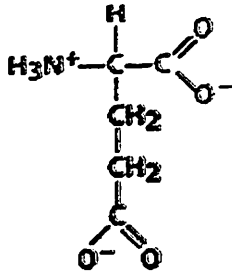


- (ii) Discuss whether or not maltose is a reducing sugar. [3 marks]
- (e) Explain why sucrose is sometimes called an 'invert sugar'. [3 marks]
- (f) Differentiate between ANY ONE of the following: [4 marks]
- (i) Amylose and amylopectin.  
(ii) Cellulose and glycogen.
- (g) Write notes on ANY ONE of the following: [5 marks]
- (i) Gelatinization.  
(ii) Retrogradation.  
(iii) A type of modified starch.

(Total = 30 marks)

3. (a) Amino acids are amphoteric. What happens when an acid or an alkali is added to their solutions? [4 marks]
- (b) Polar uncharged amino acids do not have any charged ions, but they are quite soluble in water. Discuss. [5 marks]

- (c) Shown below is the structure of glutamic acid. Identify its side chain and explain why glutamic acid remains acidic at its physiological pH. [3 marks]



- (d) Describe ANY ONE class of protein with an example. [3 marks]

(Total = 15 marks)

4. (a) Aromatic amino acids prefer  $\beta$ -pleated conformation. Why? [1 mark]
- (b) The tertiary structure of protein is held together by both covalent and non-covalent interactions. Sketch the tertiary structure of protein and show these side chain interactions. [5 marks]
- (c) Describe ANY TWO of the following: [8 marks]
- Fibrous protein structure and give an example.
  - Globular protein structure and give an example.
  - Protein denaturation.
  - Protein decomposition.

- (d) Mary, the line supervisor of Prima Small Goods Ltd was directed to modify the formulation and increase the proportion of lean meat in the sausage mixture of a newly developed sausage product. The resultant emulsion was smooth even after stuffing into casings. However, when the sausages were steam-cooked, they turned ugly brown, shrunk and became quite tough to eat so the customers rejected the product and the new sausage product was eventually phased out in the market.

Explain the function of protein in the mixture and the effects of heat-treatment on it that rendered the newly developed sausage product, a failure. [5 marks]

(Total = 19 marks)

5. Write TRUE or FALSE for each sentence.

- (a) The methods of extraction of fats and are rendering, pressing and use of solvent extraction. [½ mark]
- (b) The final product of lipid extraction process is refined oil. [½ mark]
- (c) Fats and oils are processed to optimise their end-use by modifying their melting points and nutritional quality. [½ mark]
- (d) Eutectic phase is the pitfall in blending which must be controlled to prevent unexpected hardening or softening of blended fats. [½ mark]
- (e) One of the side reactions in partial hydrogenation with a negative effect is the migration of double bonds that effectively destroys the essential fatty acid. [½ mark]
- (f) Hydrolytic rancidity is the oxidation of unsaturated fatty acids. [½ mark]
- (g) Free radical is reactive intermediate in which the chemical species is one electron short of a stable configuration. [½ mark]
- (h) Primary anti-oxidants are metal chelators whereas secondary anti-oxidants are chain breakers, radical scavengers and singlet oxygen quenchers. [½ mark]

(Total = 4 marks)

6. (a) Draw the general structure of triacylglycerol and describe its composition. [4 marks]
- (b) A triacylglycerol molecule with a *sn*-system short hand name is *sn*-MOST. Explain. Include the names of the isomers of *sn*-MOST in your explanation. [3 marks]
- (c) Shown below are the structures of fatty acids. Name each of them and compare their similarities and differences in terms of their structures and physical properties. [5 marks]

