Key Food molecules - Proteins

formation of dipeptides and polypeptides as condensation polymers of 2-amino acids

1. Draw the molecular structure of the polypeptide composed of glutamine, leucine and proline amino acids.

primary (peptide links), secondary, tertiary and quaternary structure and bonding

2. Describe the bonding that is found in the primary, secondary, tertiary and quaternary structures of a protein p474 – 484.

Primary	Secondary
Tertiary	Quaternary

3. Amino acids have both acidic and basic components. Draw the structural diagram of aspartic acid at pH<2 and pH>11 (p466).

distinction between essential and non-essential amino acids as dietary components

4. Explain why some amino acids are needed in the human diet while others are not (p463).

Metabolism of food - enzymes as protein catalysts

active site; modelling of process by which enzymes control specific biochemical reactions (lock-and-key and induced fit models)

23. Use a Venn diagram to compare the lock-and-key and induced fit models which are used to explain how enzymes control specific biochemical reactions (p528).

consequences of variation in enzyme-substrate interaction (lock-and-key mechanism) due to the behaviour of an optical isomer

24. Will an enzyme be able to catalyse a reaction with both enantiomers of a chiral molecule? Explain (p529).

action of enzymes in narrow pH ranges

25. Explain how high or low pH can result in denaturation of an enzyme. (p539)

increased temperature (denaturation) and decreased temperature (reduction in activity) on enzyme activity

26. Contrast the effect of increased and decreased temperatures on enzyme activity (p539).

use of reaction rates to measure enzyme activity; the distinction between denaturation of a protein and hydrolysis of its primary structure

27. Use a labelled diagram to compare denaturation of a protein with hydrolysis of its primary structure (p541).

Metabolism of food – energy values

the comparison of energy values of carbohydrates, proteins and fats and oils

35. Explain why fats and oils have a higher energy value than carbohydrates and proteins (p569).

Key Food molecules - Carbohydrates

formation of disaccharides from monosaccharides, and of complex carbohydrates (specifically starch and cellulose) as condensation polymers of monosaccharides

5. Name the bond connecting glucose and fructose in the disaccharide, sucrose.

glycosidic links

6. Draw a representation of a glycosidic link between two monosaccharides.

storage of excess glucose in the body as glycogen

7. What is the polysaccharide that is used to store excess glucose in the human body.

comparison of glucose, fructose, sucrose and the artificial sweetener aspartame with reference to their structures and energy content

8. Which of the carbohydrates listed above will have the greatest energy content? Justify your answer.

9. Aspartame is most soluble in acid conditions, pH 2.2 and least soluble at pH 5.2. By referring to the structure, explain the difference in solubility.

10. Glucose and fructose are highly soluble in water while starch and cellulose are insoluble. Explain (p496).

11. Explain why amylose and amylopectin have different solubilities in water (p501).

12. Explain why the solubility of aspartame in water is 0.0135 g/mL whereas the solubility of sucrose is 2g/mL. Discuss why this does not have a detrimental effect on the use of aspartame as a sweetener in coffee or tea (p498, 499).

Metabolism of food - hydrolysis of starch in the body

explanation of the ability of all humans to hydrolyse starch but not cellulose, and of differential ability in humans to hydrolyse lactose

28. Why can humans hydrolyse starch, but cannot digest cellulose? (p546)

29. Why is that some people can hydrolyse lactose while others cannot? (p546)

glycaemic index (GI) of foods as a ranking of carbohydrates based on the hydrolysis of starches (varying proportions of amylose and amylopectin) to produce glucose in the body

30. What is the glycaemic index? What is the relationship between the amount of amylose and amylopectin in food and the glycaemic index? (p546)

Metabolism of food – glucose as the primary energy source

glucose as the primary energy source, including a balanced thermochemical equation for cellular respiration

36. Write a balanced thermochemical equation for cellular respiration (p567).

37. Why is glucose considered to be a primary energy source? (p567)

Key Food molecules - Fats and oils

fats and oils (triglycerides): common structural features including ester links

13. A compound contains three different fatty acid chains: myristic, stearic and oleic. Draw the reaction pathway for the hydrolysis of this triglyceride in the human body.

distinction between fats and oils with reference to melting points

14. Explain why fats are solid at room temperature and oils are liquids.

explanation of different melting points of triglycerides with reference to the structures of their fatty acid tails and the strength of intermolecular forces

15. Stearic acid has a melting point (mp) of 70^{o}C, while lauric acid's mp is 44^{o}C. Explain (p490).

chemical structures of saturated and unsaturated (monounsaturated and polyunsaturated) fatty acids

16. Explain why a monounsaturated fatty acid with a cis arrangement around the C-C double bond has a lower melting point than the same fatty acid with a trans arrangement (p491).

distinction between essential and nonessential fatty acids

17. List an essential fatty acid and describe how it differs from non-essential fatty acids (p489, 494).

structural differences between omega-3 fatty acids and omega-6 fatty acids

18. Describe the structural differences between omega-3 fatty acids and omega-6 fatty acids.

Metabolism of food - as a source of energy and raw materials

- *general principles of metabolism of food involving enzyme-catalysed chemical reactions with reference to the breakdown of large biomolecules in food by hydrolytic reactions to produce smaller molecules*
- *subsequent synthesis of large biologically important molecules by condensation reactions of smaller molecules*

21. Compare the digestion of carbohydrates, proteins and triglycerides. Highlight the similarities and differences between the processes. (p522)

Similarities	Differences

22. Explain why it is important for the body to breakdown large biomolecules by hydrolytic reactions to produce smaller molecules. (p524)

Metabolism of food - hydrolysis of fats and oils

hydrolysis of fats and oils from foods to produce glycerol and fatty acids

31. Write a balanced chemical equation for the hydrolysis of a fat which has two oleic fatty acids and one linoleic fatty acids. (p552)

oxidative rancidity with reference to chemical reactions and processes, and the role of antioxidants in slowing rate of oxidative rancidity

32. Fats and oils can become rancid when exposed to enzymes, heat, water oxygen and light. Name one of the processes that can lead to a product becoming rancid and identify the molecules that are responsible for the change in taste and smell. (p553)

33. Explain how antioxidants slow the rate of oxidative rancidity by autoxidation. (p557)

Unit 4 AOS2 summary

CHEM TopUp Tools

Key Food molecules - Vitamins

inability of humans to synthesise most vitamins (except Vitamin D) making them essential in the diet

19. Describe how Vitamin D is synthesised in the human body (p507).

comparison of structural features of Vitamin C (water-soluble vitamin) and Vitamin D (fat-soluble vitamin) that determine their solubility in water or oil

20. Explain the differing solubilities of Vitamin C with Vitamin D (p507, 508)

Metabolism of food - coenzymes

principles of the action of coenzymes as organic molecules that bind to the active site of an enzyme during catalysis, changing the surface shape and binding properties of the active site to function as intermediate carriers of electrons and/or groups of atoms

34. Describe the role of coenzyme NAD^{+} in an enzyme reaction (p532).

Metabolism of food – calorimetry

solution and bomb calorimetry, including determination of calibration factor and consideration of the effects of heat loss

38. Describe the difference between electrical and chemical calibration.

analysis of temperature-time graphs obtained from solution calorimetry

39. Explain how to use a temperature-time graph to determine the calibration factor of a calorimeter.

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