

1. Which of the following are connected by hydrogen bonds?

- A. Hydrogen to oxygen within a molecule of water
- B. Phosphate to sugar in a DNA molecule
- C. Base to sugar in a DNA molecule
- D. Hydrogen to oxygen between two different molecules of water

(Total 1 mark)

2. Which variable has the **least** effect on enzyme activity?

- A. Temperature
- B. Light intensity
- C. pH
- D. Substrate concentration

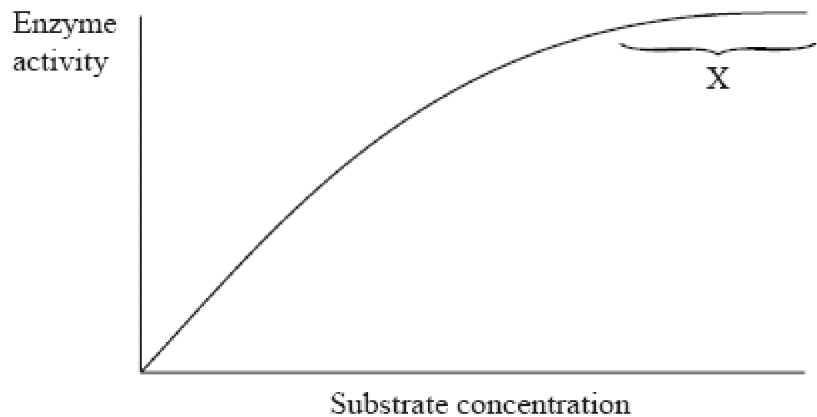
(Total 1 mark)

3. The percentage of thymine in the DNA of an organism is approximately 30%. What is the percentage of guanine?

- A. 70%
- B. 30%
- C. 40%
- D. 20%

(Total 1 mark)

4. The graph below shows the effect of substrate concentration on enzyme activity. What conclusion can be drawn about section X of the graph?



- A. The enzyme has started to denature and the reaction slows down.
- B. The reaction has finished and the substrate has been used up.
- C. The enzyme is saturated and is working at its maximum reaction rate.
- D. Some of the enzyme has been consumed and the reaction has reached a plateau.

(Total 1 mark)

5. A number of different proteins are involved in nerve function. Which of the following does **not** require a membrane protein?

- A. Active transport of sodium
- B. Diffusion of K^+ into the cell
- C. Diffusion of the neurotransmitter across the synapse
- D. Binding of the neurotransmitter to the post-synaptic membrane

(Total 1 mark)

6. Which chemical is shown in the diagram below?

- A. Monosaccharide
- B. Triglyceride
- C. Fatty acid
- D. Amino acid

(Total 1 mark)

7. What is denaturation?

- A. A structural change of a protein that results in the loss of its biological properties
- B. A change in the genetic code of an organism
- C. A change in the amino acid sequence of a protein causing a disruption of its 3D shape
- D. The process by which amino acids are broken down and ammonia is released

(Total 1 mark)

8. Which molecule is shown below?

- A. Glucose
- B. Galactose
- C. Ribose
- D. Sucrose

(Total 1 mark)

9. What is a difference between cohesion and adhesion?

- A. Only adhesion is involved in transpiration pull.
- B. Only cohesion is involved in the movement of water in soil.
- C. Only cohesion involves the interaction of water with soil mineral particles.
- D. Only adhesion involves the interaction of water with xylem.

(Total 1 mark)

10. What is the difference between galactose and lactose?

- A. Lactose is a disaccharide and galactose is a monosaccharide.
- B. Lactose is the product of anaerobic respiration in humans and galactose is the product of anaerobic respiration in yeast.
- C. Lactose is an enzyme and galactose is a hormone.
- D. Galactose is a sugar found in milk but lactose is not found in milk.

(Total 1 mark)

11. What property of water makes it a good evaporative coolant?

- A. High latent heat of evaporation
- B. Relatively low boiling point
- C. Volatility
- D. Transparency

(Total 1 mark)

12. Which statement about water is correct?

- A. The atoms within a molecule of water are held together by hydrogen bonds.
- B. Water has a low heat capacity allowing enzymatic reactions to happen at a wide range of temperatures.
- C. Water molecules are polar, therefore fatty acids do not dissolve.
- D. Ice has a higher density than liquid water, therefore some organisms can live under the ice.

(Total 1 mark)

13. Which of the following chemical elements are part of biochemical molecules in living organisms?

- A. nitrogen, sulfur, phosphorus and iron
- B. lead, oxygen, carbon and phosphorus
- C. helium, carbon, sulfur and nitrogen
- D. silicon, helium, oxygen and iron

(Total 1 mark)

14. Which substance in prokaryotes contains sulfur?
- A. DNA
 - B. Phospholipids
 - C. Proteins
 - D. Antibiotics

(Total 1 mark)

15. Male Lepidoptera (butterflies and moths) commonly drink from pools of water or from moist soil. This behaviour, called puddling, was investigated in an undisturbed area where male tiger swallowtails, *Papilio glaucus*, had been seen puddling.

Four successive sets of experiments were performed under similar conditions of temperature and humidity. In each set, equal samples of sand were spread out evenly on trays and then treated differently. Except for one dry sample (in the first set), all others were saturated with a different liquid. Results of the observations are given in the table below.

[Source: adapted from K Arms *et al.*, “Sodium: Stimulus for Puddling Behaviour by Tiger Swallowtail Butterflies, *Papilio glaucus*” (1974) *Science*, **185**: 5 (5 July–27 Sept) #4148, pp. 372–374. Reprinted with permission from AAAS]

- (a) Identify the dissolved element always present in the three samples with most puddling time.

.....

(1)

- (b) Discuss the relationship between sampling visits (V) and puddling time (T) in experiments 1, 2 and 3.

.....

.....

.....

.....

(2)

- (c) Analyse the results for experiment 4.

.....

.....

.....

.....

(2)

Study of the male moth *Gluphisia septentrionis* revealed that their puddling behaviour can last for hours. Though drinking results in the uptake of hundreds of gut-loads of fluid, this fluid becomes rapidly expelled from the digestive system through frequent anal ejections. In this experiment, the ion concentration change was calculated by subtracting ions ejected from ions taken in. The following data was collected from males drinking laboratory solutions and from natural puddles.

[Source: adapted from SR Smedley and T Eisner “Sodium Uptake by Puddling in a Moth” (1995) *Science*, **270** (15 Dec) #5243, pp. 1816–1818. Reprinted with permission from AAAS]

- (d) (i) Identify which ion the moths are retaining in their body from the laboratory solutions.

.....

(1)

- (ii) Compare the gain and loss of ions in the male moths which have drunk from laboratory solutions with the changes in those that have drunk from natural puddles.

.....

.....

.....

.....

.....

.....

(3)

The diagram below shows the digestive system anatomy of the male and female moth.

[Source: adapted from SR Smedley and T Eisner “Sodium Uptake by Puddling in a Moth” (1995) *Science*, **270** (15 Dec) #5243, pp. 1816–1818. Reprinted with permission from AAAS]

- (e) Using the diagram above, evaluate the hypothesis that male moths are better adapted than female moths to benefit from puddling behaviour.

.....

.....

.....

.....

(2)

- (f) Suggest **one** reason for puddling behaviour in male Lepidoptera.

.....

.....

(1)

(Total 12 marks)

16. (a) State the missing source, optimum pH requirement, substrate and product of the human enzymes in the table below.

Enzyme	Source	Optimum pH	Substrate	Products
Amylase	Salivary gland	7		
Lipase			Lipids	Fatty acids and glycerol

(2)

- (b) Explain the need for enzymes in digestion.

.....

.....

.....

.....

(2)

- (c) Draw a labelled diagram to show the interconnections between the gall bladder, pancreas and small intestine.

(3)
(Total 7 marks)

17. (a) Glucose and galactose are examples of monosaccharides. State **one** other example of a monosaccharide.

.....

(1)

- (b) The equation below shows the production of glucose and galactose from lactose.

- (i) There are several different types of carbohydrate. State which type of carbohydrate lactose is.

.....

(1)

- (ii) State the type of chemical reaction that occurs when lactose is digested into glucose and galactose.

.....

(1)

(c) Lactase is widely used in food processing. Explain **three** reasons for converting lactose to glucose and galactose during food processing.

1.

.....

2.

.....

3.

.....

(3)

(d) Simple laboratory experiments show that when the enzyme lactase is mixed with lactose, the initial rate of reaction is highest at 48°C. In food processing, lactase is used at a much lower temperature, often at 5°C. Suggest reasons for using lactase at relatively low temperatures.

.....

.....

.....

.....

(2)

(Total 8 marks)

18. *Up to two additional marks are available for the construction of your answers.*

(2)

(a) Outline the role of hydrolysis in the relationships between monosaccharides, disaccharides and polysaccharides.

(4)

(b) Describe the use of biotechnology in the production of lactose-free milk.

(6)

(c) Explain the importance of enzymes to human digestion.

(8)

(Total 20 marks)

19. *Up to two additional marks are available for the construction of your answers.* (2)

(a) State **four** functions of proteins, giving a **named** example of each. (4)

(b) Outline the structure of ribosomes. (6)

(c) Explain the process of transcription leading to the formation of mRNA. (8)

(Total 20 marks)

20. *Up to two additional marks are available for the construction of your answers.* (2)

(a) Draw a labelled diagram to show the fluid mosaic structure of a plasma membrane, indicating the hydrophilic and hydrophobic regions. (5)

(b) Distinguish between active and passive movements of materials across plasma membranes, using **named** examples. (4)

(c) Explain how the properties of water are significant to living organisms. (9)

(Total 20 marks)