



## Molecules (Form and function) practice questions

12 questions • 35 marks • mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name .....

Total ..... / 35

### Carbohydrates and lipids **Spec B1.1**

**1** PAPER 1A STYLE [1 mark]

Which statement describes a hydrolysis reaction?

- A. ☐ Two monomers are linked by a covalent bond and a water molecule is released.
- B. ☐ A water molecule is split and its  $-H$  and  $-OH$  are added to the products as a bond is broken.
- C. ☐ A polymer is broken into monomers by the removal of water.
- D. ☐ A monomer is oxidised to release energy for the cell.

**2** PAPER 1A STYLE [1 mark]

A molecular diagram shows a ring of five carbon atoms and one oxygen atom, with a sixth carbon outside the ring and an  $-OH$  group above the ring on carbon 1. Which molecule is shown, and which polymer is it a monomer of?

- A. ☐ Ribose, a monomer of RNA
- B. ☐ Alpha-glucose, a monomer of glycogen
- C. ☐ Beta-glucose, a monomer of cellulose
- D. ☐ Beta-glucose, a monomer of starch

**3** PAPER 1A STYLE [1 mark]

A molecule from an animal has a skeleton of four fused carbon rings, three with six carbons and one with five. Which property would allow it to enter a target cell?

- A. ☐ It is hydrophilic, so it passes through protein channels.
- B. ☐ It is amphipathic, so it forms a bilayer with the membrane.
- C. ☐ It is non-polar, so it diffuses through the hydrophobic core of the phospholipid bilayer.
- D. ☐ It is charged, so it is attracted to the phosphate heads and pulled across.

## 4

**[6 marks]**

The table shows the melting points of four fatty acids. Each has a chain of 18 carbon atoms. (a) Identify the monounsaturated fatty acid. [1] (b) Calculate the difference in melting point between stearic acid and linoleic acid. [1] (c) Describe the relationship between the number of C=C double bonds and melting point. [1] (d) Explain this relationship. [2] (e) Suggest why the oils stored in plant seeds contain a high proportion of unsaturated fatty acids. [1]

| Melting points of fatty acids with 18 carbon atoms |                            |                    |
|----------------------------------------------------|----------------------------|--------------------|
| Fatty acid                                         | Number of C=C double bonds | Melting point / °C |
| Stearic acid                                       | 0                          | 69                 |
| Oleic acid                                         | 1                          | 13                 |
| Linoleic acid                                      | 2                          | −5                 |
| Linolenic acid                                     | 3                          | −11                |

[illegible]

## 5

**[3 marks]**

Outline how the structure of glycogen makes it suitable as an energy store in animals.

[illegible]

## 6

**[3 marks]**

Explain the role of glycoproteins in cell-cell recognition, using the ABO blood groups as an example.

[illegible]

**[3 marks]**

Answer = .....

[illegible]

**[6 marks]**

[illegible]

### Spec B1.2

[1 mark]

A. ☐ The R-group of one amino acid and the R-group of the other

B. ☐ The carboxyl group of one amino acid and the amine group of the other

C. ☐ The amine groups of both amino acids

D. ☐ The alpha carbon of one amino acid and the hydrogen of the other

## 10 PAPER 1A STYLE

**[1 mark]**

How many different tripeptides could be made from the 20 amino acids coded for in the genetic code?

- A. ☐ 60  
B. ☐ 400  
C. ☐ 1140  
D. ☐ 8000

## 11 PAPER 1B STYLE

**[6 marks]**

Samples of an enzyme from a mammal were kept at different temperatures for 10 minutes, then cooled to 37 °C. The activity of each sample was then measured at 37 °C and given as a percentage of the activity of an unheated sample. The data are for practice. (a) Describe the effect of pre-incubation temperature on enzyme activity. [2] (b) Calculate the percentage decrease in activity between 50 °C and 60 °C. [1] (c) Explain why the activity of the samples kept at 70 °C and 80 °C did not recover when cooled. [2] (d) Suggest why activity was measured at 37 °C for every sample. [1]

| Activity after 10 minutes at each temperature (practice data) |                                 |
|---------------------------------------------------------------|---------------------------------|
| Pre-incubation temperature / °C                               | Activity / % of unheated sample |
| 20                                                            | 100                             |
| 40                                                            | 98                              |
| 50                                                            | 80                              |
| 60                                                            | 35                              |
| 70                                                            | 6                               |
| 80                                                            | 0                               |

[illegible]

12 PAPER 2A STYLE

**[3 marks]**

Distinguish between essential and non-essential amino acids and outline why people following a vegan diet need to pay attention to protein sources.

[illegible]

# Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B [1]

2. [1]

C C [1]

3. [1]

C C [1]

4. [6]

- (a) oleic acid [1]
- (b) 74 °C [1] Accept 74 without unit; do not accept 64
- (c) more C=C double bonds, lower melting point / negative correlation [1] Accept: largest decrease between 0 and 1 double bond
- (d) double bonds cause bends / kinks in the hydrocarbon chain [1]
- (d) chains cannot pack closely together so attractions between them are weaker / less energy needed to melt [1] OWTTE
- (e) oils stay liquid at the temperatures of plant tissues / plants are not endotherms, so stores remain fluid / easy to mobilise [1]

5. [3]

- polymer of alpha-glucose [1]
- highly branched / coiled so compact, storing much glucose in a small space [1]
- large molecule so relatively insoluble / no osmotic effect / does not leave the cell [1]
- many chain ends so glucose added or removed quickly by condensation / hydrolysis [1]
- max 3

6. [3]

- glycoproteins are proteins with carbohydrate chains attached on the outer surface of the plasma membrane [1]
- carbohydrate chain acts as a marker / antigen recognised by other cells [1]
- ABO antigens on red blood cells differ in the carbohydrate chain / A and B have an extra sugar, O has neither [1]
- antibodies bind to antigens not present on the recipient's own cells, causing agglutination / so transfused blood must be matched [1]
- max 3

7. [3]

- (a)  $1850 \div 37 = 50$  g [1]
- (b) glycogen mass =  $1850 \div 17 = 108.8$  g;  $108.8 \div 50 = 2.2$  times [1] Accept 2.1-2.2; ECF from (a)
- (c) glycogen is stored with water, so the real difference in mass is greater / triglyceride also provides thermal insulation / insoluble so no osmotic effect [1]

**8. [6]**

- both contain carbon, hydrogen and oxygen / are carbon compounds [1]
- both are made by condensation and mobilised by hydrolysis [1]
- both are insoluble in their storage form so have little osmotic effect [1]
- carbohydrates are stored as starch in plants and glycogen in animals [1]
- lipids are stored as triglycerides / in adipose tissue in animals / as oils in seeds [1]
- lipids release about twice as much energy per gram when oxidised (about 37 kJ g<sup>-1</sup> compared with 17 kJ g<sup>-1</sup>) [1]
- glycogen is stored with water so is heavier per unit of energy; triglycerides are stored without water [1]
- carbohydrates for short-term storage, lipids for long-term storage [1]
- glucose can be released from glycogen / starch more rapidly, from many branch ends [1]
- triglycerides also act as thermal insulation; polysaccharide stores do not [1]
- glucose is soluble and transported easily, so it is the form carried in blood rather than stored [1]
- max 6

**9. [1]**

**B B [1]**

**10. [1]**

**D D [1]**

**11. [6]**

- (a) little / no loss of activity up to 40 °C [1]
- (a) above 40 °C activity falls, steeply between 50 °C and 70 °C / no activity at 80 °C [1]
- (b)  $(80 - 35) \div 80 \times 100 = 56 \%$  [1] Accept 56.25 %
- (c) the enzyme was denatured / its three-dimensional shape / active site changed [1]
- (c) hydrogen bonds / weak bonds broken by increased vibration; denaturation is (usually) permanent so cooling does not restore the shape [1]
- (d) so that any difference in activity is due only to the effect of the pre-incubation / irreversible change / to control temperature during the assay [1]

**12. [3]**

- essential amino acids cannot be synthesised by the body / must be obtained from food [1]
- non-essential amino acids can be made from other amino acids [1]
- some plant proteins contain little of certain essential amino acids [1]
- so vegans need a variety of plant protein sources / combine e.g. legumes and cereals [1]
- max 3