Helicate

HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.1.3 Lipids

Topic question bank

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
8	46	No time limit	/ 46

Contents

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Triglycerides 3.1.3

0 1 . 1 Glycerol and fatty acids react to form a triglyceride.
Describe this reaction. In your answer, refer to the groups on each molecule that take part.

[4 marks]

0 1 . 2 Which row correctly describes the hydrolysis of **one** triglyceride molecule?
Tick (✓) one box.

[1 mark]

Bond broken	Number of water molecules used	Products	
Ester	1	Glycerol and three fatty acids	☐
Glycosidic	3	Glycerol and three fatty acids	☐
Ester	3	Glycerol and three fatty acids	☐
Ester	3	Three glycerol and one fatty acid	☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 Glycerol has the molecular formula $C_3H_8O_3$. Palmitic acid is a fatty acid with the molecular formula $C_{16}H_{32}O_2$.
Give the molecular formula of a triglyceride that contains **three** palmitic acids.

[2 marks]

Answer .....

7

Many small birds migrate long distances. Before migrating, a bird stores a large amount of triglyceride in its body. The triglyceride is used in respiration during the flight.

Table 1 shows information about triglyceride and glycogen as energy stores in animals.

Table 1

Energy store	Energy released when 1 g of the store is respired / kJ	Mass of water stored with each 1 g of the store / g
Triglyceride	39	Almost none
Glycogen	17	3.0

0 2 . 1 Before migrating, a bird stored 8.0 g of triglyceride.
Calculate the total mass of glycogen **and** water that the bird would need to store to release the same amount of energy.

[2 marks]

Answer ..... **g**

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Use Table 1 and your knowledge of the structure of triglycerides to explain why storing triglyceride, rather than glycogen, is an advantage to a migrating bird.

[3 marks]

5

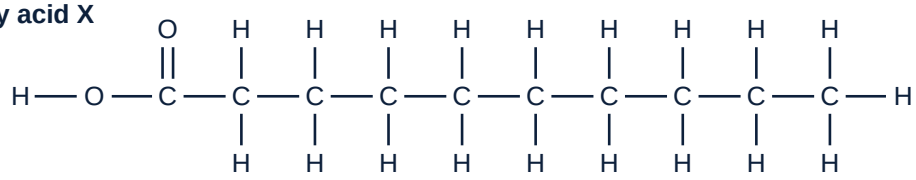
Turn over for the next question

Saturated and unsaturated fatty acids 3.1.3

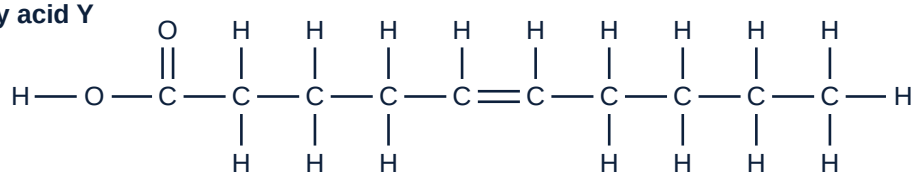
Figure 1 shows the structures of two fatty acids, **X** and **Y**.

Figure 1

Fatty acid X



Fatty acid Y



0 3 . 1 Give the molecular formula of fatty acid **Y**.

[1 mark]

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0 3 . 2 Explain how Figure 1 shows that fatty acid **X** is saturated and fatty acid **Y** is unsaturated.

[2 marks]

X .....

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Y .....

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3

Turn over for the next question

The seeds of some plants store triglycerides that contain fatty acids with very long hydrocarbon chains. Table 2 shows information about five of these fatty acids.

Table 2

Fatty acid	Number of carbon atoms	Number of carbon–carbon double bonds	Melting point / °C
Arachidic acid	20	0	75
Gondoic acid	20	1	23
Behenic acid	22	0	80
Erucic acid	22	1	34
Lignoceric acid	24	0	84

0 4 . 1 The molecular formula of arachidic acid is $C_{20}H_{40}O_2$.
Which is the molecular formula of erucic acid?
Tick (✓) one box.

[1 mark]

$C_{20}H_{38}O_2$ ☐

$C_{22}H_{42}O_2$ ☐

$C_{22}H_{43}O_2$ ☐

$C_{22}H_{44}O_2$ ☐

0 4 . 2 Nervonic acid is another fatty acid found in some seed oils. It has 24 carbon atoms and one carbon–carbon double bond.
Use Table 2 to suggest a value for the melting point of nervonic acid. Explain your answer.

[2 marks]

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.....

Answer ..... **°C**

Question 4 continues on the next page

Do not write outside the box

Some seed oils are hydrogenated for use in industry. Hydrogen is added to the two carbon atoms of each C=C double bond, so it becomes a single bond.

Triglyceride **T** in one seed oil contains one gondoic acid, one erucic acid and one nervonic acid. Its molecular formula is $C_{69}H_{128}O_6$.

0 4 . 3 Give the molecular formula of the product when **all** of the double bonds in one molecule of triglyceride **T** are hydrogenated.

[1 mark]

.....

.....

Answer .....

The melting point of a triglyceride is affected by its fatty acids in the same way as the melting points of the fatty acids in Table 2.

0 4 . 4 Hydrogenating **all** of the double bonds in triglyceride **T** raises its melting point. Use Table 2 to explain why.

[2 marks]

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.....

6

Turn over for the next question

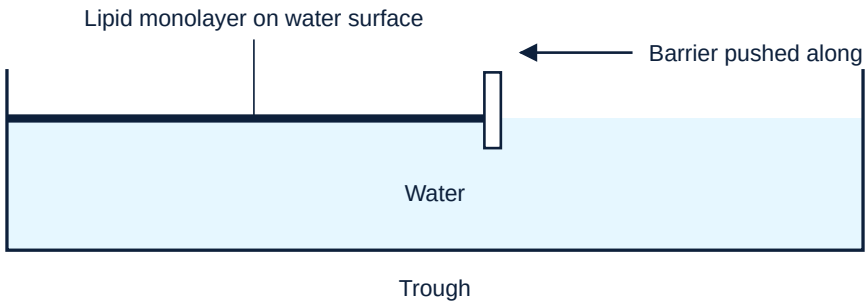
Phospholipids and the properties of lipids 3.1.3

Scientists investigated how the lipids are arranged in the cell-surface membranes of red blood cells. They:

- counted the red blood cells in a sample of blood
- extracted the lipids from the cell-surface membranes of these cells
- placed the lipids on the surface of water in a trough, where they spread out as a layer one molecule thick (a monolayer)
- pushed a barrier along the water surface until the lipid molecules were packed closely together, then measured the area of the monolayer.

Figure 2 shows the trough.

Figure 2



0 5 . 1 Most of the lipids in the monolayer were phospholipids.
Explain how the phospholipid molecules are arranged in the monolayer on the water surface.

[2 marks]

Question 5 continues on the next page

The scientists recorded these results.

- The sample contained 5.0×10^{8} red blood cells.
- The mean surface area of one red blood cell was 1.4×10^{-10} m^2.
- The area of the monolayer was 0.13 m^2.

0 5 . 2 Calculate the ratio of monolayer area to total red blood cell surface area. Give your answer to **two** significant figures.

[2 marks]

Answer ..... **: 1**

0 5 . 3 Explain how these results suggest that the phospholipids in the cell-surface membrane form a bilayer.

[2 marks]

0 5 . 4 The ratio was less than 2.0 : 1.
Suggest **one** reason why.

[1 mark]

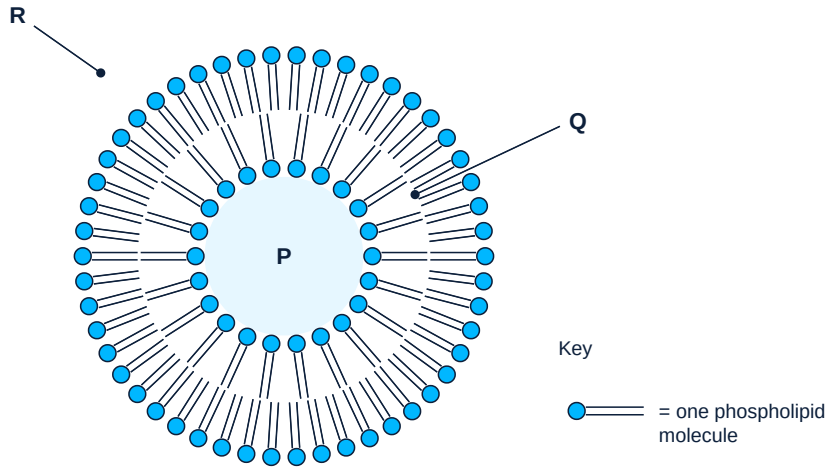
7

Turn over for the next question

When phospholipids are mixed with water, they can form liposomes. A liposome is a hollow sphere that encloses water. Liposomes are used to deliver drugs to cells.

Figure 3 shows a liposome cut in half. Regions **P**, **Q** and **R** are labelled.

Figure 3



0 6 . 1 A drug that dissolves in lipids but does not dissolve in water was added to a suspension of liposomes.
In which region of Figure 3 would this drug most likely be found?
Tick (✓) one box.

[1 mark]

P only ☐

Q only ☐

R only ☐

P and **R** ☐

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 A scientist tried to make liposomes from triglycerides instead of phospholipids. No liposomes formed.
Use your knowledge of the structures of phospholipids and triglycerides to explain why phospholipids form liposomes that can carry a water-soluble drug, but triglycerides do not.

[5 marks]

0 6 . 3 Which feature is found in **both** triglyceride molecules and phospholipid molecules?
Tick (✓) one box.

[1 mark]

A phosphate group ☐

Ester bonds ☐

Three fatty acids ☐

A hydrophilic head ☐

7

Turn over for the next question

Do not write outside the box

The emulsion test 3.1.3 (AT b, AT f)

A student crushed some sunflower seeds.

0 7 . 1 Describe how the student could use the emulsion test to show that the crushed seeds contain lipid, **and** give the result if lipid is present.

[2 marks]

The student also carried out the emulsion test on a solution of glycerol. The mixture stayed clear. Glycerol dissolves in ethanol and in water.

0 7 . 2 Explain why lipid gives a milky-white result in the emulsion test but glycerol does **not**.

[2 marks]

0 7 . 3 The student then carried out the emulsion test on a sample of cloudy apple juice. The result was cloudy. The student concluded that the apple juice contains lipid. Explain why this conclusion may **not** be valid.

[1 mark]

5

Turn over for the next question

Do not write outside the box

0 8 A student wanted to compare the lipid content of three types of seed using the emulsion test and a colorimeter. The more lipid in the sample, the cloudier the emulsion and the higher the absorbance.
Describe a method the student could use. Include how the student would make sure that the results for the three types of seed could be compared.

[6 marks]

6

END OF QUESTIONS