A-Level Biology

Lipids

Question Paper

Time available: 62 minutes
Marks available: 52 marks

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1.

(a) The general structure of a fatty acid is RCOOH.

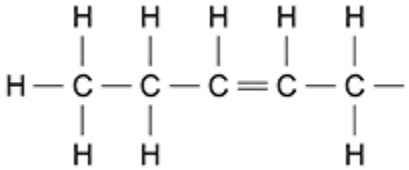
Name the group represented by COOH.

_____

(1)

(b) **Figure 1** shows the structure of a fatty acid R group.

Figure 1



Name the type of R group shown in **Figure 1**.

Explain your answer.

Type of R group _____

_____

Explanation _____

_____

(2)

(c) Describe how you would test for the presence of a lipid in a liquid sample of food.

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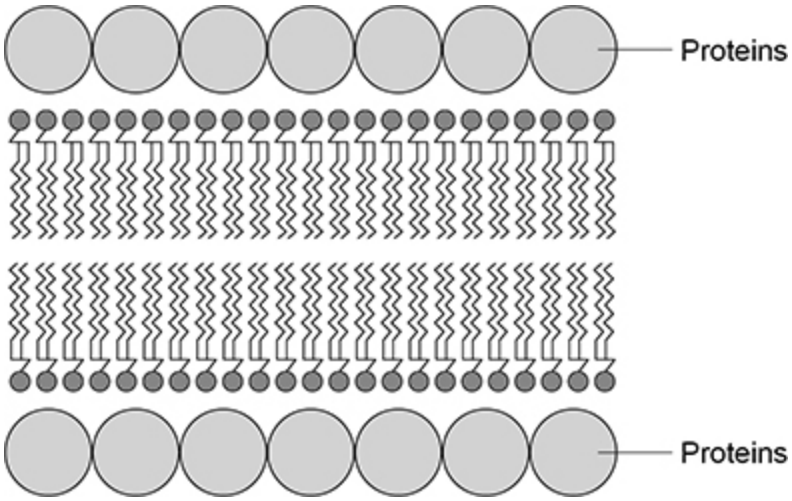
(2)

In 1935, scientists suggested a model for the chemical structure of a cell-surface membrane. **Figure 2** shows the membrane structure the scientists suggested.

Figure 2



(d) Give **one** similarity and **two** differences between the membrane structure shown in **Figure 2** and the fluid-mosaic model of membrane structure.

Similarity _____

_____

Difference 1 _____

_____

Difference 2 _____

_____

(3)

(Total 8 marks)

2. (a) Describe how a triglyceride molecule is formed.

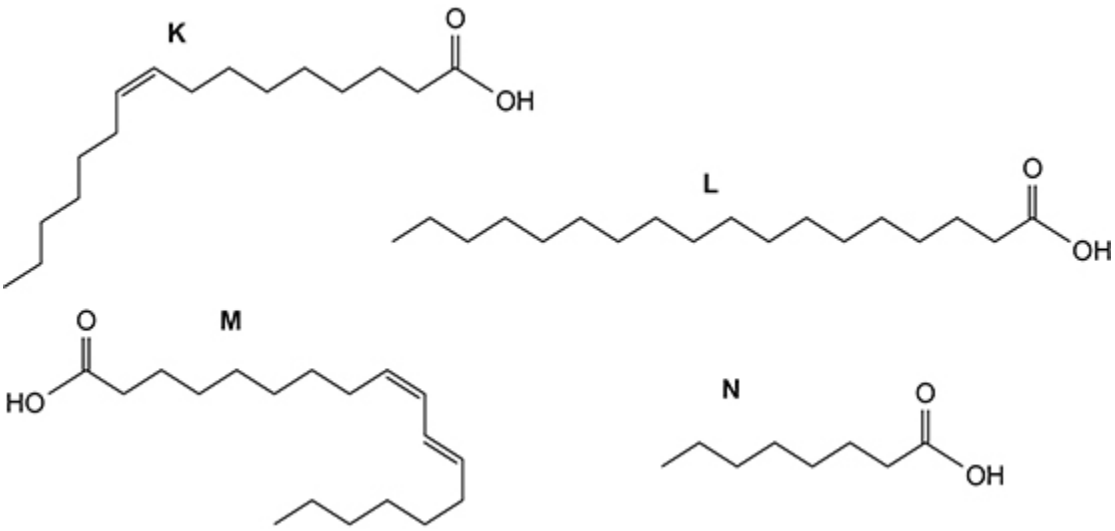
(3)

(b) **Table 1** shows some properties of four fatty acids.

Table 1

Fatty acid	Number of carbon atoms in the R group	Number of double bonds in the R group
Caprylic acid	8	0
Palmitoleic acid	16	1
Stearic acid	18	0
Linoleic acid	18	2

The figure below shows diagrams of these fatty acids.



Put a tick (✓) in **one** box that contains correct information about one of these fatty acids.

Caprylic acid is an unsaturated fatty acid represented by diagram **L**. ☐

Linoleic acid is a saturated fatty acid represented by diagram **N**. ☐

Palmitoleic acid is an unsaturated fatty acid represented by diagram **K**. ☐

Stearic acid is a saturated fatty acid represented by diagram **M**. ☐

(1)

The percentage of saturated fatty acids compared with unsaturated fatty acids found in lipid stores in seeds differs in different populations.

Scientists investigated two populations of the plant, *Helianthus annuus*.

The scientists grew young plants from seeds collected from each population. They placed the seeds on wet tissue paper so that the root growth was visible.

They grew seeds from each population at two temperatures:

- warm temperature of 24 °C
- cool temperature of 10 °C

After 10 days, the scientists measured the length of each root.

Table 2 shows some of the properties of the two populations and the scientists' results.

Table 2

Population	**Temperature in natural environment**	**In the seed – Mean percentage of fatty acids that are saturated**	**Mean length of root after 10 days at 24 °C / mm (± 2 x standard deviation)**	**Mean length of root after 10 days at 10 °C / mm (± 2 x standard deviation)**
1	Warm	10.9	8.2 (±1.0)	3.1 (±0.3)
2	Cool	6.1	5.5 (±0.9)	4.3 (±0.2)

The mean ±2 × standard deviation includes 95% of the data.

(c) The scientists used a data logger to measure the length of the root rather than a ruler.

Suggest **one** reason why they used a data logger **and** explain why this was important in this investigation.

_____

_____

_____

(1)

(d) It is known that:

- during respiration saturated fatty acids yield more energy than unsaturated fatty acids
- saturated fatty acids have higher melting points than unsaturated fatty acids
- lipases in seeds act more rapidly on liquid substrates.

Use this information and **Table 2** to show how each population is better adapted for its natural environment when compared with the other population.

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(4)

(e) Although these two populations are completely separate and show genetic variation, they are both called *Helianthus annuus*.

Explain why they are both given this name.

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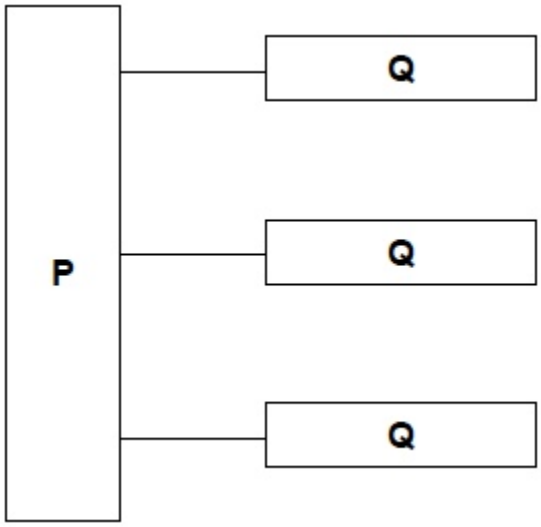
(1)

(Total 10 marks)

3. The diagram represents a triglyceride.



(a) Name the molecules represented in the diagram by:

Box **P** _____

Box **Q** _____

(2)

(b) Name the type of bond between **P** and **Q** in the diagram.

_____

(1)

(c) Describe how you would test a liquid sample for the presence of lipid **and** how you would recognise a positive result.

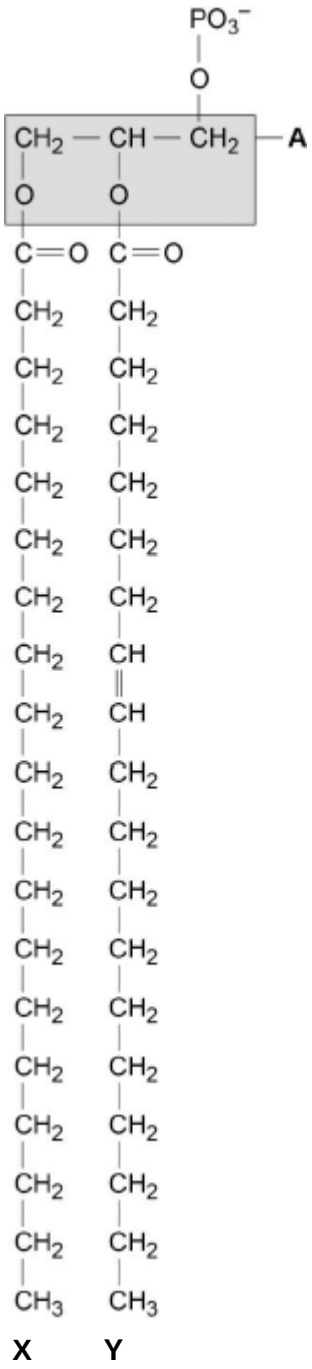
(2)

(Total 5 marks)

4. (a) Describe how you would test a piece of food for the presence of lipid.

(2)

The figure below shows a phospholipid.



(b) The part of the phospholipid labelled **A** is formed from a particular molecule. Name this molecule.

_____

(1)

(c) Name the type of bond between **A** and fatty acid **X**.

_____

(1)

(d) Which of the fatty acids, **X** or **Y**, in the figure above is unsaturated? Explain your answer.

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_____

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_____

(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	**Percentage of lipid in plasma membrane by mass**		
	Cell lining ileum of mammal	**Red blood cell of mammal**	**The bacterium *Escherichia coli***
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

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(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

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(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

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(2)

(Total 10 marks)

5. (a) Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

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(1)

(b) Describe how you would test for the presence of a lipid in a sample of food.

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(2)

(c) Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

Describe how a saturated fatty acid is different from an unsaturated fatty acid.

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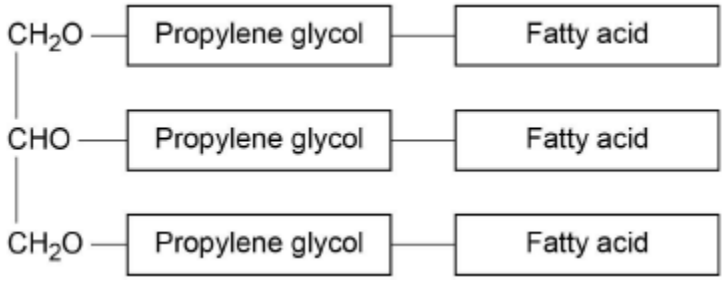
(1)

The diagram shows the structure of a fat substitute.



(d) This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

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(2)

(e) This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

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_____

(1)

(Total 7 marks)

6. (a) Some seeds contain lipids. Describe how you could use the emulsion test to show that a seed contains lipids.

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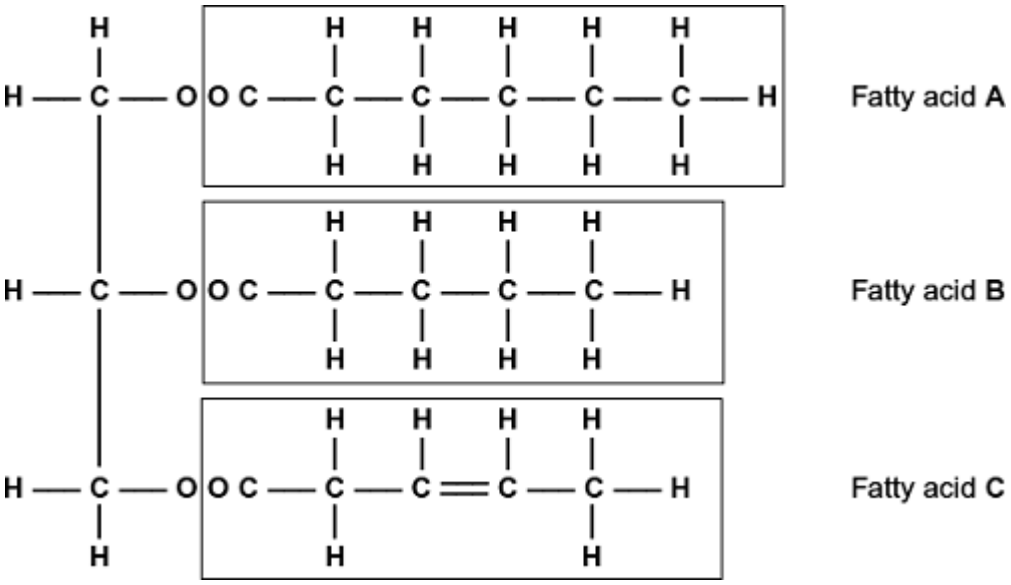
(3)

(b) A triglyceride is one type of lipid. The diagram shows the structure of a triglyceride molecule.



(i) A triglyceride molecule is formed by condensation. From how many molecules is this triglyceride formed?

(1)

(ii) The structure of a phospholipid molecule is different from that of a triglyceride. Describe how a phospholipid is different.

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_____

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(2)

(iii) Use the diagram to explain what is meant by an unsaturated fatty acid.

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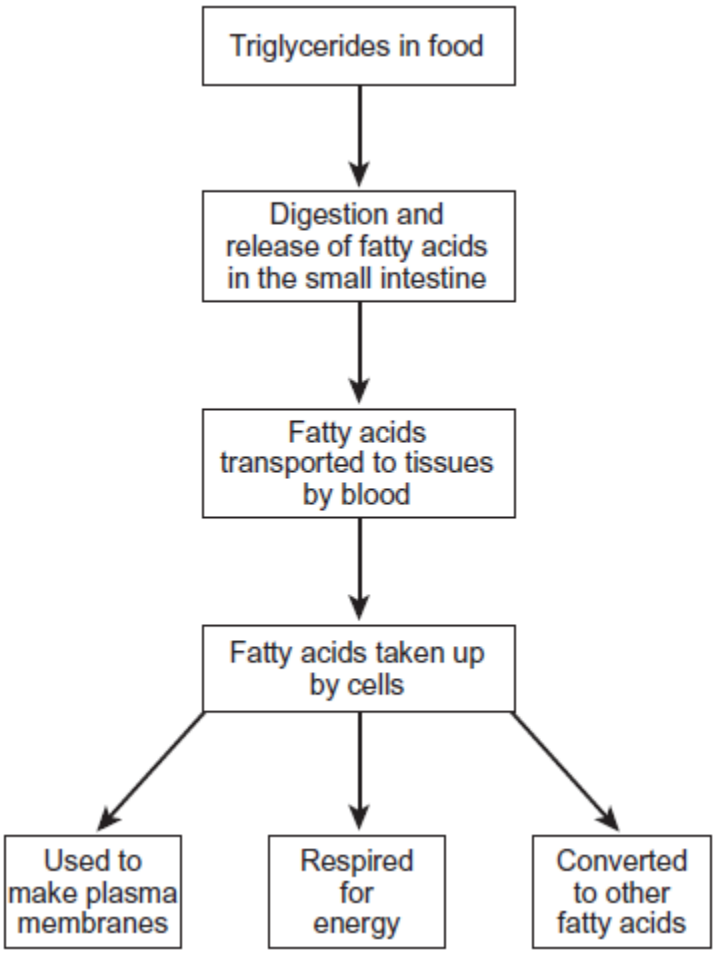
(2)

(Total 8 marks)

7. Triglycerides are taken into the body as part of a balanced diet. These triglycerides contain fatty acids including omega-3 fatty acids. It has been discovered that omega-3 fatty acids are associated with health benefits. The benefits include faster development of nerve cells and clearer vision. Omega-3 fatty acids are also associated with protection from heart disease, arthritis and cancer.

The following figure shows how omega-3 and other fatty acids are taken in and used by the bodies of animals including humans.



Use the information in the figure to explain **two** ways in which fatty acids are important in the formation of new cells.

1. _____

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2. _____

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(Total 4 marks)