

Questions

Q1.

Cells and some cell organelles are surrounded by a membrane.

Explain the arrangement of phospholipids in a membrane.

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(Total for question = 2 marks)

Q2.

(i) Triglycerides, found in living organisms, have different melting points.

Two factors that affect the melting point of a triglyceride are:

- the length of the fatty acid chains
- whether the fatty acid chains are saturated or unsaturated.

A triglyceride is made from the components glycerol and fatty acids.

Stearic acid and arachidic acid are both fatty acids.

Arachidic acid has two more carbon atoms than stearic acid.

The melting point of stearic acid is 69 °C and the melting point of arachidic acid is 76 °C.

Calculate the percentage increase in the melting point, resulting from the presence of two more carbon atoms.

Give your answer to two decimal places.

(1)

Answer %

(ii) Devise a method to investigate how the length of the fatty acids and the degree of saturation of the fatty acids affect the melting point of triglycerides.

(3)

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(Total for question = 4 marks)

Q3.

Triglycerides, found in living organisms, have different melting points.

Two factors that affect the melting point of a triglyceride are:

1. the length of the fatty acid chains
2. whether the fatty acid chains are saturated or unsaturated.

A triglyceride is made from the components glycerol and fatty acids.

(i) How many of the following statements about triglycerides are correct?

(1)

- a glycerol molecule is joined to each fatty acid by an ester bond
- an unsaturated fatty acid has at least one double bond between two carbon atoms
- all triglycerides have three fatty acids joined to a glycerol

- A** none
 B one
 C two
 D three

(ii) The table shows the relative atomic mass of the elements present in a triglyceride.

Element	Relative atomic mass
carbon	12
hydrogen	1
oxygen	16

How much lower is the molecular mass of this triglyceride molecule, after it has been made from its components, compared with the sum of its component molecules?

(1)

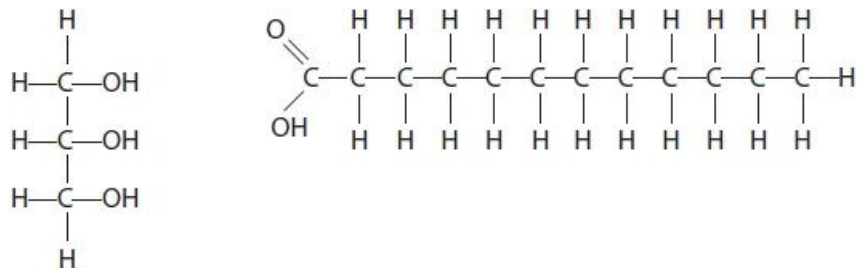
- A** 18
 B 33
 C 54
 D 99

(Total for question = 2 marks)

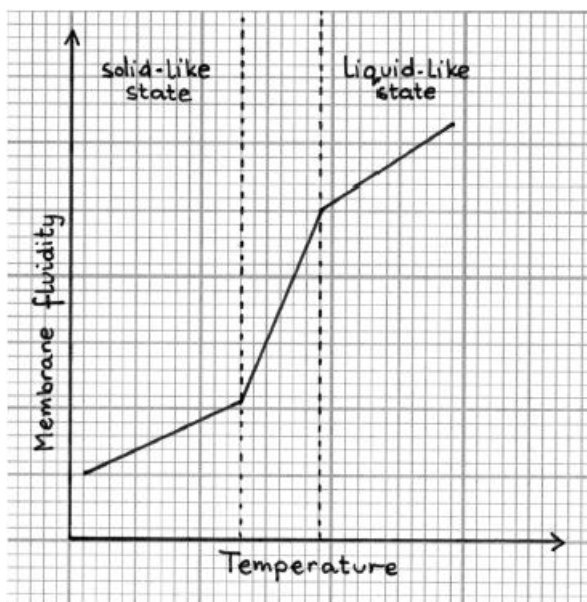
Q4.

Glycerol molecules and fatty acid molecules are used in the synthesis of cell membranes.

The diagram shows a molecule of glycerol and a molecule of a fatty acid.



This graph was sketched by a student to show how membrane fluidity changes with temperature.



(i) Describe the relationship between membrane fluidity and temperature as shown by this graph.

(2)

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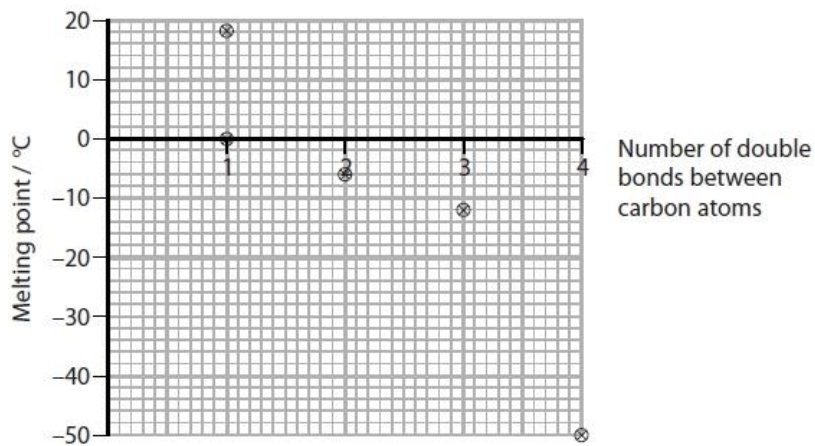
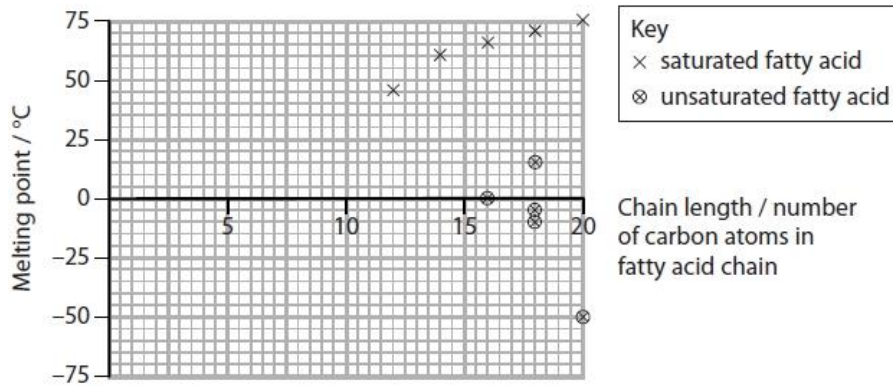
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(ii) The student found two graphs about the structure of lipids and their melting points.



The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

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(Total for question = 6 marks)

Q5.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Lipids and carbohydrates are used as respiratory substrates.

The respiration of lipids generates more ATP than the respiration of carbohydrates.

The table shows bonds that may be found in carbohydrates and lipids.

Which box in each row shows whether the bond may be found in these molecules?

(3)

Bond	Molecule that bond may be found in			
	carbohydrate only	lipid only	both carbohydrate and lipid	neither carbohydrate nor lipid
covalent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ester	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
hydrogen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Total for question = 3 marks)

Q6.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Palm plants and cocoa plants are used to produce lipids for the food industry.

Palm oil is produced from palm plants. Cocoa butter is produced from cocoa plants.

The fatty acid compositions of palm oil and cocoa butter are shown in the table.

Fatty acid	Chemical formula of fatty acid	Percentage of fatty acid found in palm oil and cocoa butter (%)	
		Palm oil	Cocoa butter
palmitic acid	$C_{16}H_{32}O_2$	45	27
oleic acid	$C_{18}H_{34}O_2$	40	31
linoleic acid	$C_{18}H_{32}O_2$	10	3
myristic acid	$C_{14}H_{28}O_2$	1	1
stearic acid	$C_{18}H_{36}O_2$	4	38

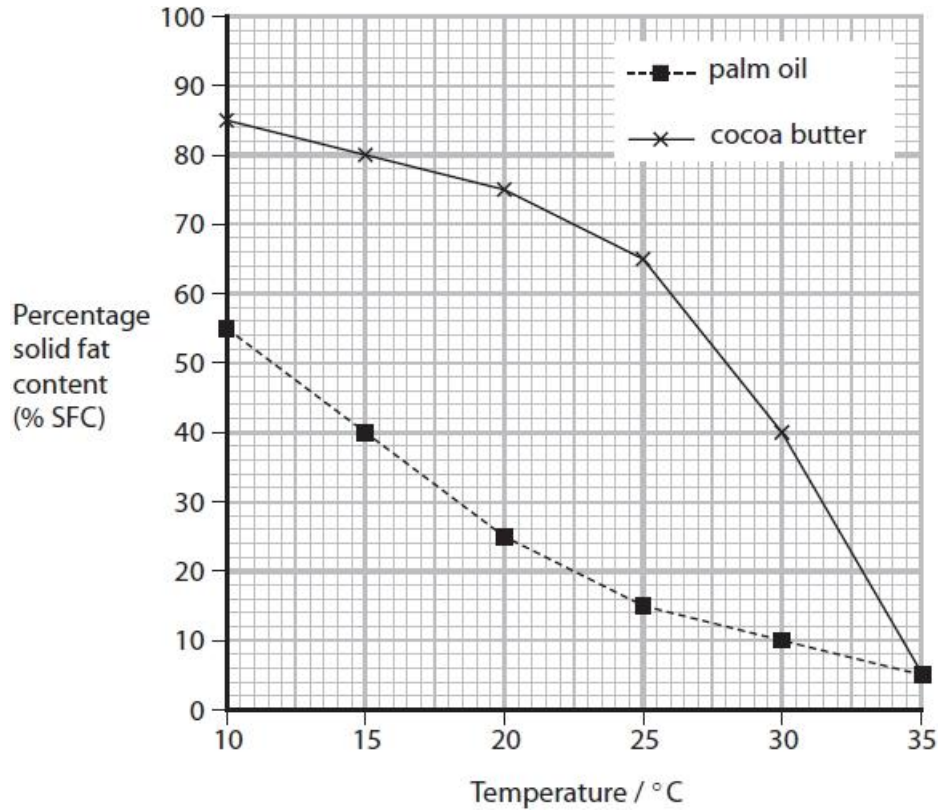
(i) How many of the named fatty acids shown in the table are saturated?

- A 1
 B 2
 C 3
 D 4

(1)

(ii) The percentage solid fat content (% SFC) is a measure of how much of a lipid is solid at different temperatures.

The graph shows the effect of temperature on the % SFC for palm oil and for cocoa butter.



Comment on the effect of temperature on the % SFC of palm oil and of cocoa butter.

(4)

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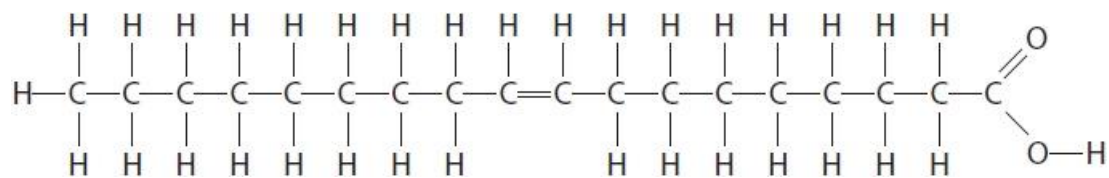
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(Total for question = 5 marks)

Q7.

Soya bean plants have been genetically modified (GM) to increase the concentration of certain organic molecules.

The diagram shows one of these molecules.



Explain what type of molecule is shown in the diagram.

(2)

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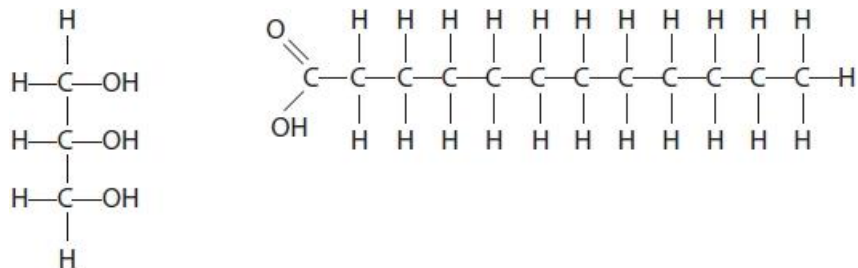
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(Total for question = 2 marks)

Q8.

Glycerol molecules and fatty acid molecules are used in the synthesis of cell membranes.

The diagram shows a molecule of glycerol and a molecule of a fatty acid.



Which of the following describes the reaction when these two molecules are joined together?

(1)

- A condensation reaction forming an ester bond
- B condensation reaction forming a glycosidic bond
- C hydrolysis reaction forming an ester bond
- D hydrolysis reaction forming a glycosidic bond

(Total for question = 1 mark)

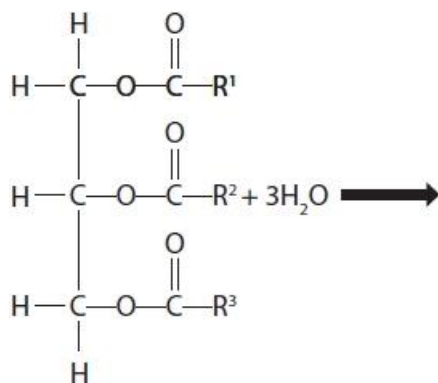
Q9.

Palm plants and cocoa plants are used to produce lipids for the food industry.

Palm oil is produced from palm plants. Cocoa butter is produced from cocoa plants.

Palm oil and cocoa butter are made of triglycerides composed of different fatty acids.

The diagram shows a triglyceride.



Complete the diagram to show the products of hydrolysis of this triglyceride.

(Total for question = 2 marks)

Q10.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Milk from cows contains a number of different types of lipid.

Lipids are made of glycerol and fatty acids.

A triglyceride is one type of lipid.

Which row of the table describes a triglyceride?

(1)

		Number of molecules		Name of bond joining molecules
		Glycerol	Fatty acid	
<input type="checkbox"/>	A	1	3	glycosidic
<input type="checkbox"/>	B	1	3	ester
<input type="checkbox"/>	C	3	1	glycosidic
<input type="checkbox"/>	D	3	1	ester

(Total for question = 1 mark)

Q11.

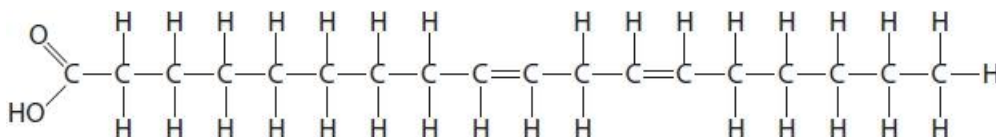
Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Milk from cows contains a number of different types of lipid.

Lipids are made of glycerol and fatty acids.

Fatty acids are either saturated or unsaturated.

The diagram shows the structure of an unsaturated fatty acid.



Which row of the table shows the differences between this fatty acid and a saturated fatty acid with the same number of carbons?

(1)

	Number of double bonds in the saturated fatty acid	Number of hydrogen atoms in the saturated fatty acid
<input type="checkbox"/> A	0	35
<input type="checkbox"/> B	0	36
<input type="checkbox"/> C	1	35
<input type="checkbox"/> D	1	36

(Total for question = 1 mark)

Q12.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Milk from cows contains a number of different types of lipid.

Lipids are made of glycerol and fatty acids.

The table shows the composition of some of the different types of lipid in milk from cows.

Type of lipid	Composition of lipids in milk from cows (%)
monoacylglycerols	0.027
diacylglycerols	0.360
triacylglycerols	97.500
free fatty acids	0.027
phospholipids	0.600

Which row of the table shows the types of lipids that are the median and mode for this set of data?

(1)

	Median	Mode
<input type="checkbox"/> A	diacylglycerols	monoacylglycerols
<input type="checkbox"/> B	diacylglycerols	triacylglycerols
<input type="checkbox"/> C	monoacylglycerols	diacylglycerols
<input type="checkbox"/> D	monoacylglycerols	triacylglycerols

(Total for question = 1 mark)

Q13.

Milk from cows contains a number of different types of lipid.

Lipids are made of glycerol and fatty acids.

Phospholipids have a different structure from other lipids, such as triglycerides.

Give one difference in the properties of phospholipids and triglycerides.

(1)

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(Total for question = 1 mark)

Q14.

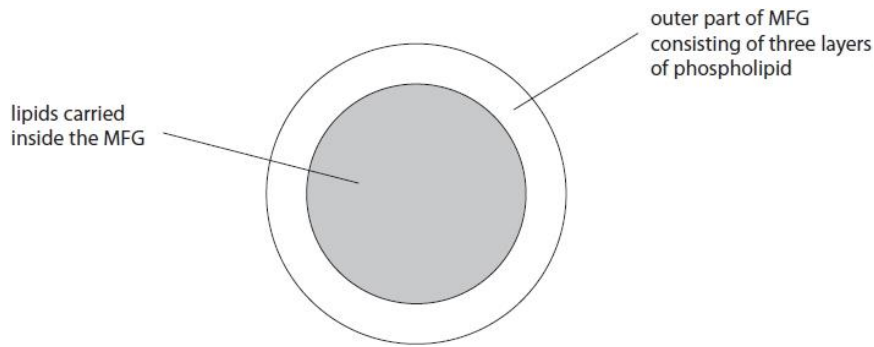
Milk from cows contains a number of different types of lipid.

Lipids are made of glycerol and fatty acids.


Milk from cows also contains a solution of proteins, lactose and mineral ions.

The lipids in milk are carried inside milk fat globules (MFG).

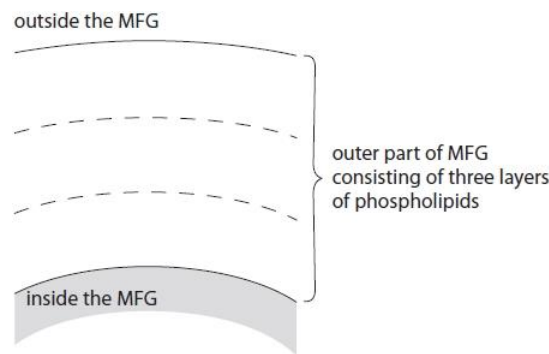
The diagram shows an MFG.



(i) Complete the diagram to show how nine phospholipid molecules would be arranged in the outer part of an MFG.

Use this shape to draw each phospholipid: 

(2)



(ii) Explain the structure of an MFG.

(3)

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(Total for question = 5 marks)

Q15.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

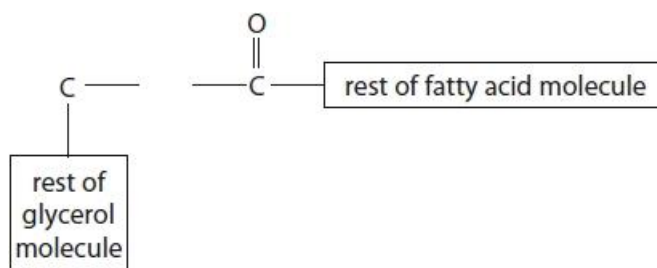
The structure of a lipid relates to its role in living organisms.

Triglycerides are lipids.

(i) The diagram shows part of a glycerol molecule and part of a fatty acid.

Complete the diagram to show the ester bond joining the fatty acid to the glycerol molecule.

(1)



(ii) The table shows the relative atomic mass of some elements.

Element	Relative atomic mass
carbon	12
hydrogen	1
nitrogen	14
oxygen	16

A triglyceride is made from a glycerol molecule and three fatty acids.

The molecular mass of the glycerol is 92 and the total molecular mass of the three fatty acids is 362.

Which is the molecular mass of this triglyceride?

(1)

- A 400
 B 436
 C 448
 D 454

(Total for question = 2 marks)

Q16.

Most human cells use carbohydrate as a source of energy.

When human cells have used up carbohydrate, they will use lipid and then protein as a source of energy.

The table shows the water content and energy content of three food sources.

Food source	Water content / arbitrary units	Energy content in dry matter / kJ g ⁻¹	Energy content in wet matter / kJ g ⁻¹	Total energy stored / kJ
Carbohydrate	2 to 3	16.8	4.2 to 6.3	3528
Triglyceride	0	37.8	37.8	567 000
Protein	2 to 3	16.8	4.2 to 6.3	100 800

(i) Explain why the water content of triglyceride is different from the water content of carbohydrate and protein.

(3)

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(ii) Using the information in the table, explain why triglycerides are a good energy store.

(2)

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(iii) Explain why the '**total energy stored**' column in this table is of limited use in drawing conclusions about the energy content of these food sources.

(2)

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(Total for question = 7 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> • arranged in a bilayer (1) • {phosphate / polar / hydrophilic} heads orientated outside as they can interact with aqueous environment (on both sides of membrane) (1) • {fatty acid / non polar / hydrophobic} tails within membrane because they turn away from the water (1) 	<p>ACCEPT phosphate heads on outside and fatty acid tails inside from labelled diagram</p> <p>ACCEPT description of aqueous environment IGNORE attracted to water</p> <p>ACCEPT water repels phospholipids / phospholipids repel water</p>	(2) Exp

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> • 10.14 		(1) CLER

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • heat (solid) samples (of the fatty acids) and measure the temperature at which they melt (1) • use fatty acids of the same chain length but with different {numbers of C C double bonds / degrees of saturation} (1) • use fatty acids of different chain length but the same {number of C C double bonds / saturation} (1) • repeat (for each fatty acid) and calculate the mean (1) 	<p>ACCEPT cool (liquid) samples (of the fatty acids) and measure the temperature at which they solidify IGNORE melting point</p> <p>ACCEPT average / identify anomalies / do a stats test</p>	(3) EXP

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>The only correct answer is D</p> <p><i>A is incorrect because all 3 statements are correct</i></p> <p><i>B is incorrect because all 3 statements are correct</i></p> <p><i>C is incorrect because all 3 statements are correct</i></p>		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>The only correct answer is C</p> <p><i>A is incorrect because three molecules of water are lost which is 54, 18 is one molecule</i></p> <p><i>B is incorrect because three molecules of water are lost which is 54, 33 is one molecule with reverse number of H and O atoms</i></p> <p><i>D is incorrect because three molecules of water are lost which is 54, 99 is three molecules with reverse number of H and O atoms</i></p>		(1) COMP

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> (overall) increase in temperature increases the fluidity (1) between the solid-like state and the fluid-like state (a small increase in temperature) has a greater increase in fluidity (1) 	<p>Allow positive correlation</p> <p>Ignore references to rate, rapid</p> <p>Allow steeper gradient, dramatic increase</p>	(2)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to four of the following:</p> <ul style="list-style-type: none"> unsaturated fatty acids have a lower melting point than saturated fatty acids (1) shorter saturated fatty acid chains have a lower melting point (1) an increase in the number of double bonds lowers the melting point (1) so membranes with a higher proportion of {unsaturated fatty acids / more double bonds / shorter chains} would be more fluid at lower temperatures (1) both these factors could influence the fluidity but without temperature values on the fluidity graph, no definite conclusion can be made (1) 	<p>Allow converse statements</p> <p>Allow fewer carbons in chain</p> <p>Should be linked to one of the previous mark points</p>	(4)

Q5.

Question Number	Answer				Mark	
		Molecule that bond may be found in				
	Bond	carbohydrate only	lipid only	both carbohydrate and lipid	neither carbohydrate nor lipid	
	covalent	<input type="checkbox"/>	<input type="checkbox"/>	X	<input type="checkbox"/>	
	ester	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>	
	hydrogen	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	(3)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	C 3 <i>A is incorrect because palmitic, myristic and stearic acid are saturated fats</i> <i>B is incorrect because palmitic, myristic and stearic acid are saturated fats</i> <i>D is incorrect because palmitic, myristic and stearic acid are saturated fats</i>		1

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to four from the following: <ul style="list-style-type: none"> • %SFC for both decreases as temperature increases for both cocoa butter and palm oil / both have 5% SFC at 35 °C (1) • the % SFC of cocoa butter is higher at all temperatures (except 35 °C) (1) • because cocoa butter has higher percentage of / more saturated fat (1) • so fatty acid chains can associate with each other more easily (1) • the % SFC of cocoa butter decreases more steeply above 25 °C / larger decrease after 25°C (1) 	<p>Accept converse</p> <p>Accept converse</p> <p>Accept pack more tightly together / has straight chains/rods which pack tightly together higher density of intermolecular contacts/bonds</p>	4

Q7.

Question Number	Answer	Mark
	An explanation that makes reference to the following: <ul style="list-style-type: none"> • fatty acid because it has a {carboxylic acid / COOH / carboxyl group} (1) • (mono)unsaturated because it has {a double bond / C=C / carbons with only one H} (1) 	(2)

Q8.

Question Number	Answer	Additional Guidance	Mark
	A (condensation reaction forming an ester bond)		(1)

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: <ul style="list-style-type: none"> • correct structure of glycerol (1) • correct structure of three fatty acids (1) 	Max one mark if other molecules e.g. water added to right hand side Accept 3 x one fatty acid	2

Q10.

Question Number	Answer	Additional Guidance	Mark
	B		(1) comp

Q11.

Question Number	Answer	Additional Guidance	Mark
	D		(1) comp

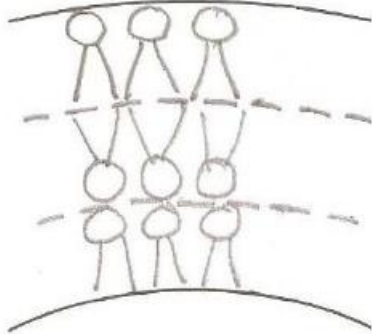
Q12.

Question Number	Answer	Additional Guidance	Mark
	A		(1) comp

Q13.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> phospholipids are polar and triglycerides are non-polar 		(1) exp

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)		<p>All 3 layers drawn correctly = 2 marks 2 layers drawn correctly = 1 mark</p> <p>There should not be gaps between the layers</p>	(2) exp

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> lipids are non-polar so cannot be carried in the solution(1) non-polar phospholipid tails enclose the lipids (1) phosphate heads are polar so can interact with the solution (1) and with each other in two adjoining layers (1) 		(3) EXP

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> an O drawn between the two covalent bonds 		(1)
(ii)	<p>The only correct answer is A</p> <p>B is incorrect because three water molecules (54) have to be subtracted, not one</p> <p>C is incorrect because three water molecules 54 have to be subtracted, not six hydrogens</p> <p>D is incorrect because three water molecules 54 have to be subtracted</p>		(1)

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> carbohydrates and proteins are {hydrophilic / polar} molecules (1) triglycerides are {hydrophobic / non polar} molecules (1) therefore water will associate with proteins and carbohydrates (1) but be repelled by the triglycerides (1) 	<p>ACCEPT {absorb / bond to} water</p> <p>ACCEPT can't bond to water</p>	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> triglycerides store more energy per gram than carbohydrates and proteins in both wet and dry matter (1) because it has a high {carbon / hydrogen} content (1) because it contains no water (1) 	<p>ACCEPT low oxygen content</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> units given for energy only (1) therefore a comparison cannot be made (1) 	<p>ACCEPT no indication of mass</p>	(2)