Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>Breaking one ester bond in a triglyceride produces glycerol and three fatty acids.</td><td></td><td>✓</td></tr><tr><td>Ribose is a hexose monosaccharide.</td><td></td><td>✓</td></tr><tr><td>In an alpha glucose molecule, the hydroxyl (OH) group is positioned below carbon 1.</td><td>✓</td><td></td></tr></table> All 3 rows correct ✓ ✓ Any 2 rows correct ✓	2	**ALLOW** a cross in place of a tick **<u>Examiner's Comments</u>** Well answered with a large number of candidates achieving 2 marks. The common error was stating that ribose was a hexose.
			Total	**2**	
2			A	1	**<u>Examiner's Comments</u>** Many candidates chose the correct option **A**. The terms intrinsic and extrinsic could be emphasised when teaching the structure of the membrane, along with the idea of fluidity rather than rigidity.
			Total	**1**	
3			A	1	**<u>Examiner's Comments</u>** The diagram proved a useful aid for candidates in choosing a response and most candidates opted for **A**, the correct response. Option **B** was a common incorrect response, and candidates could be reminded that it is one of the fatty acids that is replaced, not glycerol, when phospholipids are formed.
			Total	**1**	

4			B	1	**Examiner's Comments** Many candidates selected option B as the correct response. All other incorrect options were seen. This highlighted the need for candidates to ensure they are familiar with appropriate terminology such as polar and saturated when related to the structure of lipids.
			Total	**1**	
5			B	1	**Examiner's Comments** Many correct responses, option **B** were seen. The idea of lipids being macromolecules but not polymers is a concept that has been tested before, and forms a good discussion point in class when revising biological molecules.
			Total	**1**	
6			C ✓	1	**Examiner's Comments** Most candidates were able to pick out the link between 'poly' and the 3 double bonds shown on the image and selected the correct response C.
			Total	**1**	
7			B ✓	1 (AO1.1)	
			Total	**1**	
8	i		**1** linear scales using half of grid or more **AND** *x* axis labelled <u>temperature (°C)</u> **AND** *y* axis labelled (mean) <u>absorbance (%)</u>✓ **2** points plotted correctly for <u>mean</u> absorbance ✓ **3** all points joined with curved line ✓	3 (AO2.4)	**1 ALLOW** solidus before unit (instead of brackets) **2 ALLOW** to **±1** small square **2 IGNORE** figures plotted from trial 1, 2 or 3 **2 DO NOT ALLOW** bars **3 DO NOT ALLOW** ruled lines between points **3 ALLOW** one data point outside of curved line of best fit **3 IGNORE** line extended beyond first or last point **3 ALLOW ECF** for data plot from trial 1, 2 or 3 **Examiner's Comments** Graph skills varied, with most using the space appropriately and plotting temperature on the *x* axis and absorbance on the *y* axis, giving units for each axis and choosing a linear scale for each axis, but a proportion did not do some or all of these things. Most plotted the mean absorbance

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<td>only but some obscured the mean data by also plotting the results from each trial. Candidates should be adequately equipped in the exam with a pencil for plotting data and a rubber for erasing mistakes so that the final answer is not marred by scribbled out lines or double lines.

OCR support

OCR provides tutorials, student tests and teacher answers on creating and interpreting graphs for M3.1 at https:/www.ocr.org.uk/subjects/science/maths-for-biology/graphs/

This checklist for graphs is taken from the OCR support document ‘Learner Checklist: Graphs, Tables and Drawings’. A link to this document can be found here: https:/www.ocr.org.uk/qualifications/as-and-a-level/biology-a-h020-h420-from-2015/planning-and-teaching/

<table>
<tr><td>S</td><td>Size of the graph: does the bit with actual plotted points in take up at least half the paper?</td><td></td></tr>
<tr><td>P</td><td>Plotting: is every data point within half a little square of where it should be?</td><td></td></tr>
<tr><td>L</td><td>Line of best fit: if there’s a trend in your data, is it indicated with a smooth curve or straight line?</td><td></td></tr>
<tr><td>A</td><td>Axes right way round: the thing you changed (independent variable) along the bottom; the thing you measured (dependent variable) up the side.</td><td></td></tr>
<tr><td>T</td><td>Title: have you included a title that tells you what this graph shows?</td><td></td></tr>
<tr><td>A</td><td>Axis labels: name of each variable with the right unit symbol.</td><td></td></tr>
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<td></td>
<td></td>
<td>ii</td>
<td>In summary: Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
Using a ‘best-fit’ approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Then, award the</td>
<td>6
(AO1.2)
(AO2.3)
(AO3.1)</td>
<td>Indicative points may include:
Explanation of results
At 20°C, membrane intact / impermeable / least permeable

At, low temperature / 30°C / 40°C / 50°C, pigment escapes
Through gaps between (moving) phospholipids
As temperature increases kinetic energy increases
More, phospholipid movement / gaps
Membrane becomes more permeable</td>
</tr>
</table>

			higher or lower mark within the level, according to the ***Communication Statement*** *(shown in italics):*
			
			•
			  ○ *award the higher mark where the Communication Statement has been met.*
			  ○ *award the lower mark where aspects of the Communication Statement have been missed.*
			• ***The science content determines the level.***
			• ***The Communication Statement determines the mark within a level.***
			
			Level 3 (5–6 marks)
			Full and detailed description of how the phospholipids in the cell membrane are affected by temperature, causing the structure of the plasma membrane to become disrupted with reference to the results between 20°C and 70°C.
			
			There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.
			
			Level 2 (3–4 marks)
			A detailed description of how the phospholipids in the cell membrane are affected by temperature, causing the structure of the plasma membrane to become disrupted with reference to the results between 20°C and 70°C.
			
			There is a line of reasoning presented with some structure. The information presented is relevant and supported by some
					More, pigment loss / betalain release / colour in flask
					Higher absorbance figure
					Graph curves upwards
					
					At high temperature / 60°C / 70°C, membrane disrupted
					Phospholipid, arrangement / bilayer, breaks down / melts
					Membrane, leaky / very permeable
					Large increase in, pigment loss / betalain release / AW
					Large increase in absorbance figure
					Graph curves up more steeply
					
					Structure of phospholipids
					Phosphate (and glycerol) head
					(Two) fatty acid / hydrocarbon, tails
					
					Properties of phospholipids
					Heads, are hydrophilic / face out / face aqueous medium
					Tails, are hydrophobic / face inwards / in centre of bilayer
					Phospholipids form bilayer
					Form barrier to, water / water-soluble molecules
					IGNORE ref. proteins / cholesterol
					
					<u>Examiner's Comments</u>
					
					This was the first of two 6-mark levels of response questions on the paper. This style of question requires specific skills and candidates need guidance in how to assess what the question is asking for and how to structure their response. In this case a systematic approach to the data in the table was needed, covering the whole range of temperatures and dividing the range into sections with a common cause of permeability characteristics. Here there was the lowest temperature with zero permeability, the middle range of temperatures where progressive heating gave progressively more kinetic energy, membrane fluidity and pigment loss, and the highest temperatures where a more dramatic disruption and increase in permeability occurred. This disruption is a result of the phospholipids moving so that the bilayer arrangement breaks, which can be referred to as the bilayer melting. However, it is not correct to say that the phospholipid molecules themselves change state (melt). The question also asked for explanation in terms of both the **structure** and the **properties** of phospholipids, so both these aspects needed to

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<td>evidence.

Level 1 (1–2 marks)
A description of some of the effects on phospholipids in the cell membrane of either high or low temperature with reference to the results between 20°C and 70°C.

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks
No response or no response worthy of credit.</td>
<td></td>
<td>be referred to in a Level 3 answer.
Exemplar 1

Between 20°C and 70°C, there is a major increase in the absorbance. This is because the increase in temperature caused the proteins in the phospholipid bilayer of the plasma membrane to denature. The ~~ps~~ cytoskeleton below the ~~pe~~ plasma membrane will also denature. The higher the temperature the more proteins that will denature. ~~and so the permeability of the plasma membrane will increase. This allows~~ This will leave holes in the plasma membrane and so increase the permeability. This will allow betalain to cross the membrane and diffuse into the ~~distilled~~ water. When the ~~colour~~ colorimetry takes place, this red pigment [6]
Additional answer space if required.
will be absorbed by the blue filter, hence why the absorbance ~~[illegible]~~ increases as the temperature increases.

This response shows a clear understanding of how membrane permeability affects pigment movement which is measured by the colorimeter as light absorbance. The candidate seeks to explain a general increase in absorbance over the whole temperature range and does not distinguish between the different temperature spans with different rates of permeability increase. Their explanation is all in terms of the effects of temperature increase on proteins. As the question asks for an explanation in terms of phospholipids, the protein references are irrelevant. This is a Level 1 response.</td>
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<td></td><td></td><td></td>
<td>Total</td>
<td>9</td>
<td></td>
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<tr>
<td>9</td><td></td><td>i</td>
<td>1 more than one, C=C / double bond (between carbons) ✓
2 more than one, kink / bend ✓
3 fewer H atoms ✓</td>
<td>1 Max
(AO1.1)</td>
<td>1 ALLOW has double bond<u>s</u> (between carbons)
2 ALLOW has, kink<u>s</u> / bend<u>s</u>

<u>Examiner's Comments</u>

Many responses showed a clear understanding of saturated versus unsaturated but fewer than half picked up on the term polyunsaturated and said there would be more than one C=C double bond. References to a single kink or double bond were common.</td>
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<td></td><td></td><td>ii</td>
<td>1 (yes because) both fall 2006–2012 / 2006–2016 / 2002–2012 / 2002–2016✓
2 (no because) 1994–2002 / 1994–2006 / 2012–2016, hypercholesterolemia rises but (CVD) deaths fall / two factors show opposite trends OR 2002–2006 / 2012–2016 /1994–2016, hypercholesterolemia</td>
<td>3 Max
(AO3.4)</td>
<td>ALLOW (22–44 year olds / people) with high blood cholesterol / with the condition, for 'hypercholesterolemia'
MPs 1 and 2 IGNORE single years (look for ranges)
<table>
<tr><th>time frame</th><th>change in % hypercholesterolemia in 20-44 age group</th><th>change in CVD deaths per 100 000</th></tr>
<tr><td>1994 → 2002</td><td>13 → 16</td><td>270 → 220</td></tr>
<tr><td>2002 → 2006</td><td>16 → 16</td><td>220 → 185</td></tr>
<tr><td>2006 → 2012</td><td>16 → 12</td><td>185 → 150</td></tr>
<tr><td>2012 → 2016</td><td>12 → 13</td><td>150 → 145</td></tr>
</table>
3 ALLOW hyperchol. figures ±2 and CVD figs ±10</td>
</tr>
</table>

			does not change but (CVD) deaths fall **OR** no positive correlation in 1994–2006 **and** 2012-2016 ✓ **3** % hypercholesterolemia figure and CVD deaths figure per 100 000 people for two named years ✓ **4** correlation does not (necessarily) imply causation ✓ **5** other (named) factor affects death rate (from CVD) ✓		**3 ALLOW** processed figs e.g. 2006–2012 CVD decreases by 35 **5** e.g. obesity, physical inactivity, alcohol use, nicotine use, other (named) dietary factors, other (named) health problems, medical treatment, statins **Examiner's Comments** Candidates found this data evaluation task very challenging. Errors included reading from the wrong line, quoting figures using the wrong scale, thinking the data showed death rates for the 22-44 age group specifically and not giving a time frame in years when describing trends. In order to develop this skill candidates need practice with this sort of complex analysis task. Key points for candidates to check before framing an answer to this type of question are listed below: **Analysing graph data to discuss whether two factors are causally linked** • On the graph, highlight or mark the lines of data that are relevant to the question. Here these were the long-dashed line for people aged 22–44 with hypercholesterolaemia, and the solid line for overall CVD death rate per 100 000 people. • Check you are reading from the correct axis scales. The left-hand *y* axis scale was a scale from 0-60 for the percentage of people with hypercholesterolaemia, while the line for CVD death rate related to the right-hand *y* axis scale which ran from 0 to 300 per 100 000 people. • 'Discuss whether the statement is correct'. Include sections of the data that support the statement (yes) but also sections of the data or other factors that do not support it (no). • If for a section of the time frame both lines show the same trend, this shows they are correlated (yes) but correlation does not necessarily imply causation.
			Total	**4**	
10			**C**	1 (AO1.1)	**Examiner's Comments** Candidates who performed well on this question paper recognised that cholesterol is used to

					produce steroid hormones and chose option C as the correct response. Option A was the most common incorrect response with candidates associating cholesterol with membrane fluidity, without understanding that at high temperatures cholesterol **decreases** membrane fluidity to stabilise the phospholipid bilayer.
			Total	**1**	
11			**C**	1 (AO1.1)	
			Total	**1**	
12			**B**	1 (AO2.1)	
			Total	**1**	
13			**A** ✓	1	**Examiner's Comments** The majority of candidates gave the correct response (A).
			Total	**1**	