Mark scheme - Biological Molecules: Lipids

Question			Answer/Indicative content	Marks	Guidance
1			D ⟩	1	**Examiner's Comments** Around half of candidates were able to successfully apply their knowledge of biochemistry to the context of a plasma membrane.
			Total	**1**	
2			B ✓	1 (AO1.2)	**Examiner's Comments** Most candidates got this right. Some thought polypeptides contained ester bonds and some were perhaps unaware either that phosphodi**ester** bonds contain esters, or that they are present in polynucleotides.
			Total	**1**	
3			A ✓	1 (AO1.1)	**Examiner's Comments** The most common answer was the correct one, but many candidates answered D, which suggests a misunderstanding about the structure of cholesterol.
			Total	**1**	
4			C	1 (AO2.1)	
			Total	**1**	
5			D	1 (AO1.1)	
			Total	**1**	
6			**D ✓**	**1**	**ACCEPT A** **Examiner's Comments** Candidates could reasonably suggest either **A** or **D** as correct answers and both were credited in order to be fair to candidates.
			Total	**1**	
7			D	1	
			Total	**1**	

8		i	*formula* **M** (no mark) *because* high ratio of hydrogen to oxygen / **N** has (approximately) 2 H to 1 O (1)	1	
		ii	hydrophilic head and hydrophobic tails (1) hydrophobic part / tails, repelled / AW, by water (1) head / hydrophilic part, forms H bonds with water (1) *idea that* medium outside / inside plasma membrane is aqueous (1) *idea that* hydrophobic nature of tails results in their facing towards each other (1)	3	
			Total	**4**	
9	a	i	single bond between oxygen on glycerol and carbon on fatty acid ✓ double bonded oxygen on first carbon of the fatty acid ✓	2	**ALLOW** on any of the glycerol carbons **ALLOW** any number of carbons in chain
		ii	ester✓	1	
		iii	water✓	1	
	b		***Please refer to the marking instructions on page 3 of this mark scheme for guidance on how to mark this question. 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 higher, middle 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 middle mark where aspects of the Communication Statement are missing.* • *award the lower mark where the Communication Statement has not been met.* • ***science content determines the level.*** • ***Communication Statement determines the mark within a level.***		
			Level 3 (7−9 marks) A good range of structural details and properties are provided including reference to fats and carbohydrates in both plants and animals. Explanations are provided for each structural comment. *The explanations are clearly linked to the structure of the molecules and the use of scientific terminology is at an appropriate level. All the information presented is relevant and forms a continuous narrative*. **Level 2 (4−6 marks)** Some structural details and properties are provided including reference to molecules in both plants and animals. Explanations are provided for each structural comment. *The explanations are clearly linked to the structure of the molecules but may not fully explain how the structure suits the role and use of scientific*	Max 9	**Indicative scientific points may include: Structures (S), Properties (P) and Explanations (E):** Carbohydrates: S1. Polymers of glucose E1. Glucose can be used in respiration to release energy S2. Large molecules P2. Insoluble E2. Do not affect water potential of cell S3. 1−4 glycosidic bonds E3. Easy to make and break to release glucose / monomers S4. Coiled shape / compact E4. Take up less space in cell S5. Amylose unbranched / amylopectin with few branches E5. No need for rapid release of monomers in plants S6. Glycogen more branched E6. Allows more rapid release of monomers in animals Lipids (**ACCEPT** lipids or fats):

			terminology may not always be appropriate. The information presented is mostly relevant. **Level 1 (1−3 marks)** A limited number of structural details are provided. The explanations do not clearly show how the molecules are suited to their role. *There is a logical structure to the answer. The explanations, though basic, are clear.* 0 marks No response or no response worthy of credit		S7. Fats have more carbon-carbon bonds / carbon-hydrogen bonds P7. Fats are energy rich / contain more energy per molecule E7. More energy stored in less space P8. Fats are insoluble E8. Do not affect water potential of cell S9. Fatty acids are long carbon chains E9. Can be broken down to release two carbon / acetyl groups (which enter Krebs cycle) S10. Animal fats saturated / harder E10. Have role in protection / insulation as well as energy storage.
			Total	**13**	
10	a		any appropriate bond circled ✓	1	Accept more than one correct circle Circle should include both O atoms and the C between them **Examiner's Comments** This question asked candidates to identify the ester bond. The majority of candidates were unable to answer this correctly. **Exemplar 3** This response shows clearly what was expected.
	b		glycerol ✓	1	**Examiner's Comments** In this question candidates were expected to recall that triglycerides consist of glycerol and fatty acids. The stem of the question states that the fatty acids are reacted with methanol and these methyl esters float on top. That leaves glycerol as the more dense liquid. Less able candidates were not able to deduce this correctly.

	c	i	energy source for respiration / respiratory substrate ✓ energy storage ✓ thermal insulation ✓ electrical insulation ✓ buoyancy ✓ *idea of:* (physical) protection ✓	3 max	**DO NOT ALLOW** energy for respiration **IGNORE** for warmth unless linked to insulation e.g protection around kidneys **Examiner's Comments** This question required simple recall. The majority of candidates were credited one or two marks. Only the most able achieved all three marks. Single word responses were seldom successful. Candidates were expected to provide sufficient detail to, for example, distinguish between electrical insulation and thermal insulation.
		ii	fewer hydrogens / more double bonds / less saturated, gives lower melting point ✓ (fewer hydrogens / less saturated) more kinked, chain / molecule ✓ (molecules) less uniformly packed together (so lower temperature needed for melting) ✓	2 max	**One mark** for description (1st mark point) **One mark** for explanation. Note mp1 only awarded for clear statement of trend not for full description of data **DO NOT ALLOW** hydrogen, ions / bonds / molecules **Examiner's Comments** Candidates were expected to deduce a pattern in the results shown and to explain that pattern. Less able candidates tended to describe the results, often naming the individual methyl esters. More able candidates spotted that as the number of hydrogen atoms decreased, so did the melting point. Many candidates thought that there were more hydrogen bonds between the molecules with more hydrogen atoms and this raised the melting point. Only the most able candidates correctly explained that less hydrogen atoms meant more double bonds which caused the fatty acid chains to kink or bend. This caused less uniform packing of the molecules. **Exemplar 4** This exemplar shows a typical response. A

					correct pattern identified but an incorrect explanation of that pattern.
	d		they / fatty acids, hydrophobic / described ✓ phospholipid bilayer (formed) ✓ fatty acids / tails, on the inside / pointing inwards ✓	2 max	**ALLOW** marks in suitably annotated diagram **Examiner's Comments** This question was asking about the structure of cell membranes. Candidates were expected to recall that fatty acids are hydrophobic. As part of a phospholipid this hydrophobic nature causes the fatty acid tails to orientate towards the middle of the bilayer.
			Total	**9**	
11	a	i	**FIRST CHECK ON ANSWER LINE** **If answer = 140 or 141 award 2 marks** *If answer is incorrect allow 1 mark max for…* 21/2π = 3.344 ✓ 140.5 ✓	2 (AO 2.2)	*If answer incorrect* **ALLOW** 1 mark for evidence of calculation based on 30 ± 1 phospholipid molecules = 287 ± 20 **Examiner's Comments** Candidates found this question very challenging with only a few candidates arriving at the correct answers of 140 or 141. There were some very unrealistic answers (e.g. thousands or tens of thousands). Candidates should be encouraged to consider whether their numerical answer looks like it might be reasonable. **OCR support** There is a tutorial on estimating results on the 'Maths for Biology' website: https:/www.ocr.org.uk/subjects/biology/maths-for-biology/arithmetic-and-numerical-computation/
		ii	lipid is less dense than protein ✓ **ora**	1 (AO 3.1)	**ALLOW** phospholipids are less dense than protein **Examiner's Comments** Only a few candidates were awarded a mark

					in this stretch and challenge question. Candidates were provided with some information from which they had to draw a conclusion about the relative densities of lipids and proteins. Most restated information provided in the question or speculated about the relative content of lipoproteins in aquatic animals.
	b		storage ✓ carbon ✓ hydrogen ✓ insoluble ✓ stability ✓ bile ✓	6 (AO 1.1)	**ALLOW** vitamins **Examiner's Comments** This was well answered with most candidates gaining all of the available marks. Few achieved less than 4 marks.
	c		uses / AW, water ✓ (to) break 3 ester bonds ✓ lysis means splitting **and** fatty acids are, split / AW, from glycerol ✓	2 (AO 1.2) (AO 2.6)	**CREDIT** points from annotated diagram **ALLOW** '3' inferred from water molecules used or number of fatty acids **Examiner's Comments** Most candidates gained a mark for using or adding water. Breaking 3 ester bonds was rarely seen, however, some candidates did achieve this point by mentioning ester bonds broken by the mention of 3 fatty acids or 3 water molecules. Several candidates used diagrams to support their answers, but these were often unlabelled. Candidates are encouraged to draw fully annotated diagrams in order to facilitate to better access the marking points. Reference to the meaning of 'lysis' was rarely seen or credited. Common errors included misnaming the bonds, usually as glycosidic or phosphodiester, or saying that water was produced or hydrogen added.
			Total	**0**	
12			phosphate (on head), is hydrophilic / bonds with water	3(AO2.1 2.5)	**DO NOT CREDIT** reference to incorrect bond, e.g. covalent

			(molecules) ✓ (two) fatty acid tails are hydrophobic ✓ heads orientate towards water / tails orientate towards other fatty acids / tails orientate away from water , (so a bilayer forms)✓		This point is for a description of why a bilayer forms and key terms are not required **Examiner's Comments** Most candidates were clearly familiar with aspects of membrane structure but may merely attempted to describe the structure of membranes rather than explaining why the structure of phospholipid molecules facilitates the formation of membranes.
			Total	**3**	