Proteins And Lipids

1. The diagram below shows two molecules which are sub-units of proteins.

(a) (i) Complete the diagram above to show how a reaction takes place to join the two molecules.

[3]

(ii) Name the type of reaction involved.

[1]

. . . . . .

(iii) Name the type of bond formed.

[1]

. . . . . .

(b) (i) Why is the model of the structure of biological membranes described as 'fluid mosaic'?

[2]

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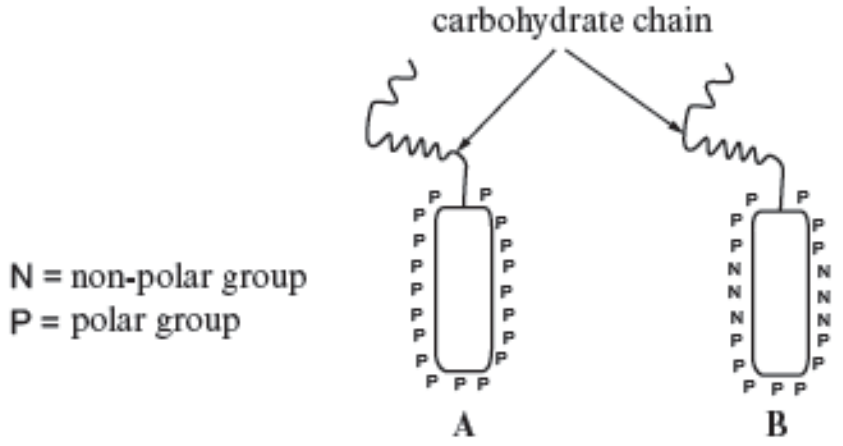
The diagrams below represent two glycoprotein molecules found in the plasma membranes of mammalian cells.



(ii) Which of the molecules A or B will form an intrinsic protein in the plasma membrane?

[1]

Molecule . . . . . .

(iii) Draw a labelled diagram of the plasma membrane using the diagrams above to show the correct positioning of glycoproteins A and B.

[2]

(iv) Give one function of the carbohydrate chains on the glycoproteins.

[1]

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(c) Some diseases are caused by abnormal proteins called prions. Some prions have a higher proportion of β pleated sheet in place of the normal helix structure.
(i) What level of protein structure is described by the terms helix and β pleated sheet?

[1]

. . . . . .

(ii) Which organelles are involved in synthesising proteins?

[1]

. . . . . .

(d) The following diagram shows one way that prions may pass into cells.

1. Plasma membrane folds inwards.

2. Plasma membrane continues to fold engulfing the material.

3. Plasma membrane fuses to enclose the material.

(i) Name the process shown in the diagram above.

[1]

. . . . . .

(ii) Name two other ways in which substances might pass into the cell.

[2]

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2.

Red blood cells are involved with the transport of oxygen around the body. Red blood cells lack internal organelles and their cytoplasm contains haemoglobin. Haemoglobin is a protein that consists of four polypeptide chains linked together.

(a) State the level of protein structure shown by haemoglobin. [1]

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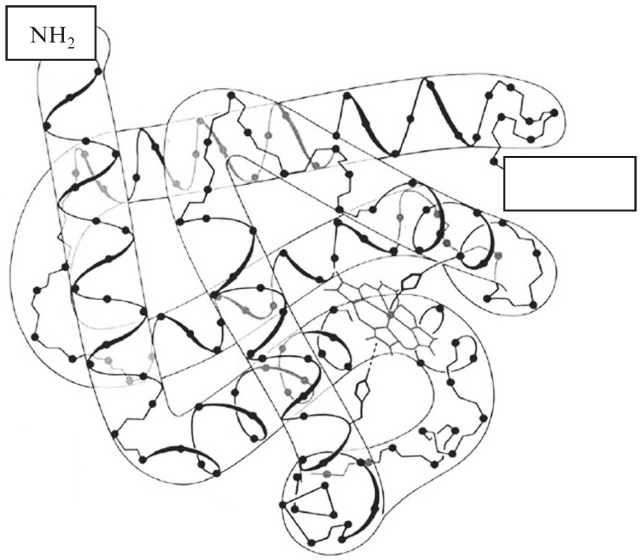
(b) The diagram below shows one of the polypeptide chains from haemoglobin.



(i) On the diagram above, use an arrow to **clearly label** an alpha –helix. [1]

(ii) Complete the diagram above by writing in the empty box, the molecular group that would be present at the end of the polypeptide chain. [1]

(iii) Name **two** types of bonds that would be present to maintain the 3D shape of this polypeptide chain. [1]

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(c) The plasma membrane contains proteins and phospholipids. Describe **two** ways in which the structure of phospholipids differ from triglycerides. [2]

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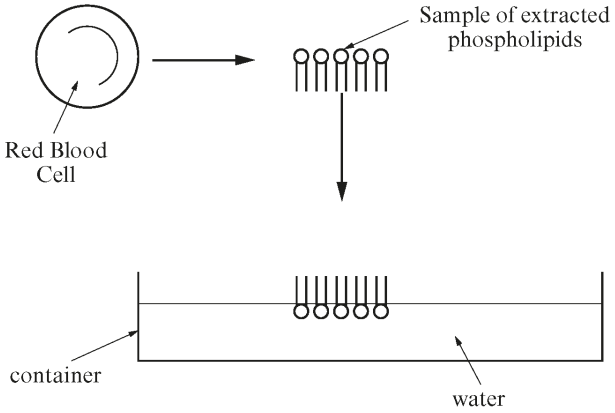
(d) In 1925, two scientists, Gorter and Grendel investigated the arrangement of phospholipids in the plasma membrane. This involved the removal of the phospholipids from the surface membrane of all the red blood cells in 10cm^3 of blood. The phospholipids were then placed on the surface of water and allowed to spread out to form a single layer, called a monofilm.



(i) Explain fully the arrangement of the phospholipid molecules as shown in the container on the diagram above. [2]

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(ii) The area covered by all the phospholipids in the monofilm was found to be 12.2m^2. The total surface area of the intact red blood cells had been previously measured. Using your knowledge of membrane structure, what would you expect the total surface area of the red blood cells to be? Explain your answer. [2]

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(Total 10 marks)

3. Answer one of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, (a) Using examples, describe the functions of carbohydrates and lipids in living organisms.

[10]

Or (b) Describe the structure and function of the rough endoplasmic reticulum, Golgi body and lysosomes.

[10]

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Marking Scheme

1. (a)
(i)
OH and H removal shown on diagram;
formation of water (H2O) shown;
dipeptide correctly drawn with C joined to N; [3]

(ii)
Condensation; [1]

(iii)
Peptide; NOT dipeptide; [1]

(b)
(i)
Mosaic: Proteins are scattered (in lipid layer);
Fluid: molecules / components / (phospho)lipids / proteins are free to move around; [2]

(ii)
B; [1]

(iii)
Drawing shows a lipid bilayer with A and B in the correct places, B intrinsic (through the middle) A extrinsic (on top or bottom, outside phosphate heads);
Need not use N and P, but must be clear which is A and B
any 1 correct label from phospholipid / hydrophobic / hydrophilic / cholesterol / phosphate (head) / lipid or fatty acid (tails);
1
1
(iv)
Cell {recognition / interaction / identification / cell to cell recognition / adhesion / signalling} / receptor qualified e.g. {hormone receptor / antigens}; [1]

(c)
(i)
Secondary; [1]

(ii)
Ribosomes / rough endoplasmic reticulum;
Accept nucleus;
NOT golgi body / nucleolus. [1]

(d)
(i)
Endocytosis (accept phagocytosis / pinocytosis);
NOT exocytosis. [1]

(ii)
Any 2:
Diffusion / osmosis;
Facilitated diffusion;
Active transport; [2]

2.

(a) Quaternary/ 4°; 1

(b) (i) (Labelled) arrow in correct position; 1

(ii) COOH/ carboxyl/ carboxylic acid; 1

(iii) Disulphide {bond/ bridges} / ionic bonds / hydrogen / hydrophobic interactions / Van der Waals; (Any 2) 1
NOT peptide / S-S (covalent – neutral)

(c) **Mark points must be comparative** Max 2

phospholipid	triglyceride
2 fatty acids	3 fatty acids;
phosphate (head)	do not contain a phosphate (head)
polar/hydrophilic head and non-polar/hydrophobic tails	non-polar/hydrophobic;

(d) (i) {Heads/ phosphates} are {hydrophilic/ polar} and are {attracted to/ in} the water; 2
{Tails/ fatty acids} are {hydrophobic/ non polar} and are {repelled by/ above/ avoid} water;
NOT react/ dissolve with water

(ii) 6.1(m^2); 2
The phospholipids are {arranged in/ formed} a {bilayer/ double layer} in the membrane;
Ref to phospholipid bilayer alone- insufficient

3.

Question			Marking details	Marks Available
8	(a)		**Carbohydrates**	Max 10
		A	Glucose for respiration;
		B	Starch for storage of {glucose/energy}in plants;
		C	Cellulose for structural support in plant cell walls/ chitin in {insect exoskeleton/ fungi};
		D	Glycogen for storage of {glucose/energy} in animals;
		E	{Glycogen/starch} insoluble so no osmotic effect;
		F	Disaccharides or named + function (e.g. sucrose for transport in plants);
			Lipids
		G	Saturated fatty acids for storage in animals/ unsaturated fatty acids for storage in {seeds/plants};
		H	Thermal insulation/buoyancy;
		I	Waxes for waterproofing in leaves;
		J	Good source of energy, twice as many as carbohydrates or value 38 kJ per g;
		K	Correct ref to protection of organ from physical damage (e.g. kidney);
		L	Electrical insulation in neurons (ref to myelin);
		M	Source of metabolic water from respiration of lipids;
			Used to make other molecules (CHO / glucose / lipids needed to make)
		N+	Any two for one mark each from:
		O	Chlorophyll *with* magnesium / phospholipids *with* phosphate/ {DNA/RNA/ATP} *with* nitrogen and phosphate / amino acids *with* nitrogen/ glycoprotein *with* protein;

Question			Marking details	Marks Available
8	(b)		**Rough Endoplasmic Reticulum**	Max 10
		A	Flattened sacs/cisternae (or from diagram);
		B	Continuous with nuclear membrane (or from diagram);
		C	With attached ribosomes (must be clearly labelled on diagram);
		D	Site of {protein synthesis/translation}/transport system;
			Golgi
		E	Golgi consists of a {series/system/group/stack} of (dynamic) flattened sacs (diagram must show at least 3);
		F	Function in packaging proteins (for secretion);
		G	Vesicles containing proteins from RER fuse with Golgi membrane and contents are shed into Golgi sacs/ coalescence of vesicles;
		H	(Contents are built into more complex molecules such as) enzymes/glycoproteins;
		I	Other Golgi function, e.g. carbohydrate secretion/ transporting or storing lipids;
		J	{Vesicles containing product/lysosomes} are budded off;
		K	Ref. to exocytosis of contents; NOT in context of lysosomes
			Lysosomes
		L	Lysosomes contain digestive enzymes/lysozyme;
		M	Function is to {break down worn out organelles/digest foreign material/ cause autolysis/ intracellular breakdown};
		N	{Lysosomes/vesicles} fuse with membrane of digestive vacuoles;
		O	Enclosed by phagocytosis; NOT in context of lysosomes
			Award Max 8 if only 2 organelles described
			Points A, B, C and E can be accepted from clear diagram
			Question 8 Total	**[10]**