CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



MARK SCHEME

2 BIOLOGICAL MOLECULES

SCORE	PERCENTAGE
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Paper 1 Multiple Choice Answers: Biological Molecules

Question	Paper	Q. No.	Answer
216	9700_m20_qp_12	7	C
217	9700_s20_qp_11	6	D
218	9700_s20_qp_12	7	C
219	9700_s20_qp_13	6	B
220	9700_w20_qp_11	7	C
221	9700_w20_qp_12	7	A
222	9700_w20_qp_13	7	C
223	9700_m19_qp_12	7	A
224	9700_s19_qp_11	7	A
225	9700_s19_qp_11	8	A
226	9700_s19_qp_12	5	B
227	9700_s19_qp_13	7	D
228	9700_w19_qp_11	7	B
229	9700_w19_qp_12	8	B
230	9700_w19_qp_13	6	B
231	9700_s18_qp_12	6	A
232	9700_w18_qp_13	7	D
233	9700_m17_qp_12	7	D
234	9700_s17_qp_12	9	D
235	9700_s17_qp_13	5	B
236	9700_w17_qp_11	6	B
237	9700_w17_qp_12	7	C
238	9700_w17_qp_13	6	C
239	9700_s16_qp_11	6	C
240	9700_s16_qp_13	6	B
241	9700_w16_qp_11	6	A
242	9700_w16_qp_13	6	D
243	9700_s15_qp_11	7	B
244	9700_s15_qp_12	11	B
245	9700_s15_qp_13	12	B
246	9700_w15_qp_11	8	C
247	9700_w15_qp_11	17	B
248	9700_w15_qp_12	7	B
249	9700_w15_qp_13	7	C
250	9700_m20_qp_12	8	A
251	9700_m20_qp_12	9	C
252	9700_m20_qp_12	10	B
253	9700_s20_qp_11	7	A
254	9700_s20_qp_11	8	B
255	9700_s20_qp_12	8	C
256	9700_s20_qp_12	9	C
257	9700_s20_qp_12	10	A
258	9700_s20_qp_13	7	B
259	9700_w20_qp_11	8	B
260	9700_w20_qp_11	9	D
261	9700_w20_qp_11	10	A

Paper 1 Multiple Choice Answers: Biological Molecules (continued)

Question	Paper	Q. No.	Answer
262	9700_w20_qp_12	8	C
263	9700_w20_qp_13	8	A
264	9700_w20_qp_13	9	A
265	9700_w20_qp_13	10	A
266	9700_w20_qp_13	11	C
267	9700_m19_qp_12	8	D
268	9700_m19_qp_12	9	A
269	9700_m19_qp_12	10	C
270	9700_m19_qp_12	11	B
271	9700_m19_qp_12	12	D
272	9700_m19_qp_12	13	B
273	9700_s19_qp_11	9	D
274	9700_s19_qp_11	10	A
275	9700_s19_qp_11	11	B
276	9700_s19_qp_11	13	C
277	9700_s19_qp_12	6	B
278	9700_s19_qp_13	8	D
279	9700_s19_qp_13	9	C
280	9700_s19_qp_13	10	B
281	9700_s19_qp_13	11	D
282	9700_s19_qp_13	12	A
283	9700_w19_qp_11	6	D
284	9700_w19_qp_11	8	A
285	9700_w19_qp_11	9	C
286	9700_w19_qp_11	10	D
287	9700_w19_qp_12	7	B
288	9700_w19_qp_12	10	A
289	9700_w19_qp_13	7	C
290	9700_w19_qp_13	8	C
291	9700_m18_qp_12	7	A
292	9700_m18_qp_12	8	D
293	9700_m18_qp_12	10	B
294	9700_s18_qp_11	6	C
295	9700_s18_qp_11	7	A
296	9700_s18_qp_11	8	C
297	9700_s18_qp_11	9	C
298	9700_s18_qp_12	7	C
299	9700_s18_qp_12	8	C
300	9700_s18_qp_12	9	D
301	9700_s18_qp_13	7	D
302	9700_s18_qp_13	8	A
303	9700_s18_qp_13	9	D
304	9700_s18_qp_13	10	C
305	9700_w18_qp_11	6	D
306	9700_w18_qp_11	7	B
307	9700_w18_qp_11	9	C

Paper 1 Multiple Choice Answers: Biological Molecules (continued)

Question	Paper	Q. No.	Answer
308	9700_w18_qp_11	10	A
309	9700_w18_qp_12	7	C
310	9700_w18_qp_12	8	A
311	9700_w18_qp_12	9	B
312	9700_w18_qp_13	8	D
313	9700_w18_qp_13	9	B
314	9700_w18_qp_13	10	C
315	9700_w18_qp_13	11	C
316	9700_m17_qp_12	8	B
317	9700_m17_qp_12	9	A
318	9700_s17_qp_11	7	D
319	9700_s17_qp_11	8	D
320	9700_s17_qp_11	9	D
321	9700_s17_qp_11	10	D
322	9700_s17_qp_12	7	B
323	9700_s17_qp_12	8	B
324	9700_s17_qp_13	6	A
325	9700_s17_qp_13	9	C
326	9700_w17_qp_11	1	B
327	9700_w17_qp_11	7	B
328	9700_w17_qp_11	8	A
329	9700_w17_qp_12	8	C
330	9700_w17_qp_12	9	A
331	9700_w17_qp_12	10	B
332	9700_w17_qp_12	13	C
333	9700_w17_qp_13	7	A
334	9700_w17_qp_13	8	B
335	9700_m16_qp_12	6	D
336	9700_m16_qp_12	7	B
337	9700_m16_qp_12	8	C
338	9700_m16_qp_12	9	A
339	9700_s16_qp_11	7	B
340	9700_s16_qp_11	8	C
341	9700_s16_qp_11	9	D
342	9700_s16_qp_12	5	B
343	9700_s16_qp_13	7	B
344	9700_s16_qp_13	8	A
345	9700_s16_qp_13	9	C
346	9700_w16_qp_11	7	A
347	9700_w16_qp_11	8	C
348	9700_w16_qp_11	9	D
349	9700_w16_qp_12	7	D
350	9700_w16_qp_12	8	D
351	9700_w16_qp_12	9	D
352	9700_w16_qp_12	11	C
353	9700_w16_qp_13	7	D

Paper 1 Multiple Choice Answers: Biological Molecules (continued)

Question	Paper	Q. No.	Answer
354	9700_w16_qp_13	8	D
355	9700_s15_qp_11	9	B
356	9700_s15_qp_11	10	B
357	9700_s15_qp_12	10	B
358	9700_s15_qp_13	7	D
359	9700_w15_qp_11	7	C
360	9700_w15_qp_11	9	D
361	9700_w15_qp_11	10	A
362	9700_w15_qp_12	8	D
363	9700_w15_qp_12	9	C
364	9700_w15_qp_13	8	B
365	9700_w15_qp_13	9	B
366	9700_m20_qp_12	11	C
367	9700_m20_qp_12	12	B
368	9700_s20_qp_11	9	A
369	9700_s20_qp_11	10	A
370	9700_s20_qp_11	11	A
371	9700_s20_qp_12	11	B
372	9700_s20_qp_12	12	D
373	9700_s20_qp_13	8	D
374	9700_s20_qp_13	9	A
375	9700_s20_qp_13	10	B
376	9700_s20_qp_13	11	D
377	9700_w20_qp_11	11	D
378	9700_w20_qp_11	12	D
379	9700_w20_qp_12	9	D
380	9700_w20_qp_12	10	D
381	9700_w20_qp_12	11	B
382	9700_w20_qp_13	12	D
383	9700_m19_qp_12	14	A
384	9700_s19_qp_11	12	B
385	9700_s19_qp_12	7	A
386	9700_s19_qp_12	8	B
387	9700_s19_qp_12	9	B
388	9700_s19_qp_13	13	A
389	9700_s19_qp_13	14	D
390	9700_w19_qp_11	11	A
391	9700_w19_qp_11	12	C
392	9700_w19_qp_12	9	B
393	9700_w19_qp_12	11	B
394	9700_w19_qp_12	12	D
395	9700_w19_qp_12	13	B
396	9700_w19_qp_13	9	C
397	9700_w19_qp_13	10	B
398	9700_w19_qp_13	11	A
399	9700_m18_qp_12	9	A

Paper 1 Multiple Choice Answers: Biological Molecules (continued)

Question	Paper	Q. No.	Answer
400	9700_m18_qp_12	11	A
401	9700_m18_qp_12	12	B
402	9700_s18_qp_11	10	A
403	9700_s18_qp_11	11	D
404	9700_s18_qp_12	10	B
405	9700_s18_qp_12	11	C
406	9700_s18_qp_13	11	A
407	9700_s18_qp_13	12	B
408	9700_w18_qp_11	11	D
409	9700_w18_qp_11	12	D
410	9700_w18_qp_11	13	C
411	9700_w18_qp_12	10	A
412	9700_w18_qp_12	11	D
413	9700_w18_qp_12	12	D
414	9700_w18_qp_12	13	C
415	9700_w18_qp_13	12	B
416	9700_w18_qp_13	14	A
417	9700_m17_qp_12	10	D
418	9700_m17_qp_12	11	C
419	9700_m17_qp_12	12	D
420	9700_m17_qp_12	13	B
421	9700_s17_qp_11	11	C
422	9700_s17_qp_11	12	B
423	9700_s17_qp_12	5	C
424	9700_s17_qp_12	6	D
425	9700_s17_qp_13	7	D
426	9700_s17_qp_13	8	A
427	9700_w17_qp_11	9	B
428	9700_w17_qp_11	10	D
429	9700_w17_qp_12	11	A
430	9700_w17_qp_12	12	B
431	9700_w17_qp_13	9	D
432	9700_w17_qp_13	10	A
433	9700_w17_qp_13	12	B
434	9700_m16_qp_12	10	D
435	9700_s16_qp_11	10	A
436	9700_s16_qp_11	11	C
437	9700_s16_qp_12	7	C
438	9700_s16_qp_12	8	A
439	9700_s16_qp_12	9	A
440	9700_w16_qp_11	10	A
441	9700_w16_qp_11	11	C
442	9700_w16_qp_12	10	A
443	9700_w16_qp_12	12	B
444	9700_w16_qp_12	13	A
445	9700_w16_qp_13	9	A

Paper 1 Multiple Choice Answers: Biological Molecules (continued)

Question	Paper	Q. No.	Answer
446	9700_w16_qp_13	10	C
447	9700_s15_qp_11	8	D
448	9700_s15_qp_11	11	A
449	9700_s15_qp_11	12	A
450	9700_s15_qp_12	7	B
451	9700_s15_qp_12	8	D
452	9700_s15_qp_12	9	C
453	9700_s15_qp_12	12	C
454	9700_s15_qp_13	8	C
455	9700_s15_qp_13	9	D
456	9700_w15_qp_11	11	D
457	9700_w15_qp_12	10	C
458	9700_w15_qp_12	11	A
459	9700_w15_qp_13	10	A
460	9700_w15_qp_13	11	B

6. 9700_w15_ms_23 Q: 4

(a) (i) (α 1–6) glycosidic ; **A** glucosidic [1]

(ii) many, terminals / ends, for, attachment of glucose / removal of glucose ;
glucose can be stored quickly ;
glucose can be, mobilised / AW, when required / quickly ;
A more easily mobilised / AW **A** glycogen can be hydrolysed easily
makes it more compact / takes up less space / high density ; [max 2]

(iii) no branching / single unbranched chain / straight / linear ;
different monomer / beta glucose / β glucose ; **ora**
alternate position of monomers in cellulose / AW ; e.g. rotated 180°
only one type of (glycosidic) bond / 1–4 only / no 1–6 ;
forms hydrogen bonds with other cellulose molecules (to give parallel chains);
forms, microfibrils / fibres ; [max 2]

(b) (i) *max 1 for correct working if no answer or answer incorrect*

$$\frac{385\,000}{2\,000\,000} \times 100$$

19.25 / 19.3 / 19 ;; [2]

(ii) **1** energy lost in processing crops to make animal feed ;

animals
2 food, not eaten / wasted ;
3 food, not digested / indigestible / not absorbed / egested
or
energy lost in, excretion / urea ;
4 energy lost, in respiration / as heat ; **A** movement / used for metabolism
5 (some) maintain constant body temperature which requires energy ; AW

humans
6 energy lost in processing animals for human food ;
7 (named) animals parts not edible ;
8 AVP ; e.g. some animals do not have enzyme to digest cellulose [max 3]

[Total:10]

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7. 9700_s19_ms_22 Q: 5

(a)	glycine in monomer column only ; **monomer**: thymine (nucleotide), α-glucose, β-glucose ; ; **polymer**: cellulose, messenger RNA, glycogen, α-globin ; ; **I** glycine **monosaccharide**: β-glucose, α-glucose ; ; **I** glycine **polysaccharide**: cellulose, glycogen ; ; **I** glycine **I** incorrect spellings *if α-globin appears once and is in monomer column instead of polymer column, and the monomer and polymer columns are otherwise correct, allow one mark (ecf)*	**5**
(b)	*any three from:* *allow points from an annotated diagram* **1** phosphate head = hydrophilic / polar ; **2** fatty acid / hydrocarbon, tail / chains = hydrophobic / non-polar ; *if mps 1 and 2 not gained, allow one mark for, hydrophilic / polar, heads and, hydrophobic / non-polar, tails* **3** (so) heads face, watery environment / tissue fluid / cytoplasm / cytosol / aqueous environment ; **4** (fatty acid) tails, form hydrophobic core / form area away from water / face each other / AW ; **5** ref. tails and hydrophobic interactions ;	**3**

8. 9700_w18_ms_21 Q: 3

(a)(i)	*any three from* (polymer / polysaccharide of) β-glucose ; glycosidic, bonds / linkages ; **A** glucosidic (β) 1–4 (glycosidic) bonds ; **R** if 1–6 also given *ref.* to (β) glucose units, linked at 180° to each other / alternately orientated / AW ; unbranched (polymer) / straight chain / linear ; able to form hydrogen bonds with parallel chains / AW ;	**3**
(a)(ii)	chloroplast / granum / thylakoid / middle lamella / large vacuole / nucleus at edge of cell ;	**1**
(a)(iii)	provide energy (for the cell) ; **R** produce energy any two examples ;; e.g. biosynthesis **A** named example active transport / proton pumping movement / described, e.g. movement of, vesicles / chromosomes endocytosis / exocytosis	**3**
(b)	*any two from* water molecules are dipoles ; **A** polar (each water molecule has) σ+ hydrogen (atoms) and a σ– oxygen (atom) ; the positively charged hydrogen (atom) of one water molecule is attracted to the negatively charged oxygen (atom) of another water molecule ; weak attraction between water molecules ;	**2**
(c)	*any two from* water molecules are polar ; ions are charged ; *ref.* attraction between water molecules and ions ; AVP ; e.g. oxygen σ– faces positive ion	**2**

9. 9700_w18_ms_23 Q: 1

(a)	*any three from* **1** modification / process / described, of, proteins / polypeptides ; **2** further detail of modification ; e*xamples of modification* folding of polypeptides / protein folding assembly of polypeptides to form quaternary structure addition of (named) prosthetic group addition of sugars / addition of carbohydrate / glycosylation cutting of polypeptides removal of, methionine / first amino acid making proteins functional **3** packaging into vesicles / formation of Golgi vesicles / formation of secretory vesicles ; **A** 'budding off' / 'breaking off' / transport proteins in Golgi vesicles **4** formation of (primary) lysosomes ; **5** AVP ; e.g. modification of lipids synthesis of, phospholipids / glycolipids synthesis of cell wall polysaccharides	**3**
(b)(i)	(mitochondria) provide / make / produce, ATP ; **A** needs a lot of, ATP / energy **R** 'produce / make, energy' (ATP / energy required for) protein synthesis / movement of (secretory / Golgi) vesicles / exocytosis ;	**2**
1(b)(ii)	*any two from* **1** mitochondria have (circular) DNA ; **2** mitochondria, have / make, (70S) ribosomes (for, protein synthesis / translation) ; **R** if 80S ribosomes **3** mitochondria can divide ; **R** by mitosis **4** AVP ; **5** AVP ; e.g. (mitochondrial / mt) DNA codes for (some mitochondrial) proteins mRNA transcribed from mtDNA mitochondria produce their own tRNA can replicate DNA **I** mitochondria have a double membrane	**2**
(c)(i)	*any three from* protein coat / capsid ; **A** protein layer **R** 'cell wall of protein' nucleic acid (core) ; **R** if 'in a nucleus' DNA or RNA ; acellular / non-cellular / 'not a cell' ; size – *accept within range* 15 nm to 1000 nm ; AVP ; e.g. (protein coat made of) capsomeres surrounded by, membrane / envelope / (phospho)lipid bilayer **I** antigens / enzymes	**3**
(c)(ii)	*any one from* (viruses) pass through plasmodesmata ; **A** 'cytoplasmic strands, through cell walls / between cells' via symplast pathway ;	**1**

10. 9700_w18_ms_23 Q: 2

(a)(i)	water shown formed from –OH and –H ; **A** H_2O formed without indicating where from peptide bond shown correctly between C of carboxylic acid and N of amino group ; complete dipeptide drawn ; **A** hydrogen 'up or down'	**3**
(a)(ii)	R group / side chain / variable group / residual group / functional group ; indicate, different amino acids / type of amino acid ; **A** specific to each amino acid **A** the two amino acids are different **A** two examples of R groups, e.g. –H and $–CH_3$ both amino acids have different R groups = 2 marks	**2**
(b)	*any two from* straight chain / linear, v helix / helical ; **I** coil(ed) **R** branched / branching β-glucose, not α-glucose ; **A** β-1:4 glycosidic bond v α-1:4 glycosidic bond (β-)glucose / monomers / residues, are arranged, rotated 180° to each other / AW ; AVP ; e.g. more hydrogen bonds	**2**
(c)	*any four from* **1** (molecules) form fibrils and fibres ; **2** hydrogen bonding between (cellulose) molecules ; **3** (cellulose molecule) is straight / linear ; **4** (straight chain allows) molecules lie parallel to each other ; *mp4 dependent on mp3* **5** gives strength (to cell wall) to, prevent cell bursting / withstand (turgor) pressure / AW ; **R** if only in context of a cellulose molecule **6** *ref.* to fibres at angles / criss-cross / AW ; **7** *idea of* many gaps, in wall / between fibres, allowing passage of water / named) substances / making cell wall permeable ; **I** plasmodesmata **R** partially / AW, permeable **8** AVP ; e.g. cellulose is insoluble many –OH groups (for hydrogen bonding)	**4**

11. 9700_m16_ms_22 Q: 1

A sucrose ;

B peptide ; **A** amide

C cellulose ;

D biuret ; **A** (dilute) potassium / sodium, hydroxide (solution) and (dilute) copper sulfate (solution)
R Millon's solution

E glycerol ;

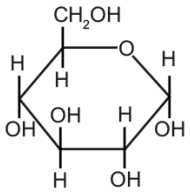
[5]

[Total: 5]

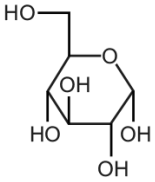
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12. 9700_s16_ms_22 Q: 6

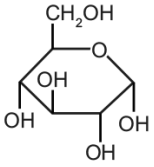
(a) (i)



1



2



3

two marks for correct drawing of ring structure **;;**
*all atoms shown **or** one of diagrams 1–3 above*

one mark if, inconsistent / incomplete, drawing:
diagram 1 – <u>one</u> missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)
diagrams 2 and 3 – adding the H to <u>one</u> of carbons 1–5 (OH groups and rest of drawing must be correct) **[2]**

(ii) glycosidic **;** **A** glucosidic **[1]**

(iii) to form / has, (glycosidic α) 1–6, bonds / links (to make branches) **;**

ref. to different shaped / specific / complementary, active site required to form bonds (for branching) **;** **[max 1]**

(b) (i) *treat as neutral unit of inheritance*
sequence of, nucleotides / bases **;**
section / length / part, of DNA (molecule) **;**
codes for a polypeptide **;** **A** protein *for polypeptide* **A** enzyme
A information to produce a polypeptide
A codes / information, for sequence of amino acids / primary structure (of a, polypeptide / protein)
R genetic code for a polypeptide **[max 2]**

(ii) **1** (in DNA / gene) altered, sequence / AW, of, nucleotides / bases **;**
I DNA sequence
2 base substitution
or base / nucleotide, replaces another, base / nucleotide**;**
A example *must be in context of, DNA / gene*
3 (mRNA synthesised) during <u>transcription</u> **;**
4 (mutation leads to) altered / AW, <u>mRNA</u> / <u>messenger RNA</u> **;**
5 (only) one (mRNA) <u>codon</u> changed / a different <u>codon</u> **;**
A one DNA, triplet / codon, changed **I** *ref. to* codon<u>s</u> changed
6 tRNA, with / has, a different anticodon **;**
7 (tRNA) brings, a different / a changed / the incorrect, amino acid, during <u>translation</u> / to the ribosome **;**
8 codon-anticodon, binding / complementary / AW **;** **A** matches
R amino acid with anticodon **[max 3]**

(c) nucleolus **;** **R** if other cell structures given
mitochondrion **;** **R** if other cell structures given

rough endoplasmic reticulum **or** Golgi (body / apparatus / complex) **;** **[3]**

[Total: 12]

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Q1.

5 (a) **(i)** haem; R. incorrect spelling
combines/binds with/carries/holds/takes up/transports oxygen; **2**

(ii) soluble/polar/hydrophilic (on outside)/compact/spherical/curled/coiled/folded (into a ball)/metabolically active;
4 polypeptides; **2**

(b) iron needed for haem/haem contains iron;
less haemoglobin (made); R. less RBCs
less oxygen transported/supplied/delivered (to cells/tissues);
less respiration/respiration rate decreased;
R.respiration less efficient/effective **max 3**

Q2.

Question **Expected Answers** **Marks**

3 (a)

roles of water	physical properties of water			
	high specific heat capacity	strong cohesive forces between water molecules	high heat of vaporisation	solvent for polar molecules and ions
transport medium in blood plasma and phloem				/
surface for small insects to walk on		/		
major component of sweat used in heat loss			/	
transpiration pull in xylem		/		
prevents wide variation in temperature	/			

Q3.

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(d) condensation (reaction) / described as elimination of water;
glycosidic, bond / link;
1:4 in, amylose / amylopectin / both;
amylose, helix / unbranched; **A** curved chain **R** straight chain
amylopectin, branched;
1:6 links (to give branches); **[max 4]**

(e) (raw material) for photosynthesis; **A** for photolysis
maintains turgidity / provides support;
pushes chloroplasts to edge of cell;
used in hydrolysis reactions;
solvent for, ions / named ion / pigment / named pigment; **[max 3]**

Q4.

3 (a)

Statement	Letter
an amino acid that is a major constituent of collagen	**J**
a component of RNA	**G** ;
a molecule polymerised to form glycogen	**D** ;
a molecule with a peptide bond	**H** ;
an important store of energy, insoluble in water	**K** ;
a molecule with hydrophilic and hydrophobic regions	**F** ;
an amino acid that forms disulfide (disulphide) bonds in proteins	**E** ;

[6]

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(b) *Assume the answer is about DNA unless indicated otherwise. A comparison is not required. Information given below is for either DNA or collagen features.* ***A*** *ideas from either column. Do not penalise if points are not corresponding on one line / sentence as long as biologically correct. Only reject if biologically incorrect. If no attempt at 2 can* ***A*** *both marks from 1 if biologically correct.*

DNA	Collagen
4 (different) monomers ;	more than four (different) monomers
(monomers =) nucleotides / polynucleotides ;	(monomers =) amino acids / polypeptides
double helix ; **A** two strands	triple helix **A** three stands
right handed helix ;	left handed helix
loose helix ;	tightly coiled
sugar ;	no sugar
phosphate / phosphorus ;	no phosphate / phosphorus **A** sulfur (sulphur) present
base(s) ;	no base(s)
phosphodiester bonds ;	peptide bonds
antiparallel strands ;	strands not antiparallel

A sugar phosphate backbone for 2 marks if nothing written by 2. [2]

Q5.

1 **(a)** **(i)** glycosidic ; [1]

(ii) hydrolysis / hydrolytic ; [1]

(iii) *assume that the answer refers to within the cell unless told otherwise*
accept any two relevant examples, e.g.
solvent / medium for reactions ;
transport medium ;
maintaining turgidity / keeping firm / prevents flaccidity / AW ;
(raw material / reactant for) photosynthesis / photolysis ;
expansion / elongation / growth ;
maintains, hydrostatic pressure / pressure potential ;
maintains water potential (gradient) ;
A maintains osmotic gradient / prevents plasmolysis
stomatal opening ;
hydrophilic interactions of membranes ;
(in vacuole) pushes chloroplast to edge of cell ;
R hydrogen bonding unqualified by ref. to membranes [2 max]

(b) spherical / ball-shaped / AW ;
has a tertiary structure ; **ignore** quaternary
hydrophilic / polar, groups on outside ;
water soluble ;
ignore 'more than one polypeptide' [2 max]

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Q6.

4 (a) (i) (describes the) sequence of amino acids (in a polypeptide chain) ; **A** order/arrangement [1]

(ii) H_2O/water, released ;
(correct) bond formation between (lysine) carboxyl group and (valine) amino group ;
dipeptide (of lysine and valine) and formed with correct structural formula ; [3]

(b) (i) *secondary*
1 regular order/pattern, based on H-bonds ;
2 between CO– group of one amino acid and NH– group of another ;
3 alpha-helix and β-pleated sheet ;

tertiary to max 4
1 folding coiling ;
2 interactions between, R groups side chains ;
3 two correctly named bonds ; e.g. hydrogen bonds, disulfide, bonds/bridges, ionic bonds, hydrophobic interactions
4 further description of bonds ; e.g. *disulfide* between cysteine (S–H) groups
hydrogen between polar groups (NH– and CO–)
ionic between ionised amine and carboxylic acid groups
hydrophobic interactions between non-polar side chains
5 ref. active site, specific/precise, shape ;
6 ref. globular/AW, shape ; **A** spherical/ball
7 ref. amino acids with, hydrophilic/polar, R groups facing to outside ; ora [5 max]

(ii) enables (protein to) function/AW ; **A** enables antimicrobial action/AW
A biological catalyst, qualified
provides active site ;
qualified ref. to specificity ; [1 max]

(c) altered, (mRNA) codon(s)/triplet(s) ; **A** named type of mutation
changed/AW, amino acid(s) ;
ref. to effects of stop codon ; e.g. shortened polypeptide chain
different, primary structure/described ;
A ref. to differences in, transcription/translation
ref. to different properties of, R group/side chain (of normal v replaced amino acid) ;
altered tertiary structure/AW ; **A** different R group interactions
A change/loss of, active site
idea of globular to fibrous change/hydrophilic R groups no longer to outside ; [3 max]

[Total: 13]

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Q7.

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3 **(a)** **(i)** primary ; **A** first
quarternary ; **A** fourth [2]

(ii) disulfide (bonds/bridges) ; [1]

(b) peptide bond broken ;
correct involvement of water ;
free –COOH/–COO^- and free –NH_2/–NH_3^+ shown ; [3]

[Total: 6]

Q8.

5 **(a)** *put ticks and crosses against the boxes*
1 – 4 and 7 – one letter only – if more than one letter mark as wrong
allow two or three correct letters for 5
allow two correct letters for 6

	statement	letter
1	contains peptide bonds	**H**
2	part of the molecule forms the hydrophobic part of cell membranes	**L**
3	contains 1-4 and 1-6 glycosidic bonds	**K**
4	forms the primary structure of a protein	**H**
5	used for energy storage in plants	**K / M / H**
6	forms a helical structure	**M / H**
7	the sub-unit molecule is β-glucose	**J**

[Total: 7]

Q9.

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5 **(a)** **A** = glycerol ;
B = ester bond ; **I** covalent
C = fatty acid *or* hydrocarbon, chain / tail ; [3]

(b) **(i)** 2, fatty acid / hydrocarbon, chain / tails ;
(third fatty acid replaced by a) phosphate group ;
AVP ; (most) contain, nitrogen / choline (attached to phosphate in, head / polar portion) ;
[max 2]

(ii) can form a bilayer ;
link between, hydrophobic core / AW, and barrier to water-soluble substances ; **A** polar / ionic
idea of, hydrophilic / phosphate, head, forming H bonds with water ;
A facing, water / watery environment / aqueous environment / cytoplasm / cytosol

ref. contribution to fluid nature of membrane ;
further detail ; e.g. mainly saturated fatty acids, less fluid e.g. mainly unsaturated fatty acids, more fluid
ref. to control over membrane protein orientation ; e.g. hydrophobic – hydrophobic interaction for 'floating' proteins [max 3]

Q10.

(b) *shown to max 2*

secondary structure ;
α / alpha, helix ; **R** 'helix' / helical structure unqualified by alpha
β pleated sheet ;
tertiary structure / folding ; **ignore** 3D shape or structure
globular ;

not shown to max 2

amino acids / primary structure / sequence of amino acids ;
(types of) R groups ;
bonds / named bonds ; **A** peptide
quaternary structure ;
prosthetic group ; [max 3]

Q11.

3 **(a)** **(i)** quarternary (structure) ; [1]

(ii) alpha / α, helix ; [1]

Q12.

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4 **(a)** glycosidic ; **A** glucosidic [1]

(b) **A** = trehalose ;
B = maltose ;
C = cellobiose ;
D = sucrose ; [max 3]

Q13.

Question			Expected Answers	Marks
2	(a)	(i)	**A** glycerol; **B** fatty acid;	**2**
		(ii)	condensation / esterification / ester bond formation;	**1**
	(b)		more energy released / stored per gram / unit / given mass; R. per mole 37 kJ v 17 kJ; A. (37-40 kJ) v (15-17 kJ) A. equivalent calorific values if calculated fats are highly reduced; more hydrogens / fewer oxygens / higher carbon to hydrogen ratio / more CH bonds; release / yield more energy when respired / oxidised;	**2 max**
	(c)		20% or more above the recommended weight / mass for height / BMI / Body Mass Index / $\frac{\text{mass kg}}{(\text{height in m})^2}$ greater than 30; A. within range (30-40)	**1**
	(d)		diabetes; coronary heart disease / atherosclerosis / cardiovascular disease / stroke / AW; hypertension / high blood pressure; cancer; arthritis / joint problems; hernia; varicose veins; gallstones; increased risk during surgical operations;	**2 max**

[Total : 8]

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Q14.

Question	Expected Answers	Marks

4 (a) *one mark per row*

statement	starch	glycogen	cellulose
glycosidic bonds between monomers	✓	✓	✓
monomer is β glucose	✗	✗	✓
stored within chloroplasts	✓	✗	✗
stored in muscle cells	✗	✓	✗
exists in two forms - branched and unbranched chain	✓	✗	✗

Do not penalise where all ✗ or ✓ s are omitted
Do penalise each row if a mixture of ✗ , ✓ , and blanks

5

5

(b) take samples at timed intervals e.g. every minute;
test with iodine solution / potassium iodide soln / **or** Benedicts ;
determine the end point, eg continue until no blue / black (colour) / yellow / brown appears **or** continue until brick red / colourless ;
time taken to reach end point e.g. record the time;
ref to use of colorimeter (for precise results) (for both experiments) **or** standards / green -> yellow -> orange -> red;
plot amount of starch remaining **or** glucose / maltose / reducing sugar produced / transmission / absorption against time / sketch graph with labelled axes;
ref to initial rate / rate calculation (e.g. $^1/_t$ or gradient from graph);

max 4

[Total 9]

Q15.

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2 **(a)** -OH is below/AW (-H) on carbon (atom) 1;

A from sketch with C1 labelled **1**

(b) **(i)** (1-4) glycosidic; **R** 1, 6 glycosidic **R** oxygen bridge **1**

(ii) **1** -OH on free molecule and end of chain indicated;

2 water eliminated/removed/condensation reaction;

3 oxygen bridge/glycosidic bond drawn in correct position relative to chain;

4 between C1 and C4, must be labelled either side of glycosidic bond; **3**

M.P.2 and **M.P.4** can be taken from written account if no diagram

(iii) cellulose; **1**

(c) amylase breaks down/hydrolyses/acts on, starch to give maltose/reducing sugar;

R glucose

maltase/amylase, denatured/active sites disrupted/tertiary structure changed, when boiled/at high temperature;

maltase does not, break down/act on/digest/hydrolyse, starch;

reference to specificity/shape and fit/lock and key explained;

R no e-s formed

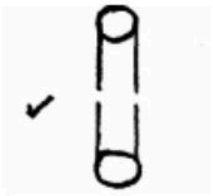
tube F is a control;

to show that there is no breakdown of starch without an enzyme **4 max**

[Total 10]

Q16.

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Question		Expected Answers	Marks
2	(a)	Bilayer/two layers; Hydrophilic part/polar head/phosphate/choline, faces, water/outside cell/tissue fluid/cytoplasm; Hydrophobic part/fatty acid chains, face each other/AW. *Accept annotated diagram*  ✓ Ref to outside/cytoplasm/ Water/tissue fluid etc.	[2]
	(b)	*Phospholipid has* Phosphate/phosphorus; Two fatty acid chains; Fatty acids of different lengths; (different numbers of carbon atoms in each chain); Different fatty acids/one is unsaturated/one has a double bond; Choline/nitrogen/base.	max [2]
	(c)	Long hydrocarbon chain/mostly CH_2 units repeated/many C-H bonds; **A** many C-H bonds Higher proportion of hydrogen/more highly reduced/few oxygen/AW; Generates much energy (when respired)/twice as much energy as carbohydrate; **A** 15-17 kJ v 37-40 kJ Compact; Can be stored in anhydrous form; Higher calorific value/more energy per unit mass/smaller mass per unit energy.	max [2]

Q17.

Question		Expected Answers	Marks
6	(a)	*Assume answers are about globular proteins* Soluble; Ref hydrophilic groups; Compact; Ref tertiary structure; AVP.	max [2]
	(b)	*2 marks if all correct, 1 mark if one wrong, no marks if two or more wrong* leu | thr | pro | glu | lys | ser	[2]
	(c)	**1 & 2** Names of four bonds; *award one mark for three named bonds.* **3** (Hydrogen bond) between polar groups; **4** (Ionic bond) between amines and carboxylic acid groups; **5** (Disulphide bond) between cysteines; **6** (Hydrophobic interactions) between non-polar side chains; **7** AVP; e.g. folding sites in 1° structures.	max [4]
			[Total: 8]

Q18.

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2 **(a)** **(i)** haem / prosthetic group ; **A** porphyrin

site of attachment of / binds with / carries / combines with / joins with / takes up / transports, oxygen ;
R absorbs / reacts with / stores
(oxygen binds to) iron ion / Fe^{2+} / FeII (in haem) ;
A atom, of iron / ferum [3]

(ii) *tertiary*
(each) polypeptide / protein, with complex 3D shape ;
folding of secondary structure / folded alpha helices ;
polypeptide / protein, coiled / folded / curled up / compact ;
1 max
quaternary
more than one polypeptide / AW ; [2]

Q19.

5 **(a)** *one mark for each row*

statement	haemoglobin	DNA	phospholipids	antibodies	
contains iron	✓	x	x	x	;
contains phosphate	x	✓	✓	x	;
able to self-replicate	x	✓	x	x	;
hydrogen bonds stabilise the molecule	✓	✓	x	✓	;
contains nitrogen	✓	✓	✓	✓	;

[5]

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(b) *AVP answers must be in context to a watery external environment*

ref to molecules held together / strong attraction / AW ;
A cohesion between water molecules
detail of hydrogen bonding, e.g. slight –ve charge on O, slight +ve charge on H ;
A water molecules are polar
high boiling point / boils at 100°C ;
high latent heat of vaporisation ;
so water is liquid over wide range of temperatures ;
(liquid so) provides, support / buoyancy ;
high (specific) heat capacity ;
stable temperature / temperature of water does not change quickly ;
large amount of energy needed to be transferred from water for it to freeze / high latent heat of fusion ;
maximum density at 4°C / less dense at 0°C ;
provides surface tension ;
ref solvent ;
AVP ;
AVP ;
e.g. ref to surface dwellers, less need for support tissue,
stable habitat qualified, ref upwelling currents
ice floats / insulates [5 max]

[Total: 10]

Q20.

2 **(a)** **(i)** *assume answer is about glycogen*

branched ;
1–6 , glycosidic, links / bonds ;
not, coiled / helical ; [2 max]

(ii) compact so large quantity can be stored ;
insoluble so no osmotic effect ;
glucose would lower water potential ; **A** decrease, more negative
(so) water would enter and cell volume would increase ;
(so) plant cells would need thicker cell walls / animal cells might burst ;
glucose reactive molecule ; [3 max]

(b) *use annotations to help award these points*

1 oxygen bridge / glycosidic bond, broken ;
2 at left hand end of chain ;
3 water shown to be involved ; **A** hydrolysis
4 free glucose molecule with –OH drawn on C1 ;
5 chain now ends with –OH on C4 ; [3 max]

[Total: 8]

Q21.

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5 **(a)** **(i)** β glucose ; [1]

(ii) glycosidic ; [1]

(b) many hydrogen bonds within the molecule ;
idea of parallel chains / AW ;
hydrogen bonds between cellulose molecules ;
to form microfibrils ;
held together by more hydrogen bonds to form fibres ; [2 max]

Q22.

3 **(a)** *primary*
sequence / arrangement / order / AW, of amino acids ;

secondary
α, helix / helices ; **A** description *ignore any ref to β / pleated, sheet*

tertiary
folding of, one / each, polypeptide / globin ; **A** coiling
(shape) held in place by interactions between, R-groups / side chains ;
A three or more named interactions

quaternary
(arrangement / interaction, of) four polypeptides / four globins / two α and two β globins ; **A** chains **A** ref. to more than one polypeptide if specific ref. to α and β chains
haem / prosthetic group ; **A** porphyrin [max 4]

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(b) six / first five and seventh, amino acids are the same ; ora amino acid at position 6 is different
both are 1. val-2.his-3.leu-4.thr-5.pro….7.glu ; *take from diagram*
variant 1 is, glutamic acid / glu (whereas), variant 2 is, valine / val ; [3]

(c) **(i)** withstands pressure ;
prevents, overstretching / AW ;
prevents, bursting / rupture / AW ; [max 1]

(ii) *assume answer is about collagen unless told otherwise*
1 polypeptides are not identical (v. 2 identical, α / β, polypeptides) ;
2 triple helix *or* three, polypeptides / helices (v. 4 polypeptides) ;
3 only composed of amino acids *or* no, prosthetic group / haem / iron ;
4 (fibrous so) not globular ;
5 no complex folding / AW (v. complex folding) ; **A** no tertiary structure
6 glycine is repeated every 3rd position / more glycine ;
7 repeating triplets of amino acids / large number repeating amino acid sequences (v. greater variety) ;
8 AVP ; e.g. different primary structure / AW
variation in amino acid sequences (v specific sequences)
all polypeptides, helical / AW (v. α different to β, polypeptides)
hydrogen bonds between polypeptides (v. Van der Waals)
covalent bonds between molecules (to form fibrils) (v. none)
300nm long polypeptides (v 5–10nm)
each polypeptide over 1000 amino acids (each 141 / 146 amino acids) [max 1]

[Total: 9]

Q23.

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4 **(a)** *allow points on annotated diagram*
if only diagram drawn, max 1 mark if not annotated
if written response given, only use diagram (if correct) to confirm mark points

1 6 carbons ; (v. 5 carbons) **A** 1 more
2 6 oxygens ; (v 4) **A** 2 more
3 12 hydrogens ; (v10) **A** 2 more
4 5 OH groups v 3 OH groups ;
} **A** more *if correct diagram drawn*

5 6-membered ring / pyranose ; (v. 5-membered ring / furanose)
6 carbon 2, OH (pointing down) / has O ; (v. H pointing down / no O) AW
7 H and OH other way round on carbon 1 ; AW
8 H and OH other way round on carbon 3 ; AW [max 3]

(b)

type of bond(s)	biological macromolecule
β,1-4 glycosidic	cellulose ;
α,1-4 and α,1-6 glycosidic	amylopectin ;
phosphodiester	mRNA ;
peptide	protein ;

R if more than one molecule in box [4]

Q24.

(b) *max 3 if only structure or only explanations given*

polysaccharide ;

chains of α-glucose (residues) ; *only need α once*
α1–4 glycosidic bonds / links ;

branches ;
(because of) α 1–6 glycosidic bonds ; *only need glycosidic once*

idea that many 'ends' to easily, add / remove, glucose ;
compact / AW ;
insoluble ;
will not affect, water potential / ψ ; AW
AVP ; [max 4]

Q25.

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(d) (i) 1 amylopectin branched / AW; **ora**
2 amylose, spiral /spiralled / helix / helical; **ora**
R α – helix
R coiled
allow ecf from mps 1 and 2 to award mp 3
3 amylose (α) 1 – 4 linkages but 1 – 4 and 1 – 6 linkages in amylopectin / amylose has 1 – 4 linkages only;
accept from clearly labelled diagram(s) [max 2]

(ii) *any one valid; e.g.*
1 for chlorophyll, structure / synthesis / formation / AW
2 for ATP functioning **A** required for energy transfers
3 for enzyme, functioning / cofactor
4 signalling ion / regulates carbon fixation
5 for, DNA / RNA, synthesis
6 stabilises, DNA / RNA, structure
7 required in, translation / joining, small and large subunits (of ribosomes) [1]

Q26.

2 (a) (i) **G ;** [1]

(ii) **B / C ;** [1]

(iii) **A / F ;** [1]

(iv) **B ;** [1]

(v) **D ;** [1]

Q27.

2 (a)

Keratin and chitin have structural functions cellulose ; collagen ; *allow only one incorrect molecule to be listed for max 1*	*Keratin is a fibrous protein* collagen ; *no marks if other molecules given*
The monomers of chitin have β-1,4 linkages between them cellulose ; *no marks if other molecules given*	*Keratin and chitin contain nitrogen* collagen / haemoglobin ; *1st mark* mRNA ; *2nd mark* *allow only one incorrect molecule to be listed for max 1*

[max 5]

Q28.

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5 (a) *mark both parts together to a maximum of four marks*

1 (polymer / polysaccharide of) β-glucose ; *allow glucose if β given for bond*
2 (1-4, β) glycosidic, bonds / linkages ; **A** glucosidic
R if 1-6 also given
3 ref. to (β) glucose units, linked at 180° to each other / alternately orientated / AW ;
4 many –OH groups projecting out (in different directions) ;
5 unbranched (polymer) / straight chain / linear ;
6 many hydrogen bonds between molecules ;
7 (straight chain allows) molecules lie parallel to each other ;
8 (form) microfibrils ;
9 many microfibrils form (cellulose) fibres ;
10 ref. to fibres at angles / criss-cross / AW ;
11 (cellulose) cell wall is permeable ;
A *idea* of many gaps, in wall / between fibres, allowing passage of water / (named) substances
12 ref. to strength to, prevent cell bursting / withstanding (turgor) pressure / AW ; [max 4]

Q29.

(c) *accept points from a diagram*

1 loss of a water molecule / condensation reaction ;

2 OH / O^-, from, carboxyl / -COOH / COO^- (group) of one amino acid ;
3 H / H^+, from, amine / NH_2 / NH_3^+ (group) of other amino acid ;
2/3 *allow one mark for ref. to involvement of carboxyl and amine group*

4 (peptide bond) links C–N ; [3]

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