AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.1.1 MONOMERS AND POLYMERS

SCORE	PERCENTAGE
/196	%

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Q1.

(a) (a monomer is a smaller / repeating) unit / molecule from which larger molecules / polymers are made;

Reject atoms / elements / 'building blocks' for units / molecules

Ignore examples

1

(b) **Similarity**

1. Both contain galactose / a glycosidic bond;

Ignore references to hydrolysis and / or condensation

Difference

2. Lactulose contains fructose, whereas lactose contains glucose;

Ignore alpha / beta prefix for glucose

Difference must be stated, not implied

2

(c) 1. (Lactulose) lowers the water potential of faeces / intestine / contents of the intestine;

Accept Ψ for water potential

2. Water retained / enters (due to osmosis) **and** softens the faeces;

Accept descriptions of soft faeces, eg faeces is less dry / less hard

2

(d) (-) 84.1(%);;

Accept (-) 84.15(%)

Allow 1 mark for

84

OR

$$\frac{2.82 \times 10^{-7} - 4.47 \times 10^{-8}}{2.82 \times 10^{-7}}$$

OR

$$\frac{2.37 \times 10^{-7}}{2.82 \times 10^{-7}}$$

2

[7]

Q2.

(a) 1. Condensation (reaction) / loss of water;

Accept each marking point if shown clearly in diagram.

2. Between amine / NH_2 and carboxyl / COOH;

Accept between amino (group) and carboxylic / acid (group)

2

(b) 1. Hydrogen bonds;

Accept as a diagram

Reject N - - - C / ionic / disulfide bridge / peptide bond

2. Between NH (group of one amino acid) and C=O (group);
OR
Forming β pleated sheets / α helix;

2

(c) 1. Different sequence of amino acids
OR
Different primary structure;

If candidate assumes proteins are the same, accept effect of different pH/ temperature

2. Forms ionic / hydrogen / disulfide bonds in different places;

2

[6]

Q3.

(a) 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid.

2

(b) Glycerol.

1

(c) Ester.

1

(d) **Y** (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain.

1

(e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100.

2

(f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;

Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape.

1

(g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

Q4.

(a) 1. Starch formed from α-glucose but cellulose formed from β-glucose;
2. Position of hydrogen and hydroxyl groups on carbon atom 1 inverted.

2

(b) 1. Insoluble;
2. Don't affect water potential;
OR

3. Helical;

Accept form spirals

4. Compact;

OR

5. Large molecule;
6. Cannot leave cell.

2

(c) 1. Long and straight chains;
2. Become linked together by many hydrogen bonds to form fibrils;
3. Provide strength (to cell wall).

3

[7]

Q5.

(a) 1. Helicase;
2. Breaks hydrogen bonds;
3. Only one DNA strand acts as template;
4. RNA nucleotides attracted to exposed bases;
5. (Attraction) according to base pairing rule;
6. RNA polymerase joins (RNA) nucleotides together;
7. Pre-mRNA spliced to remove introns.

6 max

(b) 1. Polymer of amino acids;
2. Joined by peptide bonds;
3. Formed by condensation;
4. Primary structure is order of amino acids;
5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;

Accept alpha helix / pleated sheet

6. Tertiary structure is 3-D folding due to hydrogen bonding <u>and</u> ionic / disulfide bonds;
7. Quaternary structure is two or more polypeptide chains.

5 max

(c) 1. Hydrolysis of peptide bonds;
2. Endopeptidases break polypeptides into smaller peptide chains;
3. Exopeptidases remove terminal amino acids;
4. Dipeptidases hydrolyse / break down dipeptides into amino acids.

4

[15]

Q6.

(a) 1. Maltose;
2. Salivary amylase breaks down starch.

2

(b) Maltase.

1

(c) (Mimics / reproduces) effect of stomach.

1

(d) 1. Add boiled saliva;
2. Everything same as experiment but salivary amylase denatured.

2

(e) 1. Some starch already digested when chewing / in mouth;
2. Faster digestion of chewed starch;
3. Same amount of digestion without chewing at end.

Accept use of values from graph

3

[9]

Q7.

(a) 1. **A**: phospholipid (layer);

1. Reject hydrophobic / hydrophilic phospholipid

2. **B**: pore / channel / pump / carrier / transmembrane / intrinsic / transport protein;

2. Ignore unqualified reference to protein

2

(b) (i) Condensation (reaction);

1

(ii) Organelle named; Function in protein production / secretion;

Function must be for organelle named

Incorrect organelle = 0

eg

1. Golgi (apparatus);

1. Accept smooth endoplasmic reticulum

2. Package / process proteins;

OR

3. Rough endoplasmic reticulum / ribosomes;

3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient

3. Accept folding polypeptide / protein

4. Make polypeptide / protein / forming peptide bonds;

OR

5. Mitochondria;

6. Release of energy / make ATP;

6. Reject produce / make energy

6. Accept produce energy in the form of ATP

OR

7. Vesicles;

8. Secretion / transport of protein;

2

[5]

Q8.

(a) (i) Glucose and fructose;

Ignore reference to alpha and beta

Either way around

1

(ii) Glucose and galactose;

Ignore reference to alpha and beta

Either way around

1

(b) 1. (Amylase) pancreas, produces maltose;

Place and product = 1 mark

(mark horizontally)

2. (Maltase) in / on epithelium (of small intestine), produces glucose;

Ignore references to salivary glands or saliva

Accept wall / lining of small intestine

Ignore reference to cells alone

Ignore reference to ribosomes / rER

2

[4]

Q9.

(a)

Statement	Starch	Cellulose	Glycogen
Found in plant cells	✓	✓	
Contains glycosidic bonds	✓	✓	✓
Contains β-glucose		✓	

One mark for each correct row

3

(b) Hydrolysis;

Accept: if phonetically correct

Do not accept: 'hydration'

1

(c) 1. Coiled / helical / spiral;

Feature = one mark

Explanation = one mark

Note: these are independent marking points

These must be related for <u>both</u> marks but can be in reverse order

2. (So) compact / tightly packed / can fit (lots) into a small space;

3. Insoluble;

4. (So) no osmotic effect / does not leave cell / does not affect <u>water potential</u>;

Accept: prevents osmosis

5. Large molecule / long chain;

6. (So) does not leave cell / contains large number of glucose units;

4. and 6. Accept: can' t cross membranes

7. Branched chains;

8. (So) easy to remove glucose;

2 max

(d) Two marks for correct answer of 479 - 521;

Accept: measured and actual lengths in different but correct units for 1 mark

One mark for incorrect answers in which candidate clearly divides measured length by actual length;

The actual range is 23 - 25mm, If they just divide this by 48 they gain 1 mark

Just writing the formula is insufficient, numbers must be used

2

[8]

Q10.

(a) (i) β / <u>Beta</u> glucose;

Accept b / B

*Reject any reference to alpha / **α***

1

(ii) Glycosidic;

*Reject references to **α**(1-4) glycosidic bond, but allow beta 1-4, or unspecified reference to 1-4 (1,4)*

1

(iii) OH / hydroxyl / HO;

Reject hydroxide

Reject OH / HO <u>molecule</u>

Ignore alcohol

1

(b) (i)

Starch	**Cellulose**
1. (1,4 and) 1,6 bonds / contains 1,6 bonds / branching	1. 1,4 bonds / no 1,6 bonds / unbranched / straight;
2. All glucoses / monomers same way up	2. Alternate glucoses / monomers upside down;
3. Helix / coiled / compact	3. Straight;
4. Alpha glucose	4. Beta glucose;
5. No (micro / macro) fibrils / fibres	5. Micro / macro fibrils / fibres;

1 mark per pair of contrasts, both starch and cellulose required

*Accept other comparable differences eg hydrogen bonds **within** starch but **between** cellulose molecules*

2 max

(ii) 1. H-bonds / micro / macro fibrils / fibres;

Reject strong hydrogen bonds

2. Strength / rigidity / inelasticity;

'Strong hydrogen bonds' = 0 but 'Strong hydrogen bonds give strength (to the molecule)' = 1

2

[7]

Q11.

(a) (i) Repeating units / nucleotides / monomer / molecules;

Allow more than one, but reject two

1

(ii) 1. C = hydrogen bonds;

2. D = deoxyribose;

Ignore sugar

3. E = phosphate;

Ignore phosphorus, Ignore molecule

3

(iii)

Name of base	Percentage
Thymine	34
Cytosine / Guanine	16

Adenine	34
Cytosine / Guanine	16

Spelling must be correct to gain MP1
First mark = names correct
Second mark = % correct, with adenine as 34%

2

(b) (i) 153;

1

(ii) Some regions of the gene are non-coding / introns / start / stop code / triplet / there are two DNA strands;

Allow addition mutation
Ignore unqualified reference to mutation
Accept reference to introns and exons if given together
Ignore 'junk' DNA / multiple repeats

1

[8]

Q12.

(a) Amino acid / amino acids ;

If anything else is given as well do not award mark.

1

(b) (i) 1. Affects one monomer / amino acid;
i.e. What is affected

2. Not found in all active sites;
i.e. Where it is found.
2. Must relate to active site. Enzyme is insufficient.

2

(ii) 1. **X**;

2. Enzyme in both pathways;
2. Award independently

2

(c) 1. Occupies / blocks / binds to active site;
i.e. What it does in terms of the active site.

2. Substrate will not fit / does not bind / no longer complementary to / enzyme-substrate complex not formed;

1. Ignore references to change in shape and shape of aspirin molecule.
Ignore reference to competitive inhibitor i.e. Consequence required

2

[7]

Q13.

(a) (i) Hydrolysis;

Accept phonetic spelling.

Ignore reaction.

1

(ii) (Alpha) glucose;

Accept α glucose.

Reject β glucose / beta glucose

1

(b) (i) Add Benedict's (reagent) and heat / warm;

Red / orange / yellow / green (colour);

Reject Add HCl

Accept brown, reject other colours

2

(ii) 2 products / 2 sugars produced;

*Look for idea of **two***

Accept named monosaccharides produced.

''More" insufficient for mark

Neutral if incorrect products named

Neutral ''lactose is a polysaccharide"

Neutral "lactose is not a reducing sugar"

Neutral: Reference to surface area.

1

(c) 1. Galactose is a similar shape / structure to lactose / both complementary;

Q Reject: Same shape / structure

2. (Inhibitor / Galactose) fits into / enters / binds with active site (of enzyme);

Accept blocks active site

3. Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

Look for principles:

1. Shape

2. Binding to active site

3. Consequence

2 max

[7]

Q14.

(a) 1. Hydrolysis breaks proteins / hydrolyses proteins / produces amino acids (from proteins);

2. Protein synthesis involves condensation;

2

(b) Amino acids (from calliphorin) can be joined in different sequences /

rearranged;

1

(c) 1. Fall, rise and fall;

2. Rise after 40 and fall after 80;
Ignore concentration values.

2

(d) (i) Fall / increase then fall;

Lysosomes associated with tissue breakdown;

2

(ii) 1. Tissues / cells are being broken down;

2. RNA is digested / hydrolysed / broken down;

3. By enzymes from lysosomes;

4. New proteins not made / no new RNA made;

2 max

(e) 1. (RNA) associated with making protein;

2. New / adult tissues are forming;

2

(f) 1. In the first 6 days no / little oxygen supplied / with breakdown of tracheae, no / little oxygen supplied;

2. (Without tracheae) respire anaerobically;

3. Anaerobic respiration involves reactions catalysed by enzyme **B** / conversion of pyruvate to lactate / involves lactate production;

4. Enzyme **A** / Krebs cycle is part of aerobic respiration;
Or, with emphasis on aerobic respiration:
1. Tracheae supply oxygen / after 6 days oxygen supplied;
2. (With tracheae) tissues can respire aerobically.

4

[15]

Q15.

(a) Double bond(s);

(Bonds) between carbon;
C=C bond(s) = 2 marks
'No' C=C bond(s) disqualifies 1 mark only
Accept: does not contain maximum number of H for 1 mark
Neutral: contains C=O bonds

2

(b) Graph shows negative correlation / description given;

Correlation does not mean causation / prevention / shows lower risk not

prevention;

May be due to another factor / example given;

Neutral: refs. to methodology e.g. sample size / line of best fit

***Q**: Do not allow 'casual' relationship*

3

(c) (i) Glycosidic;

Accept: if phonetically correct

Reject: ester bond

1

(ii) Contains glycerol / three fatty acids / forms three ester bonds;

Neutral: contains less fatty acids

Answers must refer to a triglyceride

Ignore refs. to incorrect bond names

Neutral: olestra has eight fatty acids / R groups

Reject: contains three glycerols

1

(iii) 9;

1

[8]

Q16.

(a) Helical / spiral / coiled;
Compact / description e.g. 'tightly packed';

Feature = one mark
Explanation = one mark

Insoluble;
Prevents osmosis / uptake of water / does not affect water potential / (starch) does not leave cell;

These must be related for both marks but can be in reverse order.

Large molecule / long chain;
Does not leave cell;

Allow idea of compact / helical / spiral / coiled due to bonding for two marks.

2 max

(b) (i) β / beta Glucose;

***Q** Reject alpha glucose*

1

(ii) Glycosidic;

1

(c) Long / straight / unbranched chains (of glucose joined by) hydrogen bonds;

***Q** Ignore reference to alpha glucose*

Form (micro)fibrils / (macro)fibrils;

Provide rigidity / strength / support;

Allow suitable descriptions for last point e.g. 'prevents bursting';

3

[7]

Q17.

(a) (i) (Lactose +) Water; → (Glucose +) Galactose;

Accept: H_2O for water

2

(ii) Hydrolysis;

Accept: if phonetically correct

1

(b) (i) (Add Biuret reagent to both solutions) – no mark;

Neutral: positive / negative result

Lactase / enzyme will give purple / lilac / mauve;

Neutral: incorrect reference to the method

OR

Lactose / reducing sugar will not give purple / lilac / mauve / will remain blue;

1

(ii) Lactase / enzyme is a protein;

Accept: lactase / enzyme contains peptide bonds

1

[5]

Q18.

(a) (i) Glucose;

Fructose;

Any order.

2

(ii) Lactose has a different shape / structure;

Does not fit / bind to active site of enzyme / sucrase;

Only allow a second mark if reference is made to the active site.
Max 1 mark if active site is described as being on the substrate.

OR

Active site of enzyme / sucrase has a specific shape / structure; Does not fit / bind to lactose;

Do not accept same shape.

2

(b) (i) Rose and fell;

Peak at 45 (minutes) / concentration of 6.6 (mmol dm^{-3});

2

(ii) Glucose (produced by digestion) is absorbed / enters blood;

Decrease as used up / stored;

2

[8]

Q19.

21 – 25	Extended abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16 – 20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.
11 – 15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.
6 – 10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail,

		or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	**Definition**
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. ‘Several’ here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary

	considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at A-level standard.

Please note that to obtain full credit, students must use information to show **the importance of how the structures of different polymers are related to their functions**.

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Topics

3.1.1	Monomers and polymers
3.1.2	Carbohydrates
3.1.4	Proteins
3.1.5	Nucleic acids
3.2.3	transport across membranes
3.2.4	Cell recognition and the immune system
3.3.3	Digestion and absorption
3.4.1	DNA, genes and chromosomes

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not

be given for topics beyond the specification which are below A-level standard.

[25]

Q20.

(a) (i) both are polymers / polysaccharides / built up from many sugar units / both contain glycosidic bonds / contain (C)arbon, (H)ydrogen and (O)xygen;

1

(ii) hemicellulose shorter / smaller than cellulose / fewer carbons;
hemicellulose from pentose / five-carbon sugars and cellulose from hexose / glucose / six-carbon sugars;

(only credit answers which compare like with like.)

2

(b) protein / nucleic acid / enzyme / RNA / DNA / starch / amylose / amylopectin polypeptide;

1

(c) (i) to make sure that all the water has been lost;

1

(ii) only water given off below 90 °C;
(above 90°C) other substances straw burnt / oxidised / broken down;
and lost as gas / produce loss in mass;

2

(d) enzymes are specific;
shape of lignin molecules will not fit active site (of enzyme);
OR
shape of active site (of enzyme);
will not fit molecule;

2 max

(e) 1. made from β-glucose;
2. joined by condensation / removing molecule of water / glycosidic bond;
3. 1 : 4 link specified or described;
4. “flipping over” of alternate molecules;
5. hydrogen bonds linking chains / long straight chains;
6. cellulose makes cell walls strong / cellulose fibres are strong;
7. can resist turgor pressure / osmotic pressure / pulling forces;
8. bond difficult to break;
9. resists digestion / action of microorganisms / enzymes;

(allow maximum of 4 marks for structural features)

6 max

[15]

Q21.

(a) (i) (Molecule) made up of many identical / similar molecules / monomers / subunits;

Not necessary to refer to similarity with monomers.

1

(ii) Cellulose / glycogen / nucleic acid / DNA / RNA;

1

(b) (i) To keep pH constant;

A change in pH will slow the rate of the reaction / denature the amylase / optimum for reaction;

2

(ii) Purple / lilac / mauve / violet;
Do not allow blue or pink.

1

(iii) Protein present / the enzyme / amylase is a protein;
Not used up in the reaction / still present at the end of the reaction;

2

[7]

Q22.

(a) (i) condensation;

1

(b) (i) **D**;

1

(ii) **C**;

1

(iii) **A**;

1

(c) absence of a double bond;
in the (hydrocarbon) chain;
unable to accept more <u>hydrogen</u> / saturated with hydrogen;

2 max

[6]

Q1.

Question (a) was a question requiring recall of a definition from the specification. Almost 60% of students gained the mark; those who failed to score only gave the first part of the definition, i.e. it is a small unit. Many students also used simpler descriptive words, such as ‘building blocks.’

Question (b) required a similarity and a difference; students generally performed well with the similarity, but failed to give a difference, with answers such as “lactulose contains fructose”. Students must state the actual difference when asked, e.g. lactulose contains fructose but lactose contains glucose.

Question (c) showed that many students do not understand high and low water potentials, confusing the two. Also, many students thought water moved from the lactulose solution into faeces, thereby showing a lack of understanding of water movement by osmosis. Only 28.6% scored two marks.

In question (d), students did not show an understanding of how to use standard form, with many choosing to ignore it. Only 12.2% of students scored two marks, and 77.9% scored zero. A common error was to base the calculation on the lower range of H^+ concentration.

Q2.

Generally, students demonstrated their good knowledge of protein structure in (a). Most students achieved a mark for naming condensation and many went further to describe the groups involved in joining together amino acids. Diagrams used to support descriptions were almost invariably accurate and labelled fully. Those who scored no marks (17%) named the reaction as hydrolysis, gave lengthy accounts of translation, referred to a reaction between H and OH, or confused the amine group with nitrate/nitrile.

In (b), 35.4% of students gained two marks, usually by referring to the involvement of hydrogen bonds in forming an alpha helix or beta-pleated sheet. The first alternative in mark point 2 was less often seen and students were often muddled about what bonded to what. Precise and well explained descriptions of hydrogen bonding were present in a few answers. Some students confused protein structure with nucleic acid structure. It was not unusual for students to have no idea about how secondary structure is produced.

In many answers to (c), students applied their understanding well and gave clear and often succinct explanations of why tertiary structures differed, using appropriate AS biology knowledge. Those who scored one mark often did not name the bonds or mention the ‘different location’ of bonds, and they could not explain the idea of ‘different sequences’. Some answers missed the point of the question by describing how tertiary structures formed, or confused DNA structure with protein structure. Some students incorrectly used the degenerate nature of the DNA code as the reason why primary structure varied. The alternative interpretation relating to changes being caused by variation in pH or temperature was seen a number of times and gained a mark.

Q7.

(a) The majority of students gained both of the marks on this question, although some failed to score because they made unqualified references to protein or lipid. Although some students had learnt the term ‘integral protein’, few qualified this to show they recognised this integral protein spanned the membrane. A few answers referred to guard cells, microvilli and mitochondria, suggesting that the students had

not understood the difference between the molecular structure of a membrane and the gross structure of cells or organelles.

(b) (i) Most students knew this term although some were clearly guessing between condensation and hydrolysis, having written both down and then crossed out one or other of the terms.

(ii) The great majority of students gave mark points 3 and 4, with a few failing to score because they used abbreviations such as ER or RER. These abbreviations were not accepted, since students were asked to name the organelle. The full name endoplasmic reticulum is given in the specification, with no abbreviation offered as an alternative. Where Golgi was given as the organelle, the associated function was not often correctly linked to protein formation. For mark point 6 (release of energy / make ATP), references to producing or making energy were not given credit. Incorrect references to cilia, microvilli, stomach acids and lysosomes suggested that some students did not understand what was meant by the term organelle.

Q8.

(a) It was pleasing to find that the vast majority of students are familiar with the monosaccharides in sucrose and lactose.

(b) This proved to be one of the most challenging questions on the paper. Only about ten percent of students got both marks and sixty-five percent scored zero. The question clearly asks about digestion of starch in the small intestine. Despite this, many had the salivary glands as the site of production of the amylase active in the intestine (which was ignored by the examiners). Very few had any idea where maltase is produced and answers ranged from the thyroid gland to the pancreas.

Q9.

Given that this question was targeted at grade **E**, it is surprising that all parts proved to be good discriminators.

(a) Nearly half of students gained full marks. Students who did not showed a vast range of incorrect answers.

(b) Most students correctly named the type of reaction as ‘hydrolysis’. The most common incorrect response was ‘condensation’.

(c) Just over 60% of students gained full marks. This was usually for relating the insolubility of starch to no osmotic effect, or the coiled shape of starch to being compact. However, some students were prevented from scoring full marks due to giving a definition of ‘compact’. The response ‘compact so can fit a lot into a small space’ was frequently seen.

(d) Nearly half of students scored full marks. A common error seen in weaker responses was to divide the actual length by the measured length. Similarly, the ability to convert between millimetres and micrometres proved to be a good discriminator.

Q10.

(a) (i) This was generally well known, although a significant number of students did not qualify the beta glucose. Amino acids and bases were given by a few students.

(ii) Also generally well known, with most students gaining the mark.

(iii) This was answered less well than the first two parts of this question. Incorrect answers included ‘hydrogen’, ‘hydroxide’ and ‘alkali’ showing students knew what should be there but not the correct term for the group.

(b) (i) This question was answered well. The most frequent correct responses were for identifying the glucose isomer and molecular shape. Incorrect responses gave functional comparisons, rather than structural, or failed to compare like with like.

(ii) Quite a high proportion failed to attempt this question otherwise it was generally answered well, with a variety of explanations that showed good understanding. Incorrect references to ‘strong hydrogen bonds’ resulted in a number of students failing to gain credit.

Q11.

(a) (i) Students were aware that polymers were made of many monomers, but in many cases went on to include descriptions in their answers that implied they did not understand what the monomers in this case were. A number of answers suggested that each strand was a monomer or that the monomers were amino acids.

(ii) Most students knew the names of the parts of the diagram; the most common mistake was giving ‘sugar’ or ‘ribose’ instead of deoxyribose.

(iii) In order to gain both marks, students had to show that they knew the names of the bases. This proved very revealing in that almost all knew the initial letters of the four bases but only a minority could write down the names correctly. About half were able to complete the simple calculation to give the percentage of the other three bases.

(b) (i) Those who failed to gain credit often did so because they were, apparently, of the opinion that one base coded for three amino acids.

(ii) Introns, non-coding DNA, start and stop codes were all known to be non-coding DNA and, thus, adding to the length of the gene without contributing to the polypeptide. Some students also mentioned addition mutations or the fact that there are two strands. A minority of students incorrectly linked the degeneracy of the genetic code to the difference in number of bases.

Q12.

There was much evidence from the answers to different parts of this question of the difficulties that many students experience with comprehension questions. It appeared that many of those of more limited ability took very little note of the information in the passage or of instructions embedded within the questions. They identified this question as relating to enzyme inhibition and sought refuge in set responses, many of which were largely irrelevant. Further evidence of the difficulties that the question presented was provided by the number of answers that were crossed through and rewritten on extra sheets.

(a) Most students correctly identified the monomers concerned as amino acids.

(b) Students, who read the question carefully and noted the information to which the lines referred, should have been able to point out in their answers to part (i) that aspirin would bind to one of the amino acids making up the active site and that

different enzymes would have different amino acid sequences. Responses along these lines were made by disappointingly few students. Better students produced economical answers to part (ii) in which they correctly identified enzyme **X** and explained that it was involved in the production of both prostaglandins and thromboxane. Others wrote at great length with tortuous logic and often included detailed quotes from the passage of marginal relevance.

(c) Many students appeared to be of the opinion that aspirin was a non-competitive inhibitor and described it binding at some site on the enzyme other than the active site. Most of these students, however, were able to gain some credit for correctly pointing out that the substrate itself could not bind and produce an enzyme-substrate complex.

Q13.

(a) (i) Most candidates correctly named the type of reaction as hydrolysis.

(ii) Most candidates correctly named glucose.

(b) (i) Most candidates gained full marks for describing the test for reducing sugars accurately. Some did not mention the need for heat, and a few could not recall the correct test – the biuret test being the most common error. A few candidates lost credit because they described the non-reducing sugar test and hydrolysed with hydrochloric acid first.

(ii) The majority of the candidates could explain the idea that one molecule of lactose was being hydrolysed to give two molecules of product, both of which were reducing sugars. The commonest reason for missing the mark was when students paraphrased the stem of the question, stating that the reason there was a higher concentration of reducing sugar was because there was more reducing sugar present. A surprising number of candidates gave answers relating to an increase in surface area.

(c) Although many candidates gained full marks on this question there was a significant number who were confused about the position of the active site, placing it on the sugar rather than the enzyme. A number of candidates thought that galactose would bind to lactose rather than lactase.

Q14.

This question was intended to be synoptic and as such required a basic understanding of principles established in other units. There were some outstanding answers but it was also disappointing to note that there were many candidates who clearly had little idea of the functions of cell organelles or of the role of ribosomes and RNA in protein synthesis.

(a) There were, perhaps inevitably, candidates who confused condensation and hydrolysis but most were able used the terms appropriately in the context of protein digestion and synthesis.

(b) Those who understood protein structure usually gained credit, but almost two-thirds of all candidates made no progress here. While the most frequent problems stemmed from confusing amino acids with bases, others appeared uncertain that proteins could be digested.

(c) Most, but by no means all, candidates identified the overall trend of decrease, increase, decrease but rather fewer supported this with data from the table relating to the age of the pupa. Where the age was quoted, it was not uncommon to see it

given in days or years. A little common sense might have excluded the latter.

(d) Answers to part (i) might have been better had more candidates distinguished between the roles of lysosomes and ribosomes. There were many responses associating an increase in lysosomes with increased protein synthesis towards the end of the time spent as a pupa.

Others linked lysosomes with disease and answered in terms of increased exposure to bacterial infection. A major misconception in the answers to part (ii) was that protein synthesis would decrease RNA concentration as it was “used up” in the process.

(e) Although some of the candidates answering this part of the question were unable to identify the trend in the table, most recognised that tissue formation involved protein synthesis and hence the increase in RNA.

(f) This question discriminated very effectively over the range of available marks but, at all levels of ability, candidates appeared to find difficulty with spelling the words aerobic and anaerobic. Examiners try to avoid being unnecessarily pedantic over the spelling of technical terms but the onus is on candidates to make their intentions clear, particularly when the words concerned are closely similar. A considerable number of candidates failed to equate tracheae with insect gas exchange and wrote of breathing and the lungs.

Q15.

(a) 42% of candidates were aware that an unsaturated fatty acid contains carbon-carbon double bonds and gained full credit. However, most candidates gained one mark for the idea of double bonds. Weaker candidates often wrote about the health benefits of unsaturated fatty acids.

(b) Nearly 60% of candidates gained at least two marks. This was typically for appreciating that the graph shows a reduced risk, not prevention, of coronary heart disease or that other factors may also reduce the risk. Many candidates also described the negative correlation. However, weaker candidates sometimes left this as ‘there is a correlation’.

(c) (i) Just over 60% of candidates correctly identified X as a glycosidic bond. Common incorrect responses seen were ‘peptide, ‘ester’, ‘ionic’, ‘covalent’ and ‘hydrogen’.

(ii) Just over half of the candidates gained the mark for stating that a triglyceride contains glycerol or three fatty acids. However, some candidates clearly confused a triglyceride with a phospholipid and made reference to a phosphate group or two fatty acids. Weaker candidates were often let down by poor expression or a lack of detail. These candidates often referred to a triglyceride containing three glycerol molecules and some confused glycerol with glycogen.

(iii) Only 20% of candidates gave the correct response 9.

Q16.

(a) Most candidates obtained at least one mark, often for indicating that starch is insoluble or has a coiled structure. Approximately a third of candidates obtained a second mark for explaining how a particular feature of starch enables it to act as a storage substance. However, a significant minority of candidates scored zero, often

by failing to provide sufficient details or by describing the structure of a protein.

(b) (i) Just over half the candidates correctly named part A as beta glucose. Glucose on its own as an answer was not credited. Common incorrect responses included alpha glucose, deoxyribose and amino acid.

(ii) Most candidates correctly named bond B as glycosidic. A common incorrect response was hydrogen.

(c) Very few candidates failed to gain at least one mark on this question. Almost a third of candidates gained all three marks. Most candidates mentioned that the cell wall provides strength and support with many also referring to the presence of hydrogen bonds. Better candidates included reference to the long, straight chains of glucose and described how microfibrils or macrofibrils are formed.

Q17.

(a) (i) It was disappointing that only one third of candidates scored full marks on this question, given that it was targeted at grade E and involved straightforward recall. However, most candidates gained at least one mark for correctly naming water as the reactant or galactose as the product. A common incorrect response for the missing reactant was ‘lactase’, despite this being given in the stem of the question. There was a wide variety of suggestions for the missing product. These included water, fructose, maltose and sucrose.

(ii) Over 70% of candidates correctly named the reaction as hydrolysis. The most common incorrect responses seen were ‘digestion’ and ‘condensation’.

(b) There was widespread failure to read the stem of each question part, which resulted in only a minority of candidates gaining full credit. It was also clear that many candidates had failed to distinguish between the terms ‘describe’ and ‘explain’ for part (i) and (ii) respectively.

(i) There were numerous references to the Benedict’s test for reducing sugars and, to a lesser extent, iodine solution and universal indicator. It was also clear from the colour changes given that many candidates were not familiar with basic food tests. Candidates who did refer to the biuret test often limited their answer to describing the method and naming the reagents involved. For those who did mention a purple colour, it was not often clear if they were referring to lactose or lactase.

(ii) Many candidates gave the answer to (b)(i) here but failed to explain why this result would be achieved.

Q18.

(a) Most candidates were able to identify glucose as one of the monomers from which a molecule of sucrose was formed, but there was less certainty about the other. Part (ii) was designed to be accessible to grade E candidates and, in view of this, it was disappointing to see so few gaining full credit. There were a number of predictable errors such as in describing the active site as being on the substrate, and in maintaining that active site and substrate were the same shape. Credit was generally lost however because of a lack of precision in the answers. There were many general references to specificity that were simply worded in terms of sucrose and lactose not being ‘specific to each other’ or enzymes being specific to a particular substrate. Good answers amplified the concepts of shape and fit with appropriate reference to complementarity and the active site of the enzyme.

(b) It is encouraging to note that most candidates were able to describe the data in the graph with appropriate precision and gained full credit for their answers to part (i). There were, however, candidates who failed to distinguish between the terms 'describe' and 'explain' and offered inappropriate responses both here and in part (ii). In part (ii), better candidates generally identified the role of absorption in raising the glucose concentration and respiration or storage resulting in the fall after 45 minutes. Difficulties arose where candidates referred imprecisely to sugar, and there were many answers where the examiners were left unclear as to whether glucose or sucrose was being discussed. It was also apparent that many candidates considered the graph to be showing some aspect of enzyme activity and responded in terms of the effect of a particular parameter on substrate or product concentration.

Q19.

Unit 8

It is difficult to comment meaningfully on the standard of the essays this year compared to that in previous years. Essays ranged from the outstanding to the extremely weak and their quality appeared at times to be independent of the quality of the responses to the other questions in the paper. Thus, there were some excellent answers to questions 1 and 2 which were followed by extremely limited essays and, at the other extreme, papers whose sole redeeming feature was a competent essay. Particularly apparent this year were the many essays which showed no evidence whatsoever of a plan. They were often poorly organised and lacked coherence, with timing often presenting an additional problem. Many candidates still see length in itself as a virtue. Such candidates often produced scripts with two or three extra sheets attached. They often started with some promise but frequently incorporated much that at best could only be regarded as being of marginal relevance.

There were some outstanding essays on this topic where the detail throughout was fully in keeping with what might be expected of an A-level candidate, and which did not stray from the theme of the relationship between structure and function. Such essays were a pleasure to read and mark. Others, although sound and attracting considerable credit, tended to belabour particular aspects unnecessarily. A frequent example of this was in protein structure where the concept of shape and fit was illustrated at considerable length with enzymes, hormones, carriers, and antibodies. All were correct and each was relevant but, taken together, they contributed little more than could be provided by considering one example. This approach not infrequently led to candidates discussing one particular polymer at great length at the expense of others, thus affecting the overall balance of the essay. At the other end of the spectrum, it was apparent that some candidates were uncertain as to the meaning of the term 'polymer'. It was not unusual to see substantial paragraphs written about lipids, and there were also frequent references to "small polymers such as glucose and maltose". Apart from this, errors often arose from a poor understanding of technical terminology. Thus a- and P-glucose were regularly confused; cellulose molecules were described as consisting of p-pleated sheets, and there was considerable uncertainty over the relationship between amino acids and DNA, the latter all too frequently being described as a polymer of the former.

Unit 9

The essays varied greatly in length and biological content, but less so in breadth and relevance. Many essays showed good evidence of planning in a way which would clearly be useful to the author, and which kept their work relevant. Some candidates failed to plan at all.

The competence with which the scientific terminology was used was pleasing, with many technical terms being used in the majority of essays. Weaker candidates tended to relate

their work in everyday language, dwelling on the distribution of large surface areas rather than on the link with transfer processes.

Many of the candidates who chose to write this essay showed themselves to be competent biochemists. They understood the nature of a polymer, and frequently opened their essay with a definition. Some of the best candidates were at pains to point out that lipids were not polymers, and so would not be discussing them. Sadly, some thought they were, and included as much on this group of substances as they did on the relevant ones.

The most frequently discussed polymers were proteins and carbohydrates. Extensive and detailed knowledge of the structure of proteins was included, with descriptions of peptide bonds, primary to quaternary structures, and the bonds which hold them together. Weaker candidates were somewhat haphazard in their descriptions, but the better ones were not only capable of demonstrating a lot of detail but their approach was highly logical. The links with function were less competent. Some simply offered a selection of proteins, while the best essays discussed the differences, for example, between those with a simple secondary structure compared with the globular examples. Frequent choices were enzymes and haemoglobin. Other interesting additions included keratin, antibodies and hormones; although most felt there was no need to comment on the fact that not all hormones are proteins. As a consequence a few lipids were mentioned. The work on the structure was in far more detail than the function in many cases, leaving candidates missing the opportunity to demonstrate detailed knowledge of the control of blood glucose, the principles of immunology, and the transport of blood gases. This was a route which could have been exploited by those capable biologists whose biochemistry is perhaps a little sketchy.

The work on the structure of carbohydrates was equally detailed by a lot of candidates who chose this essay. However, it was much more often that the function of the molecule was linked very closely to its structure. Starch and glycogen were described as large, compact molecules while the work on cellulose reflected its role in the structure of a plant. There was some confusion over the solubility of some of these molecules.

Candidates who moved on to discuss the nucleic acids were less frequently seen. Those that did gave good descriptions of their structure, but a number went on to give huge amounts of detail about the processes in which they play a part, rather than making the more careful links to their function. Full details of protein synthesis, DNA replication, and genetic engineering, were inappropriate. Weaker candidates confused nucleic acids with proteins.

It was easy for candidates to use this essay to show their A-level knowledge. Some candidates tried to use the outline of an essay they may have written earlier on a single polymer. There was a wide range of marks, with a good number of the better candidates gaining full or close to full marks.

Q20.

(a) (i) Answers to parts of this question were not infrequently marred by lack of knowledge of the basic structure of cellulose as a polymer of β-glucose. Thus, although all that was required here was to note that both molecules were polymers, many disqualified their answers by referring to cellulose as also being a pentose.

(ii) Limited question technique frequently restricted the credit available. Many candidates concentrated on functional rather than structural differences. As a consequence, the answer boxes were often so full that they rarely compared like with like and offered a valid comparison. Among the better, more focused, answers were some which unfortunately were a little too concise, referring to

hemicellulose as a pentose and cellulose as a hexose. Questions requiring structural similarities are likely to remain a feature of BYA1. Candidates clearly need an effective strategy for answering them.

(b) Starch and protein were correctly identified by many, but a range of incorrect responses included glycogen, phospholipid and various monosaccharides.

(c) (i) Answers suggested that, although candidates were clearly familiar with the term “constant mass”, they were by no means all conversant with the idea that it represented the point at which all water had been lost.

(ii) There were many correct answers. Answers to this second part, such as “Going over 90 °C would start to boil the water so that we would be unable to calculate the water content” were frequent and suggested that candidates had failed to focus on the information provided in the second paragraph of the passage. The better candidates at whom this question was directed were generally able to point out, however, that high temperatures might lead to other substances being broken down and a consequent loss in mass.

(d) Although most candidates were aware of the specific nature of enzyme action, they experienced varying degrees of difficulty in relating the general concepts involved to the context of this question. Those candidates who gained least credit were inclined to reword the question and offer an explanation in terms of the lignin covering. Others offered responses centred around lignin acting as an enzyme inhibitor. Better candidates clearly understood the concepts of molecular shape and fit and were able to apply them to this situation.

(e) Answers to this part of the question ranged from those of the more able candidates who wrote clearly and logically about cellulose structure and function, often with a pleasing level of accuracy and detail, to those which did not gain credit. Among the latter were many who failed to attempt this part of the question and others who confused cellulose with other molecular components of plant cells such as starch and plasma membranes. There was much confusion between hydrogen bonds and glycosidic bonds, and between α-glucose and β-pleated sheets.

Other incorrect assertions which frequently arose were that cellulose is formed from alternating α- and β-glucose residues, and that it contains both 1-4 and 1-6 linkages. Many candidates correctly identified strength as one of the molecule’s properties and went further in discussing the importance of this in withstanding pressures resulting from osmosis. A frequent error, however, was to assign the function of energy storage to cellulose.

Q21.

(a) Imprecise expression frequently limited the marks awarded for part (i). Care clearly needed to be taken to avoid suggesting too few components, with answers such as that a polymer consisted of ‘two or more’ monomers. Those who did not make use of the term ‘monomer’ needed to indicate, in some way, the similarity of the constituents. They did not always do this. The most frequent reason for failing to gain credit for part (ii) was where candidates gave substances, such as haemoglobin and amylopectin, which were excluded by the wording of the question. Nevertheless, many candidates gave correct answers.

(b) In part (i), most candidates recognised the importance of buffers in maintaining pH, although some associated them with temperature. Better candidates could generally develop the idea and usually gained a second mark through reference to denaturation. Unfortunately, some saw parts (ii) and (iii) as a trick and pointed out

that since starch was not a protein, it would give a negative result. Others made the same error by simply failing to focus on the right component of the mixture. Perhaps more disturbing is the continued failure of so many candidates at this level to learn the relevant information relating to basic biochemical tests. There was again much confusion over test and result, apparent both here and in the answers to Question **4** (b).

Q22.

(a) The vast majority of candidates gained the mark, with only a few confusing hydrolysis with condensation.

(b) Most candidates scored full marks, the most common error occurring in (ii) where the substrate of amylase was identified as protein.

(c) The difference between the types of fatty acids was well understood in terms of double bonds but very few candidates then went on to mention the location of the bonds or describe saturation with reference to hydrogen. Weaker candidates identified the bonds involved as hydrogen and therefore failed to obtain any marks.