AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.1.2 CARBOHYDRATES

SCORE	PERCENTAGE
/ 416	%

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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. Named structures – trachea, bronchi, bronchioles, alveoli;

Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

2. Above structures named in correct order

OR

Above structures labelled in correct positions on a diagram;

Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

3. Breathing in – diaphragm contracts **and** external intercostal muscles contract;

4. (Causes) volume increase and pressure decrease in thoracic cavity (to below atmospheric, resulting in air moving in);

For thoracic cavity accept 'lungs' or 'thorax'.

Reference to 'thoracic cavity' only required once.

5. Breathing out - Diaphragm relaxes **and** internal intercostal muscles contract;

*Accept diaphragm relaxes **and** (external) intercostal muscles relax **and** lung tissue elastic (so recoils).*

6. (Causes) volume decrease and pressure increase in thoracic cavity (to above atmospheric, resulting in air moving out);

For thoracic cavity accept 'lungs' or 'thorax'.

Reference to 'thoracic cavity' only required once.

If idea of thoracic cavity is missing or incorrect, allow ECF for mark point 6.

6

(b) 1. Both contain ester bonds (between glycerol and fatty acid);

All statements must be clearly comparative or linked by the candidate, not inferred from separate statements.

Accept mark points shown on adjacent annotated diagrams.

2. Both contain glycerol;

3. Fatty acids on both may be saturated or unsaturated;

4. Both are insoluble in water;

5. Both contain C, H and O but phospholipids also contain P;

Must relate to element.

6. Triglyceride has three fatty acids and phospholipid has two fatty acids plus phosphate group;

7. Triglycerides are hydrophobic/non-polar and phospholipids have hydrophilic and hydrophobic region;

Accept 'non-polar' for hydrophobic and 'polar' for hydrophilic.

8. Phospholipids form monolayer (on surface)/micelle/bilayer (in water) but triglycerides don't;

5 max

(c) 1. Glucose **and** galactose;

Ignore α or β for glucose

2. Joined by condensation (reaction);

3. Joined by glycosidic bond;

4. Added to polypeptide in Golgi (apparatus);;

4

[15]

Q3.

(a) 1. Cellulose is made up of β-glucose (monomers) **and** glycogen is made up of α-glucose (monomers);
2. Cellulose molecule has straight chain **and** glycogen is branched;
3. Cellulose molecule has straight chain **and** glycogen is coiled;
4. glycogen has 1,4- and 1,6- glycosidic bonds **and** cellulose has only 1,4-glycosidic bonds;

Ignore ref. to H bonds / microfibrils

2 max

(b) Any **two** from:
1. Insoluble (in water), so doesn't affect water potential;
2. Branched / coiled / (α-)helix, so makes molecule compact;
OR
Branched / coiled / (α-)helix so can fit many (molecules) in small area;
3. Polymer of (α-)glucose so provides glucose for respiration;
4. Branched / more ends for fast breakdown / enzyme action;
5. Large (molecule), so can't cross the cell membrane

*Require feature **and** explanation for 1 mark*

1. Accept Ψ or WP

1. Accept Insoluble so doesn't affect osmosis

*1. Do **not** allow ref to 'doesn't affect water leaving cells*

4. Ignore 'surface area'

4. Accept 'branched so glucose readily released'

2 max

(c) Iodine/potassium iodide;

1

(d) For correct answer of 40 (μm) award 2 marks;
Evidence of division by 500: award 1 mark

Allow tolerance of 0.5mm i.e. 20±0.5mm

2

(e) 1. Scanning electron (microscope);
2. 3D (image);

Accept SE(M)

2. Ignore any other correct features

2

[9]

Q4.

(a) 1. Polysaccharide of α-glucose;
OR
polymer of α-glucose;
2. (Joined by) glycosidic bonds
OR
Branched structure;

2

(b) 1. Hydrolysed (to glucose);
2. Glucose used in respiration;

1. Ignore 'Broken down'

2. 'Energy produced' disqualifies mp2

2

(c) 1. Membrane folded **so** increased / large surface area;
OR
Membrane has increased / large surface area **for** (fast) diffusion / facilitated diffusion / active transport / co-transport;
2. Large number of <u>protein</u> channels / carriers (in membrane) **for** facilitated diffusion;
3. Large number of <u>protein</u> carriers (in membrane) **for** active transport;
4. Large number of <u>protein</u> (channels / carriers in membrane) **for** co-transport;

1. Accept 'microvilli to increase surface area'

1. Reject reference to villi.

Note feature and function required for each marking point and reference to large / many / more.

List rule applies.

2 max

(d) 3.3×10^{-5} **OR** 3.28×10^{-5} **OR** 3.281×10^{-5};
1 mark for
Evidence of 128 (cells)
Correct numerical calculation but not in standard form gains 1 mark
(0.00003281 **OR** 0.0000328 **OR** 0.000033);

Accept any number of significant figures as long as rounding correct (3.28125×10^{-5} scores 2 marks)

2

[8]

Q5.

(a) 1. Sodium ions actively transported from ileum cell to blood;

2. Maintains / forms diffusion gradient for sodium to enter cells from gut (and with it, glucose);

3. Glucose enters by facilitated diffusion with sodium ions;

3

(b)

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		✔
I_2/KI		✔ or blank
Benedict's	✔	✔

1 mark for each correct row

3

(c) 1. Biuret: protein molecules too large to pass through tubing;
Neutral: enzyme molecules

2. Iodine in potassium iodide solution: starch molecules too large to pass through tubing;
If no tick in 04.2, allow no starch hydrolysed

3. Benedict's: starch hydrolysed to maltose, which is able to pass through tubing.
Reject: glucose

3

[9]

Q6.

(a) 1. Contents of phloem vessel pushed into insect's mouth by high pressure;

2. (High pressure in phloem vessel) caused by loading of sugars into phloem in leaf;

3. And (resulting) entry of water by osmosis.

3

(b) 1. Polysaccharides are insoluble;

2. So do not affect water potential of gut.

2

(c) 1. (Only few bacteria passed from parent, so) only a few (copies of) genes passed on (in bacteria);

2. May not / does not include all alleles (of genes, so diversity reduced)
OR
Small number of bacteria transmitted means unrepresentative sample.

2

(d) 1. Number / mass / density of insects per plant;

2. Stage of development / size of plants / insects;
Ignore any abiotic factor

2

(e) Draw around leaf on graph paper **and** count squares;

1

[10]

Q7.

(a) Lactase hydrolyses lactose in to glucose (and galactose);

1

(b) No lactase in the milk
OR
Enzyme can be reused.

1

(c) 100 cm^3 $minute^{-1}$ is too fast to bind to active site / converse for 50 cm^3 $minute^{-1}$;

1

(d) 14.1(4);

1

(e) 1. Galactose is a competitive inhibitor / attaches to the active site (of lactase);

2. Fewer enzyme substrate complexes formed.

2

[6]

Q8.

(a) Glucose (and glucose);

1

(b) (α1,4) Glycosidic;

1

(c) 1. Headings correct – mol dm^{-3} **and** volume of water / cm^3;

2. Concentration correct. ie 0.2;

2

(d) Line of best fit drawn;

Read off value at 0.45.

2

[6]

Q9.

(a) 1. A = β glucose;

B = Adenosine triphosphate;
do not accept ATP

2

(b) 1. Saturated;

1

2. Fatty acid;

1

(c) 1. Peptide bond shown correctly;

2. Rest of dipeptide structure shown correctly;

2

(d) Water;

1

[7]

Q10.

(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]

Q11.

(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]

Q12.

(a) 1. Allow equal (time for) diffusion of iodine into apple cells;

2. For comparison between apples / between harvest dates;

1. Accept equal time for reaction / colour change to occur

2. For comparison alone is insufficient.

Ignore unqualified references to fair test, controlling a variable, standardising the method.

2

(b) 1. Starch lost from the centre first / area with no starch gets bigger as it ripens;

2. (Less starch / blue / black as the) starch is converted to sugars / maltose;

3. (Less starch) as it is hydrolysed;

4. By amylase;

Less starch as it is hydrolysed into sugars scores MP2 and MP3.

3. For 'hydrolysed' accept 'as a result of hydrolysis' or 'broken down by hydrolysis'.

3 max

[5]

Q13.

(i) 1. Maltose;
2. Water;

Accept H_2O

2

(ii) Condensation;

1

[3]

Q14.

(a) 1.1 (g);

1

(b) 300(%);

1

[2]

Q15.

(a) 1. Add iodine / potassium iodide solution;

Reject if heated

2. Blue-black colour (with starch);

Accept black

Ignore purple

2

(b) 1. Hydrolysed by enzymes / hydrolysed by amylase / maltase;

If named enzyme given, it must relate to the correct substrate

2. Produces glucose (in the gut);

3. Small enough to cross the gut wall (into the blood) / monomers / monosaccharides (can) cross the gut wall (into the blood);

Accept cell membranes / epithelium / cells for 'gut wall'

3

(c) 1. Time how long it takes to go brick red;

2. Weigh precipitate;

3. Dilute glucose samples / use smaller volume of glucose samples / use greater

volume of Benedict's reagent;

Ignore references to colorimeter

1 max

[6]

Q16.

(a)

Transport through a channel protein	Q

1

Transport of small, non-polar molecules	P

1

Transport of glucose with sodium ions	S

1

(b) 1. (Y is) an enzyme/has active site/forms ES complex;

Accept catalyst

2. That makes cellulose/attaches substrate to cellulose/joins β glucose;

OR

3. Makes cellulose/forms glycosidic bonds;
4. From β glucose;

Mark in pairs (1&2 or 3&4)

2

(c) Cell wall forms outside cell-surface membrane/has cellulose on it (on the outside);

1

(d) (Tick in box next to) Hydrogen;

1

[7]

Q17.

(a) 1. Glucose;
2. Fructose;

Accept answers in either order

Ignore α and β glucose

2

(b) 1. Line graph with rate on y axis and days/time in days on x axis and linear scales;

Correct answers × 10^{-3} 1.17, 1.50, 1.83, 2.50, 3.33, 4.00, 4.00 (accept to 1DP)

2. Correct units of μg min^{-1}/per minute/$minute^{-1}$ × 10^{-3};

Reject m^{-1}

Reject if put 10^{-3} on axis for each point

'/' means separating units from what goes before i.e. accept sucrose hydrolysis per min / $\mu gx10^{-3}$

3. Rates correctly calculated and plotted, with line connecting points/line of best fit and no extrapolation;

*Do not accept a ruled **straight line** of best fit*

Accept y axis starting at 1

3

(c) 1. Sucrose hydrolysis linked to some aspect of growth;

Accept 'breakdown

2. Greater the rate of/faster hydrolysis/more SPS activity as plant grows/cells divide (up to 8/10 days);

Accept 'breakdown

Accept converse of greater rate of growth, greater rate of hydrolysis

Reject 'sucrose broken down'

3. Growth/division remains the same/slows after 8/10 days (because SPS activity is levelling off);

Accept after 8 days/at 10 days growth rate maximum/growth stops

3

[8]

Q18.

(a) 1. (before reaction) active site not complementary to/does not fit substrate;

2. Shape of active site changes as substrate binds/as enzyme-substrate complex forms;

Note. Points 1 and 2 may be made in one statement and 'complementary' introduced at any point.

Points 1&2 – active site mentioned once applies for both points

Point 2 – Ignore references to how shape change is caused

3. Stressing/distorting/bending bonds (in substrate leading to reaction);

2 max

(b) 1. Tangent to curve drawn;

Tangent drawn at about 10 minutes

2. Value in range of 8 to 11;

1 mark only for correct answer

2

(c) 1. (Rate of) increase in concentration of maltose slows as substrate/starch is used up
OR
High initial rate as plenty of starch/substrate/more E-S complexes;

Reject ref. to amylase being used up

2. No increase after 25 minutes/at end/levels off because no substrate/starch left;

Accept 'little'

Ignore references to substrate a limiting factor

2

(d) 1. Make/use maltose solutions of known/different concentrations (and carry out quantitative Benedict's test on each);

2. (Use colorimeter to) measure colour/colorimeter value of each solution and plot calibration curve/graph described;

Axes must be correct if axes mentioned, concentration on x-axis and colorimeter reading on y-axis

3. Find concentration of sample from calibration curve;

3

[9]

Q19.

(a) Starch (max 3)

1. Helical/ spiral shape **so** compact;
2. Large (molecule)/insoluble **so** osmotically inactive;

   Accept: does not affect water potential/ψ.
3. Branched **so** glucose is (easily) released for respiration;

   Ignore: unbranched.
4. Large (molecule) **so** cannot leave cell/cross cell-surface membrane;

Cellulose (max 3)

5. Long, straight/unbranched chains of β glucose;
6. Joined by hydrogen bonding;

   Note: references to 'strong hydrogen bonds' disqualifies this mark point.
7. To form (micro/macro)fibrils;
8. Provides rigidity/strength;

5 max

(b) 1. (At source) sucrose is actively (transported) into the phloem/sieve element/tube;

   Accept: 'sugar/s' for sucrose but reject other named sugars e.g. glucose.

   Accept: co-transport (with H^+ ions).
2. By companion/transfer cells;
3. Lowers water potential in phloem/sieve element/tube **and** water enters by osmosis;
4. (Produces) high (hydrostatic) pressure;

   Accept: pressure gradient.
5. Mass flow/transport towards sink/roots/storage tissue;

   Accept: sieve element/tube.
6. At sink/roots sugars are removed/unloaded;

   Accept: at sink/roots sugars are used in respiration/stored.

5 max

[10]

Q20.

(a) Accept **three** suitable suggestions:

1. (Lactase / beads) can be reused / not washed away;

   1. Accept lactase / beads not wasted

   1. Less lactase used is insufficient

2. No need to remove from milk;

   2. Accept lactase not present in milk.

3. Allows continuous process;
4. The enzyme is more stable;
5. Avoid end-product inhibition.

Ignore ref to SA

3 max

(b) 1. (Lactose hydrolysed to) galactose and glucose;
2. (So) more sugar molecules;

*2. Idea of **more** sugars essential*

3. (So) more / different receptors stimulated / sugars produced are sweeter (than lactose).

2 max

[5]

Q21.

(a) (i) ***(Both)***

1. Are polymers / polysaccharides / are made of monomers / of monosaccharides;
2. Contain glucose / carbon, hydrogen and oxygen;
3. Contain glycosidic bonds;
4. Have 1−4 links;

Neutral: references to 'unbranched', insoluble, formed by condensation, flexible and rigid

Are made of the monomer glucose = MP 1 and 2 = 2 marks

5. Hydrogen bonding (within structure).

Ignore reference to H bonds between cellulose molecules

2 max

(ii) (Starch)

1. Contains α / alpha glucose;

Assume 'it' refers to starch

Accept: converse arguments only if linked directly to cellulose

Accept: forms α glycosidic bonds

2. Helical / coiled / compact / branched / not straight;
3. 1,6 bonds / 1,6 branching;
4. Glucoses / monomers same way up;
5. No H-bonds between molecules;
6. No (micro / macro) fibres / fibrils.

2 max

(b) (i) 1. No / few organelles / very little cytoplasm / cytoplasm at edge / more room / hollow / large vacuole / large space / thick walls;

Accept strong walls for thick walls

2. (So) easier / more flow / (thick / strong walls) resist pressure.

Easier flow may be expressed in other ways e.g. lower resistance to flow

2

(ii) 1. Mitochondria release energy / ATP / site of respiration;

***Q** Reject: 'produce energy'*

but accept produce energy in form of ATP

2. For active transport / uptake against concentration gradient.
   Note: no mark is awarded for simply naming an organelle

OR:

3. Ribosomes / rough endoplasmic reticulum produce(s) proteins;
   Concept of making proteins needed

4. (Proteins) linked to transport e.g. carrier proteins / enzymes.

2

[8]

Q22.

(a) 1. Tertiary structure / 3D shape of enzyme (means);
   Accept references to active site

2. Active site complementary to maltose / substrate / maltose fits into active site / active site and substrate fit like a lock and key;
   Idea of shapes fitting together

3. Description of induced fit;

4. Enzyme is a catalyst / lowers activation energy / energy required for reaction;
   Accept "provides alternative pathway for the reaction at a lower energy level"

5. By forming enzyme-substrate complex;
   Accept idea that binding stresses the bonds so more easily broken
   Do not award point 5 simply for any reference to E-S complex

5

(b) 1. Inhibitors reduce binding of enzyme to substrate / prevent formation of ES complex;
   Max 3 if only one type of inhibition dealt with. Accept maltase and maltose as examples of enzyme and substrate (and others)
   Only once, for either inhibitor

(Competitive inhibition),

2. Inhibitor similar shape (idea) to substrate;

3. (Binds) in to active site (of enzyme);
   Accept allows max rate of reaction to be reached / max product will eventually be formed
   Accept complementary to active site

4. (Inhibition) can be overcome by more substrate;

(Non-competitive inhibition),

5. Inhibitor binds to site on enzyme other than active site;

6. Prevents formation of active site / changes (shape of) active site;

Accept does not allow max rate of reaction to be reached / max product will not be formed

7. Cannot be overcome by adding more substrate;

5 max

[10]

Q23.

1. (Drink) contains carbohydrates / sugars **so** High GI / (drink) contains carbohydrates / sugars **so** raises blood glucose concentration quickly;

Each alternative requires both aspects for credit

The second alternative requires a reference to speed eg 'quickly' or 'immediately'

2. Contains salt so glucose more rapidly absorbed;

3. Increases glucose to muscles for respiration;

4. More / faster respiration so more / faster energy release;

Reject reference to energy production

Accept more ATP produced

[3]

Q24.

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

1. Reject hydrophobic / hydrophilic phospholipid

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

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]

Q25.

(a) 1. Add iodine / potassium iodide solution to the food sample;
1. Allow 'iodine'
2. Must be in the context of the correct reagent

2. Blue / black / purple indicates starch is present;

2

(b) 1. Starch digested to maltose / by amylase;
Ignore 'hard to digest / easily digested'

2. Maltose digested to glucose / by maltase;

3. Digestion of sucrose is a single step / only one enzyme / sucrase;
3. Accept converse for starch
3. Do not accept digestion of sucrose is faster

3

(c) 1. Smoking increases risk of CHD / introduces another variable;

1

(d) (i) 1. No effect on risk with diet group 1 and 2 / lowest glycaemic load;
Simple statement of correlation is not enough for this mark

2. Above diet group 2 / in higher groups, risk increases as glycaemic load increases;

1 max

(ii) 1. (Higher GL diets lead to) more (harmful) lipids (in blood), so greater risk of atheroma;
Ignore reference to lipids in diet

2. Atheroma leads to blockage of <u>coronary artery</u> / increased risk of blood clot in <u>coronary artery</u>;

Ignore references to myocardial infarction / heart attack

2

[9]

Q26.

(a) (i) Glucose <u>and</u> fructose;

Ignore reference to alpha and beta

Either way around

1

(ii) Glucose <u>and</u> galactose;

Ignore reference to alpha and beta

Either way around

1

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

Place <u>and</u> 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]

Q27.

(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]

Q28.

(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	1. 1,4 bonds / no 1,6

bonds / contains 1,6 bonds / branching	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]

Q29.

(a) (i) (Human cells) don't have a cell wall;

Accept "they" refers to human cells.

1

(ii) (Affects) protein synthesis;

Allow description e.g. 'amino acids not joined together / translation.

Reject: affects transcription.

1

(b) 1. Mutation present / occurs;

Ignore antibiotic causes mutation.

2. Resistance gene / allele;

1. or 2.

Reference to immunity disqualifies first credited marking point.

3. Resistant bacteria (survive and) reproduce;

Reference to mitosis negates marking point 3.

2

[4]

Q30.

(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]

Q31.

(a) (i) Assumed that did not eat due to discomfort in the past;

1

(ii) Positive correlation / as lactose concentration increases the data in column C increases / percentage who do not eat the food or feel

discomfort after eating the food increases;

1

(iii) Correlation does not mean that there is a causal relationship;

May be due to some other factor / example of factor;

Do not accept casual

2

(b) 1. People self-diagnosed lactose intolerant condition;

2. Discomfort may be due to other factor / infection / other component of diet / is subjective;

3. Large variation in lactose content of specific food items / e.g. variation in lactose content of different soft cheeses;

4. Amount in a serving may vary;

5. Untruthful responses / demand characteristics;

Sample size = neutral.

2 max

[6]

Q32.

(a)

✓	✓	✓	
			✓
		✓	✓

One mark for each correct column

Mark ticks only and ignore crosses

4

(b) 1. Two marks for box round two hydrogens and one of the oxygens from OH groups on carbons 1 and 4;;

2. One mark from incorrect answer involving any two hydrogens and an oxygen from carbons 1 and 4;

Do not award marks if all atoms concerned are on same carbon atom or are on carbon atoms other than 1 and 4 or where the answer does not have two hydrogen and one oxygen

2

(c) (i) 1. Holds chains / cellulose molecules together / forms cross links between chains / cellulose molecules / forms microfibrils, providing strength / rigidity (to cellulose / cell wall);

2. Hydrogen bonds strong in large numbers;x

Principles here are first mark for where hydrogen bonds are formed and second for a consequence of this.

Accept microfibres

2

(ii) Compact / occupies small space / tightly packed;

Answer indicates depth required. Answers such as "good for storage", "easily stored" or "small" are insufficient.

1

[9]

Q33.

(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]

Q34.

So there is no / less food in digestive system;

Which could affect the absorption of glucose;

[2]

Q35.

(a) (i) 14 / 15 – 58 / 59 or 43 – 45 (mg per $100cm^3$);

Wrong calculation does not disqualify

1

(ii) The larger the person the more blood they would have so have a lower concentration of blood glucose;

as same amount of glucose absorbed / all / 50g absorbed;

2

(b) 1. Any reference to overlap between all 3 groups;

2. One lactase deficient subject had high blood glucose / similar to control;

3. Some control / Group A subjects had the similar blood glucose to LD / Group B subjects / some IBS subjects had similar results to lactase deficient subjects;

3

[6]

Q36.

(a) Increase in the first 3 – 4 hours and then decrease;

1

(b) Little / no difference (at 8 hours);

Between all groups;

2

(c) Respiration (produce CO_2);

By cells / tissues;

2

(d) Clear differences between the lactose deficient and IBS / control group;

No overlap in SD;

Accept between all groups

2

[7]

Q37.

(a) High sucrose / starch diet leads to increase in lactase activity;

1

(b) Not valid / cannot be certain because overlap in SD between high sucrose and high starch;

Study based on rats (not human) so may not apply to human;

2

[3]

Q38.

(a) (Omega-3 concentration) falls more rapidly at first;
Levels out at 140 days / concentration of 0.4%;

2

(b) (i) Two marks for correct answer of 0.04 or 0.043;;

One mark for incorrect answer which clearly identifies total fall of 1.7;

2

(ii) To take into account variation in fat content of milk / fat content varies from cow to cow;
Allows comparison;

2

(iii) The graph shows a decrease with time feeding on corn;
No control group;
Might have fallen anyway / might decrease with time rather than with time spend feeding on corn;
Other factors / other named factor might also have changed;
Only one investigation so might not be representative;

4 max

[10]

Q39.

(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]

Q40.

(a) Enzyme / active site has a (specific) tertiary structure;

Only glucose has correct shape / is complementary / will bind / fit to active site;

(Forming) enzyme-substrate complex;

***Q** Allow second mark if candidate refers to correct shape or complementary in terms of the enzyme. Do not allow 'same' shape*

***Q** Do not allow third mark if active site is described as being*

on substrate.

3

(b) (Only detects glucose whereas) Benedict's detects (all) reducing sugars / named examples;

Provides a reading / is quantitative / Benedict's only provides a colour / doesn't measure concentration / is qualitative / semiquantitative;

Is more sensitive / detects low concentration;

Red colour / colour of blood masks result;

Can monitor blood glucose concentration continuously;

***Q** Do not credit quicker / more accurate unless qualified.*

***Q** Allow Benedict's detects monosaccharides for first mark point.*

2 max

(c) (i) Broken down by enzymes / digested / denatured (by pH) too large to be absorbed;

1

(ii) Study not carried out on humans / only carried out on rats;
Long-term / side effects not known;
Scientists have vested interest;
Study should be repeated / further studies / sample size not known;

2 max

[8]

Q41.

(a) Amylase;

(Starch) to maltose:

Maltase;

Maltose to glucose;

Hydrolysis;

(Of) glycosidic bond;

***Q** Do not penalise incorrect site for digestion or incorrect site of enzyme production.*

5 max

(b) Glucose moves in with sodium (into epithelial cell);

Via (carrier / channel) protein / symport;

Sodium removed (from epithelial cell) by active transport / sodium- potassium pump;

Into blood;

Maintaining low concentration of sodium (in epithelial cell) / maintaining sodium concentration gradient (between lumen and epithelial cell);

Glucose moves into blood;

By (facilitated) diffusion;

Q *Only allow diffusion mark in context of movement of glucose into the blood.*

5 max

[10]

Q42.

(a) (Group of) similar / identical cells / cells with a common origin;

Q *Ignore references to function*

1

(b) (i) Add iodine / stain specific for starch to the slide / cells / tissue / add iodine / stain specific for starch and examine under microscope;

Blue-black / blue / black / purple;

Reject sample

2

(ii) Need a single layer of cells / only a few cells thick / not too many layers / detail obscured by cells underneath;

Light must be able to pass through;

2

(c) Both are polymers / made of monomers;

Joined by condensation / molecules can be broken down by hydrolysis;

Both have 1-4 links;

Contain C(arbon), H(ydrogen) and O(xygen) / both made up of glucose;

Both insoluble;

Both contain glycosidic bonds;

Accept other valid answers.
Ignore ref to unbranched.

2 max

[7]

Q43.

(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]

Q44.

use of water;

must be above arrowhead
OH drawn correctly in place of glycosidic bond on each monosaccharide;

[2]

Q45.

(a) presence of nuclei;

1

(b) (i) 1 mark growth clearly calculated from difference between lengths at beginning and end of lesson

2 marks correct answer of 300 µm

2

(Allow for slight measurement errors)

(ii) <u>divide</u> by time (between measurements);

1

(c) blue-black / dark blue / purple / black;
iodine added to slide / specimen / granules;

2

[6]

Q46.

(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]

Q47.

(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]

Q48.

(a) Any two from:
Loop of DNA; Non-cellulose cell wall;
Plasmid; Capsule;
Flagellum; Mesosome;
Accept small ribosomes

2

(b) (i) (Granules) turn blue-black / dark blue / black / purple with iodine;

1

(ii) Cellulose / pectin;

1

(c) Use principle:
Feature of starch;
Consequence in terms of storage;
e.g.
Insoluble;
Therefore will not "wash" out of cell / affect water potential / affect osmosis;
OR
Molecule coiled / branched;
Therefore large amount stored in small space / compact
OR
Does not affect water potential;
So no effect on entry of water (into cell);

2

[6]

Q49.

(a) Digestion / hydrolysis / breakdown of a disaccharide into monosaccharides;
OR
(glucose and galactose form lactose) glucose is a monosaccharide;

max 1

(b) (i) Dipeptidase / disaccharidase / named disaccharidase;

1

(ii) Enzymes not lost (with gut contents) / more effective absorption of products formed by these enzymes;

1

(c) No ATP formed / no energy released by respiration;
[reject "making" energy]

Link ATP to active transport (of galactose) into cells;

2

[5]

Q50.

(a) (i) 31 / 31.2;

1

(ii) Ratio would be less / smaller;
Cell is thin / has large surface area / (adapted) for diffusion;

Accept converse. Must relate to concept of ratio.

2

(b) (i) 6;

1

(ii) 11;

1

(c) Water potential inside vesicle more negative / lower;
Water moves into vesicle by osmosis / diffusion;

2

(d) Mitochondria supply energy / ATP;
For active transport / absorption against concentration gradient / synthesis / anabolism / exocytosis / pinocytosis;

Do not credit references to making, creating or producing energy.

2

(e) 1 Phospholipids forming bilayer / two layers;
2 Details of arrangement with "heads" on the outside;
3 Two types of protein specified;
e.g. passing right through or confined to one layer / extrinsic or intrinsic / channel proteins and carrier proteins / two functional types
4 Reference to other molecule e.g. cholesterol or glycoprotein;
5 Substances move down concentration gradient / from high to low concentration;

Reject references to across or along a gradient

6 Water / ions through channel proteins / pores;
7 Small / lipid soluble molecules / examples pass between phospholipids / through phospholipid layer;
8 Carrier proteins involved with facilitated diffusion;

Ignore references to active transport.

Credit information in diagrams.

max 6

[15]

Q51.

(a) glucose;

(reject alpha glucose)

1

(b) hydrolysis;

(accept catabolic)

1

(c) (long) straight / unbranched chains;
(idea of more than 1) chains lie side by side / form (micro)fibrils;

idea of H bonds holding chains together;

3

[5]

Q52.

(a) (i) **D** plasmid / ribosome(s) / cytoplasm / storage granules;
(accept any sensible structure)

E (slime / mucous) capsule

OR

slime / mucous layer;

2

(ii) protection / maintain shape / prevent lysis / strength / support;

1

(b) two of the following:
nucleus;

OR

nuclear envelope / mitochondria / chloroplasts / sER / rER / golgi apparatus / 80s ribosomes

linear DNA / chromosomes / lysosomes / vacuole / vescicles / cellulose cell wall;

2 max

(c) (i) starch digested / broken down;
by amylase / carbohydrase;

2

(ii) any sensible suggestion e.g. no secretion of amylase / functional amylase /
piece of fungus might have died;
(accept carbohydrase / enzyme for amylase)
(reject "no digestion" without qualification)

1

[8]

Q53.

(a) colour results from starch-iodine reaction;
decrease due to breakdown of starch by carbohydrase / enzyme;

2

(b) (i) curve drawn below curve on graph and starting at same point;

1

(ii) curve drawn above curve on graph and starting at same point but finishing above;
(allow curve or horizontal line)
(allow alternative curve for pH if explanation in (ii) is consistent)

1

(c) (i) 1. increase in temperature increases kinetic energy;
2. increases collisions (between enzyme / active site and substrate) / increases formation of enzyme / substrate complexes;
3. increases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(ii) 4. (decrease in pH) increases H^+ ions / protons which attach / attracted to amino acids;
5. hydrogen / ionic bonds disrupted / broken which denatures enzyme / changes tertiary structure;
6. changes shape / charge of active site so active site / enzyme unable to combine / fit with starch / enzyme-substrate complex no longer able to form;
7. decreases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(allow alternative explanation for pH if consistent with line drawn in (ii))

7

[11]

Q54.

(a) (i) fructose;

1

(ii) correctly drawn (OH group at bottom left);

1

(b) hydrolysis;

1

(c) (i) heat with Benedict's solution (*disqualify if HCl added*);
orange / brown / brick red / green / yellow colour or precipitate;

2

(ii) biuret test / NaOH + $CuSO_4$;
purple / violet / lilac / mauve;

2

[7]

Q55.

(a) A – granum / thylakoid;
chlorophyll molecules to trap light / light absorbing pigments / light dependent reaction / part of light dependent reaction;

2

B – stroma;
(contains enzymes for) carbon dioxide fixation / light-independent reaction / part of light-independent reaction;
(allow ribosome role of protein in photosynthesis)

2

(b) (i) C – starch;

1

(ii) from glucose in a condensation / polymerisation reaction / many glucose molecules joined together;

1

[6]

Q56.

(a) (i) in case normal coffee differs in some other way / to control concentration of caffeine;

1

(ii) not telling them what the drink contained / purpose of experiment;

1

(b) (i) able to continue for longer; *(not just increases performance) (disqualify if also refers to fatty acids and glycerol)*

1

(ii) breakdown of fats;
at increased rate / by mobilisation of fat stores;

2

(c) (i) idea that volumes of oxygen and carbon dioxide the same;
reference to equal moles, or quotient as 1 divided by 1 / or 6 by 6;

2

(ii) glycogen is a carbohydrate / broken down to glucose, linked to RQ;
with no caffeine, RQ nearer 1.0 / less carbon dioxide exhaled and more oxygen inhaled (or vice versa) / with caffeine higher proportion of fats / fatty acids respired;
increased time to exhaustion suggests slower use of glycogen:

3

[10]

Q57.

(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]

Q58.

(a) C_{12} ; $H_{22}O_{11}$;

2

(b) (i) heat with Benedict's;
yellow / brown / orange / red;

2

(ii) (yes)

(may appear on second line)

more precipitate in sample **B**;
both sugars are reducing sugars / give a positive test;

2

[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.

Question (a) demanded recall from section 3.3.2 of the specification; 25.6% of students gained five or six marks. Many, however, omitted any reference to the structure at all and it was surprising that very few students elected to draw a labelled sketch to show the gross structure. Many lengthy answers were seen detailing exchange of gases and the features of the alveolar epithelium, neither of which was required by the wording in the question. Many answers included tracheoles as a part of the human gas exchange system. Inhalation tended to be described in the best detail. Marking points 3 and 5 were often not awarded because of a lack of precision in describing the role of the pair of antagonistic intercostal muscles. Many students conflated the two, and referred to them generically. The relaxation and contraction of the diaphragm and its corresponding shape were frequently confused. For example, students referred to the 'flattened' or 'domed' shape of the diaphragm without stating how that occurred. This question had the highest discrimination index of the paper.

In question (b), although many students could demonstrate knowledge of phospholipids and triglycerides individually, they struggled to complete the required ‘compare and contrast’ command. When this command is used, every marking point requires a comparative statement that must be clearly made by the student: examiners will not infer links between separate statements – in this case, separate descriptions of phospholipids and of triglycerides. Many students did not include glycerol in their structure of the phospholipid. Some students were distracted into discussions of applications for the molecules, and their energetic values.

Question (c) showed that most students had learned the components of lactose and knew that it would be formed in a condensation reaction, although some omitted that this would result in the formation of a glycosidic bond. Fewer students knew that the lactose would be joined to a polypeptide in the Golgi apparatus. Many described that it would be found on the cell-surface membrane, and some tried to describe where on the polypeptide the lactose would be attached, rather than where in the cell as required by the question. Nearly half of the students scored at least two of the four available marks.

Q3.

More than 40% of the students gained both marks on question (a), usually for correctly contrasting the types of glucose (α or β), or by referring to the branched or straight chain of the molecule. Those who failed to score often did not give differences, referring only to one of the molecules.

Question (b) discriminated well. Many students wrote about starch being insoluble and therefore not affecting the water potential, and the branched nature of the molecule making it compact. However, a large number of students did not follow the instruction to both describe **and** explain features of starch that make it a good storage molecule.

In answering question (c), 87% of students correctly identified the correct test.

In answering question (d) most students were able to attempt the calculation but many were unable to convert millimetres to micrometres and therefore gained only 1 mark.

Whilst half of the students scored both marks for question (e), there were many who were unable to identify the correct type of microscope and often their evidence was that the photograph was black and white rather than in 3-D.

Q4.

This question tested topics 3.1.2 and 3.2.3 with a combination of AO1 and AO2.

(a) The majority of students scored mark point 2 for the idea that glycogen is a branched molecule or that it contains glycosidic bonds. Although many students knew that glycogen is a 'chain' of alpha glucose, fewer could use the correct terminology to state that it is a polysaccharide or a polymer. Students must take care to specify alpha glucose or α-glucose rather than a-glucose. It was not uncommon for students to describe glycogen as if it were identical to starch and to include references to amylose and amylopectin in their answers.

(b) This question required a little application of biological principles, with students' knowledge of glycogen. Many students started their answers with reference to branching molecules providing many 'ends' for enzymes – this was not relevant and is indicative of students rushing to write all they know, rather than considering what is relevant to answer the specific question asked. As with question (a), students often knew the basic principle of breaking down glycogen to release the glucose, but did not use the appropriate term of 'hydrolysis' to gain the first mark point. Many students suggested that this hydrolysis of glycosidic bonds releases energy, rather than thinking about glucose as the substrate for respiration in all human cells.

(c) Although this question gave the context of the adaptation of the cell-surface membranes of cells lining the uterus, making it an AO2 question, this should have been fairly straightforward application of knowledge from 3.2.3. Many students did not gain full marks because they seemed not to read the question sufficiently carefully. It required reference to the cell-surface membranes only, so answers relating to "one cell thick", "many mitochondria", or "a good blood supply" were not relevant. The question also required a suggestion **and** an explanation to gain each mark. It was not uncommon to see reference to "thin membranes", indicating a clear confusion between the phospholipid bilayer structure of a cell-surface membrane and the epithelial layer of an exchange surface. Reference to 'villi' also demonstrated similar confusion and prevented a student from obtaining mark point 1. It is important to note that, when referring to protein carriers / channels, only carriers can be used for active transport; either can be involved in facilitated diffusion. Also, for a membrane to be adapted for rapid transport, it must have **more** of these proteins, rather than them just being present.

(d) As with all calculations that meet the national requirement to be at the standard of higher tier GCSE Mathematics, this required a multi-step process. Firstly, students needed to work out that there would be 128 cells after 3 days: 2 cells after the first day, then another 6 divisions. This was where many students struggled. It was pleasing to see how many students could correctly use standard form to express their final answer. It should be noted that the convention for standard form to be correct is to have a number greater than 1 and less than 10, multiplied by 10 to a power, i.e. the decimal point should be after the **first** digit.

Q12.

(a) Many partial responses were seen here that did not fulfil the mark points. “For comparison” needs further qualification for credit at this level. It was surprising how few linked the investigation they had carried out into diffusion of iodine to include this when scoring mark point 1, many achieved mark point 1 with a statement more similar to that in the comments column.

(b) The command words used in this question were “describe” and “explain”. Most responses started with the explanation and those that attempted the description often did not give sufficient detail to achieve mark point 1. Many responses showed clear understanding of the starch being broken down by amylase although “hydrolysed” was less common.

Q13.

In part (i), a significant minority of students omitted water and therefore gained only 1 mark, but most correctly identified condensation as the reaction with very few giving hydrolysis in error.

Q14.

Both parts of this question proved to be good discriminators as very few students were able to carry out the calculations correctly.

Q15.

(a) Most students were able to identify the correct test for starch but a significant number did not refer to iodide solution and so did not gain the first mark point. A significant number incorrectly referred to the colour produced by starch as being purple or blue instead of blue/black or black.

(b) The correct enzymes involved in the hydrolysis of starch were known by many students but the small size of the molecules produced was rarely mentioned. When it was, the mark was often not gained due to vague references to how they were absorbed.

(c) Many students referred to the use of a colorimeter. This would not work due to the dense nature of the red precipitate. Better answers clearly described a dilution technique which would work (not serial dilution), or mentioned timing the appearance of the colour or weighing the precipitate.

Q16.

It was pleasing to see that 73% of students obtained all three marks in (a). It was also pleasing to see 80% correctly identify hydrogen bonds in (d).

In both (b) and (c), students usually appeared to ignore the diagram and the information given, despite being instructed to use both in their answers. Students were told that the diagram shows how a plant cell produces its cell wall. In the stem of (b), they were told that one function of protein Y is to transport cellulose molecules across the bilayer. The figure shows substrate molecules approaching the end of the cellulose molecules. Only 12% of students put all this together and wrote that Y was an enzyme (one mark) that makes cellulose (one mark), or that Y makes cellulose (one mark) from β glucose (one mark). Some identified Y as an enzyme for one mark but then had it breaking down cellulose into substrate. Most students (68%) wrote about Y transporting various ions or other substances not mentioned in the information or figure, or about membrane stability. In (c), many students did not seem to appreciate that evidence is something to be seen.

Q17.

It was pleasing to see that most students (86%) could name the products of the hydrolysis of sucrose in (a).

In (b), it was heartening to see how many students could correctly calculate the rates and express them in standard form. Graphing the data proved much more challenging. Only 6% of students obtained all three marks. About 2% did not attempt to draw a graph. About 29% failed to score after attempting the graph for reasons including: axes the wrong way round, non-linear scales and failure to identify the axes. About 27% obtained 1 mark for putting rate on the y axis and time on the x axis and using linear scales. About 37% obtained two marks for also correctly plotting correct numerical rates and joining the points (with a line of best fit or point-to-point). Only about 6% could correctly label the y axis, with rate as μg minute^{-1} times 10^{-3}. A very large number of students appeared to think that rate = minute^{-1} (or 'per minute). A rate is something per unit time, in this case μg. The rate is proportional to one over time.

In (c), students were asked what they could conclude about growth of plant cells from these data. They could answer using either the raw data in the table, or their graph. Many simply described the data and failed to score (38%). A similar number obtained one mark, either for noting that the rate of hydrolysis of sucrose increased as growth occurred, or that growth levelled off after 8/10 days. About 18% obtained two marks for mentioning both of these points. Only about 2% also linked hydrolysis of sucrose to growth in some way and obtained a third mark.

Q18.

In (a), 29% obtained both marks. The idea of induced fit was generally known but often poorly expressed. Some students wrote about the substrate having the same shape as the active site, rather than a complementary shape. A minority had the active site on the substrate.

The rate **at** 10 minutes in (b) was correctly calculated by 22% of students. These students drew a tangent to the curve at 10 minutes and used it to calculate rate. 19% of students obtained one mark after drawing an incorrect tangent, or making a mistake in their calculation from a correct tangent. The remainder simply divided the y axis number by the x axis number at 10 days and failed to score.

In (c), many students simply described the curve, rather than explaining. Some attempting an explanation incorrectly wrote about the enzyme being used up, or all its active sites being occupied. 13% obtained both marks for writing about a rapid rate at the start because there is lots of starch and the rate levelling off/falling to zero after 25/30 minutes as all the starch is used up. Some 43% obtained one mark for making one or other of these points.

Question (d) was based around skills that students were expected to have developed in required practical 3; that is to say the production and use of a calibration curve. The purpose of the required practicals is, generally, to allow students to practise and develop skills that can then be applied in many different settings. 21% of students obtained one mark, either for noting that the scientist would need solutions of maltose of known concentrations, or that a calibration curve would have concentration on the x axis and colorimeter reading on the y axis. About 12% obtained both of these marks. Only 5% then went on to (briefly) describe how the calibration curve would be used to determine the concentrations in the experiment.

Q19.

(a) There was a considerable range in the quality of answers for this question. Some students provided detailed explanations of how the structures of starch and cellulose are related to their functions. At the other end of the spectrum, students referred to these molecules as polypeptides and provided details on protein structure. 10% of students gained full marks and almost 15% gained zero. Although many students appreciated the importance of starch being compact they did not always relate this to its helical/spiral structure. Most students stated that starch did not affect the water potential of cells due to its insolubility. Fewer students related the branching of starch to the faster release of glucose for respiration or discussed its inability to leave a cell. Generally, more students gained marks when describing the structure and function of cellulose. Most appreciated the strength of cellulose but a common error was to relate this to 'strong hydrogen bonds'. However, a significant number of students gained credit for describing (micro/macro) fibrils.

(b) As in question 10.1, 10% of students obtained maximum marks. However, almost 30% of students scored zero in this question. The responses from students obtaining low marks included a number of factual errors; sugars being produced by sinks, phloem consisting of dead cells, the transport of sugars in the xylem, transport of glucose rather than sucrose, and transport of sugars using cohesion tension. Conversely, there were also some superb answers which included detailed explanations that went beyond the requirements of the mark scheme. This was particularly evident in the details provided on the loading of sugars from the source into the phloem via companion cells. Better answers contained extensive explanations of how co-transport is involved in this process. A significant number of students gained credit for explaining how the pressure gradient between the source and sink was established including the osmotic movement of water into the phloem. Surprisingly, few students obtained the mark for referring to the mass flow of sugars towards sinks. However, most students did describe the unloading of sugars at sinks.

Q20.

(a) The question required students to apply their knowledge to an unfamiliar context and so learned responses about enzymes did not score well. Many students incorrectly suggested that the beads increased the surface area of the lactase - they did not think of the comparison in terms of adding a solution of the enzyme directly to the milk. However many students gained two marks, usually for stating that the enzyme remained on the beads and could be re-used and also that the enzyme did not have to be removed from the milk.

(b) This question discriminated well and over half the students scored both marks. Many students could name the two monosaccharides produced when lactose is hydrolysed but it was surprising how many thought that lactose was a polysaccharide. Some students failed to gain the second marking point as they went no further than repeating the question stem in their answer.

Q21.

(a) This part discriminated more than was, perhaps, intended. In both (i) and (ii), many students did not read the question carefully enough and included comparisons of properties or function, rather than structure. For example, many wrote about starch and cellulose being insoluble but this is not a similarity of structure. About 40% obtained both marks in (i) and 60% in (ii).

(b) This required students to use the figure and apply some basic concepts. As in (a), some students did not read the stem of the question carefully enough and couched their answers in terms of structures I and J.

(i) Many students described (in various ways) the large open space in the sieve cell and some went on to suggest that this would lead to a (relatively) unrestricted flow; about 30% obtained 2 marks and 40% 1 mark.

(ii) This was where more students failed to score because of answers based around plasmodesmata (J), which are precluded by the stem of the question. Over 40% obtained 2 marks by linking energy from mitochondria to active transport. Some students missed one mark because the examiners rejected references to mitochondria creating or making energy.

Q22.

Both parts of this question discriminated well but for different reasons. Part (a) tested understanding of how enzymes work and (b) tested recall of how inhibitors of enzymes work.

(a) Many students obtained one or two marks by referring to the tertiary structure of the enzyme and/or the complementary fit; demonstrating understanding of why maltase only catalyses the reaction involving maltose. Only students with an understanding of how enzymes act as catalysts that lower activation energy obtained further marks. These students wrote about how the formation of the enzyme-substrate complex involved an induced fit. They went on to write about how this stressed bonds in the substrate molecule, making it more reactive and thus lowering the activation energy for the reaction. They also noted that the enzyme, as a catalyst, remains unchanged after the reaction. Many students appeared to be triggered by the word ‘temperature’ and wrote about why the enzyme would not work if the temperature was above or below normal body temperature; denaturing being frequently mentioned. These responses were not answering the question and did not receive any credit.

(b) About half of students obtained all five marks in this part, displaying good recall of how competitive and non-competitive inhibitors work. It was encouraging to see that quite a few wrote about the relative effects of increasing substrate concentration on the two types of inhibition. Some students got the two types of inhibitor mixed up and failed to score one or two of the marks. Poor expression also hindered quite a few, with statements such as, “The competitive inhibitor has the *same* shape as the substrate.”, or “The non-competitive inhibitor binds to the other active site of the enzyme”.

Q23.

This question was not answered well and, in some cases, not marked well either. Students and assessors alike did not consider responses in the context of an energy *boost*. Words like ‘quickly’, ‘rapidly’, ☐more’ or ‘respiration’ were frequently lacking. It is vital that assessors appreciate both what a question is asking and the essence of the marking points.

Q24.

(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.

Q25.

(a) A surprising number of students did not do well on this question. Some muddled the names of the reactant with the name of the test, such as the biuret test for starch. Others gave an incorrect procedure, such as boiling with hydrochloric acid. Some gave the wrong colour change, such as turning brown.

(b) This question discriminated clearly between students who had a good understanding of the biochemical nature of starch and students who had only a shaky memory of digestion from GCSE. The slower, two-step process by which starch is hydrolysed, firstly into maltose and then from maltose into glucose, was described well in better answers. Weaker answers referred to starch being insoluble, or a polysaccharide as the explanation for slower absorption.

(c) Almost all students gained this mark.

(d) (i) Almost all students gave a simple description of correlation, which was not true for groups 1 and 2, so did not gain the mark. This was another instance where students did not look closely enough at the data before starting to formulate their answer.

(ii) Although most students seemed to understand the idea behind this, a significant number did not write precisely enough. For example, they may have stated that risk of CHD increases as GL increases but did not specify that this was true for diet group 2 and above. Omitting to name the coronary artery as the site of atheroma development also meant that some students did not obtain mark point 3. The stem of the question stated that a diet with high GL increases the concentration of harmful lipids in the blood. Students should have realised that re-stating this would not obtain a mark and that they needed to make the link with atheroma.

Q26.

(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.

Q27.

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.

Q28.

(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.

Q29.

(a) (i) Over 90% of students correctly explained that vancomycin does not affect human cells as these cells do not contain a cell wall.

(ii) Approximately two thirds of students gained this mark by outlining the role of ribosomes in protein synthesis.

(b) This proved to be an effective discriminator. Most students obtained at least one mark often by referring to vertical gene transmission. Many students then referred to the reproduction of resistant bacteria to gain a second mark. Over a third of students gained maximum marks by explaining that a mutation leads to resistant strains or by stating that a resistant gene or allele is produced. Unfortunately, some weaker students incorrectly referred to bacteria becoming 'immune' or to bacteria reproduction by 'mitosis'.

Q30.

(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.

Q31.

(a) (i) Only better candidates clearly understood the idea that some individuals did not eat the food due to discomfort from eating it in the past.

(ii) Most candidates clearly described a positive correlation in one form or another. Candidates failing to gain this mark often provided only part of the information in the column heading C.

(iii) Better candidates had little difficulty explaining that correlation does not mean that there is a causal relationship and that some other factor may be involved. However, many candidates only provided part of this explanation for one mark or provided answers that bore little relevance to the wording of the question.

(b) Many candidates gained both marks in this question, often for understanding that self-diagnosis and subjectivity of ‘discomfort’ could make the data unreliable. The idea of untruthful responses was also often credited.

Q32.

(a) Although this question produced an even spread of marks across the entire ability

range, the overall marks were disappointing for a question largely targeted at Grade E candidates. Many appeared uncertain as to the distribution of starch and glycogen, the identity of deoxyribose as a carbohydrate or of DNA helicase as an enzyme.

(b) Most candidates were able to gain some credit for recognising that condensation involved the elimination of a molecule of water, although there were some who apparently failed to appreciate that water molecules contained two hydrogen atoms and an oxygen atom, or that condensation involved linking the molecules shown. The better candidates selected the appropriate atoms and gained both of the available marks.

(c) In part (i), candidates were usually able to make an appropriate reference to the role of hydrogen bonds in strengthening either cellulose or the cell wall. Many, however, were uncertain as to the location of these bonds and produced answers referring to linking the β-glucose residues. Part (ii) was usually well answered and most candidates were able to discuss the compact shape of starch molecules. There were, however, some answers incorrectly based on the idea of a large surface area to volume ratio.

Q33.

(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.

Q34.

Many generalisations were seen here with candidates using “valid” “reliable” and “fair test” interchangeably. These terms gained no credit when used without further explanation. Better candidates realised that the digestive system needed to be empty while less able candidates focused on the amount of extra glucose in the blood even though it wouldn’t have been labelled.

Q35.

(a) (i) Most candidates scored this mark. Those who did not had usually misread the graph.

(ii) Many candidates made the link that a larger person would have more blood but the second marking point, that therefore there would be a lower concentration of glucose, was less frequently seen. Candidates frequently

described the glucose as being more spread out. This was not given credit. A common misconception was that diffusion distances in larger people were greater. As in question 10, candidates who referred simply to different masses, rather than to masses being high or low, did not gain credit.

(b) Better candidates realised that there was considerable overlap between the groups and scored at least two marks. Less able candidates decided that in many cases the test was fine and ignored the overlap.

Q36.

(a) This was answered well with most candidates scoring the mark. Those who did not offered vague descriptions of trend, referring only to the shape of the curve. This should have been supported with data from the axes.

(b) This was a very straightforward question and candidates scored well. The commonest error was to refer to curves levelling off without any reference to this happening at the *same* value.

(c) There were some really good answers here with many candidates scoring the mark for respiration. Better candidates linked this idea to cells but others often confused ventilation and respiration. Statements such as glucose goes to the lungs and gets breathed out were not uncommon.

(d) Many candidates score the first mark stating there was a clear difference between the lactose deficient group and the IBS or control group. Good candidates achieved the second marking point of there being no overlap between the standard deviations. Candidates appeared to understand that a small standard deviation indicated reliable data. However, they were often uncertain of the implications of overlapping values.

Q37.

(a) This question was well answered with most candidates making the required connection.

(b) This question was not well answered. The commonest response was that it is not possible to generalise from rats to humans. Only the very best candidates grasped the concept of overlapping standard deviation. Although the concept of standard deviation was understood, only the best candidates were clear about an overlap in the standard deviation suggesting an uncertain conclusion.

Q38.

(a) Many centres gave credit to descriptions which only indicated that the omega-3 concentration fell but made no reference to the rapidity of fall. Similarly credit was given to any answer which stated that the concentration reached 0.4% at 140 days, even if there was no mention of the concentration levelling out.

(b) (i) The calculation was carried out correctly by many, and two marks were scored. A large number gained one mark for correctly identifying a fall of 1.7.

(ii) It was rare to see more than one mark awarded. This was almost universally for the idea of being able to make comparisons between the cattle or milk. Often any reference to a comparison was awarded credit.

(iii) A large majority of candidates recognised that the graph showed the omega-3

concentration decreasing with time. A variety of suggestions was offered to account for the decrease, but few suggested that the concentration might have fallen anyway.

Q39.

(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.

Q40.

(a) This question proved to be an effective discriminator with only a third of candidates obtaining maximum marks. Most candidates gained at least one mark often for stating that glucose has a complementary shape to the enzyme in the biosensor. Although many candidates did gain a second mark for referring to the active site a significant number did not and often suggested that an active site is present on the substrate.
There were, however, some excellent explanations of the way in which enzymes work including references to their tertiary structure and the formation of enzyme substrate complexes.

(b) The majority of candidates gained at least one mark often by stating that the Benedict's test only provides a colour or does not measure the concentration of blood glucose. Another common correct response was that the Benedict's test detects not only glucose but all reducing sugars. However, a number of candidates incorrectly stated that the Benedict's test detects all sugars. A few candidates indicated that the red colour produced during a positive Benedict's test would be masked by the colour of the blood. Responses which simply referred to the biosensor being more accurate or quicker without any further details were not credited.

(c) (i) Most candidates obtained this mark by suggesting that insulin would be digested or broken down by enzymes. A few candidates did suggest that it

may be too large to be absorbed or that it could be denatured by acid in the stomach.
Candidates who failed to gain the mark often suggested that it would be broken down by amylase.

(ii) This was very well answered. Almost every candidate obtained at least one mark often by indicating that the study had not been carried out on humans. Many candidates then linked this to unknown long term or side effects to gain a second marking point. It was also pleasing to note the number of responses which displayed an understanding of 'How Science works' including references to the vested interests of scientists, unknown sample size and the need for further or repeat studies.

Q41.

(a) This question proved to be an effective discriminator. Most candidates gained at least one mark by mentioning the enzyme amylase. Many of these candidates gained a second mark for naming maltose as the product of the action of amylase on starch.
However, it was not uncommon to see starch being broken down directly into glucose by amylase. There were also a significant number of answers which included irrelevant references to bile, lipase and a range of proteases. A few candidates confused maltose and maltase but others had little difficulty in quickly accumulating maximum marks by describing the hydrolytic action of maltase in breaking maltose down into glucose.
Fortunately, the mark scheme did not penalise candidates for incorrect sites of enzyme production or incorrect sites of digestion. The action of enzymes on glycosidic bonds was infrequently mentioned by candidates. Almost twenty percent of candidates obtained maximum marks often displaying impressive use of terminology and understanding of this topic.

(b) This proved to be much more demanding that part (a) with a much lower mean mark being obtained. A number of candidates simply repeated their answer to part (a) or provided details on the digestion of other carbohydrates such as lactose and sucrose.
There were also a number of blank or very brief answers. The most accessible marking points related to the movement of glucose from the epithelial cells into the blood by (facilitated) diffusion. The process by which glucose entered the epithelial cells was less well understood. Many candidates had some idea that sodium ions are involved but it was not always clear where they were moving to or from. The role of active transport caused similar confusion for a number of candidates and there were also some references to osmosis. However, despite this there were some outstanding responses demonstrating a thorough understanding of co-transport.

Q42.

(a) In defining a tissue, care needs to be taken to produce a definition that excludes organs and other levels of organisation. Thus, it is essential to refer to the cells involved being similar or with a common origin. To say that a tissue consists of cells that carry out a particular function lacks the necessary precision.

(b) In part (a)(i), most candidates appeared to appreciate that iodine solution could be used to locate starch but often failed to note the specific requirement of the question. There was a tendency to describe the test concerned without heeding the need to find out where in the cells the starch was present. On occasions, candidates failed to note that this question was directed towards what a student should do, and there were a number of inappropriate answers involving electron microscopes and

ultracentrifugation. Most of the answers to part (b) (ii) identified the need to produce a section through which light could pass but seldom developed the arguments further to embrace the points made in the mark scheme. Some of the less able candidates confused optical and electron microscopes.

(c) Although most candidates produced sound answers to part (c), some occasionally went far beyond the two differences required in the question. They should be aware that this approach is not without its drawbacks. Examiners cannot be expected to select correct answers from a mixture of correct and incorrect responses. In order to be fair to all, once the required number of responses has been exceeded, correct answers are disqualified by those that are clearly wrong. ***Guidance for Teachers Marking ISAs*** on the AQA Website has useful information about the application and interpretation of mark schemes.

Q43.

(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.

Q44.

Many candidates copied the orientation of the two hexoses and gained one mark for the correct monosaccharides. However, several candidates inverted the second hexose and then failed to copy it correctly. It was more common to see water as a product rather than a reactant, although few candidates included this at all. A small but significant number of responses showed water being removed with the direct linking of carbons one and four.

Q45.

This question targeted grade E and most candidates revealed a sound knowledge of the principles and skills tested here.

(a) The presence of a nucleus was usually correctly identified as being a eukaryotic feature, although there were occasional inappropriate references to cell walls.

(b) (i) The majority of candidates measured hypha length to an acceptable level of

accuracy although errors of a centimetre or more were surprisingly frequent. Most completed the necessary subtraction to arrive at a value for growth but problems were frequently encountered with the use of the scale bar and conversion to micrometres.

(ii) Candidates were expected to provide a method of calculation but a significant number, although identifying the key variables of growth and time, could not supply the necessary idea of growth divided by time.

(c) It was expected that candidates would draw on their knowledge of the biochemical test for starch in their responses. While most were successful, many answers made no attempt to link this to the context of the question and wrote generally about "doing the iodine test" on "the food" or on "the solution". There was occasional confusion with Benedict's test and the biuret reaction. Some referred incorrectly to the reagent as potassium iodide and a few were rather more concerned about representing their findings than testing for starch.

Q46.

(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.

Q47.

(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).

Q48.

(a) The wording of the question made it clear that candidates were required to give features found in prokaryotic cells. Many of those who failed to gain credit for this very straightforward question ignored this instruction, and listed features of a eukaryotic cell which would not be found. Such answers failed to gain credit.

(b) Among those candidates who clearly knew which test should be used, some identified the reagent as 'potassium iodide' while others limited their responses to 'iodine test'. Credit was withheld in both these cases, in the first instance for the use of an incorrect reagent and in the second, for an inadequate answer. The instruction 'Describe' should have indicated that rather more was required. The most frequent error in part (ii) was to identify the polysaccharide concerned as protein, although there were also numerous references to glycogen.

(c) Most candidates were able to give both a relevant aspect of starch molecules and a consequence of the feature described, and thus gained maximum credit. Those who failed to do so, either did not add significantly to information provided in the question with answers such as 'It is insoluble, so can be stored' or concentrated on aspects of glucose which were linked to its function as a respiratory substrate, clearly an

inappropriate approach to this question.

Q49.

(a) It was common to see answers that referred to galactose as the single breakdown product of ll lactose and answers of this nature did not gain credit.

(b) Part (i) tended to be well answered by candidates though part (ii) did not elicit the desired response in many instances. Many candidates answered in terms of surface area. Some candidates realised the enzymes would pass out of the body but identified this as an example of excretion. Unfortunately these candidates often made the same error in 2 (a) (i).

(c) The assertion that mitochondria *made* energy prevented a significant number of candidates scoring one of the marks available. Many candidates scored both the marks available.

Q50.

(a) Although, in part (i), most candidates showed sufficient familiarity with the concept of a ratio to be able to calculate the answer correctly, part (ii) presented more difficulties. The few candidates who analysed the question with sufficient care and began their answers with wording along the lines of “The height to breadth ratio of an epithelial cell . . “ were usually able to obtain credit. The main problems which arose elsewhere were either a failure to make any reference to a ratio, or to answer in terms of the milk-producing cell. These approaches, coupled with confused explanation, severely limited the marks that could be awarded in many cases.

(b) Most candidates recognised that a molecule of galactose would contain six oxygen atoms. Predictably, the most frequent incorrect answer in part (ii) was 12 and this appeared with considerable frequency.

(c) This question required candidates to apply their knowledge of water potential to unfamiliar material. Most demonstrated that they understood the principles involved but gave the impression, yet again, of relying on their knowledge of seemingly similar, but very different, questions which had been set in the past. Those who related their answers to the vesicles usually gained full credit. Unfortunately many lost their way by attempting to describe water movement into the cell or, in some cases, the membrane.

(d) Those candidates who avoided the obvious pitfall of describing mitochondria as “making” energy and referred to releasing energy or producing ATP were able to gain at least one mark. They were not always successful in gaining the second, however. Some of these less convincing answers were based on bland statements about the ATP or energy being “needed” by the cells. Others treated energy as a specific substance required by the baby.

(e) There were some outstanding answers to this question and candidates from some centres demonstrated not only a good understanding of membrane structure but were able to relate this clearly to diffusion. Less able candidates showed that they understood the structure of a plasma membrane in terms of the phospholipid bilayer but were less certain of the role of proteins in diffusion, often failing to link them with facilitated diffusion.

Q51.

(a) Most of the candidates knew glucose as the monomer of cellulose.

(b) Most candidates knew that the type of reaction converting cellulose to monomers was hydrolysis, but some candidates gave condensation instead.

(c) Few candidates scored full marks in part (c) - many did not realise the significance of straight chains or were vague on the location of hydrogen bonds. Many referred to cell wall structure rather than cotton and significant numbers of candidates confused cellulose with the beta pleated sheet or helices of proteins. This question was, therefore, a good discriminator.

Q52.

(a) There was evidence of some confusion concerning the drawing of the plasmid in this question. In order not to disadvantage the candidates, any reasonable structure was accepted. The most common answers were ribosomes and plasmid for **D**. Not many candidates knew capsule for **E**. Common incorrect answers were 'cell wall' and 'membrane'.

(b) Most candidates could give a function for the cell wall, but some gave vague statements such as 'keeping the structure'.

(c) Many candidates realised that starch had been digested, but few could name amylase as the specific enzyme. Many gave a credible explanation for the piece of fungus not having a clear area; the most common answer was that the fungus had died or was unable to secrete an enzyme to digest the starch. Answers stating the starch had not been digested were not accepted.

Q53.

(a) This was a well answered question with a significant number achieving full marks.

Most candidates gained one mark by recognising that the fall in intensity was the result of the breakdown of starch. A frequent omission, which lost a mark, was a failure to give the reaction of the starch with iodine as the reason for the colour change.

(b) The curves were generally well drawn with candidates achieving both marks. Marks were lost by careless drawing of the origin which should start at the same point on the *y* axis as the existing line. Another error was to draw the pH line to meet the original after 16 minutes. A minority of candidates seemed to misunderstand the graph, drawing and labelling the pH 2 line below the original line and the 35° C line above it, but then correctly explained the effect of these changes in part (c).

(c) This was a very well-answered question with candidates well prepared and able to make the main points, particularly in part (i). Thorough answers were often produced in part (ii) but there were more candidates unable to explain fully the effect of pH. There was less understanding of how a decrease in pH, resulting in an increase in *Yt* ions, affects the shape of the active site. A number of candidates, having given very good explanations, omitted to state the effect on the rate of activity which lost a mark if insufficient of the other marking points had been gained.

Q54.

(a) (i) This question was well answered. Glucose was the commonest incorrect response.

(ii) A significant number of candidates failed to gain the mark on this question. The most frequent error was to change the glycosidic bond to an H group instead

of an OH group. A number failed to use the information in the diagram, drawing a glucose molecule or six-carbon ring. Inaccurate drawing was also a cause of candidates failing to gain the mark.

(b) Condensation was the most common mistake, but most candidates correctly stated hydrolysis. Hydrolysation was occasionally given.

(c) The responses to this question were surprisingly varied. Many candidates were either unfamiliar with reducing and non-reducing sugars and their respective tests, or misunderstood the action of the enzyme. Many gained a mark for the correct colour change but gave muddled accounts incorrectly describing the use of hydrochloric acid or omitting heat. Many candidates gave the Biuret test or stated the correct reagents. Answers suggesting the mixture should be heated were not penalised. The correct colour was usually given. The weakest candidates confused the two tests, and in some cases the test for starch was given.

Q55.

(a) This was answered well by the majority of candidates, with many scoring full marks. Part (i) was answered better than (ii), as a significant number identified **B** as the cytoplasm, even though they correctly gave its role in photosynthesis.

(b) Many candidates identified the main substance in **C** as starch. Although some candidates mentioned glucose as the substrate, only a minority explained how starch was formed from the glucose. There was a wide range of incorrect answers including chlorophyll, water and protein.

Q56.

It was pleasing to find a higher proportion of candidates performing well on this question than had been anticipated, and a considerable number gained at least 6 or 7 marks. In particular, an encouraging number managed to get to grips with part (c), although often the weakest candidates made no attempt.

(a) Most candidates answered both parts well.

(b) (i) The majority gained a mark, but a significant number merely stated that caffeine improved performance without describing how. Some recited all the results from the table, including the glycerol and fatty acid concentrations, and were disqualified from the mark.

(ii) A good proportion recognised that the glycerol and fatty acids would have been derived from the breakdown of fats, for which they gained credit. Very few appreciated that the fats would be likely to have come from fat stores in the body rather than from, for example, the caffeine. A number proposed explanations in terms of more fats or fatty acids being ‘needed’ in order to be able to exercise for longer.

(c) (i) Many realised that the equation showed that the volume of oxygen absorbed was the same as the volume of carbon dioxide given out. Not all went on to explain how this ratio gave an RQ value of 1.0. It was encouraging, however, to see that many candidates explained their answer in terms of moles. Inevitably, a proportion of candidates ignored the equation altogether and suggested, for example, that a value of 1.0 was chosen because glucose is what is normally used in respiration.

(ii) Many of the better candidates provided good explanations, citing the evidence

that the RQ being closer to 0.7 when caffeine was taken, showed that fatty acids were being respired. Fewer actually pointed out that glycogen would be broken down to glucose, and that an RQ closer to 1.0 would suggest that the glycogen stores would be used more rapidly. Credit was awarded for those who pointed out that the longer time to exhaustion would in itself suggest that glycogen stores were being used more slowly. Weaker candidates often ignored reference to the data and tried to offer explanations based on time spent on anaerobic respiration, or the overall rate of respiration being slower after drinking coffee. Many confused glycerol and glycogen, or assumed they were the same substance.

Q57.

(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.

Q58.

(a) Most candidates gained the idea of C_{12}, but not the condensation of the two sugars involving the loss of the water molecule, $C_{12}H_{24}O_{12}$ was therefore a common answer.

(b) The Benedict's test was well rehearsed, although heating was sometimes either omitted or just implied by use of a waterbath. Weaker candidates included the use of a hydrolysing agent as an initial stage in the test. The results of A and B were described by the better candidates in terms of amount of visible precipitate, but very few then attempted to explain the result.