AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.3.3 DIGESTION AND ABSORPTION

SCORE	PERCENTAGE
/218	%

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Q1.

(a) Diffusion

Automarker

1

(b)
1. **Droplets** increase surface areas (for lipase / enzyme action);
2. (So) faster hydrolysis / digestion (of triglycerides / lipids);
3. **Micelles** carry fatty acids and glycerol / monoglycerides to / through membrane / to (intestinal epithelial) cell;

1. Context is important

1. Reject micelles increase surface area

2. Ignore 'breakdown'

3. Ignore 'small enough'

3. Accept description of membrane

3. Reject any movement through membrane proteins

3

(c)
1. Golgi (apparatus);
2. Modifies / processes triglycerides;
3. Combines triglycerides with proteins;
4. Packaged for release / exocytosis
   OR
   Forms vesicles;

Ignore 'processes and packages' unqualified

2. Reject synthesises triglycerides

3. Accept 'forms / are lipoproteins'

4

[8]

Q2.

(a)
1. Binary fission;
2. Replication of (circular) DNA;
3. Division of cytoplasm to produce 2 daughter cells;
4. Each with single copy of (circular) DNA;

1. Ignore reference to 'chromosome'

2. Ignore 'copy'.

4. Ignore references to number of plasmids.

2 max

(b)
1. Both denatured (by high temperature);
2. Denaturation faster at 60 °C due to more (kinetic) energy;
3. Breaks hydrogen / ionic bonds (between amino acids / R groups);
4. Change in shape of the active site / active site no longer complementary **so** fewer enzyme-substrate complexes formed / substrate does not fit;

3. Ignore references to disulphide bonds

3. Accept (at 60 °C) Change in shape of the active site /

*active site no longer complementary **so** no enzyme-substrate complexes formed / substrate does not fit;*

4

(c) 1. To digest protein;
2. (So) they can absorb <u>amino acids</u> for growth / reproduction / protein synthesis / synthesis of named cell component;
OR
(So) they can destroy a toxic substance / protein;

1. For 'digest' accept 'break down' here.

2. Accept '(so) they can destroy antibodies / antibiotics / viral antigens / bacterial antigens'

2

(d) 1. <u>Hydrolyse</u> (peptide bonds) to release amino acids;
2. Amino acids can cross (cell) membrane;
OR
Dipeptides cannot cross (cell) membrane;
OR
Maintain concentration gradient of amino acids for absorption;
OR
Ensure (nearly) maximum yield from protein breakdown;

2. Ignore references to crossing gut membranes.

2. Accept 'there are carrier proteins for amino acids'

2. Accept 'no carrier proteins for dipeptides'

2

[10]

Q3.

(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]

Q4.

(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]

Q5.

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

6 max

(b)
1. Polymer of amino acids;
2. Joined by peptide bonds;
3. Formed by condensation;
4. Primary structure is order of amino acids;
5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;
   Accept alpha helix / pleated sheet
6. Tertiary structure is 3-D folding due to hydrogen bonding <u>and</u> ionic / disulfide bonds;
7. Quaternary structure is two or more polypeptide chains.

5 max

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

4

[15]

Q6.

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

2

(b) Maltase.

1

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

1

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

2

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

Accept use of values from graph

3

[9]

Q7.

(a) 1. 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]

Q8.

(a) 1. In phospholipid, one fatty acid replaced by a phosphate;

Ignore references to saturated and unsaturated

Accept Pi/PO_4^{3-} / (P)

Reject P/Phosphorus

Accept annotated diagrams

1

(b) 1. Add ethanol, then add water;

Reject ethanal/ethonal

Accept 'Alcohol/named alcohol'

2. White (emulsion shows lipid);

Accept milky – Ignore 'cloudy'

Sequence must be correct

If heated then DQ point 1

Reject precipitate

2

(c) Saturated single/no double bonds (between carbons)
OR
Unsaturated has (at least one) double bond (between carbons);

Accept hydrocarbon chain/R group for 'between carbons' for either

Accept Sat = max number of H atoms bound

'It' refers to saturated

1

(d) 1. (Fat substitute) is a different/wrong shape/not complementary;
OR
Bond between glycerol/fatty acid and propylene glycol different (to that between glycerol and fatty acid)/no ester bond;

2. Unable to fit/bind to (active site of) lipase/no ES complex formed;

If wrong bond name given (e.g. peptide/glycosidic), then penalise once

2

(e) It is hydrophilic/is polar/is too large/is too big;

Ignore 'Is not lipid soluble'

1

[7]

Q9.

(a) Dipeptidase/s;

Accept: membrane bound dipeptidase/s.

1

(b) 1. <u>Endopeptidases</u> hydrolyse internal (peptide bonds)
OR
<u>Exopeptidases</u> remove amino acids/hydrolyse (bonds) at end(s);

Accept: break for hydrolyse.

Accept: endopeptidases break (proteins) into shorter chains.

2. More ends or increase in surface area (for exopeptidases);

2

(c) 1. No/less ATP produced
OR
No active transport;

2. Sodium (ions) not moved (into/out of cell);

Accept: sodium (ions) increase in cell.

Accept: sodium (ions) cannot diffuse into cell.

3. No diffusion gradient for sodium (to move into cell with amino acid)
OR
No concentration gradient for sodium (to move into cell with amino acid);

Accept: converse for all three points.

Note: no active transport of sodium (ions) equals 2 marks.

3

[6]

Q10.

(a) Any **one** from:

1. Numerical readings / not subjective / colour change subjective / gives quantitative data / not qualitative / gives continuous data;
2. Greater accuracy;

Accept greater precision

1 max

(b) Fatty acids produced;

1

(c) 1. No more (fatty) acids produced;
2. All triglycerides/fat//lipids/substrate used up / enzyme denatured;

2

(d) 1. Line starting at same point and falling above original line;
2. Levels off at same pH, but later;

Accept the line still falling at 4 minutes

Do not credit if levels off at higher pH

2

[6]

Q11.

(a) Ribosome/rough endoplasmic reticulum;

Ignore RER or endoplasmic reticulum unqualified

1

(b) 1. Does not digest protein inside cells;

Accept named examples

2. So (pancreatic) cell/tissue/function not destroyed/damaged;

2

(c) (i) Peptide (bond);

1

(ii) 1. Inhibitor is a similar shape to the substrate;
2. (Inhibitor) blocks active site/is complementary to the active site/binds to the active site (of trypsin);
3. Substrate can't bind to active site / no/fewer ES complexes formed;

3

[7]

Q12.

(a) C.

Ignore name of organ

1

(b) E.

Ignore name of organ

1

(c) 1. Active site (of enzyme) has (specific) shape / tertiary structure / active site complementary to substrate / maltose;

Reject active site on substrate.
Must have idea of shape
Assume "it" = maltase
Accept (specific) 3D active site
Reject has same shape

2. (Only) maltose can bind / fit;

Accept "substrate" for "maltose"

3. To form enzyme substrate complex.

Accept E−S complex

3

[5]

Q13.

(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 coronary artery / increased risk of blood clot in coronary artery;
Ignore references to myocardial infarction / heart attack

2

[9]

Q14.

(a) (i) For person with pancreatitis / blocked pancreatic duct:

1. At 0 h / start higher than healthy person / higher than healthy person throughout;

2. Rises then falls whereas healthy person falls then rises;

3. At 48 h / end, below the starting value whereas healthy person is the same (as at start);
Differences required for all points

2 max

(ii) 1. Little / less / no amylase can enter small intestine;
Accept gut or intestine but reject wrong locations e.g. stomach

2. Little / less / no starch digested (in intestine);

2

(b) 1. Amylase is specific (to starch);

2. No starch in human blood / cells / tissues / starch only in plants;

2

(c) 1. Could digest own body / own proteins;
e.g. 'could digest carrier proteins in body cells' would score 2 marks
e.g. 'could digest antibodies in blood' would also score 2 marks

2. Example of protein digested e.g. membrane protein, antibody, named protein in blood;

Do not credit unsuitable example such as muscle proteins

2

[8]

Q15.

(a) 1. Enzyme hydrolyses / breaks down protein to amino acids;

2. Products are soluble / can be washed away;

2

(b) **Arguments for biological washing powder:**

3 max if only arguments against biological washing powder are referred to

1. More effective with all stains;

Accept different ways of expressing 'effective' e.g. higher % of stain removed

2. Greater improvement with salad dressing / chocolate milkshake / chocolate pudding;

Arguments against biological washing powder:

3. Little / less improvement with raspberry sorbet / raspberry smoothie;

4. Only tested 5 / a small number of stains;

5. Only chose stains that would work / didn't select stains that wouldn't work;

6. Only included results that did work / didn't show results that didn't work;

7. Only one set of results / not repeated;

8. Only compared against one washing powder / may not be true for other washing powders;

Ignore references to unknown masses of powder, temperature of washes or other aspects of technique or different fabrics

4 max

(c) 1. Enzyme **S** effective across a wider range of temperatures;

2. Enzyme **S** *more* active above 50 °C / active up to 80 °C / active above 60 °C;

3. Enzyme **S** more active below (about) 37 °C temperature;

4. (Although) Enzyme **P** has higher rate of reaction at optimum / 40 – 50 °C;

5. Enzyme **P** denatured above 50 °C;

*Answers should be in the context of choosing enzyme **S** but, if **P** is chosen, points 4 and 5 may still be awarded, if described*

In points 2 and 3, a temperature must be stated. Allow ± 5

degrees of values shown

3 max

(d) 1. Stains caused by different substances;

2. Enzymes are specific;

3. Active site specific to substrate / other substrates cannot fit active site;

This could be expressed in other ways e.g. 'other substrates are not complementary to the active site'

3

[12]

Q16.

(a) In one country where the percentage of fat (in the diet) is 35%, the death rate (from breast cancer) is 20 per 100 000;

Must have reference to country

Accept … 1 per 5 000 / 0.02%

1

(b) 1. No. of deaths from breast cancer divided by total population × 100 000;

2. No. of deaths from breast cancer divided by all deaths × 100 000;

3. Sample and count deaths from breast cancer in 100 000 people;

If sample not 100 000 then must scale appropriately

1 max

(c) 1. Positive correlation;

2. But correlation does not show causation / some other (named) factor may be involved;

3. Evidence against positive correlation e.g. different death rates at same % fat / similar death rates at different % fat / some countries with higher death rate have lower fat intake;

1. Accept description of positive correlation / directly proportional.

Accept positive relationship.

2. Do not accept casual in place of causal.

3. Answer must be consistent with data.

3

[5]

Q17.

(a) 1. Phagocyte attracted to bacteria by chemicals / recognise antigens on bacteria as foreign;

2. Engulf / ingest bacteria;

3. Bacteria in vacuole / vesicle;

4. Lysosome fuses with / empties enzymes into vacuole;

5. Bacteria digested / hydrolysed;

1. Accept names chemical e.g. toxin

2. Allow description of engulfing

3. Accept: bacteria in phagosome

5. Neutral: Break down

5. Accept digestive enzymes destroy bacteria

5. Do not accept ''destroy bacteria'' as it is in question stem

4 max

(b) 1. Microvilli provide a large / increased surface area;

2. Many mitochondria produce ATP / release or provide energy (for active transport);

3. Carrier proteins for active transport;

4. Channel / carrier proteins for facilitated diffusion;

5. Co-transport of sodium (ions) and glucose or symport / carrier protein for sodium (ions) and glucose;

6. Membrane-bound enzymes digest disaccharides / produce glucose;

1. Reject villi on epithelial cells

1. Accept brush border

2. Accept large SA:vol ratio

3. Need idea of ''lots''

4. Reject: energy produced

5. Accept Na^+K^+ pump

6. Neutral: Channel proteins

7. Accept named example

6

[10]

Q18.

(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]

Q19.

(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]

Q20.

(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]

Q21.

(a) pH goes down and levels out;
after 30 min / pH 6.5;

2

(b) Enzyme not used up in reaction;

1

(c) Curve will be less steep:
*Only accept answers relating to curve **not** rate of reaction*

1

[4]

Q22.

(a) Measure with eyepiece graticule / scale;
Calibrate with stage micrometer / scale on slide / object of known size;
Repeats and calculate the mean;
OR
Use a ruler to estimate the field diameter under microscope;
How many droplets go across the field;
Repeats and calculate mean;

Accept references to radius

3

(b) (i) Two mark for correct answer of 4 : 1;;
One mark for incorrect answer but working shows that candidate has clearly attempted to compare values of r^2 / 6^2 and 3^2 / 36 and 9;

Idea of comparing ratios
A ratio of 1 : 4 should gain 1 mark

2

(ii) Small droplets have a larger surface area to volume ratio;
More surface for lipase (to act), leading to faster digestion of triglycerides;
Fatty acids are produced more quickly so pH will drop more quickly in curve Y / with bile salts / less fatty acids in curve Z / without bile salts so pH drop more slowly;

3

[8]

Q23.

(a) Diet including saturated fats leads to higher plasma cholesterol concentrations;
Higher in all age groups;
But sample size is very small;
Standard deviations overlap / suggest wide variation;

3 max

(b) The sex of individual is a risk factor for high cholesterol;
To remove a / one variable / to establish a fair test;

2

(c) Monkeys and humans closely related therefore similar conclusions might be drawn;
High concentrations of plasma cholesterol lead to an increased risk of cardiovascular disease in humans;
Don't know if diet has the same effect in monkeys (as in humans) / could have different effects because not the same species;

3

[8]

Q24.

(a) (i) Mitochondrion;

Neutral: cristae

1

(ii) (Site of aerobic) respiration / ATP production / energy release;

Q *Reject: anaerobic respiration*

Q *Reject: energy produced*

Active transport / transport against the concentration gradient;

Accept: energy produced in the form of ATP

2

(b) 89 – 91 gains 2 marks;

Correct answer gains 2 marks outright

Principle of:

$\frac{\text{correct measured length}}{\text{magnification}}$ gains 1 mark;

89-91 (mm) / 1000 or 8.9-9.1 (cm) / 1000 gains 1 mark

2

(c) Suitable explanation given e.g.

Accept: converse arguments

Reduced surface area; (So) less absorption;

*Neutral: structure **Z** incorrectly named*

(Membrane-bound) enzymes less effective;
(So) proteins / polypeptides not digested;

Reduced surface area for absorption gains 2 marks

Cell membranes damaged;
(So) Fewer / less effective carrier / channel proteins;

Accept: references to diffusion and active transport for 'absorption'

Carrier / channel proteins damaged;
(So) less absorption;

Reject: active transport if linked to channel proteins

2

[7]

Q25.

(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]

Q26.

(a) (Most of) bromelain is digested / not absorbed / broken down in blood;

1

(b) Total volume of blood;

1

[2]

Q27.

(a) Two marks for correct answer of 64.285 / 64.3 / 64;

(allow 1 mark for (8100 / 100 × 30) / 37.8)

2

(b) dissolve in / add ethanol then mix with water;
emulsion / white colour indicates triglycerides present;

2

(c) (i) increase the surface area for absorption;

(ignore wrong ref. to name)

1

(ii) **R** = tissue fluid / interstitial fluid / extracellular fluid / intercellular space;
S = lymph(atic) vessel / lymph capillary / lacteal;

2

(iii) proteins are synthesised by **U**;
involvement of ribosomes;
protein isolation / transport (inside RER);
vesicle formation;

2 max

(iv) exocytosis / description of;
because of size / too large to leave by other methods;

2

[11]

Q28.

(i) Lack of ATP;

Pump = <u>active</u> transport / requires <u>energy</u> / ATP provides <u>energy</u> / transport is up concentration gradient;

2

(ii) Concentration of Na^+ inside cell no longer less than concentration in gut lumen / no longer a concentration gradient;
No (facilitated) diffusion of NA^+ ions possible / amino acid absorption requires diffusion of Na^+ ions into cell;

2

(iii) Diffusion / facilitated diffusion;

1

[5]

Q29.

(i) In all cases reject 'energy' unless qualified

A – <u>facilitated</u> diffusion as transport protein needed but ATP not needed;
B – active transport 'energy' unless as (transport protein and) ATP needed; qualified
C – (simple) diffusion as neither ATP nor transport protein needed;
(Ignore all references to concentration gradients)

3

(ii) creates low concentration of amino acids / Na^+ in cell concentration gradient established between lumen and cell (of amino acids or Na^+)

2

[5]

Q30.

(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]

Q1.

There were no problems with question (a); it was well answered.

Question (b) asked for the advantages of lipid droplet **and** micelle formation. Students seemed to group both together ('they' or 'it') and give the same advantages. Many students failed to use the diagram to help them. For mark point two, there were lots of answers referring to making digestion easier; easier digestion does not equate to faster digestion. Only 3.7% of students scored all three marks.

As with (b), students did not use the diagram to help them answer question (c). Most answers just referred to lipids rather than to triglycerides. There were also a lot of generic answers of "packages and processes proteins"; failing to acknowledge that the question is about triglycerides, not proteins. There were several answers stating that the Golgi apparatus produces proteins from lipids or mistaking lysosomes for vesicles. Only 2.9% scored four marks, with over 70% scoring 1 or 2 marks.

Q2.

(a) There were many excellent answers to this question, with over 50% of students achieving both marks. The majority of students knew that bacteria divide by binary fission, but often did not include sufficient, or specific enough, detail in their description of what happens during this process to score the second mark. There were several statements about mitosis and some descriptions of viral replication.

(b) This question required an **explanation** and so there were no marks for a description of the graph. Many students gave lengthy descriptions and, even if they went on to write creditworthy statements after this, they had wasted much time and energy. The first requirement was for students to realise that, since the 30 °C line stays at 100%, both lines at 50 °C and 60 °C show denaturation of the enzymes. Many students got this far, but their explanations of what happens to the protein during denaturation were often incomplete or imprecise. For example, some stated that 'bonds' would be broken or that 'hydrogen, ionic, disulfide and peptide bonds' would be broken, so not achieving mark point 3. The mark least often awarded was for the explanation that a temperature of 60 °C would denature the enzyme more quickly because of the increased (kinetic) energy at this temperature.

(c) / (d) Both of these questions required careful reading of the question stems to access the mark points; many students got half-way through their answers, but gave insufficient detail to score full marks. For question (c), many students appreciated that the extracellular proteases would digest protein and this might protect the bacteria in some way, but their answers were not specific enough to gain credit for this idea. Similarly, many appreciated that extracellular protein digestion would provide useful products for the bacteria but did not go on to state that these products would be amino acids that could be used for growth / protein synthesis within the bacteria. For question (d), it was pleasing to see how many students could state that the dipeptidases would hydrolyse bonds in dipeptides, but many were not confident what these bonds were, or what the products of this hydrolysis would be. Many did not continue their answer to state the importance of this hydrolysis with reference to the passage of amino acids across the cell-surface membrane into the cells for absorption.

Q7.

(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.

Q8.

About two thirds obtained the mark in (a) for a correct description of the difference between a triglyceride and a phospholipid. Those who failed to score either did not know about the structure of these molecules or just described the structure of a phospholipid (or triglyceride).

In (b), about 40% of students could fully describe how to test for a lipid and obtained both marks. A minority described tests for other biological molecules. Many made errors in their descriptions of the emulsion test or of a positive result. These errors included: adding water before ethanol, heating the mixture, the presence of a precipitate and failing to note that the colour of the emulsion would be white.

Most students scored the mark in (c). Those who didn't got saturated and unsaturated the wrong way round in terms of carbon-carbon double bonds.

In (d), 28% obtained both marks for stating that the fat substitute would not bind to the active site of lipase because it has a different shape to a triglyceride. A similar percentage obtained one mark. Those who failed to score often ignored the question's reference to lipase and wrote about bile salts, micelles and methods of absorption.

Q9.

(a) Approximately 50% of students correctly identified the type of enzyme as a dipeptidase. The most common incorrect response was protease.

(b) Only one in five students obtained both marks in this question. Students who obtained one mark usually correctly identified the role of either endopeptidases or exopeptidases. However, there were many students who confused the roles of these enzymes or suggested that endopeptidases work outside cells and endopeptidases inside cells.

(c) In marking this question, particular care was taken to ensure that no students were disadvantaged due to the error in the diagram. Consequently, any references to ATP producing ATP and Pi were not penalised. Most students obtained the mark for stating that the respiratory inhibitor would prevent the production of ATP. Students who did not gain this mark usually referred to the inhibitor blocking or changing the shape of the carrier protein involved in moving the amino acid rather than mentioning ATP or active transport. Over 40% of students obtained a second mark for describing that the movement of sodium ions would be affected. Many other students simply referred to amino acids no longer being absorbed without any

reference to sodium ions. Answers obtaining maximum marks clearly explained that a diffusion/concentration gradient for the movement of sodium ions would not be maintained. Again, incomplete explanations simply referred to the movement of amino acids without any reference to sodium ions. Overall on the paper, this question proved to be the most effective discriminator.

Q10.

(a) More than 80% of students correctly stated that the pH probe would give a more accurate or precise reading or that assessing a colour change would be subjective.

(b) It was disappointing that more than half the students did not recognise that the decrease in pH was due to fatty acid production. There were many answers that referred to the products of carbohydrate digestion or of protein digestion in their answer.

(c) Most students knew that the pH remains constant as all the triglycerides had been hydrolysed or that the low pH could have denatured the enzyme. Unfortunately there were many who disqualified their answer by suggesting that the enzyme would be used up or all the active sites would be full. Relatively few students went on to explain why this would result in a constant pH.

(d) It was pleasing to see that almost 70% of students were able express their answer correctly on the graph.

Q11.

(a) 62% correctly named the rough endoplasmic reticulum or the ribosome as the site of trypsin production. Those who did not score usually failed to specify the rough endoplasmic reticulum or simply gave the abbreviation RER. Students should be reminded that only those abbreviations given in the specification or in a question should be used in exam answers.

(b) This question discriminated well, with students writing about proteins within the cells not being digested and so the cell would not be damaged or its function would not be impaired. The problem for many students was that they failed to recognise that the question was about the inactive enzyme within the cell. A common mistake was that it enabled the storage of large amounts of enzyme within the cell, or that it is a control mechanism over the rate of digestion.

(c) (i) 84% correctly named the peptide bond.

(ii) Students are clearly familiar with this type of question and many gave excellent answers. There were, however, the usual mistakes of referring to the active site on the wrong molecule and many thought that the inhibitor would be a similar shape to trypsin or its active site. Inevitably, there were a few students who confused competitive and non-competitive inhibition.

Q12.

(a) More than 80% of students correctly named organ C.

(b) More than 62% of students correctly named organ E.

(c) There was considerable evidence of a good understanding of the importance of the (specific) active site of the enzyme. This was expressed in a variety of ways. Students discussed the importance of the tertiary structure determining the active

site. Many indicated that the active site of maltase was complementary to either the substrate or maltose. Unfortunately some students incorrectly stated that maltose possessed the specific active site. Nearly all students had a clear understanding of the resultant enzyme-substrate complex.

80% of students scored two marks, often because they failed to indicate that maltose would bind / join / fit or attach to the maltase and so form the enzyme-substrate complex. The poor expression of some students resulted in them suggesting that the complementary shapes were matching. Unfortunately this conveyed the idea of the shapes being the same.

Q13.

(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.

Q14.

(a) (i) The first part of this question required the description of differences. Many students were able to identify two appropriate differences but it was also the case that the Marking Guidelines were not always applied as given, in particular, where only one statement was made and no difference shown.

(ii) A common weakness with answers to this question was a failure to identify the location of where little or no amylase would reach and less starch digestion would occur as a result of a blocked pancreatic duct. Only a few students considered that salivary amylase would not be affected.

(b) Many students identified the specific nature of amylase but did not always explain that there would be no harmful effects because the substrate for amylase (starch) was not found in blood.

(c) In this part, students were frequently able to suggest that body proteins would be digested but were less able to offer a suitable example of a protein. It was common to see a hopeful reference to “blood cells” without a specific identification of (cell) membrane proteins or other blood proteins, such as antibodies, that would have gained credit. Occasionally, assessors allowed protein examples that would not be part of the blood and therefore not answering the question asked.

Q15.

(a) There was some weakness with both the answers to this question and the assessment of what was written. As mentioned before, marking points show the minimum required answer and marking point 1 clearly identified that amino acids would be formed. It was disappointing that quite a few assessors felt that “smaller proteins are formed” or simply that “proteins are digested” was sufficient to award this marking point.

(b) In the main, students used the information provided well to answer this question. The majority referred to trusted ideas such as the limited number of stains used or that there was only a single set of results. Higher scoring students used the more sophisticated arguments, such as not including results where there was no change, and made specific reference to the actual stains.

(c) It was also the case that many students answered this question well, particularly where appropriate temperatures were identified to support the use of enzyme **S** or to explain why enzyme **P** was inappropriate for use. However, the general idea, that enzyme **S** was effective across a wider range of temperatures, was often not recognised.

(d) Many students finished with full credit in this question. In weaker answers, as was often the case with many questions, students failed to translate the idea in the question first. Thus, ‘a wider range of stains’ was not explained as caused by different substances being present but this did not prevent most being able to identify that the specific nature of enzymes was due to their active site.

Q16.

(a) Candidates often failed to appreciate that point A referred to just one of the 24 countries represented on the graph. The graph showed two points with 35% fat that had different death rates. A number thought that 20 in 100 000 was the same as 200 000.

(b) This question proved to be challenging for many with only the more able gaining the mark. Some suggested a suitable method but then failed to multiply their answer by 100 000. There were many vague answers such as use hospital records, or reading the answer from the graph.

(c) The majority gained two marks for evaluating the data on the graph, although many simply repeated a stock answer along the lines of there being „a positive correlation but correlation does not mean causation". Unfortunately, some candidates failed to gain the first mark by failing to state that the correlation was positive. The better candidates actually looked at the data and gave examples which did not fit in with the pattern – for example, the widely differing death rate with 35% fat in the diet.

Q17.

(a) Phagocytosis was well understood by candidates and many gained full marks. Many, however, wasted time by describing antigen presentation which was not

required. Almost all candidates knew that the bacteria would be engulfed and many referred to their inclusion in a phagosome or vacuole. Weaker candidates failed to gain marks through imprecision, e.g., not realising that the lysosomes fuse with the phagocytic vesicle and just writing about them releasing enzymes or not specifying what sort of enzymes and then repeating the stem by saying the bacteria were destroyed without any mention of digestion or hydrolysis.

(b) Many candidates failed to realise that this question was about cell adaptation. There was a lot of confusion between adaptations of the cell and of the intestine wall generally, with many answers focusing on factors such as a good blood supply and maintaining a steep concentration gradient. Such responses were not relevant to this question. Many candidates had a good understanding of glucose co-transport and described this in detail, usually gaining two or three marks, even though their answers were not focused on cell adaptation. Most scored one mark for understanding a large surface area was involved but many attributed this to villi rather than to microvilli. Better candidates gained a further two marks for explaining the cells would have a large number of mitochondria that provide the ATP for active uptake.

Q18.

(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.

Q19.

(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.

Q20.

(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.

Q21.

(a) This was often generously marked. For the first marking point candidates were required to state that the pH decreased and then levelled off. Centres often gave credit for the second point for any mention of pH 6.5 or 30 minutes, even when there was no reference to levelling.

(b) This was well answered by the majority of candidates. Some candidates misinterpreted this question and responded by explaining what would happen if the enzyme concentration changed during the investigation.

(c) Some centres credited responses that referred to rate, rather than to the gradient or 'steepness' of the curve. Many candidates experienced difficulty in expressing this simply. In some centres, candidates who had difficulty describing the difference drew the curve on the resource material. This was sometimes not credited by the centre, despite the curve being shallower than curve Z.

Q22.

(a) This presented major difficulty to the vast majority of candidates, despite its inclusion as a required procedure in the specification (Section 3.3.2). Nevertheless most candidates made an attempt but this usually involved the incorrect use of magnification and observed size.

A minority of responses included the use of eyepiece graticules and stage micrometers or equivalent pieces of apparatus. Difficulty was experienced when trying to explain calibration.

Many candidates attempted to use a ruler directly for measurement of the drops rather than using it to estimate the field of view.

(b) (i) A large number gained both marks with ease. The calculation of the ratio of surface areas of the droplets proved difficult to others, many not gaining any marks at all. Some candidates gave the ratio in reverse.

(ii) There was a large variation in the responses of candidates in this part. Only a minority of candidates mentioned surface area to volume ratio for the first marking point. Many centres rewarded responses which made no reference to the volume.

Candidates who did not make reference to the surface area to volume ratio, but had realised that the surface area of the droplet was normally larger, were able to suggest that greater contact was possible with the lipase or enzyme. Most centres credited the fourth marking point too generously, awarding the mark when there was no reason for the fall in pH.

Q23.

(a) Few candidates scored high marks for this question. The majority recognised the

pattern in the data and provided simple accurate descriptions of the relationship. It was pleasing to see some good answers about the overlapping standard deviation values, but some candidates experienced difficulty with this concept. In their attempt to express the idea of large variation between the groups, they inadvertently suggested that the standard deviation values were themselves large. Many centres gave credit for such comments.

(b) A few centres marked this question severely while others marked it extremely leniently. The idea of the sex of an individual being a risk factor for high cholesterol was poorly expressed by the vast majority. Candidates had greater success with the idea of removing a variable so that a fair test was carried out.

(c) To achieve the first mark, candidates had to imply that the two similar species were closely related to each other; therefore similar conclusions could be drawn. The third marking point required a reference to the two species responding differently to the same diet. A large number of centres marked this question with considerable leniency, especially in relation to marking point three.

Q24.

(a) (i) Over 90% of candidates correctly identified organelle **Y** as a mitochondrion.

(ii) This question proved to be a good discriminator. Most candidates gained at least one mark for the function of mitochondria in terms of respiration, energy release or ATP production. Better candidates usually went on to link this to active transport. Unfortunately, some candidates disqualified the first mark through poor expression e.g. ‘energy produced’ and ‘produces ATP for respiration’. Similarly, some answers referred to facilitated diffusion and linked this to a requirement for ATP. A minority of candidates incorrectly referred to structure **Y** as either ‘microvilli’ or ‘ribosome’. This resulted in incorrect answers relating to surface area and protein synthesis respectively.

(b) Most candidates gained one mark for the principle of dividing the measured length by the magnification. However, only the best candidates were able to convert the measured length to micrometres. Candidates who failed to score often divided the magnification by the measured length.

(c) Most candidates scored one mark for mentioning a reduced surface area. The more able usually went on to link this to reduced absorption for full marks. However, some candidates disqualified this mark by referring to less protein being absorbed. Relatively few candidates referred to the cell membrane or membrane proteins.

Q25.

(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.

Q27.

Unit 6

(a) Although the correct answer was given by many candidates, a significant minority made arithmetical errors or rounded their answers incorrectly.

(b) The emulsion test was most frequently cited but the method was often not described correctly.

Many of these responses used water or ethanol as the sole reagent or cited an incorrect test. A small minority of candidates gave details of incubating with lipase and testing for pH change, these answers received the appropriate credit.

(c) Microvilli were correctly identified and their function described by most candidates in part (i).

Part (ii) caused problems to the weaker candidates and the vast range of alternative answers generated by these candidates indicated that they had not understood the diagram. Part (iii) produced good responses from the candidates who correctly identified the rough endoplasmic reticulum, although a small proportion thought the structure was the Golgi body. Part (iv) was generally poorly answered. The most common incorrect response was facilitated diffusion.

Often these responses were given in answers which clearly indicated the size of the chylomicrons and it was interesting to observe the lack of coherent thinking displayed by many candidates.

Unit 7

(a) Calculations of the recommended daily lipid intake were often incorrect, a common error being to disregard the given energy content of one gram of lipid. Some spoiled their answers by inappropriate rounding or by compounding rounding approximations in a two-stage calculation.

(b) Many candidates did not know the details of the emulsion test for lipids. Benedict.s, the biuret test and the iodine test were all suggested.

(c) In (i), most knew that the microvilli shown in the diagram would increase the surface area for absorption of the products of digestion. However, in (ii), the identification of **R** and **S** was rarely correct. **R**, the tissue fluid, was sometimes thought to be

'cytoplasm', a 'blood vessel', or merely a 'space'. **S**, the lymph vessel or lacteal, was thought to be a 'blood vessel', a 'lysosome', even the 'small intestine'. In part (iii), many recognised organelle **U** as the rough endoplasmic reticulum and knew that the protein part of the chylomicron would be made here, better candidates emphasising the part played by its ribosomes. Some correctly suggested a role in transport, perhaps mentioning vesicle formation. Others incorrectly thought triglycerides were synthesised here, despite the indication in the diagram that this was fulfilled by the smooth ER. It was evident in (iv) that many candidates had no appreciation of the size of the chylomicrons – despite having been given the information in the stem to section (d) that they were composed of many triglyceride molecules and were surrounded by proteins. Hence, 'diffusion', 'facilitated diffusion' and 'active transport' were not sensible answers. Better candidates knew that such large structures could only leave the cell by exocytosis.

Q28.

Some candidates clearly did not know the meaning of the term oxidative phosphorylation, in part (i), and thought that the poison DNP was a direct inhibitor of pump **Y** in the plasma membrane of the intestinal epithelial cell shown in the diagram, due to its direct attachment to the membrane protein. Others thought the DNP prevented the breakdown of ATP rather than its synthesis, although a fair proportion were on the right track and many realised that there could be no active transport in the presence of DNP (for whatever reason) and hence scored at least one mark. Some candidates left this section blank, presumably preferring not to wrestle with the complexities of what may have been to them an unfamiliar diagram.

In (ii), many candidates were unsure about the nature of the concentration gradient in the presence of DNP and implied there would now be a 'greater' concentration of sodium ions inside the cell than in the lumen of the small intestine – although by what mechanism was not at all clear. Many were content to state that no more entry of sodium ions and amino acids would be possible rather than giving the extra detail that diffusion would no longer be able to occur.

Opinions were divided in part (iii), although most realised that diffusion or facilitated diffusion of amino acids out of the epithelial cell would occur at point **Z** on the diagram. 'Active transport' was a common wrong answer, despite the lack of use of ATP at **Z** compared with its breakdown illustrated elsewhere – at point **Y**.

Q29.

In (i), candidates needed to be aware of the distinction between kinetic energy and energy stored in a molecule of ATP. It is incorrect to say that diffusion and facilitated diffusion require no energy. They require no ATP but the molecules must have kinetic energy or they will not move. In part (ii), some candidates explained why amino acids are continually absorbed into the capillary, but most, correctly, explained how removing amino acids by active transport maintains a low concentration in the epithelial cell and, therefore, a concentration gradient between the lumen and the cell.

Q30.

(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.