Mark schemes

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

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

2

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 throughtubing;

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] (a) 1. Helicase;

3

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 and 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] (a) 1. Maltose;

4

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

5

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 greatervolume of Benedict's reagent;

Ignore references to colorimeter

1 max

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

6

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]

7 (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]

8 (a) Dipeptidase/s;

Accept: membrane bound dipeptidase/s.

1

(b) 1. Endopeptidases hydrolyse internal (peptide bonds)

OR

Exopeptidases 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]

9

(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 complexesformed;

3

[7]

10

(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 "malt ose"

3. To form enzyme substrate complex.

Accept E−S complex

3

11 **[5]** (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]

12

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

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

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

3. At 48 h / end, below the starting value whereas healthy person is thesame (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] (a) 1. Enzyme hydrolyses / breaks down protein to amino acids;

13

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 / chocolatepudding;

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 otherwashing 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]

14 (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 beinvolved;

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]

15

(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 activetransport);

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

16 **1**

(ii) Positive correlation / as lactose concentration increases the data in column Cincreases / 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 / issubjective;

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

4. Amount in a serving may vary;

5. Untruthful responses / demand characteristics;*Sample size = neutral.*

2 max

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

17

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 Bsubjects / some IBS subjects had similar results to lactase deficient subjects;

3

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

18 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]

(a) Measure with eyepiece graticule / scale;

19

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] (a) pH goes down and levels out;

20 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] (a) (i) Mitochondrion;

21

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:

$\frac{\textit{correct measured length}}{\textit{magnification}}$ 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] (a) Diet including saturated fats leads to higher plasma cholesterol concentrations;

22

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]

23

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

1

(b) Total volume of blood;

1

[2]

24

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

25

(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] (i) Lack of ATP;

26

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] (i) In all cases reject ‘energy’ unless qualified

27

A – <u>facilitated</u> diffusion as transport protein needed but ATP not needed;
B – active transport ‘energy’ unless as (transport protein and) ATP needed; qualifiedC
– (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] (a) Digestion / hydrolysis / breakdown of a disaccharide into monosaccharides;

28

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]