EXAM PAPERS PRACTICE

Carbohydrates 1

Level: AQA A Level 7402
Subject: Biology
Exam Board: Suitable for all boards
Topic: Carbohydrates 1
Type: Mark Scheme

To be used by all students preparing for AQA A Level Biology 7402 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1

(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]

2 (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]

3 (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]

4

(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]

5

(a) 1.1 (g);

1

(b) 300(%);

1

[2]

6

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]

7

(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]

8

(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]

9

(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]

10

(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]

11 (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]

12 (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]

13 (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]

14 (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]

15 (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]

16 (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]

17 (a) ATP

1

(b) (i) 2.57:1/2.6:1/18:7;
Correct answer however derived scores two marks
72:28 scores one mark
Correct working from wrong figures scores 1 mark
Accept
0.4 / 0.39 / 0.389 / 0.3889

2 max

(ii) Low intensity;
At low intensity/below 40% mainly fat used / at high intensity/ above 40% mainly carbohydrate used;
Long duration exercise;
Percentage fat used increases with time / percentage carbohydrate used decreases with time;

3

[6]

18 (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]

19

(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]

20

(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]

21

(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]

22

(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]

23 (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]

24 (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]

25 (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]

26 (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]

27 (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]

28 (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]

29

(a) (i) 1. Maltose;
2. Water;
Accept H_2O

2

(ii) Condensation;

1

[3]

30

(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]

31 (a)

Transport through a channel protein	Q
Transport of small, non-polar molecules	P
Transport of glucose with sodium ions	S

1
1
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]

32 (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 / μgx10^{-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]

33 (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]

34 (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]