Carbohydrates and Lipids

Mark Scheme 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Biological Molecules
Sub Topic	Carbohydrates and Lipids
Booklet	Theory
Paper Type	Mark Scheme 3

Time Allowed : **78 minutes**

Score : **/ 65**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** **(i)** *assume answer is about glycogen*

branched ;
1–6 , glycosidic, links / bonds ;
not, coiled / helical ; [2 max]

(ii) compact so large quantity can be stored ;
insoluble so no osmotic effect ;
glucose would lower water potential ; **A** decrease, more negative
(so) water would enter and cell volume would increase ;
(so) plant cells would need thicker cell walls / animal cells might burst ;
glucose reactive molecule ; [3 max]

(b) *use annotations to help award these points*

1 oxygen bridge / glycosidic bond, broken ;
2 at left hand end of chain ;
3 water shown to be involved ; **A** hydrolysis
4 free glucose molecule with –OH drawn on C1 ;
5 chain now ends with –OH on C4 ; [3 max]

[Total: 8]

2 **(a)** -OH is below/AW (-H) on carbon (atom) 1;

A from sketch with C1 labelled **1**

(b) **(i)** (1-4) glycosidic; **R** 1, 6 glycosidic **R** oxygen bridge **1**

(ii) **1** -OH on free molecule and end of chain indicated;

2 water eliminated/removed/condensation reaction;

3 oxygen bridge/glycosidic bond drawn in correct position relative to chain;

4 between C1 and C4, must be labelled either side of glycosidic bond; **3**

M.P.2 and **M.P.4** can be taken from written account if no diagram

(iii) cellulose; **1**

(c) amylase breaks down/hydrolyses/acts on, starch to give maltose/reducing sugar;

R glucose

maltase/amylase, denatured/active sites disrupted/tertiary structure changed, when boiled/at high temperature;

maltase does not, break down/act on/digest/hydrolyse, starch;

reference to specificity/shape and fit/lock and key explained;

R no e-s formed

tube F is a control;

to show that there is no breakdown of starch without an enzyme **4 max**

[Total 10]

3 **(a)** *one mark per row*

statement	starch	glycogen	cellulose
glycosidic bonds between monomers	✓	✓	✓
monomer is β glucose	✗	✗	✓
stored within chloroplasts	✓	✗	✗
stored in muscle cells	✗	✓	✗
exists in two forms - branched and unbranched chain	✓	✗	✗

Do not penalise where <u>all</u> ✗ <u>or</u> ✓ s are omitted
Do penalise each row if a mixture of ✗ , ✓, and blanks

5

(b) take samples at <u>timed</u> intervals e.g. every minute;
test with iodine <u>solution</u> / potassium iodide <u>soln</u> / **or** Benedicts ;
determine the end point, eg continue until no blue / black (colour) / yellow / brown appears **or** continue until brick red / colourless ;
<u>time</u> taken to reach end point e.g. record the time;
ref to use of colorimeter (for precise results) (for both experiments) **or** standards / green -> yellow -> orange -> red;
plot amount of starch remaining **or** glucose / maltose / reducing sugar produced / transmission / absorption against time / sketch graph with labelled axes;
ref to initial rate / rate calculation (e.g. $^{1}/_{t}$ or gradient from graph);

max 4

[Total 9]

4 **(a)** **(i)** **A** glycerol;
B fatty acid; **2**

(ii) condensation / esterification / ester bond formation; **1**

(b) more energy released / stored per gram / unit / given mass;
R. per mole
37 kJ v 17 kJ; A. (37-40 kJ) v (15-17 kJ) A. equivalent calorific values if calculated
fats are highly reduced;
more hydrogens / fewer oxygens / higher carbon to hydrogen ratio / more CH bonds;
release / yield more energy when respired / oxidised; **2 max**

(c) 20% or more above the recommended weight / mass for height / BMI / Body Mass Index / $\frac{\text{mass kg}}{(\text{height in m})^2}$ greater than 30;
A. within range (30-40) **1**

(d) diabetes;
coronary heart disease / atherosclerosis / cardiovascular disease / stroke / AW;
hypertension / high blood pressure;
cancer;
arthritis / joint problems;
hernia;
varicose veins;
gallstones;
increased risk during surgical operations; **2 max**

[Total : 8]

5 **(a** either diagram A or B below (or more detailed – e.g. all carbons and all bonds shown in diagram A) **;;**
A CH_30 for CH_2OH
I incorrectly numbered carbons

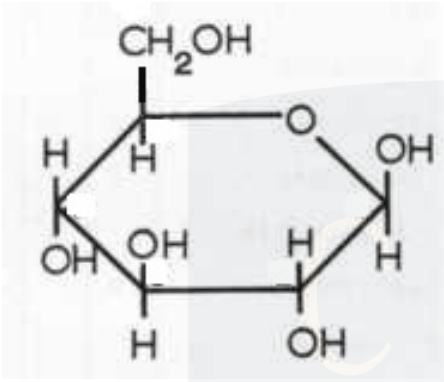

diagram A

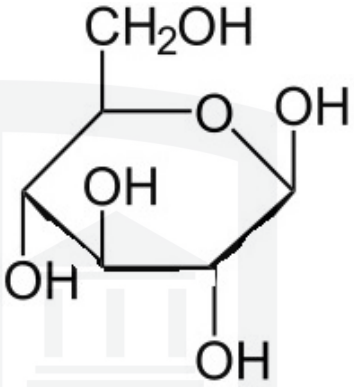

diagram B

*if incorrect (e.g. If one or more H missing from the ring in diagram A **or** if an H added to diagram B ring) allow one mark if*:

- hexose ring with oxygen shown in correct position and
- CH_2OH group in correct position and

OH groups of ring in correct position. **[2]**

(b) (i) accept *T. maritima* or **T** and *A.tumefaciens* or **A** throughout for the β-glucosidases
*accept **T** if stated as **B** (as long as **A** is clearly mentioned)*
*if only **A** or **T** stated, look for comparative phrase*
compare optimum temperatures

1 optimum temperature, **A** lower (than **T**) / **T** higher (than **A**) **;**
A maximum activity **A** is at a lower temperature

2 40 °C(**A**) v 85° C(**T**) / **A** lower by 45 °C **;**

3 one difference in shape of curve before or after optimum **;**
e.g. after optimum, **T** does not have the less steep decrease after the initial steep decrease (unlike **A**)
before optimum, steepest increase for **A** is at the lower temperatures, (unlike **T**)

compare activity below and above 55 °C

4 below 55 °C, **A** has a higher activity / above 55 °C **A** has a lower activity, (than **T**) **;**
ora
A has a higher activity at low(er) temperatures and a lower activity at high(er) temperatures ora

5 comparative data to support mp 4 **;**

compare temperature ranges of activity

6 temperature range for activity is greater for **A ;** ora

7 (**A**) spans 80 °C v (**T**) spans 65 °C **; A** (**A**) 10–90 °C v (**T**) 30–95 °C

*compare **L** for both*

8 has a lower, **L** / lowest temperature for (detectable) activity **or** ora
L is 20 °C lower for **A ; A** 10 °C (**A**) v 30 °C (**T**) **;**

9 (at **L**), A (relative) activity = 35%, **T** = 10% **;**

*compare **H** for both*

10 **T** has a higher, **H** / highest temperature for detectable activity **or** ora
H is 5 °C higher for **T ; A** 95° (**T**) v 90 °C (**A**) **;**

11 (at **H**) (relative) activity = 4%, **T** = 60% **;**

if mp 10 data given to support mp 1, then CON = no marks for mp 1 or 10 **[max 4]**

(ii) **1** primary structure, dictates, folding of the polypeptide chain / tertiary structure **;**
A idea that differences in primary structure leads to differences in, secondary / tertiary, structure
A in terms of folding to give the active site

similarity

2 same / (very) similar, (shape of) active site **;**

3 active site (shape) is complementary to / AW, substrate / cellobiose **; R** matches
A ES complex forms

differences

4 differences in, side-chain / R-group, interactions / AW **;**

5 qualified **;** e.g. differences in, numbers / types, of bonds
differences in bonding to give different stabilities
R different bonds without further qualification
R peptide bond

6 suggestion for thermal stability of **T ;** e.g. more bonds / more of a named bond type

7 suggestion of how active site may work in different ways **;**
e.g. at lower temperatures, **T** induced fit mechanism may mean active site does not mould fully round substrate **[max 4]**

[Total: 10]

6 **(a** *one mark per row*
penalise once for stated ecf and then mark to max 4 [6]

	name of organelle	function
A	*cell surface membrane*	*control of movement of substances into and out of the cell*
B	nucleolus	production of, ribosomes / rRNA / tRNA ;
C	mitochondrion **A** mitochondria	one from ; aerobic respiration ATP synthesis/ production / AW link reaction Krebs cycle oxidative phosphorylation **R** produces energy / ATP energy
D	smooth endoplasmic reticulum **R** SER or smooth ER	lipid / sterol / cholesterol / steroid, synthesis ; *ecf if SER, or Golgi is named organelle*
E	rough endoplasmic reticulum **R** RER or rough ER	one from ; protein / polypeptide, synthesis translation modification of protein / described (e.g. folding, glycosylation) protein transport (to Golgi) *ecf if RER*
F	Golgi (body / complex /apparatus)	one from ; modification of protein glycosylation / described modification of lipid pack(ag)ing (of), protein / lipids production of, (Golgi / secretory) vesicles / lysosomes ***ignore*** synthesis of protein *allow ecf if smooth endoplasmic reticulum*
G	lysosome *or* Golgi / secretory, vesicle	contains /storage of, hydrolytic / digestive, enzymes *or if Golgi vesicle* transfer / transport, of, protein / lipids ;

(b) *max 3 if only structure or only explanations given*

polysaccharide ;

chains of α-glucose (residues) ; *only need α once*
α1–4 glycosidic bonds / links ;

branches ;
(because of) α 1–6 glycosidic bonds ; *only need glycosidic once*

idea that many 'ends' to easily, add / remove, glucose ;
compact / AW ;
insoluble ;
will not affect, water potential / ψ ; AW
AVP ; [max 4]

[Total: 10]

7 **(a)** *electron microscope*
accept ora for light microscope

1 higher resolution / better resolving power;
A high *only if further detail confirms understanding*

2 more easily able to distinguish between two (separate) points / AW;
A *if no comparative but mp 1 or relevant point in mp 3 gained*

3 **AVP**; able to see points closer together than 200 nm **A** range 100 – 300 nm
can see points up to 0.5 nm (0.0005 μm) apart but LM is 200 nm (0.2 μm) **A** range 0.2 – 1.0 nm
electrons have shorter wavelength (than light)
wavelength of electrons shorter than size of additional structures seen [max 2]

(b) *each feature must be briefly qualified to gain max 3*
penalise once if feature correct but not correctly qualified / or not qualified

1 detail of mitochondria; e.g. inner membrane / crista(e)
double membrane
ribosomes
(circular) DNA

2 detail of chloroplasts; e.g. double membrane
internal membranes
thylakoid(s) / grana / intergrana / lamellae
ribosomes

3 ribosomes, qualified; e.g. visible as small dots
scattered throughout / in cytoplasm
on RER

4 smooth endoplasmic reticulum / SER, qualified; e.g. no ribosomes / tubular / membranous

5 rough endoplasmic reticulum / RER, qualified; e.g. ribosomes / membranous / flattened cisternae;

4/5 endoplasmic reticulum / ER, qualified; e.g. smooth and rough / membranous / throughout cytoplasm

6 Golgi vesicles / secretory vesicles / lysosomes qualified;
e.g. forming from Golgi
ref. exocytosis (not for lysosomes)
seen as (small) sacs / AW
membranous

7 heterochromatin darker staining / euchromatin lighter staining;
A chromosomes seen as heterochromatin and euchromatin

8 nucleus has, nuclear envelope / two membranes;

9 nuclear pores in nuclear envelope;

10 cell surface membrane, qualified; e.g. to the inside of the cell wall

11 *idea that* (cell) membranes are visible, qualified; e.g. thin / round / within organelles /

named organelle [max 3]

(c) *award two marks if correct answer is given, only one mark if μm (units) given*

× 1600;;
A in range of × 1400 to × 1800

(8 000 / 5 μm)
7 000 / 5 μm = (1400)
9 000 / 5 = (1800)

award one mark if correctly measured and divided by 5 μm but incorrectly converted
award one mark if incorrect measurement (e.g. whole cell) but correct formula used (i.e. divided by 5 μm) [2]

(d) (i) 1 amylopectin branched / AW; **ora**
2 amylose, spiral /spiralled / helix / helical; **ora**
R α – helix
R coiled
allow ecf from mps 1 and 2 to award mp 3
3 amylose (α) 1 – 4 linkages but 1 – 4 and 1 – 6 linkages in amylopectin / amylose has 1 – 4 linkages only;
accept from clearly labelled diagram(s) [max 2]

(ii) *any one valid; e.g.*
1 for chlorophyll, structure / synthesis / formation / AW
2 for ATP functioning **A** required for energy transfers
3 for enzyme, functioning / cofactor
4 signalling ion / regulates carbon fixation
5 for, DNA / RNA, synthesis
6 stabilises, DNA / RNA, structure
7 required in, translation / joining, small and large subunits (of ribosomes) [1]

[Total: 10]