CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9700 BIOLOGY

9700/23 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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CAMBRIDGE
International Examinations

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	alternative valid point (examples given)

1 (a) (i) **A** – nuclear envelope **;**
B – rough endoplasmic reticulum **; R** RER / ER / smooth ER
C – (large sub-unit of) ribosome **; A** ribosomal RNA, **R** rRNA [3]

(ii) **D** – transfer / t, RNA **;** [1]

(iii) *at* **1** – transcription **;**
A post-transcription modification / removal of introns
A DNA / gene, copied (to synthesise mRNA)
A genetic information copied
R DNA copied onto mRNA
R DNA code copied onto mRNA

at **2** – amino acid activation **;**
A attachment / AW, of (specific) amino acid (to specific tRNA)

at **3** – translation / condensation of amino acids / formation of peptide bond(s) (between amino acids) **;**
A codon-anticodon binding
I (poly)peptide synthesis [3]

(b) a protein combined with, a carbohydrate / sugars / AW **;**
A protein with sugar
R protein with, glycogen / polysaccharide [1]

(c) *antibody molecule*
has (2) heavy and (2) light chains / two types of polypeptide / different types of polypeptide **;**
idea that each different, polypeptide / chain, is coded for by a gene **;**
ref. to gene coding for enzyme for carbohydrate attachment (to make the glycoprotein) **;**
[max 2]

(d) *points can be taken from an annotated diagram*
1 variable region / Fab region, has antigen binding sites **;**
2 *ref. to* specificity for binding antigen / complementary (shape) to the antigen **;**
A *idea of* sequence of amino acids (on light and heavy chain) giving specific shapes
3 (IgG has) two (antigen) binding sites (per antibody molecule) **;**
4 heavy chains / Fc / constant, region binds to (receptors on), phagocytes / named phagocyte **;**
5 hinge region gives flexibility when binding to, antigen / pathogen / AW **;**
6 disulfide bridges, give stability / hold chains together / AW **;**
award on a diagram if bond and chains are labelled
7 AVP **;** e.g. R groups bind to antigen
bind to antigen by, hydrogen bonding / ionic bonding
constant region gives antibody class / AW [max 4]

[Total: 14]

2 (a) (i) **A** Ψ *for water potential*
I moisture
A aperture *for stomatal aperture throughout*
both units must be used at least once to award mp3 and mp7

similarities
1 when, stomatal aperture is 0 (μm) / stomata are closed, no, transpiration / water loss **;**
2 as stomatal aperture increases rate of transpiration increases in both groups of plants **;**
3 comparative use of figures with units in support of mp2 for either condition **;**

differences
in moving air
4 stomatal aperture, influences / controls / AW, rate of transpiration at all apertures **;**
in non-moving air
5 at stomatal apertures 15 μm and above rate of transpiration does not increase further / reaches a plateau / remains constant **;**
6 stomatal aperture has most effect on rate of transpiration in non-moving air at low apertures **; ora**

comparing moving and non-moving
7 comparative use of figures with units to show rates of transpiration at the same stomatal aperture **;** [max 3]

(ii) **A** water vapour potential *for water potential*
1 *ref. to* increasing width of stomatal aperture allows more water vapour to diffuse out **; ora**
R osmosis, **R** evaporate out
I evaporation from mesophyll
2 (intercellular) air spaces in leaf, are fully saturated / have high water potential / AW **;**
3 in moving air, water vapour is blown away / does not remain around the leaf **; A** low humidity around the leaf, **A ora** *for non-moving air*
4 in moving air, water potential gradient, is steep / maintained / increases / AW **;**
ora for non-moving air, **R** concentration gradient
5 so in moving air, high / higher, rate of diffusion of water vapour *in terms of an idea of a* gradient **; A ora** [max 3]

(b) (i) *advantage of having, stomata in pits / AW*
water vapour / moist air, builds up / trapped, in the, pit / groove / crypt **;**
A sunken stoma(ta)
reduces water potential gradient, between air inside the leaf and outside / AW **;**
A diffusion gradient
less transpiration / less diffusion of water vapour out (through stomata) / water is conserved **;**
R prevents water (vapour) loss
less water needs to be absorbed **;** [max 2]

(ii) *treat 'less gas exchange' unqualified as neutral*
cannot absorb carbon dioxide (during the day when photosynthesis occurs) **;**
rate of photosynthesis is reduced / no photosynthesis **;**
AVP **;** e.g. less water / minerals, reaches leaf cells (for other processes)
cooling effect of transpiration does not occur
slow growth [max 1]

(iii) **I** moisture

1 leaves, rolled / curled, so, stomata on inside / humid layer builds up / moist air builds up, (in enclosed area) **;**
A less steep water potential gradient
R coiled / curved

2 trichomes / hairs, create, a layer of non-moving air around the leaf / allow humid area to build up **;**
A less steep water potential gradient

3 (leaves are), thick / succulent, to store water **;**

4 thick(er) (waxy) cuticle reduces, transpiration / water loss **;**
A makes more waterproof, **A** waxy layer for cuticle

5 reflective cuticles, reduce heat load / AW **; A** shiny cuticles reflect heat ;

6 needle-like leaves to reduce surface area (to volume ratio so less, transpiration / water loss) **;**
A small leaves
R spikes / spines, unqualified

7 layers of epidermal cells, to reduce (cuticular) transpiration / water loss **;**

8 thick walled epidermal cells, to reduce (cuticular) transpiration / water loss **;**

9 *ref. to* hinge cells, leaf curling / wilting / AW **;**
A leaves wilt to reduce exposure to the sun **;** [max 2]

[Total: 11]

3 (a) *description*

1 activity / rate, increases to a, maximum / plateau **;**
A 'levels off' / remains constant **/** reaches V_{max}

2 increase in, activity / rate, slows **;**

3 data quote with units to support any correct statement **;**
e.g. mp 1128–132 au at 250–300 mM
e.g. mp 2 0 to 120 au between 0 and 100 mM, 120–128 au between 100 and 200 mM
A au for arbitrary units

explanation
at low / increasing, concentration of hydrogen peroxide

4 substrate / hydrogen peroxide, (concentration) is limiting (factor) **;**

5 active sites, unoccupied (low concentration) / become more occupied (increasing concentration) **;**
R active side *(penalise once)*

6 (low concentration) few collisions between enzyme and substrate / few ESC formed
or
(increasing concentration) more collisions between enzyme and substrate / increasing ESC formed **;**

at high (activity slows) / higher (plateau) concentration of hydrogen peroxide

7 enzyme / catalase, concentration / AW, becomes / is, limiting (factor) **;**

8 maximum number of enzyme-substrate complexes formed **;**
A ES complexes / ESCs

9 (all) active sites, saturated / (always) occupied **; A ora** [max 5]

(b) amino acid at position 2, is part of active site / helps to give shape to active site / helps form the structure of the active site **;**

plus one from:
idea of different, R group / side chain, gives different properties **;**
A tryptophan has a, hydrophobic / larger, R group / serine has a polar R group, different properties **;**
(slightly) different, folding of polypeptide / secondary structure / tertiary structure / active site / catalytic site / binding site **;**
suggested reasons e.g. electrons less easily transferred
ref. to induced fit , more efficient with **P ;** ora
different interactions between polypeptides (in catalase) **;** [2]

(c) 1 increased, metabolic rate / protein metabolism (after feeding) means, increased / more, hydrogen peroxide (produced) **;**

2 *idea that* less effective, catalase / **Q**, means, more hydrogen peroxide remains / less hydrogen peroxide broken down **; ora**
more hydrogen peroxide from increased metabolism is broken down faster in ***P*** *= 2 marks*

3 hydrogen peroxide, interferes with / is damaging to / AW, egg production **;**

4 AVP **;**
I *ref. to* oxygen production and use in aerobic respiration [max 2]

(d) bind to, allosteric site / site other than active site **;**
causes change in (shape of) active site **;**
A changes shape in active site (so) substrate cannot bind (to enzyme / active site) / enzyme-substrate complex cannot form **;** [max 2]

(e) needed for, facilitated diffusion / active transport **;**
A description of active transport e.g. moving, molecules / ions, against a concentration gradient
ref. to (some) substances are, water soluble / polar / hydrophilic / ionic / charged **;**
I large cannot pass through, phospholipid bilayer / hydrophobic core **;** [max 2]

(f) **1** barrier between cell cytoplasm and, external environment / AW **;** e.g. tissue fluid
R barrier unqualified
R 'keeps cell contents in'
R 'membrane surrounds the organelles'
R barrier for water soluble substances
2 receptor for, hormone / neurotransmitter / cell signalling substance / AW **;**
A signal receptor
3 cell recognition / acts as cell surface antigen **;**
4 cell-to-cell adhesion **;**
5 site for, enzymes / catalysing reactions **;**
6 anchoring the cytoskeleton / AW **;**
7 selection of substances that enter or leave a cell **;**
R controls / regulates substances that enter cell
8 formation of hydrogen bonds with water for stability **;**
9 AVP **;** e.g. *ref. to*, changing shape of cell / flexibility of cells e.g. phagocytosis [max 3]

[Total:16]

4 **(a)** **(i)** (α 1–6) glycosidic **; A** glucosidic [1]

(ii) many, terminals / ends, for, attachment of glucose / removal of glucose **;**
glucose can be stored quickly **;**
glucose can be, mobilised / AW, when required / quickly **;**
A more easily mobilised / AW **A** glycogen can be hydrolysed easily
makes it more compact / takes up less space / high density **;** [max 2]

(iii) no branching / single unbranched chain / straight / linear **;**
different monomer / beta glucose / β glucose **; ora**
alternate position of monomers in cellulose / AW **;** e.g. rotated 180°
only one type of (glycosidic) bond / 1–4 only / no 1–6 **;**
forms hydrogen bonds with other cellulose molecules (to give parallel chains)**;**
forms, microfibrils / fibres **;** [max 2]

(b) **(i)** *max 1 for correct working if no answer or answer incorrect*

$$\frac{385\,000}{2\,000\ 000} \times 100$$

19.25 / 19.3 / 19 **;;** [2]

(ii) **1** energy lost in processing crops to make animal feed **;**

animals
2 food, not eaten / wasted **;**
3 food, not digested / indigestible / not absorbed / egested
or
energy lost in, excretion / urea **;**
4 energy lost, in respiration / as heat **; A** movement / used for metabolism
5 (some) maintain constant body temperature which requires energy **;** AW

humans
6 energy lost in processing animals for human food **;**
7 (named) animals parts not edible **;**
8 AVP **;** e.g. some animals do not have enzyme to digest cellulose [max 3]

[Total:10]

5 **(a)** **I** *ref. to* walls, unqualified **I** *ref. to* vasoconstriction

nicotine
1 damages the, endothelium / (inner) lining / tunica intima **;**
2 increases blood pressure (which can damage the endothelium) **;**
3 increases risk of, blood clotting / thrombus formation **;**
A thrombosis, **A** increases stickiness of platelets

carbon monoxide
4 damages the, endothelium / inner lining / tunica intima **;**
allow even if mp1 given
5 so increases risk of, blood clotting / thrombus formation **;**
A thrombosis
6 *idea of* overall reduced oxygen supply to coronary artery walls **;**
7 AVP **;** e.g. inflammation / (increases risk of) atheroma *or* plaque *or* atherosclerosis [max 3]

(b) **(i)** (the by-pass vessels) supply (oxygenated) blood from the aorta **;**
supply oxygen to, cardiac / heart / ventricle, muscle **;**
supply, glucose / fat / fatty acids **;**
reduce / prevent, anaerobic respiration **;**
A so (muscles) can (continue to) respire aerobically
prevent death of, muscle / heart cells / heart tissue
A prevents angina [max 3]

(ii) **I** lifestyles, healthy or otherwise
I 'better health care'

education
early education / educate children (about heart disease)
or
leaflets / posters / continuing education, about effects of heart disease **;**

diet
encourage / educate about, healthy eating / balanced diet **;**
ref. to labelling of foodstuffs **;**
tax on, sugar / fats **ora** e.g. reduce cost of 'healthy' foods
or
idea of regulation against foods with, high sugar / fat **;**
A junk food

smoking
educate about dangers of smoking / anti-smoking campaigns **;**
provide ways to stop smoking / example **;** e.g. tax on cigarettes / nicotine patches / E-cigarettes
smoking bans **;**

exercise
finance use of / build more, activity centres / AW **;**
encourage, greater activity / exercise **;**

medical
idea of, check-ups / screening population (at risk of heart disease / high blood pressure / high cholesterol) **;**

provide / subsidise, drugs to, reduce blood pressure / lower cholesterol **;**

research
funding research into heart disease **;** [max 3]

[Total: 6]