

**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

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<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – October/November 2015</b>	<b>9700</b>	<b>23</b>

Mark scheme abbreviations:

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

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

- 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]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

2 (a) (i) **A**  $\Psi$  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 ( $\mu\text{m}$ ) / 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  $\mu\text{m}$  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]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

- (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]**

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

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 20 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 site (*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]

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

- (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) ( $\alpha$  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/ $\beta$  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]

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

(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) 1 *ref. to walls, unqualified* 1 *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]



Page 9	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	23

- (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]**