

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International Advanced Subsidiary and Advanced Level

## **MARK SCHEME for the May/June 2015 series**

### **9700 BIOLOGY**

**9700/22**

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 – May/June 2015</b>	<b>9700</b>	<b>22</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 equation, or by extra guidance)
<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

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- 1 (a) A right ventricle ;                    A r. ventricle                    R RV
- B vena cava ;                    A vena cavae
- I superior / upper / inferior / lower / posterior
- R if other terms used
- C atrioventricular node ;                    A AVN
- D coronary arteries ;                    A coronary artery                    A coronary capillaries
- I coronary vessels
- E bicuspid / left atrioventricular / mitral (valve) ;                    [5]

[Total: 5]

- 2 (a) 1 cilia, qualified ; e.g. absent / short / destroyed / smaller / damaged / AW
- R cilia killed                    R hairs for cilia                    R mucus damages cilia
- A ciliated (epithelial) cells, absent / destroyed / damaged
- 2 ref. to presence of, scar tissue / scarring ; **BOD** scar
- R cilia are scarred (idea is, scar tissue formation / more connective than usual)
- note idea of scar tissue in place of, cilia / ciliated epithelium = 2 marks*
- 3 idea of affecting, coordinated movement / synchronous rhythm, (of cilia) ;
- A cilia paralysed
- A if stated that excess mucus inhibits movement
- A ecf if 'hairs' instead of cilia for mp 1
- 4 mucus, not moved (effectively) / accumulates ;
- 5 idea that, bacteria / *B. pertussis* / *Bordetella* / pathogens, accumulate (in airways) / are trapped in mucus
- A mucus, good growth medium for pathogens / AW                    [max 3]

- (b) mucous gland ;                    A mucous glands                    [1]

- (c) if another mode of transmission given (e.g. faecal-oral / contact / sexual transmission) = 0 marks for this part-question I in unpasteurised milk

- 1 aerosol / droplet, infection ;

*only need to have one of 'infected' / 'uninfected' to gain mps 2 and 3*

- 2 infected / AW, person, coughs / breathes / spits / talks / sneezes ;
- 3 uninfected / AW, person, inhales / inspires / breathes in, droplets ;

*2/3 allow one mark if mps 2 and 3 given with no reference to, infected / uninfected*

- 4 organism / pathogen / bacteria / *B. pertussis*, in, airborne droplets / droplets in air ;
- A without 'airborne' or 'in air' if mp 2 gained                    [max 2]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- (d) (i) 1 DNA/gene/*MUC5AC*, unwinds/AW ; I unzips  
2 H-bonds break between, (complementary) bases/base pairs/strands ;  
I unzips  
3 one / a, strand, acts as template/(complementary) copied ;  
I ref. to, sense/coding and antisense/non coding  
4 ref. to (involvement of) RNA polymerase ;  
I ref. to direction of, movement/strand formation  
5 (free) complementary RNA nucleotides added ;  
**A** described in terms of correct base-pairs (C with G and A with U minimum)  
6 step-by-step/sequentially/AW ;  
7 sugar phosphate backbone sealed/phosphodiester bonds formed ;  
**A** sugar phosphate backbone formed  
8 (product is) messenger RNA/mRNA ; **A** primary transcript  
9 AVP ; e.g. transcription factors required to initiate transcription  
RNA polymerase binds to promoter (sequence)  
helicase unwinds  
ref. to activated (RNA) nucleotides  
ref. to proof reading  
(transcription ends at) transcription terminator [max 4]
- (ii) Golgi (body/complex/apparatus) ;  
**A** RER/rough ER/rough endoplasmic reticulum  
*one of*  
2 transport/movement, to cell (surface) membrane (from Golgi) ;  
**A** through cytoplasm (for Golgi or RER)  
**A** transport to Golgi *if RER given in mp1*  
3 ref. to bulk transport, across cytoplasm/to cell surface membrane ;  
4 ref. large size and difficulty of movement across, cell/cell surface membrane ;  
5 it, functions extracellularly/is released to the outside of the cell/is secreted ;  
I ref. to exocytosis *as it is in the question* [max 2]
- (e) 1 shortness of breath/dyspnea/difficulty breathing/restriction of airflow ;  
**A** rapid breathing **R** heavy breathing  
2 chronic/persistent/AW, cough/coughing ; I cough, blood/mucus  
**A** constant coughing **A** smoker's cough  
3 chest tightness ; **A** chest pain **R** heart pain  
4 wheezing ;  
5 fatigue/weakness ;  
6 difficulty, when exercising/with physical activity/with mobility ;  
7 more prone to/frequent, chest/respiratory/named, infections ;  
8 barrel (shaped) chest ;  
9 cyanosis (blue, face/fingers)  
10 AVP ; e.g. weight loss/anorexia  
swollen, ankles/feet  
**not excess mucus as this is in the question** [max 4]

[Total: 16]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- 3 (a) same, water potential/ $\Psi$ (inside + outside)/ no water potential gradient ;  
**A** same solute potential I osmotic potential  
(so) no, net/overall, movement of water (molecules) ;  
**A** osmosis does not occur

[2]

- (b) for two marks match correct plasma component and, mechanism/membrane component if no mechanism given

plasma component ;	mechanism ;	membrane component ;
oxygen carbon dioxide steroids/ steroid hormones	(passive) diffusion <b>A</b> movement from high to low concentration	(phospho)lipid bilayer/ hydrophobic core (of membrane)
glucose amino acid(s) named amino acid mineral/inorganic, ions named ion e.g. sodium ions/ $\text{Na}^+$ , magnesium ions/ $\text{Mg}^{2+}$ chloride ions/ $\text{Cl}^-$ , hydrogen ions hydrogen carbonate ions/ $\text{HCO}_3^-$ phosphate ions/ $\text{HPO}_4^{2-}$ potassium ions ( $\text{K}^+$ )	facilitated diffusion ;  <b>A</b> active transport <b>A</b> cotransport	transport(er)/ carrier / integral /intrinsic / transmembrane, protein ;  <b>A</b> channel protein for facilitated diffusion  <b>A</b> pump protein for active transport

**A** urea, with any of the three mechanisms and relevant membrane component to match the mechanism stated

[3]

- (c) (x) 1000 ;; **A** (x) 947 / 947.4 or 1053/1052.6  
if units given = one mark only

if incorrect allow one mark for correct length measured 9/9.5/10 mm and knowledge of formula is correct (magnification = image length/actual length – this can also be seen by workings e.g.  $9.5 \text{ mm} \div 9.5 \mu\text{m}$ ) but incorrect conversion factor used for final calculation

[2]

- (d) feature = one mark, with appropriate explanation = one mark

**F** red blood cells/haemoglobin, close to body cells ;  
**F** (capillary) endothelium/capillary wall, one cell thick/ thin ; **A** epithelium  
**E** short distance/AW (for oxygen to move to cells) ;

**F** ref. to, diameter/size, red blood cell and capillary (lumen) similar ;  
**E** slows down flow (to allow sufficient oxygen to move out)/short distance (for oxygen to move to cells) ;

[max 2]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- (e) no / fewer, gaps / fenestrations / pores, in endothelium / capillary wall ;  
**A** spaces  
 ref. tight junctions between (endothelial) cells ; **A** epithelial cells  
*idea that* cells wrap round / fewer cells make up capillary wall, so reduces  
 (endothelial) cell-cell contact ;  
*idea of* layer around capillary / basement membrane, impermeable ;

[max 1]

[Total: 10]

- 4 (a) either diagram A or B below (or more detailed – e.g. all carbons and all bonds shown in diagram A) ;;  
**A** CH<sub>3</sub>O for CH<sub>2</sub>OH  
**I** incorrectly numbered carbons

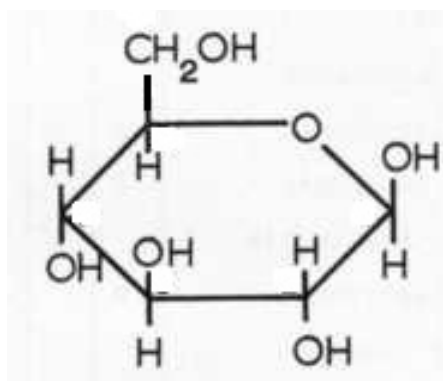


diagram A

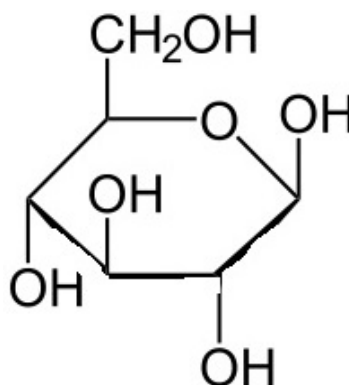


diagram B

*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<sub>2</sub>OH group in correct position and
- OH groups of ring in correct position.

[2]

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- (b) (i) accept *T. maritima* or **T** and *A. tumefaciens* or **A** throughout for the  $\beta$ -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
- optimum temperature, **A** lower (than **T**)/**T** higher (than **A**) ;  
**A** maximum activity **A** is at a lower temperature
  - 40°C(**A**) v 85°C(**T**) / **A** lower by 45°C ;
  - 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
  - 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
  - comparative data to support mp 4 ;  
  
 compare temperature ranges of activity
  - temperature range for activity is greater for **A** ; ora
  - (**A**) spans 80°C v (**T**) spans 65°C ; **A** (**A**) 10–90°C v (**T**) 30–95°C  
  
 compare **L** for both
  - A** 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**) ;
  - (at **L**), **A** (relative) activity = 35%, **T** = 10% ;  
  
 compare **H** for both
  - 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**) ;
  - (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
- same/(very) similar, (shape of) active site ;
  - active site (shape) is complementary to/**AW**, substrate/cellobiose ; **R** matches  
**A** ES complex forms  
 differences
  - differences in, side-chain/**R**-group, interactions/**AW** ;
  - 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
  - suggestion for thermal stability of **T** ; e.g. more bonds/more of a named bond type
  - 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]

5 (a)

*A reverse wording for both  
mark vertically/one mark each correct column*

description of event	outcome for the individual	production of memory cells / yes or no	precise type of immunity acquired by individual
individual <b>P</b> is injected with a live, weakened disease-causing organism	individual <b>P</b> does not become ill from the disease and has long-lasting protection from the disease	yes	artificial active
individual <b>Q</b> is exposed to a disease-causing organism and is immediately injected with a specific antibody	individual <b>Q</b> does not become ill from the disease but suffers from the disease a year later	no	artificial passive

[2]

(b) bone marrow ; **A** stem cells / myelocytes I white blood cell

[1]

- (c) (i) 1 healthy body cells, (recognised as) self / have self-antigens ; **A** non-foreign  
 2 cancer(ous) / tumour, cells, (recognised as) non-self / have non-self antigens ;  
**A** foreign  
 3 idea that changes occur to structure of cell surface membrane of, cancer(ous) /  
 tumour, cells ;  
 4 phagocytes have receptors for, non-self / foreign, antigens **or**  
 phagocytes have receptors for antibody complexed to non-self / foreign antigens ;

[max 2]



Page 9	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	22

- (ii) 1 uncontrolled /AW, mitosis / (mitotic) cell division / cell replication / cell cycle ;  
**either**  
2 one example of a change occurring in a healthy cell  
e.g. proto-oncogene to oncogene  
mutation of / switching of, tumour suppressor gene  
uncontrolled growth  
increase in growth proteins  
shorter interphase (of cell cycle)  
(rapid) DNA replication  
cells do not respond to signals (from other cells)
- or**  
further detail of tumour formation ;  
e.g. cells immortal / no apoptosis / no programmed cell death  
no contact inhibition / cells continue to grow when they contact other cells  
cell cycle checkpoints not controlled  
abnormal /AW, mass of cells formed  
undifferentiated / unspecialised, cells / tissue / mass  
cells do not function (as tissue of origin) [2]

[Total: 7]

- 6 (a) (i) (a) habitat ;  
(a) population ;  
producers / organisms ; [3]
- (ii) (a) niche ;  
(an) ecosystem ; [2]

- (b) (i) *energy losses from*
- 1 reflection (from leaf surface) ;
  - 2 idea that some light, passes through (leaf) / misses chloroplasts / strikes non-photosynthetic tissue ;  
**A** suggestion that cell walls may not allow all of light through
  - 3 heating plant ; **I** lost as heat to surroundings **A** converted to heat
  - 4 evaporation ; **A** transpiration
  - 5 not all light (reaching chlorophyll) is, the right wavelength (for photosynthesis) / AW / absorbed by chlorophyll ;  
**A** idea that only a proportion of light energy is useable  
**A** absorbed and, lost as phosphorescence / lost as luminescence / re-emitted
  - 6 ref. to photosynthetic process inefficient ; **A** loss of heat energy during photosynthesis
  - 7,8 AVP ;; e.g. ref. to photorespiration  
ref. to factors that limit photosynthesis [max 3]

<b>Page 10</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2015</b>	<b>9700</b>	<b>22</b>

- (ii) 1 increased production of / more, biomass / plant matter / named (e.g. carbohydrate / cellulose / starch / oils) ; **R** more plants **I** more crop **I** food  
 2 (so) more energy / more energy stores ;  
     **A** more chemical energy produced  
     **A** higher energy  
     **A** suggestion that high PE crop may be more energy dense  
 3 more crop / greater yield, per unit, area / volume / time ; **A** each year  
 4 idea of (comparatively) less space required (for growing) ;  
 5 ref. to supplying increasing demand for, food / fuel ;  
 6 more, profit (for farmers) / economic / AW ; **I** cheaper  
 7 AVP ; e.g. efficient use of carbon dioxide **[max 2]**

(iii) *credit all valid answers – this list is not exhaustive*

**e.g. compound**

**e.g. function of compound**

amino acids

production of proteins (for cell growth);  
**A** provide energy / for respiration

proteins

cell division / mitosis / increase in cell number /  
 increase in, biomass or yield / (cell) membranes ;  
**A** reproduction **A** cell cycle  
**A** (tissue) repair  
**A** provide energy / for respiration

enzymes

synthesis of, macromolecules or organic molecules /  
 anabolic reactions / for photosynthesis / for  
 respiration ; **[max 2]**  
**A** named molecules e.g. carbohydrates / amino  
 acids / proteins / lipids / nucleic acids

(organic / nitrogenous) bases

component / synthesis of, nucleotides  
 component of, DNA / RNA / nucleic acids ;

nucleotides

component / synthesis of, DNA / RNA ;

DNA

ref. genes / genetic material / coded information /  
 genetic information, (for protein synthesis) ;

RNA

ref. transcription / translation / protein synthesis ;

(some) phospholipids

(for cell) membranes ; **R** lipids

ATP

synthesis / anabolic reactions / active transport /  
 translocation / described ;  
**A** provide energy for reactions

chlorophyll

photosynthesis / light (dependent) stage ;

NADP

(in) photosynthesis / light (dependent) stage ;

NAD

(involved in) respiration ;

FAD

(involved in) respiration ;

auxin

growth hormone / cell elongation / cell division ;

cytokinin

growth hormone / root growth ;

**[Total: 12]**