

**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

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.

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**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

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- 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]

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- (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]

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- 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]

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- (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

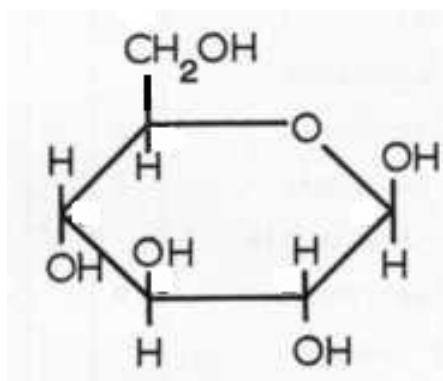


diagram A

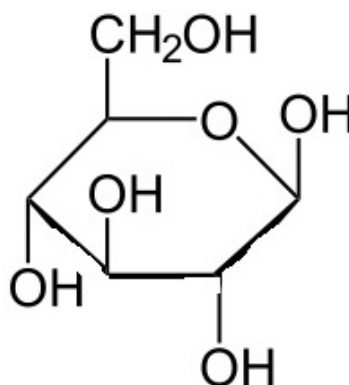


diagram B

*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]

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- (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]

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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]



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- (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]

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- (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]**