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.

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

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the equation, or by extra guidance)
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

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]**

(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]

3 **(a)** same, water potential / Ψ(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 **[**

(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 **A** 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 / Na^+, magnesium ions / Mg^{2+} chloride ions / Cl^-, hydrogen ions hydrogen carbonate ions / HCO_3^- phosphate ions / HPO_4^{2-} potassium ions (K^+)	facilitated diffusion **;** **A** active transport **A** cotransport	transport(er) / carrier / integral / intrinsic / transmembrane, protein **;** **A** channel protein for facilitated diffusion **A** 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 mm ÷ 9.5 μm) 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]**

(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_30 for CH_2OH
I incorrectly numbered carbons

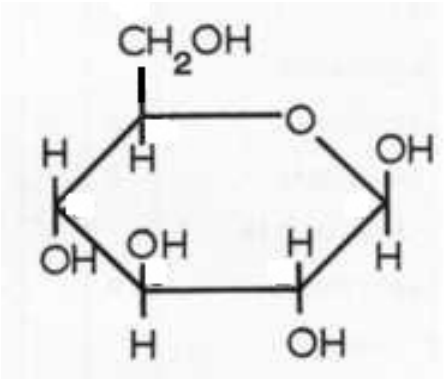

diagram A

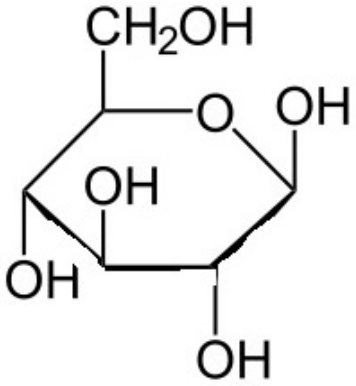

diagram B

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-glucosidas
*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 **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**) **;**

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]

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 **P** is injected with a live, weakened disease-causing organism	individual **P** does not become ill from the disease and has long-lasting protection from the disease	yes	artificial active
individual **Q** is exposed to a disease-causing organism and is immediately injected with a specific antibody	individual **Q** 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]

(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 <u>during photosynthesis</u>
7,8 AVP ;; e.g. ref. to photorespiration
ref. to factors that limit photosynthesis **[max 3]**

(ii) **1** increased production of / more, biomass / plant matter / named (e.g. carbo… 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]