CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 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 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 as guidance)

1 (a) (i) mitochondria **;** **A** mitochondrion [1]

(ii) can change shape / fluid membrane structure / *ref. to* flexible **;**
different orientation when section taken / AW **;** **A** different sections cut
some may be dividing / *ref. to* mitochondrial fission; **I** growing [max 1]

(b) (i) ribosomes **;** **A** ribosome **I** *ref. to* size e.g. 70 S / 80 S [1]

(ii) *circle around* 0.025 μm **;** [1]

(c) (i) plasmodesmata **;** **A** plasmodesma [1]

(ii) *assume answer is in context of between adjacent cells but* **R** if <u>within</u> a cell
I incorrect naming of plasmodesmata
I description of cytoplasmic strands

facilitates / more rapid / allows / AW, transport / communication / exchange / transfer (of substances) **;**
substances do not need to cross, cell (surface) membranes / cell walls **;**
for, movement / AW, of, substances / materials / nutrients / water **;**

named example **;**
e.g. movement / diffusion / AW, of sucrose to sieve tube (from companion / transfer, cell)
water travels by, <u>symplastic</u> pathway **I** incorrect mechanism e.g. osmosis
water avoids, apoplastic / cell wall, pathway
proteins too large to cross, cell wall / cell surface membrane

A *idea of* substances moving in and out of cells *only if plasmodesmata given in* ***(i)*** [max 1]

(d) **I** descriptions e.g. extensions / hair-like

microvilli / **A** microvillus **R** villi / villus **R** cilia

and *one from:*

absorption / uptake of products of digestion
secretion / release of (extracellular), enzymes / other named secretion
digestion (at the cell surface) / breakdown of (ingested) food / AW
excretion / release of, waste / excess, substances
increases surface area **;** [1]

[Total: 7]

2 (a) **I** *ref. to* other components of tobacco smoke that enter bloodstream

1 contains carbon monoxide and nicotine (which contribute) **;**
R if tar also stated

contribution to atherosclerosis

2 damage to / AW, endothelium / (inner) lining / tunica intima / inner wall **;**
A also as consequence of increased blood pressure *mp8*

3 increased accumulation of LDLs **;** AW *in context of the vessel walls*
A cholesterol / lipids / lipoproteins / fats / triglycerides

4 inflammation **;**

5 more / arrival of / attraction of, phagocytes / macrophages / monocytes / neutrophils **;**
A leucocytes / white blood cells
A phagocytes, have increased adherence / 'stick' more, to lining

6 phagocytes engulf, LDLs / AW, and die (in situe)
or
formation of / presence, foam cells **;**

7 (contributes to) formation of, atheroma / atheromatous plaque **; A** plaque
I atherosclerosis

features that may have a consequential effect

8 one risk factor (caused by components of smoke) **;**
one from:
increased blood pressure *must be in context e.g. adrenalin release owing to nicotine* **I** atheroma increases blood pressure
increased stickiness of platelets (promotes clotting)
thrombus formation / thrombosis / (blood) clotting
increased, (serum) cholesterol / triglyceride / LDL, concentration
decreased, HDL / 'good' cholesterol, concentration
increased, oxidation / reactivity / AW, of LDLs [max 3]

(b) (i) phagocytosis **; A** act as phagocytes

engulf / attack / destroy / AW, pathogens / bacteria / microorganisms **;**
A viruses
A act as, antigen presenting cells / APCs
I antigens / foreign organisms / organisms

remove / engulf / AW, foreign substances / dead cells / cell debris / AW **;** [max 1]

(ii) *following inhalation* **I** *ref. to* contract / relax

1 alveoli / air sacs / lungs, over expand / over inflate / over stretch / AW **;**

2 (alveoli have) no / poor, recoil **; A** do not, rebound
A lungs do not, recoil / deflate properly

3 (alveoli / lungs) cannot return to normal size / remain, (fully) stretched **;**
A do not, decrease in size after, stretching / inhalation / AW

4 alveoli / air sacs, do not push out air (effectively) / have trapped air / AW **;**
I oxygen trapped [max 2]

(c) (i) biological catalyst **/** described **;**
e.g. biological molecule / protein that, increases the rate of / catalyses
speeds up, a reaction
molecule that, increases the rate of / speeds up / catalyses, metabolic
/ biological / cell(ular) reaction

one of:
globular protein **;**
remains unchanged (at end of reaction) / not used up (in reaction) **;**
lowers the activation energy (of a reaction) **;** [max 2]

(ii) *points can be gained from diagrams if not contradicted in written answer*

1 (shape of) substrate / elastin, complementary to (shape of) active site **;**
R matching / same
A description e.g. substrate fits (into) active site
diagram – label active site + substrate (shapes must be complementary)

2 lock is, enzyme / elastase / active site, and key is, substrate / elastin **;**

3 formation of, enzyme-substrate complex / ES complex / ESC **;**
A successful collision between enzyme and substrate
A substrate, binds / AW, at / to, the active site
diagram – ESC no label required if following on from mp1

4 peptide fragments / peptides / products, released / formed **; A** amino acids
diagram – allow without label if sequence clear and products shown

following points need to be annotated if shown on diagram

5 hydrogen / temporary, bonds form between, enzyme / active site, and substrate **;**

6 detail of how Ea lowered **;** *term Ea not required and points can be general*
strain on (peptide) bond
electron transfers
reactants held close for bond forming (i.e. water joining) [max 3]

(d) (i) **I** active site of A1AT changes shape / acts as non-competitive inhibitor
R if macrophage elastase stated

cannot bind / not complementary, to active site **;** **A** elastase / enzyme
H / temporary, bonds cannot form with active site **;**
no longer, prevents entry / binding, of substrate **;** **A** (so) substrate can bind [max 1]

(ii) *consequence must be correctly linked to an event*

1 neutrophil elastase, active / not inhibited / AW **;** **A** increase rate of reaction
2 (so) TIMP-1 inactivated **;** **A** other / macrophage elastase, inhibitor
3 (so) macrophage elastase, active / functioning / not inhibited / not regulated **;**
4 (so) more, macrophage and neutrophil / of both elastases, (to breakdown elastin) **;**
5 *ref. to* consequence **;** e.g. bursting alveoli / breakdown of alveolar walls / formation one large air sac / decrease in surface area for gas exchange [max 3]

(e) **1** mRNA, binds / AW, to ribosome **;** **A** ribosomal RNA **I** rRNA
A mRNA moves to ribosome
2 tRNA with amino acid (to / at, ribosome) **;** **A** aminoacyl / charged, tRNA
3 tRNA / anticodon, specific to an amino acid **;** **A** specific tRNA / anticodon for the amino acid
4 *ref. to* start codon; **A** $AUG^{(met)}$ / first codon is AUG / initiator tRNA **;**
5 (complementary) base pairing / binding, between anticodon and codon **;**
6 first and second tRNAs bind / two tRNAs bound (at a time)
or (tRNAs bring) amino acids, side by side / close **;**
7 peptide bond formation **;**
8 ribosome moves along, one codon / AW **;**
9 next (aminoacyl) tRNA arrives / amino acids added one at a time **;**
10 elastase / polypeptide, released when STOP codon reached **;**
A process continues until a STOP codon reached
11 AVP **;** e.g. *ref. to*, aminoacyl / A, site, and, peptidyl / P, site
small subunit (of ribosome) attaches to mRNA
aminoacyl tRNA synthetase binds amino acid to tRNA
ATP required for tRNA-amino acid binding
peptidyl transferase for peptide bond formation
ref. to, exit / E, site, on ribosome ribosome moves 5' to 3' [max 5]

[Total: 20]

3 **(a)** **A** = interphase **I** *ref. to early / late*
C = metaphase **;**
both needed for one mark [1]

(b) (**C**) **L**, **N**, **M**, **K** **;** [1]

(c) **1** *idea that* centromere, has divided / divides (separating, sister / identical, chromatids) **;**

2 centromere attached to spindle fibre; **A** spindle

3 shortening / contraction, of spindle fibres (pulling centromeres) **;**
A spindle, contracts / shortens

4 (so) sister / identical, chromatids, move to opposite poles **;**
need idea of separated, so **A** ends / sides / halves
A sister / identical, chromatids, will end up, at separate poles / in separate cells

[max 3]

[Total: 5]

4

(a) *ignore descriptions or further qualification*
no marks for each box if other mechanisms given

active transport **; A** active uptake
exocytosis **; I** bulk transport / secretion
diffusion **; I** passive / simple **R** facilitated diffusion [3]

(b) **I** *ref. to* small increase in partial pressure causes more oxygen to associate
A pp / pressure, for partial pressures

1 this is the range of (partial) pressures occurring in respiring tissues **;**
A (partial) pressures in respiring tissues are low

2 (for a) small / 1.6 kPa, decrease in partial pressure **;**

3 (so) allows, large quantity of / more, oxygen to, be released / dissociate **;**
A oxygen dissociates more, easily / readily

4 affinity of haemoglobin to oxygen decreases **;**
in context of, as oxygen is released / as partial pressure decreases

5 data to support **;** e.g. 60–62% to 28–30% / 30–32% difference [max 2]

[Total: 5]

5 (a) *assume response refers to infectious unless otherwise stated*

caused by a pathogen **;** **ora A** microorganism / microbe
transmissible / communicable / passed from one, organism / person, to another **;**
ora

examples to support explanation
two examples of pathogen types **;** *two of:*
bacterium / bacteria
virus / viruses
fungus / fungi
protoctist **A** protozoa

example of non-infectious, disease / category **;**
e.g. genetic disorders / named (e.g. sickle cell anaemia / cystic fibrosis)
cancer / named cancer (e.g. lung)
degenerative disease / named (e.g. chronic bronchitis, emphysema / COPD / coronary heart disease) lifestyle / AW

(b) (red blood cells contain) haemoglobin **;**
plasma proteins **; A** plasma contains proteins
named protein in blood plasma or within (red / white) cells **;**
e.g. fibrinogen / albumin / globulin / antibodies / (protein) hormone / enzyme / transport proteins / membrane proteins
R steroid hormone / named steroid hormone [max 2]

(c) (i) not all countries with *Anopheles* have malaria / example using Fig. 5.2 **;**
e.g. (although, Anopheles / vector, shown as present),
no / few, cases (of malaria) in, North America / Europe
(although, *Anopheles* / vector, occurs elsewhere) malaria, only / mainly, in subtropical and tropical areas **;**

explanations:
Plasmodium / parasite / pathogen, not present in all areas where *Anopheles* is located / AW **;**
conditions (where *Anopheles* located) not always suitable for life cycle of, *Plasmodium* / parasite / pathogen **;**
some, areas / countries, have eradicated the disease (but still have the vector) **;**
AVP **;** e.g. some countries have better prevention methods against malaria
AVP **;** some countries have effective treatment for malaria
I vaccination [max 3]

(c) (ii) *assume ref. to A. gambiae unless stated otherwise*

occurrence

1 (in Africa) wide distribution / large numbers **;**
2 occurs where high density of humans **;**
3 occurs (in climate) where *Plasmodium* is, present / able to survive **;** AW
A e.g. *idea of* Plasmodium requiring temperatures above approx. 20 °C where *A. gambiae* is also present

*well adapted **or** better adapted than other mosquito vectors*

4 better adapted to complete life cycle / lays eggs in large variety of habitats / can withstand (more) polluted waters / larvae able to eat a wide variety of food **;**
5 short(er) life cycle / long(er) breeding season **; A** reproduces quickly
6 withstands, dry / drier, conditions / larger temperature variation / higher temperatures **; I** better adapted to climate
7 (more) resistant to, pesticides / insecticides **; R** immune

feeding

8 feed mainly / AW, on human blood **;**
9 takes, large(r) / more frequent, blood meals **;**
10 takes blood meal / bites / feeds, at night (when humans less able to notice) **;**
11 mouthparts, well adapted for feeding on humans / can penetrate clothing**;**

as host for Plasmodium

12 good host for / very susceptible to, parasite / *Plasmodium* **;**

AVP **;** e.g. able to migrate to find hosts
quick to adapt to changing human habitation
better adapted to find (human) hosts
females live for longer
A. gambiae present in Africa, where, malaria control is difficult

[max 3]

(d) (i) large egret / yellow winged bat / eastern green mamba **;** [1]

(ii) 1 insufficient numbers of bats **;**
2 (so) not enough energy / energy available is low (to sustain needs) **;**
3 energy loss at each level / progressively less energy transferred / inefficient / transfer of energy / AW **;**
4 example of energy loss from bat intake **;** *in context of mamba feeding*
e.g. inedible parts / named indigestible parts / faeces / egestion
5 example of energy loss in food chain (to bat) **;**
e.g. death but not eaten
excretion
respiration
heat loss, in movement / digestion
allow either point below if not awarded for mp 4
inedible parts / named examples
indigestible parts / faeces / egestion [max 3]

(iii) use biological control **;**
introduce / increase numbers of / AW, predators (of mosquito) / named e.g. guppy / dragonfly / yellow winged bats **;**
to eat / consume / reduce number of, mosquitoes **;**
grow crops other than sweet potato / grow less sweet potato **;**
A do not grow sweet potato
numbers (of mosquito) reduce so fewer, act as vectors / feed on humans **;**
AVP **;** e.g. use genetic modification to produce sweet potato crop with toxin against mosquito [max 2]

(e) nectar / nectaries / flowers / phloem (tissue) **/** (phloem) sap / sieve tubes / vascular bundles / stem / leaf **;**
I *ref. to*, source / sink
R if includes, roots / 'potatoes' / xylem, *for this mp only, then for mp 2 allow explanation for the other stated part that is correct*

explanation **;**
e.g. fluid feeders / piercing and sucking mouthparts / proboscis for feeding
(fluids provide) source of carbon / energy / sugar / sucrose
A glucose / fructose
(fluids provide) source of, nitrogen / amino acids
near to, vascular bundles / phloem *for, stem / leaf*
for phloem sap / AW *for vascular bundles* [2]

[Total: 18]

6 (a) 1 *idea of* different distances **;** *must be comparative*
e.g. atria pump blood shorter distance **ora**
atria pump blood a short distance and ventricles pump blood a long distance
atria pump blood to ventricles and ventricles pump blood to, (other parts of) body

2 (so) resistance to overcome by atria is low(er)
or
(so) ventricles need to overcome, great(er) / AW, resistance **;**

3 (so) atria generates lower pressure
ventricles generate higher pressure **;** AW
A force for pressure
R ventricles withstand high pressures
A low pressure / high pressure *if mp1 or mp2 gained* [max 2]

(b) septum **; R** atrioventricular septum [1]

(c) (i) **I** *ref. to* xylem / transpiration stream

transpiration
involves only water (molecules) **;**
involves, evaporation / diffusion / evaporation and diffusion **;**
I *ref. to* evaporating surface
movement out to (external) environment / loss from leaves **; A** aerial parts
affected by, external factors / humidity / light / wind speed / temperature **;**
occurs in one direction / from air spaces through stomata **;**
ATP not required **;**

translocation
involves, assimilates / photosynthates / sucrose / other named **; A** cell sap
involves (hydrostatic) pressure gradients **; A** mass flow
involves transport in phloem (sieve tubes) **;**
flow from source to sink / AW **;**
ATP used (to enable loading of sucrose into phloem sieve tube) **; A** active [max 1]

(ii) both involve, transport / movement of substances **; R** if transport in xylem stated
both involve water **;**
both require energy **;** *(transpiration – evaporation requires heat energy and translocation – hydrogen ions pumping out of companion cells)* [max 1]

[Total: 5]