CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge Pre-U Certificate

MARK SCHEME for the May/June 2015 series

9790 BIOLOGY

9790/01 Paper 1 (Structured), maximum raw mark 100

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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CAMBRIDGE
International Examinations

Notes:

The following abbreviations may be used in mark schemes:

;	separates marking points
/	alternative and acceptable answers for the same marking point
allow / accept / **A**	answers that can be accepted
not / reject / **R**	answers that are not worthy of credit
ignore / **I**	statements that are irrelevant – applies to neutral answers
AW / owtte	credit alternative wording / or words to that effect
ecf	error carried forward
(words)	bracketed words that are not essential to gain credit
<u>words</u>	underlined words must be present in answer to gain credit
max	indicates the maximum number of marks that can be given
ORA	or reverse argument
AVP	any valid point – marking points not listed on the mark scheme but which are worthy of credit

Section A

1 C ; [1]

2 D ; [1]

3 A ; [1]

4 C ; [1]

5 C ; [1]

6 B ; [1]

7 B ; [1]

8 B ; [1]

9 C ; [1]

10 A ; [1]

11 A ; [1]

12 C ; [1]

13 D ; [1]

14 A ; [1]

15 C ; [1]

16 D ; [1]

17 phosphodiester / phosphoester ; [1]

18 pinocytosis / endopinocytosis ; [1]

19 binomial (nomenclature / classification / taxonomy) **;** [1]
A Linnaean nomenclature

20 warfarin / warfarin sodium **;** [1]
A aspirin
A trade names

Section B

21 (a) *idea that* (chromosomes) fully condensed (so can be seen as separate structures) / ORA ;
not constrained by nuclear envelope / AW ;
all chromosomes in focus on metaphase plate / AW / ORA ;

[max 1]

(b) *assume answer is for Fig. 21.1 and scanning electron microscope*
accept ORA throughout if answer is stated for Fig. 21.2 or light microscope
max 3 on explanation

description:
1 two chromatids per chromosome, easily seen / AW ;
2 centromere, easily seen / AW ;
explanation:
3 higher resolution of scanning electron microscope ;
4 more able to distinguish between, two (close) points / the two chromatids ;
5 greater depth of field ;
6 AVP ; e.g. electrons have shorter wavelength than light
able to see points closer together than 200 nm
able to see points down to 0.5 nm (0.0005 μm) apart

description:
7 fatter / shorter / AW, appearance of, chromatids / chromosome ;
explanation:
8 ref. to different preparation of specimen for viewing ;
9 suggestion that electron microscope image at lower magnification ;

description:
10 surface contours / 3-dimensional appearance ;
explanation:
11 electrons reflect off surface / AW ; **A** relevant explanation e.g. coated with gold

[max 4]

(c) *in metaphase 2*
would only see one of each pair ;
would only see 23 chromosomes ; **A** haploid number present
would only see one sex chromosome ;

[max 1]

(d) *to have, hereditary haemochromatosis / Lafora disease*
homologous chromosomes / both chromosome 6s, carry the mutation
or
two copies of the, mutation / mutant allele, are present ;
must inherit from both parents / must be homozygous ;

normal / healthy
mutation present in, heterozygote / heterozygous genotype ; **A** (only) one copy
normal allele / AW, able to express sufficient functioning, HFE protein / laforin ;

[max 2]

(e) *hereditary haemochromatosis:*

1 change in (DNA), base / nucleotide, sequence **;** **A** base substitution
2 changed (mRNA) codon **;**
3 (different) tRNA brings different amino acid (to normal) to ribosome / AW **;**
4 altered primary structure / tyrosine in amino acid sequence of polypeptide chain instead of cysteine **;**
5 altered / AW, tertiary structure (of HFE protein) **;**
6 further detail **;** e.g. ref. to post-translational modification disrupted
ref. to interactions between R-groups changed
loss of disulfide bridges
binding to, chaperone protein / beta-2-microglobulin, is decreased
so, protein does not reach membrane / remains in Golgi body
7 iron levels not regulated / AW **;**
A increased uptake of iron (into cells) / decreased iron export (from cells) / too much iron absorbed from dietary intake / iron accumulates in organs
8 further detail **; ;**
\+ e.g binding to transferrin receptors (TfR) impaired
9 (so) iron(-loaded transferrin) entry via TfR, increases / unregulated
regulation of, hepcidin / iron-regulating hormone, does not occur
(so) efflux / export, of iron does not occur (as hepcidin is involved with iron channel ferroportin)
10 sign / symptom **;**
e.g. (early) fatigue, pain in joints, erectile dysfunction, absent periods
(later) diabetes, loss of libido, jaundice, arthritis, chest pain, shortness of breath, swelling in hands and feet

[max 5]

(f) *allow points from genetic diagrams*
allow references to, people with disease / affected, and, unaffected / healthy, if individuals not specifically stated

not enough information because

if autosomal:

1 father would be homozygous recessive for both **;**
2 both children have inherited mutant alleles from their father **;**
3 the daughter has inherited (chromosome 6 with) normal alleles from her mother (so is healthy) **;**
4 the son has inherited (chromosome 6 with) mutant alleles from his mother, so has the disorders **;**

if sex-linked:

5 father would be hemizygous / have only one chromosome carrying the mutant alleles **;**
6 daughter has inherited the X chromosome with both mutant alleles from her father and X chromosome with both normal alleles from her mother (so is healthy) **;**
7 the son has inherited the Y chromosome from his father **;**
8 the son has inherited the X chromosome with mutant alleles from his mother, so these are expressed **;**

[max 5]

[Total: 18]

22 (a) (i) decrease in (total) area covered by *Z. marina* ;
breaking up the, area / habitat, into several smaller, areas / habitats / AW ;
A ref. to patches of *Z. marina*
(leads to) *Z. marina* populations, subdivided / separated / smaller ;
(production of) habitats that are, separated from other habitats / isolated ;
increase in edge effects / decrease in ratio of interior:edge ;

[max 2]

(ii) *any one relevant, e.g.*
clearing areas for:
beaches for tourists ;
construction of harbours ;
beach-side accommodation / coastline development ;
pollution / described ; e.g. sewage outlets / fertiliser run-off / causing eutrophication / resulting in algal blooms ;
dredging ;
greater marine activity leading to, increased turbidity / greater wave action / damage (from propellers, moorings etc.) ;
fishing practices / named ; e.g. trawling, dynamite
release of warm water from power plants ;

[max 1]

(iii) *decreased, size / area, of habitat:*
1 decreases species richness / decreases number of species / reduces species biodiversity ;
2 further detail ; e.g. reduced, genetic diversity / gene pool
smaller area cannot sustain high numbers, smaller populations
more vulnerable
3 destruction / loss / AW, of habitat of, endangered / threatened, species (that interact with *Z. marina*) ;
4 examples of why decrease in populations of species may occur ; ;
\+ e.g. movement of organisms to remaining habitats causing, crowding /
5 increased competition
more easily seen in clear areas and predated upon
food source for grazers decreases
ref. to overall effect on food chain / decrease in energy input to ecosystem
decrease in substrate for attachment by other plants
loss of breeding ground / needed to complete life cycle
ref. loss of spatial complexity / fewer available niches
less protection from currents / increase in speed of currents / more turbulence
ref. to effect on species (e.g. shore birds and waterfowl) that rely on populations living, in / on, *Z. marina*
sediments and nutrients no longer trapped, increasing threat from, phytoplankton / algae
decrease in water quality
decrease in dissolved oxygen
ref. disadvantage of inbreeding depression (from reduced genetic diversity)
6 detail of *Z. marina* as a keystone species ; **A** description of keystone species

7 examples of loss of other benefits provided by *Z. marina* ; ;
+ e.g. prevents shoreline erosion
8 reduces wave action
traps carbon
increases water quality / clarifies water *(allow once only)*
increases dissolved oxygen *(allow once only)*
9 ref. to problems with, increase in edge effects / decrease in ratio interior:edge ;

[max 4]

(b) (i) restriction, endonuclease / enzyme ;
polymerase chain reaction / PCR ;

[max 1]

(ii) 1 separation in an electric field / AW ;
2 ref. to buffer, to maintain pH / allows flow of current ;
3 fragments placed at, cathode / negative end (of gel) ;
4 DNA / phosphate groups, negatively charged ;
5 fragments, move towards / attracted to / AW, anode / positive, (end of gel) ;
6 gel impedes flow of fragments (towards anode) / AW ;
7 shorter fragments / fragments of smaller mass / fragments of smaller size, move, faster / further (per unit time) ;
A described e.g. larger fragments nearer to cathode

[max 4]

(c) number of, matching bands / bands that have moved the same distance / fragments of the same size ;
A idea of comparing locations / positions (of bands) **or** distance fragments have travelled

[1]

(d) *look for ORA*
human disturbance:
1 no obvious link ;
2 qualified with comparative statement or data ;
e.g. more similar, values of genetic similarity / genetic diversity, between Del Monte Beach (no disturbance) and Elkhorn Slough (disturbance) than to Tomales Bay (no disturbance)
Del Monte Beach and Tomales Bay both no disturbance but very different genetic, similarities / diversities

depth distribution:
3 the lower the plants below sea level, the, higher the genetic similarity / lower the genetic diversity / ORA ;
4 plants that remain below sea level have, higher genetic similarity / lower genetic diversity / ORA ;
5 comparative data to support ;
e.g. –3.0 m to –13.0 m below has 0.68 genetic similarity but 0.5 m above to –5.0 m below has 0.44 similarity

plant morphology:

6 population with plants showing no variation in plant morphology has, highest genetic similarity / lowest genetic diversity / ORA **;**

7 comparative data to support **;**
e.g. Del Monte Beach has 0.68 genetic similarity but, Elkhorn Slough has 0.62 / Tomales Bay has 0.44

general:

8 all populations show genetic diversity so, reproduction (could be) mainly sexual / many founder plants which then reproduce asexually **;**

9 higher genetic diversity in Tomales Bay may be due to arrival / immigration of new genotypes **;**

10 genetic diversity may be linked to conditions in each location / high genetic diversity in Tomales Bay may be because of varied conditions **;**

11 AVP **; ;** e.g. ref. to Tomales Bay high diversity and adaptability (e.g. plant morphology)
\+ comment on range of depth and diversities
12 suggestion Elkhorn Slough diversity would be higher if no human disturbance

[max 5]

[Total: 18]

23 (a)

	feature	*nervous system*	*endocrine system*
1	communication	impulse(s)	hormone(s) **;**
2	nature of communication	electrical (and chemical)	chemical **;** **A** type of chemical with named hormone e.g. oestrogen is steroid
3	mode of transmission	axons / nerve fibres / neurones	blood (stream) / circulatory **;**
4	response destination	muscle / glandular (tissue)	target, organs / tissue / cells **;** **A** named examples
5	transmission speed	fast	slow(er) **;**
6	effects	more localised	(can be) widespread **;**
7	response speed	fast	slow(er) **;**
8	effects	temporary / reversible	can be long-lasting / permanent **;**

[max 3]

(b) (i) fixed / inbuilt / instinctive / genetic / inherited / AW, (response to a given stimulus) **;**
A not learned

[1]

(ii) learned behaviour corresponding to observations 1, 2 and 3 all correctly named **;**
observation 1: habituation
observation 2: operant conditioning **A** instrumental conditioning
observation 3: classical conditioning **A** respondent / Pavlovian, conditioning

observation 1:
sheep have stopped responding to, a repeating stimulus / continual traffic noise
or
stimulus / traffic noises, have little or no, relevance / significance (to survival) / AW **;**

observation 2:
behaviour modified by, previous actions / consequences of an action / unlatching of gate / discovery of (supplemental) feed
or
reward (of supplemental feed) acts as a positive reinforcement (to unlatch gate) / AW **;**

observation 3:
sight / smell, of food on trailer produces a, reflex / unconditioned, response
or
stimulus of tractor sound becomes associated with (stimulus of) food on trailer / AW **;**

[4]

[Total: 8]

24 (a) 1 one or a few layers of / thin / AW, murein / peptidoglycan **;**
2 outer, membrane / layer / AW, and correct ref. to chemical nature **;**
A lipids / lipoproteins / lipopolysaccharides (LPS) / phospholipids
R cholesterol
if marking points 1 and 2 not given, allow one mark for idea of murein and outer layer of lipid

3 AVP **;** e.g. porins / porin channels, in outer membrane
periplasm between cell surface membrane and wall / peptidoglycan in periplasm
LPS includes lipid A, core polysaccharide and O antigen

[max 2]

(b) 2.2 μm **; ;** **[2]**

if no answer or incorrect answer, allow 1 mark for correct working or correct measurement divided by magnification (30 000)
66 000 μm (66 mm) / 30 000 **A** 65 / 67 mm

(c) (i) 1 enters via wounds / description of cause of wound **;**
e.g. pruning, frost, feeding insects, emergence of lateral roots
A entry via root damage / AW
2 example of spread **;**
e.g. by farm machinery, pruning, propagating plant parts, irrigation water
3 bacteria attach to (damaged) plant cells **;** **A** use of pilus for entry of DNA into cells
4 (T / transferred) DNA / (segment of) Ti / tumour inducing, plasmid, enters (cytoplasm / nucleus) **;**
5 integrates into / AW, (plant) chromosomal DNA / genome **;**
6 (production of plant hormone leads to) abnormal / rapid, cell growth / division (produces tumour) / AW **;** **A** rapid
7 AVP **;** e.g. synthesis of cellulose fibrils for attachment to, plant cell / other bacterial cells
genes in T-DNA coding for proteins for auxin and cytokinin synthesis
T-DNA has genes for enzymes that lead to opine production by plant and opines serve as, C / N, source for *Agrobacterium* growth
plant defence mechanisms suppressed
gall produces nutrient-rich environment for bacterial population growth

[max 4]

(ii) 1 useful as a <u>vector</u> **;** **A** for (Ti) plasmid or bacterium
2 useful to transfer, genes / DNA, into plants **;**
A use of, prokaryote to transfer gene to eukaryote
3 infects wide range of host (plants) **;**
4 ref. to / example of, genetically modified crops **;**
5 further detail of plasmid / engineering the bacterium **;**
e.g. can remove virulence genes **A** plant does not get gall disease
can keep insertion genes
easy insertion of (foreign) genes (into plasmid)
A easily genetically manipulated
6 plant cell transcribes introduced genes **;**
7 non-host cell products synthesised (successfully) **;**
8 ref. to ease of gene cloning by, plasmid / bacterial, replication **;**
9 AVP **;** e.g. ease of integration into chromosome

[max 2]

(d) 1 ref. to auxin causing cell, elongation / expansion / division **;**
2 ref. to binds to, receptor **;**

cell elongation:
3 (binding to receptor leads to) increase in number of proton pumps / H^+-ATPases **;**
A activation of proton pumps
4 protons / H^+, leave cell / AW **;**
5 pH of cell wall, decreases / lowers **;** **A** becomes more acidic
6 activation of expansin (protein / s) **;**
7 weaken cell wall / AW **;**
8 (movement H^+ out causes) movement in, K^+ / cations / solutes **;**
9 water in by <u>osmosis</u> **;**
10 turgor pressure, causes elongation / expansion **;**

accept points below for cell elongation or to explain cell division:
11 (auxin) promotes / stimulates, degradation of Aux / IAA, proteins / transcriptional blocking factors / repressors **;**
12 that normally bind, transcription factors / auxin response factors / ARFs **;**
13 (so) inhibition of transcription (of genes responsible for growth) removed / (gene) transcription possible **;**

14 AVP **;** e.g. *receptor for cell elongation* auxin binding protein 1 / ABP1, (in cell surface membrane)
receptor for cell division TIR1 / transport inhibitor response protein 1, (in nucleus)
auxin / TIR1 can bind to protein to promote attachment of ubiquitin to Aux / IAA proteins

[max 4]

(e) (i) to bring water (and mineral ions) **;** **[1]**

(ii) *max 2 for structure*

function 1:
allow, unhindered / uninterrupted / AW, flow
or
reduced resistance to flow / allow max volume (per unit time) to be transported / AW **;**

matched to relevant structure:
sieve, plates / pores *in context of end walls* **;**
peripheral cytoplasm / AW
or
no, nucleus / vacuole / tonoplast / ribosomes / Golgi (apparatus) / few mitochondria / modified ER **;**

function 2:
transport of, sugars / sucrose / amino acids / assimilates / photosynthates **;**
R if matched to incorrect mechanism e.g. active transport, diffusion

matched to relevant structure:
column-shaped / longer than wide / elongate / AW, cells **;**
cells end to end to form a tube / AW **;**

function with structure:
plasmodesmata only to companion cells to maintain pressure for transport **;**
plasmodesmata to companion cells for, unloading / loading (of assimilates) **;**

[max 3]

(iii) *strong:*
continuous / large, requirement for assimilates / AW **;**
A nutrients
A sucrose metabolised (for growth)
due to, (fast) cell growth / division **;**

sink:
unloading of / AW, assimilates / AW **;**
water follows (unloaded solutes) osmotically **;**
maintains (steep) pressure gradient **;**

[max 2]

[Total: 20]

25 (a) (i) genetically identical (pigs) / (pigs with) same DNA / AW ;
idea of clones from same, ancestor / donor, pig
or
sexual reproduction / fertilisation, not involved ; **A** one parent (cell)

[2]

(ii) *positive:*
no different to using pigs for, other medical treatments / food ;
acceptable (ethically) as useful for life-saving ;

negative for pig:
cloned pigs may have, health issues / shorter life span ;
ref. to potential for lower quality of life than farmed pigs / examples ;
e.g. ref. to potential, pain / suffering
conditions in which pigs are reared
social life (time of separation from mother / reared singly or in litters)

negative for recipients:
religious objections ;
cultural objections ;

[max 1]

(iii) (sugar groups / sugars), act as antigens
or
no / few, antigens added to surface (of cells of transplant organ) ;
idea that no, foreign / non-self, antigens introduced into humans ;
A epitopes for antigen
reduced / no, (primary) immune response / recognition by immune system (cells) ;
A decreased risk of immune rejection
no / fewer, histocompatibility / tissue incompatibility, problems ;

[max 2]

(b) (i) pre-formed antibodies / antibodies already present / AW ; **A** agglutinins
(pre-formed antibodies) specific to antigens associated with transplant organ / AW ;
(antibodies formed as a result of), ABO blood grouping, mis-matched / incompatible, blood transfusion / AW ;
A pregnancy
AVP ; e.g. most sensitive organs are those with extensive blood supply
results in, agglutination / clumping, of red blood cells

[max 2]

(ii) immunosuppressant drugs ; **A** anti-rejection drugs
any two from:
(so) no (primary) immune response ; **A** weak immune system / AW
decreased / no, B- / T-, cells ;
(so) decreased / no, recognition of / binding to, antigens of donated organ ;
no clonal expansion ;
no / decreased, antibody production (specific to antigens of organ) / cytokine release ;

[max 3]

[Total: 10]

26 (a) (i) **E** = pulmonary / pulmocutaneous ; **[1]**

(ii) **F** = oxygenated blood, **G** = mixed blood / oxygenated and deoxygenated blood ;
A comparative description
difference in carbon dioxide concentration ;

[max 1]

(b) *assume fish unless stated otherwise*

1 circulatory system is less complex / ORA ;
2 single circulatory system (not double) / blood flows through the heart once in one complete circuit of the body ;
3 two heart chambers ; **A** single atrium
4 has branchial circulation / circulation via gills (not lungs) ;
5 blood from gills, goes directly to (rest of) body / does not return to heart ;
6 lower (systemic) pressure ;
7 less efficient delivery of oxygen (to distant tissues) ;

8 AVP ; ; e.g. bulbus / conus, arteriosus in fish aorta
\+ sinus venosus before atrium in fish
9 counter current flow in gills
(amphibians) cutaneous circulation deoxygenated blood to, buccal cavity / skin (for diffusion)

[max 4]

[Total: 6]