Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **May/June 2020**

MARK SCHEME

Maximum Mark: 100

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided • Any response marked *ignore* in the mark scheme should not count towards ***n*** • Incorrect responses should not be awarded credit but will still count towards ***n*** • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Question	Answer	Marks
1(a)	*any **five** from:* 1 (ACTH) binds to receptor on cell surface membrane (of adrenal gland cells) ; 2 G protein activated ; 3 adenylyl cyclase activated ; 4 cyclic AMP made from ATP ; 5 (cyclic AMP) second messenger ; 6 (cyclic AMP) binds to kinase (enzyme) ; 7 *ref. to* enzyme cascade / activation of enzymes by phosphorylation ; 8 amplifies signal ; 9 (amplification of signal) results in synthesis of cortisol ;	**5**
1(b)	negative feedback ;	**1**
1(c)	*any **two** from:* 1 uncontrolled mitosis / continuous cell cycle / cell cycle checkpoints not controlled ; 2 abnormal mass of cells formed ; 3 no programmed cell death / no apoptosis / cells immortal ; 4 AVP ; e.g. mutation of, tumour suppressor gene / (proto)oncogene	**2**

Question	Answer	Marks
1(d)	*any **one** from:* 1 decrease in water potential of the blood **;** 2 eating food with high salt content **;** 3 excessive panting (because of increased body temperature) **;** 4 AVP **;** e.g. diabetes	**1**

Question	Answer	Marks
2(a)(i)	gametes correctly entered **;** genotypes correct **;** **A** ecf phenotypes match genotypes **;** **A** ecf *ratio of fruit colours:* 12 white : 3 yellow : 1 green **;** **A** ecf	**4**

	AB	**Ab**	**aB**	**ab**
AB	**AABB** white	**AABb** white	**AaBB** white	**AaBb** white
Ab	**AABb** white	**AAbb** white	**AaBb** white	**Aabb** white
aB	**AaBB** white	**AaBb** white	**aaBB** yellow	**aaBb** yellow
ab	**AaBb** white	**Aabb** white	**aaBb** yellow	**aabb** green

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Question	Answer	Marks
2(a)(ii)	plant **P**: **AaBB ;** plant **Q**: **Aabb ;**	**2**
2(a)(iii)	random / independent, assortment **;** metaphase I **;**	**2**
2(b)(i)	*Freedom II because:* 1 contains, viral / foreign, DNA / genes *or* has DNA from 2 different, sources / organisms **;** 2 *ref. to* genetic engineering / GMO / genetic modification / transgenic **;**	**2**
2(b)(ii)	*advantage:* improved yield / plants do not die of disease / crop not lost **;** *disadvantage:* viral proteins might cause allergies / may be social resistance to GM crops **;**	**2**

Question	Answer	Marks
3(a)(i)	*any **two** from:* 1 group of (morphologically) similar organisms **;** 2 that interbreed to produce fertile offspring **;** 3 occupy same niche **;** 4 AVP **;** e.g. detail of molecular similarity	**2**

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Question	Answer	Marks
3(a)(ii)	*any **five** from:* 1 *ref. to* geographical isolation ; 2 no, gene flow / interbreeding, between, **A** and **B /** populations ; 3 different, selection pressures / environmental conditions (for **A** and **B** populations) ; 4 different mutations occur (in **A** and **B** populations) ; 5 some mutations make individuals better adapted ; 6 those individuals, survive / reproduce ; 7 pass on advantageous alleles ; 8 *ref. to* many generations ; 9 reproductive isolation ; 10 allopatric speciation ;	**5**
3(b)(i)	*any two from mp1-4 and one for mp5* *any **two** from:* 1 DNA sample placed in well (at end of gel) ; 2 *ref. to* electric field / current ; 3 (negatively charged) DNA attracted to, anode / positive electrode ; 4 shorter fragments move further in unit time / ora ; ***one** from:* 5 compare band position to identify cat species ;	**3**

Question	Answer	Marks
3(b)(ii)	*any **two** from:* 1 quicker test ; 2 cheaper / good for low income countries ; 3 portable / no special lab needed / no need to send off sample to be tested ; 4 many sequences can be stored / *ref. to* bioinformatics ; 5 AVP ; e.g. more successful prosecutions deters others form illegal trading / new enforcement measures available	**2**

Question	Answer	Marks
4(a)	1 less / no, ATP made ; 2 (so) poor muscle contraction / AW *or* (so) reduced impulse transmission ;	**2**
4(b)	*any **three** from:* 1 different children have different amounts of mutant, mtDNA / mitochondria ; 2 only mother / siblings, above threshold of mutant, mtDNA / mitochondria, will show symptoms ; 3 *ref. to* not showing typical patterns of inheritance ; 4 (mutant) mtDNA / mitochondria, inherited maternally *or* males do not pass on (mutant), mtDNA / mitochondria ;	**3**

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Question	Answer	Marks
4(c)	*any **two** from:* *arguments for* 1 more diagnosis, means better management of those with the deficiency **;** 2 can prevent losing further children to the deficiency / can decide to not have children / can choose to have children after embryo testing **;** 3 *ref. to* possibility of using enucleated donor egg for mutated mtDNA **;** *any **two** from:* *arguments against* 4 different opportunities for people to access the test **;** 5 no cure **;** 6 some people person may still lead a normal life **;** 7 many mutations still unknown so may still not lead to positive diagnosis **;**	**3**
4(d)	*any **two** from:* 1 change in, formation of α helix / secondary structure **;** 2 change in, folding of / bonds in, tertiary structure **;** 3 change in, 3D specific shape **;**	**2**

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Question	Answer	Marks
5(a)(i)	*any **three** from:* 1 not, made all the time / constitutive**;** 2 gene switched on / protein made, (only) when needed **;** 3 triggered by absence of glucose **;** 4 concentration increases when galactose present **;**	**3**
5(a)(ii)	transporter / channel, for galactose *or* to, allow galactose into cell / increase permeability to galactose **;**	**1**
5(b)(i)	$\frac{2012}{5275} \times 100$ **;** 38(%) **;**	**2**
5(b)(ii)	***either** any **two** from mp1, mp2 or mp5* ***or** any **two** from mp3, mp4 or mp5* *either* 1 (Msn2 in nucleus) higher when glucose is absent **;** 2 (as) Msn2 / transcription factors, bind to DNA in nucleus **;** *or* 3 (Msn2 in nucleus) lower when glucose is present **;** 4 (as) Msn2 is not, needed in nucleus / bound to DNA **;** *plus* 5 AVP **;** e.g. *ref. to* diffusion / movement, of tagged Msn2 / unbound Msn2 distributed equally in nucleus and cytoplasm **;**	**2**

Question	Answer	Marks
5(c)	*any **three** from:* 1 antibodies are too big to enter cells ; 2 making monoclonal antibodies is, expensive / time consuming ; 3 making monoclonal antibodies harms, mice / animals ; 4 immunofluorescence is only used on dead cells ;	**3**

Question	Answer	Marks
6(a)(i)	anaerobic conditions / no oxygen available / little oxygen available ;	**1**
6(a)(ii)	carbon dioxide ;	**1**
6(a)(iii)	dehydrogenation ; decarboxylation ;	**2**
6(a)(iv)	red blood cell / erythrocyte ; (so) no mitochondria ;	**2**
6(a)(v)	substrate-linked phosphorylation ;	**1**
6(b)(i)	volume of carbon dioxide produced ÷ volume of oxygen consumed ; per unit time ;	**2**
6(b)(ii)	lipids / fatty acids, metabolised (not having fed) ; sugar / carbohydrates, metabolised (after feeding) ;	**2**

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Question	Answer	Marks
6(b)(iii)	$\frac{95}{32}$ *or* 95 ÷ 32 **;** 2.97 **;**	**2**
6(b)(iv)	*any **two** from:* 1 substrate immediately available to muscle cells **;** 2 no need to break down, glycogen / energy stores **;** 3 glycogen still available as substrate between feeds **;** 4 AVP **;** e.g. cannot carry stores as need to be light to fly	**2**

Question	Answer	Marks
7(a)		**5**

description	letter
enzyme with a high optimum temperature	**D ;**
enzyme in bundle sheath cells	**E ;**
process that slows down the rate of photosynthesis	**J ;**
compound that releases carbon dioxide into bundle sheath cells	**F ;**
cells that stop oxygen reaching bundle sheath cells	**H ;**

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Question	Answer	Marks
7(b)	*any **three** from:* 1 aerenchyma so oxygen can reach submerged, parts / roots ; 2 ridges on underwater leaves to hold air close to, leaf surface / stomata ; 3 grow taller to keep leaves and flowers above water level ; 4 high tolerance to ethanol so roots can respire anaerobically ; 5 produce more ethanol dehydrogenase to breakdown ethanol from anaerobic respiration ;	**3**

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Question	Answer	Marks
8(a)	*any **four** from:* 1 *ref. to* use of quadrats ; 2 *ref. to* size (of quadrat) ; 3 grid marked out ; 4 use of random number generator 5 measure species frequency ; 6 use of key *or* Braun Blanquet / other named, scale ; 7 measure, species abundance / percentage cover ; 8 repeat sampling ; 9 both sites treated the same ;	**4**
8(b)(i)	0.23 and 0.05 ;	**1**
8(b)(ii)	$\Sigma (n \div N)^2 = 0.19$; $D = 0.81$;	**2**
8(b)(iii)	field **A** has a higher species diversity than field **B** ;	**1**

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Question	Answer	Marks
9(a)	*any **eight** from:* 1 DNA denatured / ssDNA produced ; 2 by heating to, 94 / 95 °C ; 3 add primer (DNA) ; 4 complementary base pairing (with sample DNA) ; 5 at 55–65 °C ; 6 *ref. to* annealing ; 7 DNA polymerase builds new strands / AW ; 8 by adding free nucleotides ; 9 at 70–75 °C ; 10 *ref. to Taq* polymerase thermostable ; 11 does not need replacing ; 12 new strand denatured and process repeated ; 13 process is automated ;	**8**

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Question	Answer	Marks
9(b)	*any **seven** from:* 1 can produce large(r) quantities ; 2 use bacterial host / hamster cell host / insect larva cell ; 3 product exactly the same as human protein ; 4 (as) product has same amino acid sequence 5 no immune response ; 6 no side effects ; 7 no risk of transfer of disease ; 8 easier to obtain purified product ;	**7**

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Question	Answer	Marks
10(a)	*any **eight** from:* 1 fibres are multinucleate ; 2 cell surface membrane is sarcolemma ; 3 sarcoplasm has many mitochondria ; 4 sarcoplasmic reticulum membranes have protein pumps ; 5 transverse system tubules / T-system ; 6 *ref. to* myofibrils ; 7 thick filament / myosin, attached to M line ; 8 thin filament / actin, attached to Z line ; 9 interdigitation of filaments causes striated appearance ; 10 description of one of, A / H / I, bands ; 11 sarcomere is the distance between M lines ; 12 myosin is a fibrous protein with globular protein head ; 13 actin is a chain of globular protein molecules ; 14 tropomyosin / troponin, attached to actin ; *allow marks from an annotated diagram*	**8**

Question	Answer	Marks
10(b)	*any* ***seven*** *from:* 1 acid-growth (hypothesis) ; 2 auxin stimulates proton pumps ; 3 (in) cell surface membrane ; 4 protons / H^+, pumped into cell wall ; 5 using energy / by active transport ; 6 pH of cell wall decreases / cell wall becomes (more) acidic ; 7 pH-dependent enzymes activated ; 8 *ref. to* expansins ; 9 bonds between cellulose microfibrils broken ; 10 *idea that* cell wall, 'loosens' / becomes more elastic / able to stretch ; 11 (more) water enters cell / turgor pressure increases ; 12 (so) cell (wall) expands ;	**7**

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7 Guidance for chemical equations

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State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Question	Answer	Marks
1(a)	idea of shortage of, glutamate / an amino acid, in diet ;	1
1(b)	*any **two** from:* 1 uncontrolled mitosis / continuous cell cycle / cell cycle checkpoints not controlled ; 2 abnormal mass of cells formed ; 3 no programmed cell death / no apoptosis / cells immortal ; 4 AVP ; e.g. mutation of, tumour suppressor gene / (proto)oncogene	2
1(c)	osmoreceptors in hypothalamus ;	1
1(d)	*any **five** from:* 1 (ADH) secreted / released, into blood by posterior pituitary ; 2 binds to receptors on cell surface membranes ; 3 of collecting duct cells ; 4 enzyme cascade ; 5 vesicles with aquaporins move towards (cell surface) membrane ; 6 add aquaporins to (cell surface) membrane ; 7 water moves from collecting duct into blood, down a water potential gradient / by osmosis ; 8 water potential of blood rises ;	5

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>AAbb, Aabb, aaBB, aaBb ;</td><td>1</td></tr>
<tr><td>2(a)(ii)</td><td>
<table>
<tr><td></td><td>Alfresco</td><td>Di Nizza</td><td>or</td><td>Di Nizza</td><td></td></tr>
<tr><td>parent genotypes</td><td>aabb</td><td>Aabb</td><td></td><td>aaBb</td><td>;</td></tr>
<tr><td>gametes</td><td>ab</td><td>Ab ab</td><td></td><td>aB ab</td><td>;</td></tr>
<tr><td>offspring genotypes</td><td>aabb</td><td>Aabb</td><td></td><td>aaBb</td><td>;</td></tr>
<tr><td>offspring phenotypes</td><td>long</td><td>spherical</td><td></td><td>spherical</td><td>;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>2(a)(iii)</td><td>random / independent, assortment ;
metaphase 1 ;</td><td>2</td></tr>
<tr><td>2(b)(i)</td><td>any two from:
1 gourds might become invasive ;
2 more competition from gourds might reduce food production ;
3 might harm gourd genetic diversity ;
4 resistant gourds might have, unknown / adverse, effects on ecosystem ;</td><td>2</td></tr>
</table>

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Question	Answer	Marks
2(b)(ii)	*any **two** from:* 1 resistance gene makes hybrids more susceptible to *Erwinia* **;** 2 gene flow less of a problem than predicted (for this GMO) **;** 3 GM squashes are 'safe' to grow **;** 4 AVP **;** e.g. could still be a problem in areas lacking, beetle / *Erwinia*	**2**
2(b)(iii)	insecticides used to, kill beetle vector / prevent beetles spreading *Erwinia* **or** beetles may only feed on hybrids **;**	**1**

Question	Answer	Marks
3(a)	*any **four** from:* 1 *ref. to* geographical isolation**;** 2 no, gene flow / breeding, between populations (on the different islands) **;** 3 different, selection pressures / environmental conditions (on the different islands) **;** 4 different mutations occur (on the different islands) **;** 5 some mutations make individuals better adapted **;** 6 those individuals, survive / reproduce **;** 7 pass on advantageous alleles **;** 8 *ref. to* many generations **;** 9 reproductive isolation **;** 10 allopatric speciation **;**	**4**
3(b)	*any **two** from:* 1 bind to complementary base sequences in mtDNA **;** 2 (so) only amplify specific mtDNA sections / AW **;** 3 mtDNA section, differences / similarities, used to assess how closely related the subspecies **;**	**2**

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Question	Answer	Marks
3(c)	*any **one pair** from:* 1 large quantity in the cell ; 2 (so) easier to, extract / amplify, DNA for testing ; *or* 3 small genome size ; 4 (so) easier to locate specific section of DNA to test ; *or* 5 mtDNA is, a single copy of DNA / not paired alleles / haploid ; 6 (so) only mutation causes it to change ; *or* 7 inherited maternally ; 8 (so) all mtDNA sections are shared between all members (of maternal) family ; *or* 9 mutation rate is higher / no enzymes to repair mutations / faster molecular clock ; 10 (so)more choice of suitable sections of mtDNA to test / more accurate time estimate ;	**2**
3(d)	*any **two** from:* 1 habitat loss ; 2 more competition for, space / mates ; 3 reduction in prey ; 4 poaching / hunting / poisoning (by humans) ; 5 disease ;	**2**
3(e)	*any **two** from:* 1 morphological / physiological / behavioural / biochemical, similarity to mainland tigers / *Panthera tigris* ; 2 genetically similar to, mainland tigers / *Panthera tigris* ; 3 may be able to breed with, mainland tigers / *Panthera tigris*, to produce fertile offspring ;	**2**

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Question	Answer	Marks
4(a)	*any **three** from:* 1 repeat treatment causes, bigger / more rapid, immune response **;** 2 (so) target cells (expressing new protein) short-lived / AW **;** 3 decrease in (trans)gene expression on re-administration **;** 4 AVP **;** e.g. *ref. to* antibody binding / antibodies attract phagocytes	**3**
4(b)	*any **four** from:* *naked DNA* 1 has to be injected into target cell / lack of organ-specific delivery **;** 2 low efficiency of cellular uptake **;** 3 rapidly broken down **;** *viruses* 4 small packaging capacity / only small amount of DNA can be carried **;** 5 low probability of integration (into host genome) **;** 6 cause mutations in host DNA / (gene) insertion disrupts gene function / insertional mutagenesis **;** *liposomes* 7 low ability to, add DNA / genes, into target cells (genome) / low transduction efficiency **;**	**4**
4(c)(i)	1 red blood cells had 'self' antigens **;** 2 not recognised as foreign **;**	**2**
4(c)(ii)	(red blood cell) has no nucleus so no, DNA / transcription / translation, of targeting proteins **; ora**	**1**

Question	Answer	Marks
5(a)	*any **three** from:* **transcription factor** / **promoter** 1 (C, H, O, N and) S / (C, H, O, N and) P ; 2 protein / DNA ; 3 amino acids / nucleotides ; 4 peptide bonds / phospho(di)ester bonds ; 5 globular / double helix ;	**3**
5(b)(i)	1 (because) sequences already known ; 2 (because) large, number of base pairs / quantity of data, to search ;	**2**
5(b)(ii)	chromosome **D** as it contains the most (possible) Mig1-binding promoter sites ;	**1**
5(b)(iii)	1 Mig 1 (also) regulates genes involved in other pathways ; 2 there could be several copies of (one or more of) these five genes ;	**2**
5(c)	*any **three** from:* 1 production of a repressor protein ; 2 repressor protein binds to operator ; 3 prevents RNA polymerase binding to promoter ; 4 *lac* / structural, genes not transcribed ; 5 repressor only binds when, not bound to lactose / lactose absent ; 6 regulatory gene / gene I, codes for repressor (protein) ;	**3**

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Question	Answer	Marks
6(a)(i)	homeostatis / negative feedback ;	1
6(a)(ii)	sarcoplasmic reticulum ;	1
6(a)(iii)	*any **four** from:* 1 (Ca^{2+}) binds to troponin ; 2 troponin changes shape ; 3 troponin / tropomyosin, moves ; 4 binding sites on actin exposed ; 5 myosin heads, attach / form cross bridges ; 6 myosin head tilts and pulls actin ;	4
6(a)(iv)	*any **two** from:* 1 activates protein kinase ; 2 acts as second messenger ; 3 AVP ; e.g. stimulates signaling cascade activates other (named) enzyme	2

Question	Answer	Marks
6(b)	*any **three** from:* 1 decreased uptake of glucose / decreased permeability to glucose ; 2 decreased glycogenesis ; 3 decreased glucose, oxidation / respiration ; 4 change in, fatty acids / fat, metabolism ; 5 AVP ; e.g. *ref. to* effect on glucagon	**3**

Question	Answer	Marks
7(a)	volume of carbon dioxide produced ÷ volume of oxygen consumed ; per unit time ;	**2**
7(b)(i)	25 ; 18 ;	**2**
7(b)(ii)	0.72 ;	**1**
7(b)(iii)	lipid / fatty acid ;	**1**

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Question	Answer	Marks
7(c)(i)	*any **four** from:* 1 ETC / electron transport chain, functions as normal **;** 2 H^+ / protons, pumped into intermembrane space **;** 3 proton gradient established **;** 4 most, H^+ / protons, diffuse through, DNP **;** 5 into matrix **;** 6 less / fewer, H^+ / protons, pass through ATP synthase **;** 7 less ATP produced **;**	**4**
7(c)(ii)	*any **two** from:* 1 tiredness **;** 2 weight loss **;** 3 increased, heart rate / breathing rate	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(a)</td><td>
<table>
<tr><td>5</td><td>1</td><td>8</td><td>6</td><td>2</td><td>4</td><td>3</td><td>7</td></tr>
</table>
;;

all correct = 2 marks
four in correct consecutive sequence = 1 mark
</td><td>2</td></tr>
<tr><td>8(b)</td><td>
<table>
<tr><td></td><td>Fungi</td><td>Plantae</td><td></td></tr>
<tr><td>method of nutrition</td><td>heterotrophic</td><td>autotrophic</td><td>;</td></tr>
<tr><td>storage polysaccharide</td><td>glycogen</td><td>starch</td><td>;</td></tr>
<tr><td>main component of cell wall</td><td>chitin</td><td>cellulose</td><td>;</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>8(c)</td><td>bacteria ;</td><td>1</td></tr>
<tr><td>8(d)</td><td>RNA or DNA ;

single-stranded or double-stranded ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
9(a)	*any **nine** from:* 1 DNA cut with restriction enzymes ; 2 (DNA) fragments placed in wells in gel ; 3 at cathode ; 4 current / electric field, applied ; 5 fragments negatively charged ; 6 move towards anode ; 7 gel acts as a molecular sieve ; 8 smaller fragments move, faster / further, than larger ones ; 9 current switched off ; 10 *ref. to* Southern blotting / AW ; 11 *ref. to* staining / (gene / DNA) probes, for visualisation ; 12 alleles have different positions on gel ; 13 AVP ; e.g. desired, DNA / allele, selected / increased, by PCR	**9**

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Question	Answer	Marks
9(b)	*any **six** from:* *if present* 1 enables early treatment ; 2 lifestyle changes ; 3 elective / preventative, mastectomy ; 4 regular check ups ; 5 prevents unnecessary prolonged suffering if discovered and treated early ; 6 prevents early death ; 7 AVP ; e.g. social or family advantage of preventing parent's early death *if not present* 8 removes worry ; 9 *ref. to* planning a family ; 10 AVP ; e.g. prevention / early diagnosis, cheaper than later treatment	**6**

Question	Answer	Marks
10(a)	*any **seven** from:* 1 pigments arranged in light-harvesting clusters ; 2 photosystems ; 3 accessory pigments surround primary pigment ; 4 accessory pigment example ; e.g. chlorophyll b / carotene 5 primary pigment is chlorophyll a ; 6 reaction centre ; 7 accessory pigments absorb light energy ; 8 *ref. to* different wavelengths to chlorophyll a ; 9 pass energy on to, chlorophyll a / primary pigment / reaction centre ; 10 pigments absorb light at different wavelengths / maximising light absorbed for photosynthesis ;	**7**

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Question	Answer	Marks
10(b)	*any **eight** from:* 1 carbon dioxide fixation / carbon dioxide combines with RuBP ; 2 using rubisco ; 3 6C unstable compound formed ; 4 2 x GP formed ; 5 GP reduced to TP ; 6 using ATP ; 7 and reduced NADP ; 8 from light-dependent stage ; 9 TP / GP, combines with, nitrate ions / ions containing nitrogen ; 10 ions enter via roots ; 11 ATP required ;	**8**

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2020**

MARK SCHEME

Maximum Mark: 100

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided • Any response marked *ignore* in the mark scheme should not count towards ***n*** • Incorrect responses should not be awarded credit but will still count towards ***n*** • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>any two from:

1 (fruits are) yellow and round ;

2 fruits do not resemble either parent ;

3 fruits resemble Floridor (variety) ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>gametes correctly entered ;

genotypes correctly worked out ;

phenotypes match genotypes ;

ratio of fruit phenotypes 9 yellow round : 3 yellow long : 3 green round : 1 green long ;

<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>ab</th></tr>
<tr><td>AB</td><td>AABB
yellow round</td><td>AABb
yellow round</td><td>AaBB
yellow round</td><td>AaBb
yellow round</td></tr>
<tr><td>Ab</td><td>AABb
yellow round</td><td>AAbb
yellow long</td><td>AaBb
yellow round</td><td>Aabb
yellow long</td></tr>
<tr><td>aB</td><td>AaBB
yellow round</td><td>AaBb
yellow round</td><td>aaBB
green round</td><td>aaBb
green round</td></tr>
<tr><td>ab</td><td>AaBb
yellow round</td><td>Aabb
yellow long</td><td>aaBb
green round</td><td>aabb
green long</td></tr>
</table>
</td><td>4</td></tr>
</table>

Question	Answer	Marks
1(b)	*any **three** from:* 1 meiosis, cannot occur / is disrupted ; 2 33 / odd number of, chromosomes ; 3 three copies of each (homologous) chromosome ; 4 chromosomes cannot (all), pair up / form bivalents / undergo synapsis ; 5 in prophase 1 ; 6 gametes / ovules (pollen), not formed ;	**3**
1(c)(i)	different genera / chromosome numbers different (22 and 40) / offspring would be sterile ;	**1**
1(c)(ii)	*any **two** from:* 1 genetic engineering / genetic modification / recombinant DNA technology ; 2 use restriction, enzyme / endonuclease, to cut *C. ecuadorensis*, genome / DNA ; 3 use, vector / plasmid / *A. tumefaciens* ; 4 to insert WMV-resistance gene into watermelon (cells) ;	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>any two from:
1 uncontrolled mitosis / continuous cell cycle / cell cycle checkpoints not controlled ;
2 abnormal mass of cells formed ;
3 no programmed cell death / no apoptosis / cells immortal ;
4 ref. mutation ;
5 ref. tumour suppressor genes / (proto)oncogenes ;</td><td>2</td></tr>
<tr><td>2(a)(ii)</td><td>any three from:
1 ref. (effect on) neurosecretory cells in hypothalamus ;
2 production / synthesis, of ADH, decreases / stops ;
3 idea of less ADH secreted (into blood) by posterior pituitary ;
4 collecting duct walls less permeable to water ;
5 water remains in collecting duct / most water remains in urine ;</td><td>3</td></tr>
<tr><td>2(b)</td><td><table>
<tr><th>feature</th><th>nervous system</th><th>endocrine system</th></tr>
<tr><td>signal</td><td>impulse</td><td>hormone ;</td></tr>
<tr><td>method of transmission of signal</td><td>neurone / axon ;</td><td>in blood</td></tr>
<tr><td>type of communication</td><td>electrical ;</td><td>chemical</td></tr>
<tr><td>duration of effect</td><td>short term</td><td>long-lasting ;</td></tr>
</table></td><td>4</td></tr>
</table>

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Question	Answer	Marks
3(a)(i)	*any **four** from:* *pre-zygotic* 1 mate preference / sexual selection, based on plumage **;** 2 mate preference / sexual selection, based on song **;** 3 AVP **;** e.g. not, geographic / temporal, as they mate to produce hybrids *post-zygotic* 4 no (normal) sperm in hybrids / all hybrids sterile **;** 5 *idea that* all nests with hybrid male, in male-female pair, were parented by another male (of same species as female) **;** 6 selection against hybrids because of, reproductive failure **;** 7 comparative data quote to support mp4, mp5 or mp6**;**	**4**

Question	Answer	Marks
3(a)(ii)	*any **five** from:* 1 *ref. to* geographical isolation ; 2 no, gene flow / interbreeding, between populations ; 3 different, selection pressures / environmental conditions ; 4 different mutations occur ; 5 some mutations make individuals better adapted ; 6 those individuals, survive / reproduce ; 7 pass on advantageous alleles ; 8 *ref. to* many generations ; 10 reproductive isolation ; 11 allopatric speciation ;	**5**
3(b)(i)	*specific primer* to, select / bind to, the target region (for amplification) ; *restriction enzyme* cut DNA at specific, restriction / recognition, site *or* produces fragments of different lengths ; *gel electrophoresis* separates the fragments into length order ;	**3**

Question	Answer	Marks
3(b)(ii)	1 one fragment versus two fragments ; *any **one** from:* 2 one fragment because no restriction site in target region ; 3 the two species do not share the same SNP ;	**2**
4(a)	*any **two** from:* 1 chloride ions / Cl^-, do not leave / stay inside, epithelial cell ; 2 (so) no, difference of water potential between inside and outside of cells ; 3 no <u>osmosis</u> (of water) out of the cell ;	**2**
4(b)	*any **three** from:* *if test negative* 1 reduces worry (during pregnancy) ; 2 non-CF child will not have to go through the same procedure if they choose to have children ; *if test positive* 3 early, treatment / management of, CF symptoms ; 4 option of, (therapeutic) abortion / termination ; 5 ref. to reducing frequency of CF allele (in the human population) ;	**3**

Question	Answer	Marks
4(c)	*any **three** from:* 1 therapeutic abortion not needed **;** 2 increases probability of successful pregnancy **;** 3 single biopsy less, dangerous / damaging, to embryo (than double biopsy) **;** 4 cheaper as, more successful / higher pregnancy rate **;** 5 preselection / choosing, may be against beliefs **;**	**3**

Question	Answer	Marks
5(a)(i)	*structural gene:* **C ;** *control (regulatory) sequence:* **B ;** *repressor molecule:* **A ;**	**3**
5(a)(ii)	*any **two** from:* 1 is not, made all the time / constitutive **;** 2 gene switched on / protein made, (only) when needed **;** 3 triggered by a, change / stimulus / molecular signal / Msn2 / absence of glucose **;** 4 concentration increases when galactose present **;**	**2**
5(b)(i)	$\frac{226}{806} \times 100$ **;** 28 (%) **;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(b)(ii)</td><td>1 (Mig1 in nucleus) low(er) when glucose is absent ; ora
2 (as) Mig1 is not, needed in nucleus / bound to DNA ;</td><td>2</td></tr>
<tr><td>5(c)</td><td>any two from:
lac Z / gene for β-galactosidase ;
lac Y / gene for, lactose permease / β-galactoside permease ;
lac A / gene for β-galactoside transacetylase ;</td><td>2</td></tr>
<tr><td>6(a)</td><td><table><tr><th>description</th><th>letter</th></tr><tr><td>accessory pigment</td><td>D ;</td></tr><tr><td>location of ATP synthase</td><td>A ;</td></tr><tr><td>acts as reaction centre</td><td>C ;</td></tr><tr><td>transports hydrogen atoms</td><td>F ;</td></tr><tr><td>diffuses through ATP synthase</td><td>H ;</td></tr><tr><td>broken down in photolysis</td><td>E ;</td></tr></table></td><td>6</td></tr>
<tr><td>6(b)(i)</td><td>cellulose / starch ;</td><td>1</td></tr>
<tr><td>6(b)(ii)</td><td>nitrogen ;</td><td>1</td></tr>
<tr><td>7(a)(i)</td><td>area A – intermembrane space ;
process B – chemiosmosis / ATP synthesis ;
substance C – oxygen ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
7(a)(ii)	enzyme / protein / polypeptide ;	1
7(a)(iii)	substrate–linked phosphorylation ;	1
7(b)(i)	22 (÷) 7 ; 3.14 ;	2
7(b)(ii)	*any **two** from:* 1 more red blood cells so more haemoglobin; 2 more haemoglobin to carry oxygen ; 3 more chance of aerobic respiration **or** less chance of anaerobic respiration ;	2
7(c)	*any **two** from:* 1 (relatively) more C–H bonds ; 2 more reduced NAD produced ; 3 more hydrogen atoms to build up proton gradient ; 4 more, chemiosmosis / oxidative phosphorylation ;	2
7(d)(i)	(thermal) insulation ;	1

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Question	Answer	Marks
7(d)(ii)	*any **two** from:* 1 (thermo)receptors in the skin detect change **;** 2 *ref. to* threshold / all or nothing law **;** 3 sensory neurone sends impulse (to hypothalamus) **;**	**2**
7(d)(iii)	*any **two** from:* 1 increased, glycogenolysis / glucose available **;** 2 (so) increased respiration **;** 3 (so) more heat energy generated (and transferred to blood) **;**	**2**

Question	Answer	Marks
8(a)	*any **five** from:* 1 lay out a, line / tape **;** 2 (line / tape) runs from low tide area to high tide area **;** 3 *ref. to* use of quadrats **;** 4 *ref. to* interrupted belt transect **;** 5 place quadrats at regular intervals **;** 6 measure species frequency **;** 7 use of key **or** Braun Blanquet / other named, scale **;** 8 repeat sampling **;**	**5**
8(b)(i)	**B** and **C** **;**	**1**
8(b)(ii)	Pearson's linear correlation / Spearman's Rank **;**	**1**

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Question	Answer	Marks
9(a)	*any **eight** from:* *discontinuous* 1 one / few, genes control a phenotype ; 2 qualitative ; 3 discrete categories / no intermediates ; 4 different alleles at single gene locus have large effect on phenotype ; 5 different genes have different effects ; 6 little / no, contribution by environment to phenotype 7 example ; e.g. albinism / sickle cell anaemia / haemophilia / Huntington's disease *continuous* 8 several genes control a phenotype ; 9 quantitative ; 10 range of categories / many intermediates ; 11 different alleles at single gene locus have small effects ; 12 environment has considerable influence on phenotype ; 13 example ; e.g. height / mass	**8**

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Question	Answer	Marks
9(b)	*any **seven** from:* 1. choose parents with good features ; 2. breed these ; 3. repeat for many generations ; 4. introduction of disease resistance ; 5 named crop disease ; 6 dwarf varieties ; 7 (dwarf varieties) mutant alleles for gibberellin synthesis ; 8 (dwarf varieties) more energy put into grain than into height (of plant) ; 9 (dwarf varieties) less susceptible to being knocked over by weather ; 10 inbreeding leads to uniformity ; 11 named example ; e.g. standard height / cobs ready to harvest at same time 12 hybridisation leads to hybrid vigour ;	**7**

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Question	Answer	Marks
10(a)	*any **eight** from:* 1 mechanical energy converted to electrical ; 2 cell membrane depolarises ; 3 (if at least) two hairs touched (within 35 seconds); 4 action potential occurs ; 5 action potential / depolarisation, spreads over, leaf / lobe ; 6 *ref. to* hinge / midrib, cells ; 7 H^+/ protons, pumped out of cells / pumped into cell walls ; 8 cell wall, loosens / cross-links broken ; 9 calcium pectate dissolves (in middle lamella) ; 10 Ca^{2+} (ions) enter cells ; 11 water enters by osmosis ; 12 cells, expand / become turgid ; 13 change from convex to concave ; 14 trap shuts, quickly / in <1s / in 0.3s ;	**8**

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Question	Answer	Marks
10(b)	*any **seven** from:* 1 maintain constant internal environment ; 2 despite changes in the, internal / external, environment ; 3 changes in, factor / stimulus, detected by receptor ; 4 named factor ; e.g. temperature / water potential / blood glucose concentration 5 impulses to CNS / input ; 6 *ref. to* central control / CNS, decision ; 7 impulses to effector / output ; 8 hormones to target cells 9 named effector ; e.g. muscle / gland 10 corrective action ; 11 factor returns to set point ; 12 negative feedback ; 13 AVP ; e.g. fluctuations around set point	**7**

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