Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **May/June 2022**

MARK SCHEME

Maximum Mark: 100

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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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).

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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
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- 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.

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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).
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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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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.

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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.

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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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Examples of how to apply the list rule

State **three** reasons…. [3]

A	1	Correct	✓	**2**
	2	Correct	✓	
	3	Wrong	×	

B	1	Correct, Correct	✓, ✓	**3**
(4 responses)	2	Correct	✓	
	3	Wrong	ignore	

C	1	Correct	✓	**2**
(4 responses)	2	Correct, Wrong	✓, ×	
	3	Correct	ignore	

D	1	Correct	✓	**2**
(4 responses)	2	Correct, CON (of 2)	×, (discount 2)	
	3	Correct	✓	

E	1	Correct	✓	**3**
(4 responses)	2	Correct	✓	
	3	Correct, Wrong	✓	

F	1	Correct	✓	**2**
(4 responses)	2	Correct	✓	
	3	Correct CON (of 3)	× (discount 3)	

G	1	Correct	✓	**3**
(5 responses)	2	Correct	✓	
	3	Correct Correct CON (of 4)	✓ ignore ignore	

H	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	CON (of 2) Correct	(discount 2) ✓	

I	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	Correct CON (of 2)	✓ (discount 2)	

I

Question	Answer	Marks
1(a)(i)	Eukarya **;** Animalia **;**	**2**
1(a)(ii)	*any **one** from:* warning to predators / to deter predators **;** AVP **;**	**1**
1(b)	*any **three** from:* **1** Ca^{2+} (stays) in, cytoplasm / sarcoplasm **;** **2** Ca^{2+}, binds / bound, to troponin **;** **3** tropomyosin, shifted / does not cover (myosin) binding sites (on actin) **;** **4** myosin-actin, cross bridges / bonds, exist / remain **;** **5** sarcomere(s) / muscle, contracted / shortened / paralysed **;**	**3**
1(c)	*any **three** from:* **1** Ca^{2+}, enters / diffuses into, synaptic knob **;** **2** through (voltage-gated) calcium (ion) channels **;** **3** vesicles containing acetylcholine **;** **4** move to / fuse with, presynaptic membrane **;** **5** exocytosis of acetylcholine **;**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
any four from:
<table>
<tr><th colspan="2">structure</th><th>function</th></tr>
<tr><td>1</td><td>thylakoid(s) / granum / grana</td><td>light dependent reaction / photophosphorylation ;</td></tr>
<tr><td>2</td><td>thylakoid <u>membrane</u>(s)</td><td>have (named), pigments / photosystems / LHC / electron carriers / ETC / ATP synthase ;</td></tr>
<tr><td>3</td><td>thylakoid membranes / grana, have large surface area / are many in number</td><td>to absorb (more) light ;</td></tr>
<tr><td>4</td><td>stroma</td><td>for light independent reaction / Calvin cycle ;</td></tr>
<tr><td>5</td><td>stroma</td><td>has, (named) enzymes / RuBP / reduced NADP ;</td></tr>
<tr><td>6</td><td>stroma colourless OR stroma contains water</td><td>so light reaches thylakoids OR as a medium for reactions / for photolysis</td></tr>
<tr><td>7</td><td>DNA / ribosomes</td><td>make (named), chloroplast proteins / proteins for photosynthesis ;</td></tr>
<tr><td>8</td><td>starch grains / lipid droplets</td><td>store, (named) product of photosynthesis / (chemical) energy ;</td></tr>
<tr><td>9</td><td>envelope</td><td>compartmentalisation ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>2(b)</td><td>
any three from:
1 light excites electrons in, P700 / PS1 (reaction centre chlorophyll) ;

2 electrons passed, along carriers / to ETC ;
3 H^+ / protons, pumped into <u>thylakoid</u>, space / lumen ;

4 H^+ / protons, diffuse (back to stroma) through ATP synth(et)ase ;
5 makes ATP ;
6 AVP ;
</td><td>3</td></tr>
</table>

Question	Answer	Marks
2(c)	*any **seven** from:* *description* **D1** identify wavelengths for chlorophyll (a) absorption **;** **D2** identify wavelengths for phycoerythrin absorption **;** **D3** identify wavelengths for phycocyanin absorption **;** **D4** chlorophyll (a), has peaks / absorbs mainly, in blue and red **;** **D5** phycoerythrin absorbs in blue and green and yellow **;** **D6** phycocyanin absorbs in (green) yellow and red **;** *explanation* **E7** red algae / deep water, get(s) green (and yellow) light **;** **E8** chlorophyll (a) absorbs, no / little, green (and yellow) light **;** **E9** phycoerythrin / phycocyanin / accessory pigments, absorbs wavelengths not absorbed by chlorophyll (a) **;** **E10** combined pigments absorb, greater range of / any / all, wavelengths **;** **E11** increases / more / high(er) rate of, light dependent stage / photosynthesis **;** **E12** (so) more / lots of, (named) organic compounds / growth **;**	**7**

Question	Answer	Marks
3(a)	anabolic / condensation / polymerisation **;**	**1**
3(b)	**1** to, phosphorylate / add phosphate to, glucose **;** *and any **one** from:* **2** stops glucose leaving the cell **;** **3** activates glucose / makes glucose less stable **;** **4** to make fructose (1,6) bi(s)phosphate **;**	**2**
3(c)	cytoplasm **and** mitochondrial matrix **;**	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(d)</td><td>any two from:
1 decarboxylated / loses carbon dioxide ;
2 dehydrogenated / oxidised / loses H ;
3 →, 2C / acetyl, (group) joins coenzyme A to make acetyl coA ;</td><td>2</td></tr>
<tr><td>3(e)</td><td>any three from:
<table>
<tr><th></th><th>mitochondria</th><th>chloroplasts</th></tr>
<tr><td>1</td><td>oxidative phosphorylation</td><td>photophosphorylation ;</td></tr>
<tr><td>2</td><td>inner mitochondrial membrane / crista(e)</td><td>thylakoid membrane ;</td></tr>
<tr><td>3</td><td>reduced NAD / reduced FAD, give e^- / H^+</td><td>photolysis / water / PS1 / chlorophyll, give e^- / H^+ ;</td></tr>
<tr><td>4</td><td>(H^+ →) intermembrane space</td><td>(H^+ →) thylakoid, space / lumen ;</td></tr>
<tr><td>5</td><td>oxygen, final, e^- / H^+, acceptor</td><td>NADP final, e^- / H^+, acceptor ;</td></tr>
<tr><td>6</td><td>(makes) water / H_2O</td><td>(makes) reduced NADP ;</td></tr>
</table></td><td>3</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><th>statement</th><th>genetic engineering using a plasmid</th><th>gene editing</th></tr>
<tr><td>It can produce a transgenic organism.</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>It can modify the characteristics of an organism.</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>It can delete unwanted DNA.</td><td></td><td>✓ ;</td></tr>
<tr><td>It uses an enzyme that cuts DNA.</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>It can use RNA to precisely locate the target gene.</td><td></td><td>✓ ;</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>4(b)(i)</td><td>A ;</td><td>1</td></tr>
<tr><td>4(b)(ii)</td><td>any three from:
1 more food / increase yield / help solve global demand for food ;
2 improves quality of, fruit / oranges / crop ;

3 more income for, growers / farmers ;
4 cheaper / lower cost, fruit / oranges / food (to consumer) ;
5 spend less on / use less / no need for, (bactericidal) chemicals / pesticides ;</td><td>3</td></tr>
</table>

Question	Answer	Marks
5(a)	*any **four** from:* **1** geographical isolation **/** allopatric (sub)speciation **;** **2** little / no, (inter)breeding / gene flow, between populations **;** **3** different, selection / selective, pressures (on each population) **;** **4** different mutations (in each population) **;** **5** adaptation to, environment / habitat / climate / food / vegetation **;** **6** gives, morphological / ecological / behavioural, differences **;**	**4**
5(b)(i)	*any **two** from:* **1** natural / selection **;** **2** dark, colour / fur, selected for / adaptive / good, in woods / warm / shade **;** **3** camouflage / right colour, protects against, (named) predators **;**	**2**
5(b)(ii)	*any **two** from:* **1** genetic drift / not natural selection **;** **2** as small size in north not, adaptive / beneficial **;** **3** (small) lose heat faster / harder to keep warm **;** **4** smaller fat reserves not good with unstable food supply **;** **5** less food in north reduces, growth / size **;** **6** AVP **;**	**2**
5(c)	*any **three** from:* **1** (hybrid populations have) more, genetic variation / alleles **;** **2** genes / mutations / alleles, from both (sub)species **;** **3** more potential to adapt / can adapt better (in future) **;** **4** genes / alleles, for migration may let some find new habitats **;** **5** have, genes / alleles, for, warm and cold / different temperatures **;**	**3**

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Question	Answer	Marks
5(d)	*any **three** from:* **1** obtain, blood / tissue / DNA **;** **2** (test) both (sub)species / migratory and non-migratory **;** **3** use PCR to amplify DNA **;** **4** use, (gel) electrophoresis / DNA profiling / DNA fingerprinting, **and EITHER** compare results **OR** to see genetic, differences / changes **;** **5** sequence DNA and, count / identify, differences / changes **;** **6** check / test, for correlation between, DNA / genetic profiles / alleles / markers, and migratory behaviour **;** **7** use, databases / bioinformatics, to find, name / role of, genes / sequences (that, differ / are associated with migration) **;** **8** AVP **;**	**3**

Question	Answer	Marks
6(a)	homeostasis / negative feedback **;**	**1**
6(b)(i)	blood(stream) / circulation **;**	**1**
6(b)(ii)	**A** – adenyl,(-yl) / (-ate), cyclase **;** **B** – cyclic AMP / cAMP **;**	**2**
6(b)(iii)	amplifies signal / expands message **;**	**1**
6(b)(iv)	break down glycogen / glycogen → glucose / glycogenolysis **;**	**1**
6(c)	*any **four** from:* **1** blood on, pad / strip, inserted into, biosensor / glucometer **;** **2** glucose oxidase **;** **3** (glucose) → gluconic acid and hydrogen peroxide **;** **4** (electric) current / flow of electrons / voltage **;** **5** (current) proportional to glucose, quantity / concentration **;** **6** digital / numerical, reading (on screen) **;**	**4**

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Question	Answer	Marks
7(a)	*gene* length of DNA coding for a polypeptide **;** *allele* alternative / different, form / version, of a gene **;**	**2**
7(b)	*parents phenotypes* red eyes apricot eyes *parents genotypes* C^RC^H C^AC^W *gametes* (C^R C^H C^A C^W) *offspring genotypes* C^RC^A C^RC^W C^HC^A C^HC^W **;** *offspring phenotypes* red eyes (red eyes) apricot eyes honey eyes **;** *ratio* 2 : 1 : 1 **;**	**3**
7(c)	**1** cross with, white-eyed fly / C^WC^W **;** *any **two** from:* **2** if all red-eyed then C^RC^R **;** **3** if (some red-eyed and) some apricot-eyed then C^RC^A **;** **4** if (some red-eyed and) some honey-eyed then C^RC^H **;** **5** if (some red-eyed and) some white-eyed then C^RC^W **;**	**3**

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Question	Answer	Marks
8(a)(i)	*any **three** from:* **1** habitat loss **;** **2** for, agriculture / building / roads / forestry / mines / development **;** **3** hunting / fishing **;** **4** collecting plants **;** **5** humans aid spread of (animal / plant) disease **;** **6** humans aid spread of, alien / invasive / competing, species **;** **7** (named) pollution / pesticides **;**	**3**
8(a)(ii)	**1** $\frac{29\,000-7000}{2000-1950}$ **or** $\frac{29\,000-7000}{50}$ $\frac{22\,000}{50}$ **;** **2** 440 **;**	**2**

Question	Answer	Marks
8(b)	*any **seven** from:* **1** (named) food **;** **2** (named) medicines **;** **3** wood / fibres / paper / rubber **;** **4** genetic diversity for future use **;** **5** science / technology / research **;** **6** education **;** **7** aesthetic / wellbeing **;** **8** (eco)tourism / attract visitors **;** **9** ethical / moral / stewardship **;** **10** local cultural significance **;** **11** maintain / protect / stability of, food chains / food webs **;** **12** pollination / ecosystem services **;** **13** protect against, soil erosion / coastal erosion / flooding **;** **14** soil formation **;** **15** (named) mineral, cycles / recycling **OR** *ref. to* stage in cycle of named element **;** **16** climate stability **;**	**7**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(a)</td><td>
<table>
<tr><th>letter</th><th>feature</th></tr>
<tr><td>B</td><td>location of Calvin cycle</td></tr>
<tr><td>D</td><td>made of cellulose</td></tr>
</table>
; ;
</td><td>2</td></tr>
<tr><td>9(b)</td><td>any four from:

1 H^+ pumped, out of guard cell / into cell wall of guard cell ;
2 inside of cell becomes (relatively) negatively charged ;
3 K^+ enters cell by facilitated diffusion ;

4 water potential of cell decreases ;
5 water enters cell by osmosis ;
6 cell, expands / increases in volume / becomes turgid ;
7 stoma opens due to thick inner wall ;</td><td>4</td></tr>
</table>

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<table>
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<tr><td>10(a)</td><td>
<table>
<tr><th>motor</th><th></th><th>sensory</th></tr>
<tr><td>1 transmits impulses from CNS to effector</td><td>and</td><td>transmits impulses from, receptors / (named) sense organs, to CNS</td></tr>
</table>
;
plus two from:
<table>
<tr><th>motor</th><th></th><th>sensory</th></tr>
<tr><td>2 cell body at end of, neurone / axon</td><td>and</td><td>cell body, in middle of / part-way along, neurone OR cell body not at end of, neurone / axon</td></tr>
<tr><td>3 cell body in, CNS / brain / spinal cord</td><td>and</td><td>cell body in (dorsal root) ganglion</td></tr>
<tr><td>4 long axon OR
axon</td><td>and</td><td>short axon OR
axon and dendron</td></tr>
<tr><td>5 dendrites attached to cell body</td><td>and</td><td>dendrites attached to dendron</td></tr>
</table>
;
</td><td>3</td></tr>
<tr><td>10(b)</td><td>any three from:
1 no myelin slow and myelin fast(er) / myelin increases speed ;
2 no myelin = 0.5–2 m s^{-1} and with myelin > 5 / up to 120 m s^{-1} ;
3 as axon diameter increases speed increases ;
4 diameter (+ units once) and speed (+ units once) for two neurones ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
10(c)	*any **three** from:* **A –** *any one reason from:* **1** Na^+ / sodium, channels already open **OR** Na^+ has already entered neurone **OR** no more Na^+ channels to open **OR** less Na^+ outside to diffuse in **OR** less steep Na^+ concentration gradient **;** **B –** *any one reason from:* **2** sodium channels are, inactive / unresponsive **OR** potassium channels are open **OR** membrane is, impermeable / less permeable, to Na^+ **OR** membrane is more permeable to K^+ **;** **C –** *any one reason from:* **3** harder to reach threshold **OR** potassium channels are (still) open **OR** sodium-potassium pumps need to restore the resting potential **;** **4** hyperpolarisation at **C ;**	**3**

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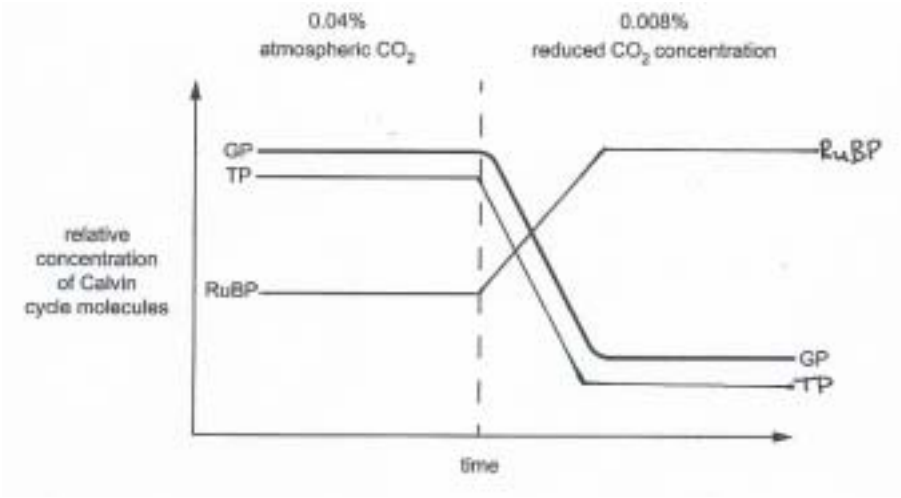
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underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Question	Answer	Marks
1(a)(i)	DOPA / dopaquinone / melanin **;**	**1**
1(a)(ii)	cyclic AMP / cAMP **; A** calcium ions	**1**
1(a)(iii)	*any **two** from:* 1 albino / albinism **;** 2 no pigment or melanin in skin / pale skin **or** white hair **;** **Ignore** fair, skin / hair 3 red / pink, eyes / irises **; A** blue 4 poor vision / described **or** eyes sensitive to light **or** jerky eye movements **; Ignore** blindness	**2**
1(b)	symbols **;** e.g. **B** allele for black fur **b** allele for (light) brown fur parental genotypes **Bb x Bb** gametes **B b B b** ; offspring genotypes **BB Bb (Bb) bb ;** offspring phenotypes black black (black) (light) brown **;** *accept gametes mark from a Punnett square*	**4**

Question	Answer	Marks
2(a)(i)	*any **two** from:* 1 *ref. to* light energy / photons **;** 2 for, light-dependent stage / photophosphorylation / photolysis / photoexcitation / photoactivation **;** 3 to make, reduced NADP / ATP **;** 4 to open stomata (for CO_2 to enter) **;**	**2**
2(a)(ii)	*correctly showing that TP reduces to a plateau below GP* **;** *correctly showing that RuBP increases to a plateau* **;** 	**2**

Question	Answer	Marks
2(a)(iii)	1. decrease in / no, CO_2, diffusing / moving, to, air spaces / palisade cells / mesophyll cells / chloroplasts / stroma **;** *any **two** from:* 2 **stress** response / AW **;** 3 *ref. to* abscisic acid / ABA **;** 4 *ref. to* action of Ca^{2+} as a second messenger **;** 5 stomata close **;**	**3**
2(b)(i)	$\frac{28 - 20.5}{20.5} \times 100$ **or** $\frac{7.5}{20.5} \times 100$ **;** **A** 20.4 or 20.6 **A** 37.3 or 35.9 *answer to 1 decimal place* 36.6 (%) **;** *apply ecf*	**2**

Question	Answer	Marks
2(b)(ii)	*any **four** from:* *no mention of increased or more – ecf and max 3* 1 Sox4 plants have an **extra copy** of *SBPase* gene **;** 2 (overall) increased, expression / transcription, of *SBPase* gene (so more SBPase) **;** 3 increased (rate of) / more, regeneration / production, of RuBP **;** 4 (so) increased / more, carbon fixation / Calvin cycles / light independent reaction / TP / GP **;** 5 more, glucose / sucrose, for respiration / ATP production **or** more, starch / lipid, for storage **or** more cellulose for cell walls **;** 6 more, amino acids / proteins, for growth **;** 7 more, cell division / cell elongation / mitosis **;** 8 AVP **;** e.g.(new) SBPase / *SBPase* gene, more efficient	**4**
2(b)(iii)	*nitrogen needed to produce:* nucleotides for, transcription (of *SBPase* gene) / expression (of *SBPase* gene) / mRNA production **;** amino acids for, protein synthesis / SBPase production / enzyme production **;**	**2**

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Question	Answer	Marks
3(a)	*any **four** from:* *accept **ora*** 1 pyruvate converted to, acetyl group / 2C group / acetyl CoA (in link reaction) **;** 2 NAD needed (in link reaction) **;** 3 (where) NAD becomes reduced **;** 4 reduced NAD goes to ETC **;** 5 ETC / oxidative phosphorylation, works if oxygen is present **or** oxygen is the final electron acceptor **;** 6 (so) reduced NAD is oxidised / NAD is regenerated **;**	**4**
3(b)	*any **five** from:* 1 <u>glycolysis</u> **;** 2 phosphorylation of glucose **;** 3 splitting of fructose (1,6) bi(s)phosphate / AW **;** 4 (into) two, triose phosphate / TP **;** 5 (TP) oxidised / dehydrogenated, to pyruvate **;** 6 net 2 ATP / 4 ATP, produced **;** 7 (2) reduced NAD produced **;**	**5**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><th>statement</th><th>genetic engineering using a plasmid</th><th>gene editing</th></tr>
<tr><td>It may cause the organism to produce a different protein.</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>It may cause a single base pair in a gene to be changed.</td><td></td><td>✓ ;</td></tr>
<tr><td>The success of the technique can be evaluated using marker genes.</td><td>✓</td><td>;</td></tr>
<tr><td>It may use the CRISPR system.</td><td></td><td>✓ ;</td></tr>
<tr><td>It uses DNA ligase.</td><td>✓</td><td>;</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>4(b)(i)</td><td>C ;</td><td>1</td></tr>
</table>

Question	Answer	Marks
4(b)(ii)	*any **three** from:* 1 increased / high, (crop) yield **;** 2 *idea of* less food shortages / more food production / helps solve global demand for food **;** 3 less need to remove weeds (by hand) **;** 4 more income for, growers / farmers **or** *ref. to* economic benefit for, country / region **;** 5 cheaper / lower cost, to buy **;** 6 AVP **;** e.g. less need for deforestation of other land	**3**

Question	Answer	Marks
5(a)	*any **four** from:* 1 geographical isolation / barrier qualified **; Ignore** separation 2 no, interbreeding / gene flow (between European and American populations) **;** **Ignore** reproductive isolation here (needs to be late on in process) 3 different, environmental (conditions) / selection pressures **;** 4 random / different, mutations **;** 5 **different**, alleles selected for / gene pool / changes in allele frequency **;** 6 populations have different, morphological / physiological / behavioural, features **;** 7 after, a long time / many generations, reproductive isolation occurs / cannot interbreed to produce fertile offspring **;** 8 allopatric (speciation) **;**	**4**

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Question	Answer	Marks
5(b)	*any **three** from:* 1 not possible / difficult, to come to a (reliable) conclusion **; A** AW 2 small difference in height / heights are similar (so natural selection **not** more important than genetic drift) **;** 3 taller / lighter, bison could be an advantage in reaching higher vegetation (so natural selection **may** be important) **;** 4 difference in mass, may not be due to genetic factors / may be due to nutrient value of diet / may be due to quantity of food, (so natural selection may **not** be important) **;** 5 genetic drift (in ancestral population) may have led to, European bison being, taller / lighter **or** American bison being, shorter / heavier **;**	**3**
5(c)	1 European bison has a, close / recent / common, ancestor with that of, cattle / *Bos* **or** European bison is more closely related to, cattle / *Bos*, (than to American bison) **;** 2 European bison may have interbred with, cattle / *Bos* **;** 3 mitochondria are inherited from, mother / female **;**	**3**

Question	Answer	Marks
5(d)	*any **four** from:* 1 obtain / use, blood / cells / tissue / DNA **;** 2 from, both species / cattle and European bison **;** 3 use PCR to, replicate / amplify, DNA **;** 4 use, electrophoresis (described) / DNA profiling / DNA fingerprinting, to see genetic differences / compare the banding (patterns) **;** 5 sequence DNA and, count / identify, (percentage) difference / similarity **or** sequence DNA and compare the, nucleotide / base, sequence **;** 6 use, genome / DNA, microarray **; R** for gene expression 7 *ref. to* bioinformatics / database / (computer) software **;** 8 similarity indicates, close relationship / more recent split **;** 9 if they can breed to produce (viable) offspring (they are closely related) **;**	**4**

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Question	Answer	Marks
6(a)	**G** – embryo to aleurone layer **;** **A** – aleurone layer to endosperm **;**	**2**
6(b)	*any **three** from:* 1 hydrolyses / breaks down / digests / converts, starch / amylose **;** 2 in endosperm **;** 3 to, maltose / glucose **;** 4 (glucose) used by embryo **;** 5 (glucose used) for, respiration / growth **;**	**3**

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Question	Answer	Marks
6(c)	*any **four** from:* *accept distilled water for **A**, 500mg dm^{-3} for **B** and 1000mg dm^{-3} for **C**.* 1 seeds of **B** and **C** germinated before seeds of **A** **or** seeds soaked in gibberellin germinated before seeds soaked in distilled water **; ora** 2 **rate** of (increase in percentage) germination was, highest in **C** **or** higher in **C** than, **B** / **A** **or** higher as the concentration of gibberellin increases **; ora** 3 **final** / **day 10** / **maximum** (percentage) germination was, highest in **C** **or** higher in **C** than, **B** / **A** **or** higher as the concentration of gibberellin increases **; ora** 4 data quote between two groups **;** mp1 – **A** by day 6 and **B** and **C** by day 2 mp1 – **A** germinates four days after **B** and **C ora** mp2 – **A** – 2.2 **B** – 5.2 **C** – 9.2, percentage germination day^{-1} mp3 – **A** – 22% **B** – 52% **C** – 92% mp3 – **A** to **C** = 70% more, **A** to **B** = 30% more, **B** to **C** = 40% more 5 percentage germination in **C** levels off after 9 days **;** 6 AVP **;** e.g. no seeds germinate by day 1	**4**

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Question	Answer	Marks
7(a)	RNA polymerase attached to promoter **;** repressor detached from operator **;**	**2**
7(b)(i)	structural (gene) **;**	**1**
7(b)(ii)	lactose permease **; A** beta-galactoside permease movement / transport, of lactose into cell **or** makes (cell surface) membrane (more) permeable to lactose **;**	**2**
7(c)	1 population increases, then levels off, increases, then levels off / AW **;** *any **three** from:* 2 (first increase) glucose, metabolised / respiration **;** 3 (first levelling off) glucose has run out **;** 4 (first levelling off) lactose, hydrolysed / broken down, into, glucose / galactose **;** 5 (second increase) glucose / galactose, metabolised / respired **;** 6 (second levelling off) lactose / glucose / galactose, has run out **;** 7 AVP **;** e.g. *idea of* time delay (for, lactose permease / beta galactosidase, to work)	**4**

Question	Answer	Marks
8(a)	microvilli **;** **A** brush border	**1**
8(b)	no movement of, chemicals / substances / ions, between the, chemoreceptor / cells / (cells) **A ;** **Ignore** food **A** named dissolved substance	**1**

Question	Answer	Marks
8(c)	*any **seven** from:* 1. Na^+ ions enter, (chemo)receptor cell / **A**, through, microvilli / **Y** / channel (proteins) **;** 2 cell **surface** membrane depolarised **;** 3 receptor potential **;** 4 *ref. to* threshold **;** 5 (voltage-gated) Ca^{2+} / calcium, channels open **;** 6 Ca^{2+} ions enter, cytoplasm / cell / **A ; A** presynaptic knob 7 vesicles (of neurotransmitter), move towards / fuse with, cell **surface** membrane / presynaptic membrane **;** 8 exocytosis (described) / secretion, of (named) neurotransmitter **;** 9 neurotransmitter binds to receptor on, postsynaptic / (sensory) neurone / **B**, <u>membrane</u> **;** 10 Na^+ / sodium, channels open **or** Na^+ enter (sensory) neurone / **B ;** 11 postsynaptic membrane / (sensory) neurone membrane, depolarised **;** 12 *ref. to* threshold **;** *allow either mp4 or mp12*	**7**

Question	Answer	Marks
9(a)	to generate a high, blood pressure / hydrostatic pressure **;** **Ignore** to increase the blood pressure to force, plasma / fluid / water, through basement membrane / into the Bowman's capsule / into lumen **;** **R** osmosis / diffuse **Ignore** named substance e.g. glucose	**2**
9(b)(i)	**A** – basement membrane **;** **B** – podocyte **;**	**2**
9(b)(ii)	*any **three** from:* **A** basement membrane 1 acts as a, filter / filtration barrier **;** 2 only, named molecules / ions / molecules less than 68 000–70 000 (R)MM, can pass through **or** red blood cells / large proteins, cannot pass through **;** **B** podocyte 3 has, gaps / slits / projections / pores **;** 4 allows, fluid / water / filtrate, to pass into the, lumen / Bowman's capsule **;** 5 produces, **A** / basement membrane **;**	**3**

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Question	Answer	Marks
10(a)	*any **three** from:* 1 marking, not harmful (described) / cannot be removed (described) **;** 2 constant population size **;** 3 no, births / deaths (described) **or** no, immigration / emigration / migration **;** 4 (sufficient time for) marked individuals to mix with rest of population **;** 5 (penguins are) mobile ;	**3**
10(b)	*any **three** from:* 1 loss of habitat / example **;** 2 climate change **;** 3 predation **;** 4 competition for, food / resources / breeding sites / example **;** 5 new disease **;** 6 pollution / example **;** 7 numbers get so low that population can't recover / AW **;**	**3**
10(c)	13 000 / 1.3×10^4 **;**	**1**

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Question	Answer	Marks
10(d)	*any **four** from:* 1 multicellular ; 2 eukaryote / eukaryotic / (cells) contain a nucleus ; 3 specialised cells / tissues / organs ; 4 heterotrophic (nutrition) / described ; 5 nervous system ; 6 cilia / flagella ; 7 mobile / motile ;	**4**

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2022**

MARK SCHEME

Maximum Mark: 100

Published

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.

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

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **23** printed pages.

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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.

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>1 loop of Henle ;

2 collecting duct ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>antidiuretic hormone / ADH ; A vasopressin</td><td>1</td></tr>
<tr><td>1(a)(iii)</td><td>1 as the RMT increases the concentration of urine increases ; A positive correlation

2 two pairs of comparative figures ;

<table>
<tr><td></td><td>RMT</td><td>urine conc.</td></tr>
<tr><td>beaver</td><td>1.4</td><td>0.90</td></tr>
<tr><td>kangaroo rat</td><td>8.6</td><td>10.50</td></tr>
</table>

any three from:

kangaroo rat
3 little water available / AW ; Ignore desert Ignore rivers & lakes for ora

4 loop of Henle / collecting duct, is longer ;

5 (so) more reabsorption of water occurs ; Ignore retaining more water

6 (so) urine (of kangaroo rat) more concentrated / small volume of urine ;

allow ora for beaver</td><td>4</td></tr>
</table>

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Question	Answer	Marks
1(b)	*any **two** from:* 1 *ref. to* metabolic water / water from respiration **;** 2 it obtains water through the (named) food it eats **;** 3 AVP **;** e.g. behavioural response / no or less sweating	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>
any four from:

similarities
1 photoactivation of chlorophyll / AW, occurs in both ; A excite electrons (for AW)

2 ETC involved in both ;

3 ATP produced in both ;

differences
<table>
<tr><th>cyclic</th><th>non-cyclic</th><th></th></tr>
<tr><td>4 only PSI</td><td>PSI and PSII both involved</td><td>;</td></tr>
<tr><td>5 no, reduced NADP / oxygen, produced</td><td>reduced NADP / oxygen, produced</td><td>;</td></tr>
<tr><td>6 no photolysis
or
no oxygen-evolving
complex involved</td><td>photolysis
or
oxygen-evolving
complex involved</td><td>;</td></tr>
<tr><td>7 electrons emitted from PSI
returned to PSI
or
PS1 is source of electrons</td><td>electrons emitted from PSII are replaced by water
or
water is source of electrons</td><td>;</td></tr>
</table>
</td><td>4</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(ii)</td><td>any two from:

1 no ATP and reduced NADP made ;

2 no, GP / TP, made
or
no, Calvin cycle / light-independent reaction ;

3 no regeneration of RuBP ;</td><td>2</td></tr>
<tr><td>2(b)(i)</td><td>any four from:

1 as the CO_2 concentration increases, the rate of fixation of CO_2 increases ;

2 (as) CO_2 concentration is the limiting factor ;

3 as the CO_2 concentration increases, the rate of fixation of CO_2, remains the same / plateaus ;

4 (as) CO_2 concentration is no longer the limiting factor
or
temperature / light intensity / RuBP regeneration, is the limiting factor ;

5 paired data quote with units to support, mp1 / mp3 ;

<table>
<tr><td></td><td>CO_2 concentration / mg m^{-3}</td><td>CO_2 fixation rate / µmol CO_2 m^{-2} s^{-1}</td></tr>
<tr><td rowspan="2">mp1</td><td>50 ±10</td><td>1 ±0.25</td></tr>
<tr><td>1200–1280</td><td>42 A 41.75</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>mp3</td><td>from 1200–1910</td><td>42 A 41.75</td></tr>
</table>
</td><td>4</td></tr>
</table>

Question	Answer	Marks
2(b)(ii)	*any **three** from:* *assume Sox4 – accept ora for wild* 1 the rate of fixation of CO_2 is higher in Sox4 compared to wild type **or** Sox4 reaches a higher (maximum) rate of CO_2 fixation **;** 2 (wild type) 42 vs (Sox4) 47 μmol CO_2 $m^{-2}s^{-1}$ **;** 3 (Sox4 has) more SBPase **or** there is a faster (rate of) regeneration of RuBP **or** (new) SBPase more effective **;** 4 more RuBP to react with, CO_2 / rubisco **;**	**3**

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Question	Answer	Marks
3(a)	*any **two** from:* substrate-linked (phosphorylation) **; A** substrate level phosphorylation chemiosmosis / oxidative (phosphorylation) **;**	**2**
3(b)	*any **six** from:* 1 hydrogen / electron, carriers **; R** hydrogen ions / hydrogen molecules 2 in glycolysis NAD becomes reduced **;** 3 (so that) triose phosphate becomes, oxidised / dehydrogenated **;** 4 in the link reaction NAD becomes reduced **;** 5 (so that) pyruvate becomes, oxidised / dehydrogenated **or** for production of acetyl coenzyme A **;** 6 in the Krebs cycle both NAD **and** FAD become reduced **;** 7 to regenerate oxaloacetate **;** 8 (deliver, hydrogen / H^+ and e^-), to inner mitochondrial membrane / to cristae / to ETC / for oxidative phosphorylation / for chemiosmosis **;** 9 *ref. to* ATP production **;** 10 *ref. to* recycling of, NAD / FAD **;**	**6**

Question	Answer	Marks
3(c)	*any **two** from:* 1 *ref. to* increase / decrease / control, of (rate of the) link reaction **;** 2 allows build-up of acetyl CoA to be used in the Krebs cycle **;** 3 enzyme becomes active again when, coenzyme A increases / ratio falls **;** 4 allows more coenzyme A, to enter / return to, the link reaction **;** **A** not enough CoA to enter the link reaction **ora** 5 AVP **;** e.g. end product inhibition	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><th>statement</th><th>genetic engineering using a plasmid</th><th>gene editing</th></tr>
<tr><td>It can add a new phenotypic characteristic to an organism.</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>It can change an A-T base pair to C-G.</td><td></td><td>✓ ;</td></tr>
<tr><td>It can inactivate a desired selected gene in an organism.</td><td></td><td>✓ ;</td></tr>
<tr><td>It may change DNA in a way that cannot be told apart from a natural mutation.</td><td></td><td>✓ ;</td></tr>
<tr><td>It requires a DNA donor and a recipient.</td><td>✓</td><td>;</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>4(b)(i)</td><td>A ;</td><td>1</td></tr>
<tr><td>4(b)(ii)</td><td>any three from:

1 less food waste ; A increases quality of food

2 idea of less food shortages / more food production / helps solve global demand for food ;

3 more income for, growers / farmers
or
ref. economic benefit for, country / region ;

4 crop can be grown, when there is a water shortage / in poor quality soil / in harsh environment ;</td><td>3</td></tr>
</table>

Question	Answer	Marks
5(a)	*any **four** from:* 1 (partial) geographical, isolation / separation / barrier**;** 2 little / no, interbreeding / gene flow (between puma populations) **;** 3 different, environmental (conditions) / selection pressures **;** 4 e.g. climate / vegetation / habitat / available prey **;** 5 random / different, mutations **;** 6 different, alleles selected for / gene pool / changes in allele frequency **;** 7 allopatric (sub speciation) **;**	**4**
5(b)	*any **three** from:* 1 obtain, blood / cells / tissue / DNA **;** 2 from two (or more) individuals, at different locations / across range / from North and South America / from the different subspecies **;** 3 use PCR to, replicate / amplify DNA **;** 4 use, gel electrophoresis / DNA profiling / DNA fingerprinting **;** 5 sequencing of DNA **;** 6 use, genome **/** DNA, microarray **; R** for gene expression 7 *ref. to* bioinformatics / database / (computer) software **;** 8 compare similarity (of different sub species)**;**	**3**

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Question	Answer	Marks
5(c)(i)	*any **two** from:* *discontinuous (no mark) because:* 1 feature either present or absent **;** 2 categoric **;** 3 no range / no intermediates **or** qualitative data **or** does not show a normal distribution curve**;**	**2**
5(c)(ii)	*any **three** from:* 1 these features are controlled by, genes / alleles **;** 2 *ref. to* genetic drift **;** 3 (population went through a) <u>bottleneck</u> **;** 4 low / reduced, number of alleles / genetic diversity / genetic variation / genetic polymorphism (in population) **;** **A** some alleles lost 5 inbreeding **;** 6 low / reduced, heterozygosity **or** high / increased, homozygosity **;** 7 rare / deleterious, recessive alleles show their effects (as homozygous) **;** 8 AVP **;** e.g. number of breeding males reduced even more as some have, non-functional / undescended, testes	**3**

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Question	Answer	Marks
5(c)(iii)	*any **two** from:* 1 Texas is closest to Florida **; ora A** / **B**, distant / far away 2 (Texas and Florida pumas) are most closely-related / most genetically similar share most recent common ancestor **;** **ora A** / **B** 3 Texas and Florida, climates / habitats / environment, are similar **; ora** for **A / B** 4 AVP **;** e.g. Texas has too many pumas	**2**
6(a)	1 microvilli **; A** brush border **I** papillae 2 increase surface area **;** 3 (so), more (Na^+) channels / more Na^+ enter **;**	**3**

Question	Answer	Marks
6(b)	*any **six** from:* 1 vesicles of neurotransmitter are stimulated to move **;** 2 vesicles fuse with, cell surface membrane / presynaptic membrane **;** 3 exocytosis (described) / secretion, of (named) neurotransmitter **;** 4 neurotransmitter diffuses across, synapse / (synaptic) cleft / gap between cells **A** and **B ;** 5 neurotransmitter binds to receptors **;** 6 on, cell surface / postsynaptic / (sensory) neurone / **B**, membrane **;** 7 Na^+ / sodium, channels open **;** 8 Na^+ enter, (sensory) neurone / **B ;** 9 postsynaptic membrane / (sensory) neurone membrane, depolarised **;** 10 *ref. to* threshold **;**	**6**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)</td><td>gene – a length of DNA / a sequence of DNA nucleotides, that codes for a particular, protein / polypeptide ;

locus – the position of a, gene / allele, on a chromosome ;</td><td>2</td></tr>
<tr><td>7(b)</td><td>parent genotype (AaBb × AaBb)

parent phenotype brown (brown) ;

gametes AB Ab aB ab × (AB Ab aB ab) ;

<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>ab</th></tr>
<tr><td>AB</td><td>AABB</td><td>AABb</td><td>AaBB</td><td>AaBb</td></tr>
<tr><td>Ab</td><td>AABb</td><td>AAbb</td><td>AaBb</td><td>Aabb</td></tr>
<tr><td>aB</td><td>AaBB</td><td>AaBb</td><td>aaBB</td><td>aaBb</td></tr>
<tr><td>ab</td><td>AaBb</td><td>Aabb</td><td>aaBb</td><td>aabb</td></tr>
</table>
;;

offspring phenotypes linked to genotypes ;

ratio – 9 brown : 3 black : 4 white ;</td><td>6</td></tr>
</table>

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Question	Answer	Marks
7(c)	*any **three** from:* 1 (base), substitution / deletion / insertion **or** frame shift **;** 2 *ref. to* change in, primary / secondary / tertiary, structure (of polypeptide / protein) **or** change in, 3D / active site, shape **;** 3 *ref. to* stop codon **;** 4 (so) no / inactive, tyrosinase produced **;** 5 tyrosine not converted to, DOPA / dopaquinone **;** 6 melanin not formed **;**	**3**

Question	Answer	Marks
8(a)	*any **two** from:* 1 loss of habitat / described **;** 2 climate change / global warming **;** 3 predation **;** **I** hunting 4 competition for, food / resources / breeding sites / example **; A** not enough food 5 new disease **;** 6 numbers get so low that population can't recover / AW **;**	**2**
8(b)	*any **three** from:* 1 trade ban (if species is in danger of extinction) **;** 2 if species is not (yet) at risk of extinction permit required **;** 3 *ref. to* border controls / checks **; A** fines / punishment if caught 4 (provide countries with) lists of species that are, rare / endangered **;** 5 encourages governments, to join CITES / to abide by CITES regulations **;** 6 AVP **;** e.g. every few years they have a conference with their members	**3**

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Question	Answer	Marks
8(c)	*any **four** from:* 1 captive breeding / description ; 2 assisted reproduction / example ; 3 reintroduce into the wild ; 4 medical care ; 5 education / public awareness ; 6 research ; 7 projects in the field ; 8 *ref. to* maintaining genetic databases, to avoid inbreeding **or** working with other zoos ;	**4**

Question	Answer	Marks
9(a)	**A** – axon / axoplasm **;** **B** – Schwann cell nucleus **;**	**2**
9(b)	1 myelinated has faster speed (of transmission of action potential) **;** *plus* *any **three** from:* 2 (myelinated) Na^+ channels **only** occur at nodes of Ranvier **or** (non-myelinated) Na^+ channels occur along length of neurone **;** 3 (myelinated) depolarisation **only** occurs at nodes **or** (non-myelinated) depolarisation occurs along length of neurone **;** 4 (myelinated) long local circuits **or** (non-myelinated) short local circuits **;** 5 (myelinated) saltatory conduction / described **;** 6 AVP **;** e.g. 100 ms^{-1} v 2 ms^{-1}	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)(i)</td><td>

*any **three** from:*

1 as the, blood glucose / glucose concentration, increases the, blood insulin / insulin concentration, increases **; A** positive correlation

2 data quote with unit **;**

data quote for mp1

time of day ±1.5 min	blood glucose conc / mmol dm^{-3} ±0.025	time of day ±1.5 min	blood insulin conc / pmol dm^{-3} ±1
07.00	4.3	07.15	30
08.00	6.2	08.00	280

data quote for mp5

time of day ±1.5 min	blood glucose conc / mmol dm^{-3} ±0.025	time of day ±1.5 min	blood insulin conc / pmol dm^{-3} ±1
08.00	6.2	08.00	280
09.00	4.45	09.00	120

3 increase in, blood glucose / glucose concentration, **causes** release of insulin (from pancreas) **; ora**

4 insulin stimulates the conversion of glucose to glycogen / glycogenesis
or
insulin increases permeability (of liver / muscle) cells to glucose / AW **;**

5 insulin causes, blood glucose / glucose concentration, to return back to set point **;**

6 *ref. to* negative feedback **;**

</td><td>**3**</td></tr>
</table>

Question	Answer	Marks
10(a)(ii)	*any **three** from:* *max 2 if only glucose or insulin curve mentioned* 1 *ref. to* delay before both graphs increase / AW **;** 2 peaks for both would be lower **;** 3 both curves would take longer to decrease **;** 4 time is needed for starch to be, broken down / converted (to glucose) **;** 5 to glucose **;**	**3**
10(b)	*any **four** from:* 1 *ref. to* adenylyl cyclase **;** 2 formation of, cyclic AMP / cAMP **;** 3 cAMP acts as a second messenger **;** 4 activation of (protein) kinase **;** 5 enzyme cascade **;** 6 amplification of signal **;** 7 glycogenolysis / gluconeogenesis / described **;** 8 glucose released into blood **;**	**4**

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