Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **May/June 2023**

MARK SCHEME

Maximum Mark: 100

Published

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Generic Marking Principles

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- the standard of response required by a candidate as exemplified by the standardisation scripts.

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- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
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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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7 Guidance for chemical equations

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A	accept
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AVP	any valid point
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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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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)	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>description</th><th>letter</th></tr>
<tr><td>accumulates (builds up) a high concentration of protons</td><td>B ;</td></tr>
<tr><td>makes triose phosphate</td><td>A ;</td></tr>
<tr><td>makes some chloroplast proteins</td><td>D ;</td></tr>
<tr><td>pumps protons</td><td>C ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(b)(i)</td><td>any four from:

1 spot / extract, placed on, pencil line / base line / line of origin ;
2 repeat / concentrate, spot / extract ;
3 end / base, of paper, suspended / placed, in (named) solvent ;
4 mark the solvent front after, some time / paper removed / solvent moves ;
5 R_f value = distance moved by, spot / pigment / component / solute ÷ distance moved by solvent (front) ;
6 compare (R_f) with known R_f values to identify, constituents / pigments ;
7 detail of method ;</td><td>4</td></tr>
<tr><td>1(b)(ii)</td><td>any three from:

1 (pigments / they / to) absorb / capture / harvest, <u>light</u> (energy) ;
2 increase (range of) / more / different, wavelengths / colours of light, can be absorbed ;
3 increase, efficiency / rate, of, photosynthesis / light dependent reaction OR
increase / broader, action spectrum ;
4 ref. two of: chlorophyll a / chlorophyll b / carotene / xanthophyll ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(a)(i)	**1** (self-contained unit containing) community of / all / different, organisms / populations / species, **and** their interactions **;** **2** (with the) biotic and abiotic, environment / factors **OR** with each other and with the physical environment **;**	**2**
2(a)(ii)	role / function, of a species within its, ecosystem / habitat **;**	**1**
2(b)(i)	(interrupted belt) <u>transect</u> **;**	**1**
2(b)(ii)	*were assessed:* **1** abundance / density / (%) frequency / % cover, of (selected) species **;** *not assessed:* **2** number / range, of (different), ecosystems / habitats **;** **3** genetic, variation / diversity (within each species) **;**	**3**
2(c)(i)	*Haematopus* / *Larus* **;**	**1**
2(c)(ii)	*any **two** from:* **1** eukaryotic (cells) **;** **2** autotrophic / photosynthetic **;** **3** cellulose cell wall **;** **4** aquatic **;** **5** not motile / sessile **;** **6** multicellular **;** **7** no, vascular tissue / xylem / phloem **;**	**2**
2(d)	*any **four** from:* **1** rats no longer, prey on / eat, birds / eggs / chicks **;** **2** mussels / sea snails, decrease because there are more (named) birds **;** **3** seaweeds increase because there are fewer, mussels / (sea) snails **;** **4** Hawadax has changed to match a rat-free island **;** **5** rats were an, invasive / alien, species / predator **;** **6** AVP **;**	**4**

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Question	Answer	Marks
3(a)(i)	*any **two** from*: **1** oxygen / gas, supply / diffusion / transfer **;** **2** to, submerged / underwater, cells / tissues / roots **;** **3** for <u>aerobic respiration</u> **;**	**2**
3(a)(ii)	*any **one** from:* **1** anaerobic respiration / ethanol fermentation **;** **2** high tolerance to, alcohol / ethanol **OR** high / more, alcohol / ethanol, dehydrogenase **;**	**1**
3(a)(iii)	*any **three** from*: **1** cross / breed, rice / plants / individuals, with fast-growing stems **;** **2** select / choose, and breed offspring with fast-growing stems **;** **3** repeat (crossing **and** selection) over generations **;** **4** hybridise / outbreed / out-cross **OR** avoid / reduce, inbreeding depression / background selection **;**	**3**
3(a)(iv)	*any **three** from*: **1** auxin increases <u>stem,</u> growth / length / height **;** **2** protons / hydrogen ions / H^+, move / pumped, into cell wall(s) **;** **3** (expansins) break, links / (H) bonds, between <u>cellulose</u>, molecules / microfibrils **;** **4** water enters cell(s) by osmosis **;** **5** <u>cells</u>, elongate / expand / increase in volume / swell **;**	**3**
3(b)	*any **three** from*: **1** *O. nivara*, adapted to / selected for, dry / drier, conditions / habitats **;** **2** different habitats / ecological isolation **;** **3** prevent interbreeding / no gene flow / reproductive isolation **;** **4** polyploidy / auto(poly)ploidy **;** **5** AVP **;**	**3**

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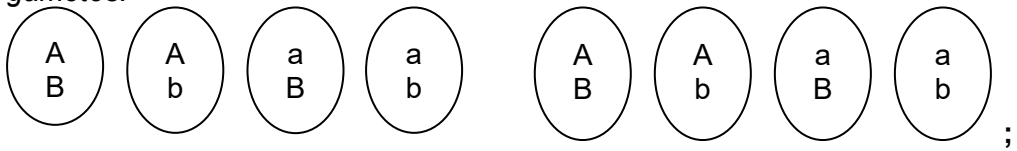
Question	Answer	Marks
4(a)(i)	DNA, combined / joined, from, two / different, organisms / sources ;	1
4(a)(ii)	*any **three** from:* *(protein made in, bacteria / yeast, so)* **1** can be made in, large / unlimited, quantities ; **2** cheap to make / low cost / cost-efficient ; **3** does not, harm / involve, animals / pigs / cows ; **4** no risk of (named) disease, transfer / infection ; *(sequence identical to human sequence so)* **5** does not cause, allergy / inflammatory response / immune response / antibody production ; **6** acts more rapidly ; **7** do not, develop tolerance to it / need larger doses ;	3
4(b)(i)	cow ;	1
4(b)(ii)	*any **three** from:* **1** obtain (normal human), gene / DNA, from (m)RNA by reverse transcriptase / using restriction enzyme ; **2** use gene editing (to alter human gene) ; **3** obtain (nucleotide) sequence for (normal human) insulin gene ; **4** synthesise, new / analogue, gene / nucleotide sequence ; **5** put, new / analogue, gene in, bacteria / yeast ; **6** add <u>promoter</u> for, gene expression / protein synthesis ; **7** AVP ;	3
4(c)	*any **three** from:* **1** can, share / search / access, data(base) / information / sequences ; **2** from anywhere / online ; **3** can, compare / align / analyse, (multiple) sequence<u>s</u> ; **4** rapid / fast(er) (process) ; **5** can, quantify / count, nucleotide differences ; **6** closely-related species have few, differences / mutations ;	3

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Question	Answer	Marks
5(a)(i)	**A** = glomerulus **;** **B** = Bowman's capsule **;**	**2**
5(a)(ii)	*any **four** from:* **1** ultrafiltration **;** **2** high(er) pressure due to afferent arteriole wider than efferent arteriole **;** **3** capillary endothelium has, fenestrations / gaps / holes / pores **;** **4** small molecules / (named) ions / glucose / amino acids / urea / water, **and** **EITHER** leave, blood / plasma / capillary / glomerulus **OR** enter, capsule / filtrate / tubule **;** **5** basement membrane forms, (main) filtration / selective, barrier **;** **6** (R)MM / M_r, limit of, 68 000 to 70 000 (Da) / 68–70 kDa **;** **7** podocytes, form slit pores / support basement membrane **;**	**4**
5(b)(i)	**C** adenyl(yl) cyclase **;** **D** c(yclic) AMP **;**	**2**
5(b)(ii)	*any **four** from*: **1** in both as Na^+ concentration increases ADH concentration increases (after a, certain / stated, point) **;** **2** in, type C / SIAD, ADH rise occurs at a lower Na^+ concentration **;** **3** comparative figures **;** **4** (ADH →) more aquaporins / greater permeability to water, in collecting duct / DCT **;** **5** (C / SIAD / ADH →) more water reabsorbed, at collecting duct / at DCT / into blood **;** **6** (C / SIAD / ADH →) small(er) volume of / (more) concentrated, urine **;** **7** type C / SIAD, causes, high blood water potential / low blood Na^+ concentration **;**	**4**

Question	Answer	Marks
6(a)(i)	**AAb^hb^h** **Aab^hb^h** **AAb^hb** **Aab^hb ; ;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)(ii)</td><td>long, white / albino ;</td><td>1</td></tr>
<tr><td>6(b)</td><td>
1 F1 parent genotypes: AaBb x AaBb ;

2 gametes:


;

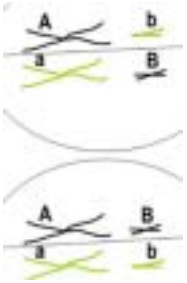
3 F2 offspring genotypes:

<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>
4 evidence of deduction of phenotypes from (min 9 different) genotypes ;

5 F2 offspring phenotype ratio:
9 : 3 : 3 : 1
black short | white short | black long | white long ;
</td><td>5</td></tr>
</table>

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<tr><td>6(c)(i)</td><td>any three from:

1 because they are, on separate chromosomes / not linked ;
2 each, bivalent / <u>pair</u> of homologous chromosomes, orients itself separately ;
3 (at equator) in metaphase I of meiosis ;
4 gives, four / different / new, combinations of alleles / gametes ;
5 parental allele combinations are not, preserved / fixed ;
6 AVP ;

</td><td>3</td></tr>
<tr><td>6(c)(ii)</td><td><table>
<tr><th>phenotype</th><th>observed number (O)</th><th>expected number (E)</th><th>$(O - E)^2$</th><th>$\frac{(O - E)^2}{E}$</th></tr>
<tr><td>short, black fur</td><td>25</td><td>27</td><td>4</td><td>0.148</td></tr>
<tr><td>long, black fur</td><td>11</td><td>9</td><td>4</td><td>0.444</td></tr>
<tr><td>short, white fur</td><td>8</td><td>9</td><td>1</td><td>0.111</td></tr>
<tr><td>long, white long</td><td>4</td><td>3 ;</td><td>1</td><td>0.333</td></tr>
</table></td><td>1</td></tr>
<tr><td>6(c)(iii)</td><td>1.036 ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
7(a)	(pyruvate) – serine **;** (oxaloacetate) – asparagine **;**	**2**
7(b)(i)	**1** chloride (ions) / Cl^-, not, sodium ions / Na^+ (enter post-synaptic neurone) **;** **2** glycine not choline (re-enters / recycled to, pre-synaptic neurone) **OR** glycine not, broken down / hydrolysed, but acetylcholine is (in synaptic cleft) **;**	**2**
7(b)(ii)	*any **two** from*: **1** Cl^- decreases, membrane / resting, potential (difference) / voltage **;** **2** harder / need more depolarisation, to reach threshold **;** **3** glycine is inhibitory **;**	**2**
7(b)(iii)	*any **four** from*: **1** sodium-potassium pump / active transport **;** **2** Na^+, out / leaves **and** K^+, in / enters **;** **3** three Na^+ for two K^+ **;** **4** some K^+ can diffuse out of neurone **OR** ($\times$20) more K^+ diffuses out than Na^+ diffuses in **OR** membrane is ($\times$20) more permeable to K^+ (than Na^+) **;** **5** inside of, axon / neurone, is more negative (than outside) **OR** outside of, axon / neurone, is more positive (than inside) **;**	**4**

Question	Answer	Marks
8	*any **four** from:* **1** DNA / chromatin / chromosomes / chromatids, condense **;** **2** homologous chromosomes, pair up / undergo synapsis / form bivalents / form tetrads **;** **3** crossing-over **;** **4** between non-sister chromatids **;** **5** detail of crossing over **;** **6** chromosomes (stay) joined at, cross-over points / chiasmata **;**	**4**

Question	Answer	Marks
9(a)	**1** environmental **;** **2** discontinuous **;**	**2**
9(b)	*any **five** from*: *coenzyme A:* **1** accepts / binds to / transfers, acetyl (group) **;** **2** acetyl / 2C fragment, + oxaloacetate → citrate **;** **3** (joins) link reaction **and** Krebs cycle **;** *NAD / FAD:* **4** transfer / transport / carry / accept / reduced by, H^+ and e^- / H (atoms) / hydrogen (atoms) **;** **5** *ref.* dehydrogenation (reactions) / dehydrogenase (enzymes) **;** **6** transport, to cristae / to inner mitochondrial membrane / to ETC / for oxidative phosphorylation **;** **7** NAD (accepts H) in glycolysis **and** link reaction **and** Krebs cycle **;**	**5**

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Question	Answer	Marks
10	*any **six** from:* **1** *Ie* allele codes for a, non / less, functional enzyme **;** **2** 3 beta-hydroxylase **;** **3** alanine replaced with threonine at active site **;** **4** inactive gibberellin / GA20, not converted to, active gibberellin / GA1 **;** **5** no / less, gibberellin to bind to, (intracellular) receptor / GID1 **;** **6** no / less, gibberellin-receptor-DELLA complexes formed **;** **7** DELLA not broken down **;** **8** DELLA (stays) bound to, transcription factors / PIF **;** **9** transcription factor / PIF / RNA polymerase, cannot, bind to promoter **;** **10** growth genes / XET gene, (stay) switched off / not transcribed / not expressed **;** **11** stem does not elongate **/** internode length is small **OR** no / less, cell division in stem **;**	**6**

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Question	Answer	Marks
1(a)(i)	*any **one** from:* *glucose* is activated / made reactive **;** becomes unstable **;** cannot leave cell **;** energy level increased **;** concentration gradient maintained **;**	**1**
1(a)(ii)	*any **one** from:* carrier / acceptor / provider, of, hydrogen (atoms) / electrons **or** provider of H ions **and** electrons **; R** H ions alone used for redox reactions **;** used to reduce, ethanal / pyruvate **;**	**1**
1(a)(iii)	substrate-linked / substrate level **;**	**1**

Question	Answer	Marks
1(b)	*any **three** from:* 1 (inner) mitochondrial membrane impermeable (to pyruvate) **;** 2 carrier (protein) **; A** symport / MPC (mitochondrial pyruvate carrier) 3 lower concentration of pyruvate outside mitochondrion **ora** **or** against concentration gradient **;** 4 oxygen available **;** 5 ATP / energy **;**	**3**
1(c)	*any **three** from:* 1 decarboxylation **; A** description 2 dehydrogenation / oxidation, (of pyruvate) **; A** description 3 reduced NAD produced **;** 4 formation of, acetyl coenzyme A / acetyl CoA **;**	**3**

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Question	Answer	Marks
2(a)	haploid is one (complete) set of chromosomes **;** diploid is two (complete) sets of chromosomes **;** *if only comparative statement = max 1* e.g. haploid is n chromosomes and diploid is 2n haploid is half the number of chromosomes as diploid / AW	**2**
2(b)	*prophase I* chromosomes / chromatin, condense / shorten / fatten **I** DNA **or** homologous chromosomes pair up / bivalents form **or** crossing over / synapsis / chiasmata formation **;** *metaphase I* homologous (pairs of) chromosomes / bivalents, line up on the, equator / metaphase plate **or** random / independent, assortment, of homologous (pairs of) chromosomes / bivalents **;** *anaphase I* chromosome(s) / one of each pair of chromosomes, moves (to pole / end of cell) **;** *telophase I* chromosomes reach the opposite, poles / centrosomes / centrioles / end of cell **or** chromosomes decondense / chromatin formation / chromosomes become diffuse **;**	**4**
2(c)	<u>cytokinesis</u> **;**	**1**

Question	Answer	Marks
3(a)(i)	discontinuous **;**	**1**
3(a)(ii)	*any **two** from:* 1 mutation **A** description **or** (formation of a) new allele **;** 2 change in, environment / selection pressure **; A** description 3 cross pollination / cross breeding / hybridisation **;** 4 new allele combination / codominant alleles together **;**	**2**
3(a)(iii)	*any **three** from:* *both types* 1 (inter)breed to produce fertile offspring / not reproductively isolated **;** 2 occupy the same niche **;** 3 same / similar, morphology / physiology / biochemistry **;** **A** description **I** fruit shape 4 have, similar / same, genes / DNA sequences / genomes **;** 5 similar / same, proteins / amino acid sequences **;**	**3**

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Question	Answer	Marks
3(b)	*any **five** from:* 1 (populations) can produce many offspring / AW ; 2 genetic variation occurs (in populations) / described ; 3 *ref.* mutations / sexual reproduction / gamete formation / random fertilisation ; 4 *ref.* competition qualified ; e.g. mates / food / resources 5 *ref.* selection pressure ; 6 some individuals have advantageous, adaptations / phenotype / traits / AW ; 7 (so) they, survive / reproduce / have a selective advantage ; 8 (so) pass on their advantageous allele(s) ; 9 (so) the (advantageous) allele frequency increases ;	**5**

Question	Answer	Marks
4(a)	Bacteria **and** Archaea **;**	**1**
4(b)	*any **four** from:* 1 obtain (specific restriction endonuclease) gene, qualified **;** e.g. gene extracted from the, DNA / genome, of E. coli / bacteria gene synthesised from the mRNA of E. coli / bacteria gene synthesised from nucleotides 2 PCR to make more copies of, gene / DNA **;** 3 cut a plasmid, with a restriction enzyme / to give sticky ends **;** 4 combine / mix / join, gene with plasmid using ligase **;** 5 add plasmid to, E. coli / bacteria **; A** transformation of E. coli 6 use marker genes to, select / identify, bacteria / E. coli, with recombinant plasmids **;** 7 *ref.* culture bacteria / use fermenter **;** 8 *ref.* extraction / purification (of enzyme) **;** 9 AVP **;** e.g. heat shock / calcium ions / electroporation (detail mp5) complementary sticky ends anneal / make phosphodiester bonds (detail mp4)	**4**

Question	Answer	Marks
4(c)	*any **three** from:* 1 (data stored is) a large amount of, amino acid / nucleotide / base / DNA, sequences **;** 2 share data / access data quickly **;** 3 compare (amino acid / nucleotide / base / DNA) sequences **;** 4 use to, predict / visualise / model, the structure of the enzyme **;** 5 identify restriction endonuclease to use **or** find / discover, new restriction endonucleases **;**	**3**

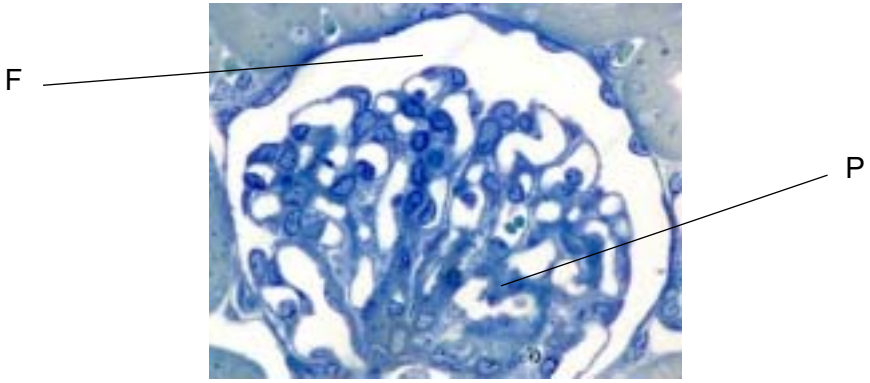
Question	Answer	Marks
4(d)	*any **four** from:*	**4**

feature	electrophoresis	chromatography	
1 separation role	both – are separating techniques **or** both – involve movement of substances		;
2 molecule separated	DNA / RNA / proteins	pigments / named pigment / amino acids	;
3 medium	gel / named gel	paper / glass / silica gel / named medium	;
4 separated by	(electric) current / electric field / electricity	solvent / named solvent	;
5 separated due to	charges / polarity / lengths / mass	solubilities / mass	
	both – separate by mass		;
6 visualisation using	dyes / ethidium bromide / UV light	different colours of pigments / dyes not added / UV light not used	
	both - dyes can be added (if TLC)		;
7 identification by	use, DNA ladder / known length of DNA **or** use of DNA probe	use R_f value	
	both - use of, references / known values		;

Question	Answer	Marks
5(a)(i)	$q^2 = 0.6$ **or** $q = \sqrt{0.6}$ **or** $q = 0.775$ **or** $p = 0.225$ **;** $2pq = 2 \times 0.225 \times 0.775$ **or** 0.35 **;** *allow ecf from mp1* 35 % **;** *allow ecf from mp2*	**3**
5(a)(ii)	*any **four** from:* 1 no migration **or** no flow of, alleles / genes, into / out of, the population **;** 2 population is isolated / described **;** e.g. separated by geographical barrier **I** *ref to* island alone 3 random mating is occurring **;** 4 rats move around island / AW **;** 5 large population **;** 6 rats have high reproductive rate / no predators **;** 7 rats are diploid **;** 8 have two different alleles (for the gene) / heterozygous **;**	**4**

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Question	Answer	Marks
5(b)	*any **three** from:* 1 new allele initially found in heterozygotes **;** *dominant advantageous allele* 2 (new) dominant allele is, expressed in heterozygote / always expressed **;** 3 selection can act on individuals with dominant allele straight away / AW **;** *recessive advantageous allele* 4 (new) recessive allele is not expressed, in heterozygote / due to dominant allele **or** recessive allele only expressed in homozygous recessive (genotype) **;** 5 selection can only act on individuals who are homozygous recessive **;** 6 it takes time for homozygous recessive (genotype) to occur / AW **;**	**3**

Question	Answer	Marks
6(a)		**2**
6(b)(i)	$\frac{118-52}{60}$ **or** $\frac{118-52}{69}$ **or** $\frac{118-52}{51}$ **;** 1.1 **or** 1.0 **or** 1.3 **;** $cm^3\ min^{-1}\ y^{-1}$ **;** **A** $cm^3\ min^{-1}$ / year **A** year(s) $^{-1}$ **R** yr or yrs or mins	**3**

Question	Answer	Marks
6(b)(ii)	*any **three** from:* 1 high(er), hydrostatic / blood, pressure causes higher GFR **; ora** 2 water / solute, potential gradient between glomerulus and Bowman's capsule affects GFR **;** 3 kidney disease / named, decreases GFR **;** e.g. damage to nephron or basement membrane / cancer 4 dehydration / lower water potential of blood, decreases GFR **; ora** 5 high altitude decreases GFR **; ora** 6 drugs / named, affects GFR **;** e.g. diuretics / beta blockers / vasodilators / NSAIDS / ACE inhibitors 7 larger difference between afferent arteriole lumen and efferent causes higher GFR **; ora**	**3**

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Question	Answer	Marks
6(c)	*any **seven** from:* 1 Na^+, actively transported / pumped, out of cells **;** 2 Na^+ enter blood **;** 3 Na^+ concentration in cells decreases **or** Na^+ concentration gradient (between pct lumen and cytoplasm) / described **;** 4 Na^+ enter cells from, filtrate / lumen **;** 5 by facilitated diffusion **;** 6 cotransport of, glucose / amino acids **; I** secondary active transport 7 water potential of cells decreases **;** 8 water enters cells from (filtrate / lumen) by, osmosis / down the water potential gradient **;** 9 glucose / amino acids, leave cells by, (facilitated) diffusion / described **;** 10 glucose / amino acids, reabsorbed **or** move into , tissue fluid / blood **;** 11 AVP **;** e.g. other named ions reabsorbed	**7**

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Question	Answer	Marks
7(a)	*any **four** from:* 1 respiration rate decreases / less ATP produced **;** 2 reduces activity of (named) enzymes / description **;** 3 reduces movement of, Ca^{2+} / Na^{+} / ACh / neurotransmitter **;** 4 (*in neuromuscular junction*) less / no, acetylcholine broken down acetylcholine remains attached to receptors acetylcholinesterase, less active / inactive **;** 5 (*in sarcomere*) fewer / no, Ca^{2+} bind to troponin fewer / no, cross bridges formed fewer / no, power stokes **;** 6 (*in sarcomere*) less / no, detachment of myosin heads (from actin) fewer / no, cross bridges broken ATPase / myosin head, less active / inactive hydrolysis of ATP, slower / stops **;** 7 AVP **;** e.g. shivering / reduced blood flow to muscle / energy diverted for thermoregulation (*idea*)	**4**

Question	Answer	Marks
7(b)	*any **three** from:* 1 Na^+ channels don't open **A** Na^+ do not, diffuse / move, into neurone **or** stay open **;** **A** Na^+ always, diffuse / move, into neurone 2 (axon) membrane, cannot be depolarised **or** (axon) membrane stays depolarised **;** 3 no action potentials, generated / transmitted (along motor neurone) **or** continuous action potentials, generated / transmitted (along motor neurone) **;** 4 Ca^{2+} does not enter presynaptic knob / vesicles not stimulated to move / no ACh release (at neuromuscular junction) **or** Ca^{2+} always enters presynaptic knob / vesicles always stimulated to move / ACh continually released (at neuromuscular junction) **;** 5 consequence e.g. paralysis / described or continued muscle contraction **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(a)(i)</td><td>
any two from:

1 higher rate of activity (of rubisco) in GM rice (throughout) ;

2 (low CO_2 concentrations) rate of activity for both increases ;

3 comparative figures – GM and non-GM at one CO_2 concentration ;
<table>
<tr><th rowspan="2">atmospheric CO_2 concentration / mg dm^{-3} ±5</th><th colspan="2">rate of activity of rubisco / arbitrary units</th></tr>
<tr><th>non-GM rice ±0.05</th><th>GM-rice ±0.05</th></tr>
<tr><td>0</td><td>0.7</td><td>0.80</td></tr>
<tr><td>100</td><td>1.8</td><td>2.70</td></tr>
<tr><td>200</td><td>2.4</td><td>3.95</td></tr>
<tr><td>280</td><td>2.6</td><td>4.15</td></tr>
<tr><td>300</td><td>2.6</td><td>4.15</td></tr>
<tr><td>400</td><td>2.6</td><td>4.30</td></tr>
<tr><td>500</td><td>2.6</td><td>4.45</td></tr>
<tr><td>600</td><td>2.6</td><td>4.55</td></tr>
</table>
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
8(a)(i)	*plus* *levels off because:* 4 carbon dioxide <u>concentration</u> no longer limiting **or** light <u>intensity</u> limiting **or** temperature limiting **or** rubisco active sites saturated (with carbon dioxide) **or** less RuBP available **;**	
8(a)(ii)	active site **;** **A** allosteric site	**1**
8(b)(i)	carbon (dioxide) fixation **;** **A** carboxylation	**1**
8(b)(ii)	reduction / hydrogenation **;**	**1**
8(b)(iii)	6 / 5 **;**	**1**
8(b)(iv)	*any **two** from: list rule* 1 hexose / named **;** e.g. glucose / fructose 2 disaccharide / named **;** e.g. sucrose / maltose 3 starch / cellulose **;** 4 amino acids **;** 5 glycerol / fatty acids **;**	**2**

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Question	Answer	Marks
9(a)	glands ; cell surface membrane / plasma membrane ; **A** liver (cells) second messenger / cAMP ; **A** enzyme cascade / phosphorylation of enzymes / signalling cascade (striated) muscles ; collecting duct ; homeostasis ;	**6**
9(b)(i)	1 insulin, produced / released ; 2 increase in uptake of glucose into cells ; 3 detail of uptake ; e.g. increase permeability of cell surface membrane (to glucose) / GLUT added to cell surface membrane 4 increase / stimulates, respiration of glucose (in cells) / phosphorylation of glucose ; 5 (stimulates) glycogenesis / conversion of glucose to lipids ;	**3**
9(b)(ii)	*ref.* glucagon ;	**1**

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Question	Answer	Marks
10(a)	*any **three** from:* 1 safe location **or** protected from, predators / hunters / poachers **;** 2 research qualified **;** e.g. disease control / into diet / behaviour 3 raise funds **;** 4 work with local, communities / governments or conservation projects **;** 5 education / raise awareness **;** 6 medical / veterinary / health, (care) **;**	**3**
10(b)	*any **four** from:* 1 unnatural environment / described **; ora** 2 effect of captivity on fertility **;** 3 refuses to mate **;** 4 low availability of suitable mates / AW **; ora** 5 stress / pressure **;** 6 AVP **;** e.g. zoo capacity / zoos control number they breed	**4**
10(c)	**A** – fertilisation occurs / sperm or semen added **;** **B** and **C** – surrogacy / described **;** cryopreservation / described **;**	**3**

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2023**

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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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PUBLISHED

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)	**P** – citrate **A** citric acid **Q** – NAD / NAD^+ **R** – reduced NAD / NADH **A** $NADH_2$ **S** – carbon dioxide / CO_2 **T** – FAD **U** – reduced FAD / $FADH_2$ **;;;** *6 correct = 3 marks* *5/4 correct = 2 marks* *3/2 correct = 1 mark*	**3**
1(b)	*any **two** from:* 1 transfer of phosphate group to ADP / ADP phosphorylated / ADP + P_i → ATP **;** 2 substrate-linked phosphorylation **;** **A** substrate-level phosphorylation **R** if oxidative phosphorylation 3 enzyme (catalysed reaction) **;**	**2**

Question	Answer	Marks
1(c)	*any **four** from:* 1 small / water-soluble, so can move around cell **;** 2 loss of phosphate / hydrolysis, leads to energy release **;** 3 (release energy) immediately / in small packets **or** *ref.* 30.5 kJ (mol^{-1}) **;** 4 can be, recycled / regenerated **or** ATP ⇆ ADP + Pi **;** 5 link between energy-yielding and energy-requiring reactions / AW **;** 6 high turnover / described **;** 7 *ref to* ATPase **;**	**4**

Question	Answer	Marks
2	*any **seven** from:* 1 (random) mutation **;** 2 directional selection **;** 3 antibiotic acts as selection pressure / AW **;** 4 bacteria with, mutation / gene / allele, (that codes for antibiotic resistance), have selective advantage **;** 5 (so) survive / reproduce **;** 6 *ref.* binary fission / asexual reproduction / vertical transmission **;** 7 *ref.* transduction / transformation / conjugation / horizontal transmission **;** **I** sexual reproduction 8 (resistance) allele frequency increases / gives rise to a population of resistant bacteria **;** 9 fast (evolution) due to short generation time **;** 10 increased chance of resistance if people do not finish full course of antibiotics / overuse of antibiotics **;** 11 AVP **;** e.g. some antibiotics may act as mutagens e.g. enzymes that break down the antibiotic	**7**

Question	Answer	Marks
3(a)(i)	*the operon has:* promoter **;** operator **;** three structural genes / named three structural genes **;** *lacZ* **or** β galactosidase gene *lacA* **or** lactose / β galactoside, permease gene *lacY* **or** transacetylase gene ***I** regulatory genes / order of named parts*	**3**
3(a)(ii)	*any **four** from:* *lacI gene* 1 is always expressed **;** 2 controls (structural) gene expression **;** 3 codes for the repressor (protein) **;** 4 repressor, binds to the operator / blocks the promoter **;** 5 prevents, (structural) gene expression / RNA polymerase binding to promoter **;** 6 lactose / allolactose, binds to repressor **;** 7 (so) repressor cannot bind to operator / promoter unblocked / gene expression can occur **;**	**4**

Question	Answer	Marks
3(b)	1 enzymes / proteins, made continuously / all the time **;** 2 (because) enzymes / proteins, needed / necessary (for cell) **;** 3 end product inhibition / made until product concentrations too high **;**	**3**

Question	Answer	Marks
4(a)	*any **three** from:* 1 donor not needed **;** 2 immediate effect **;** 3 *idea that* easy to administer treatment **;** 4 no immune response / no rejection **;** 5 less invasive **;** 6 AVP **;** e.g. lower risk to health / cheaper / quicker	**3**

Question	Answer	Marks
4(b)	*any **four** from:* 1 given a drug to increase number of stem cells (in bone marrow) **;** 2 *ref. to* virus / vector, containing, normal / healthy, allele **;** 3 remove, bone marrow / stem cells **;** 4 mix stem cells with, viral / vector (to allow transfer of normal allele) **;** 5 radiotherapy / drug, to make space in bone marrow / to kill stem cells (in bone marrow) **;** 6 (transduced stem) cells, infused / injected, into blood **;** 7 (lymphocytes) produce functioning ADA **;** 8 AVP **;** e.g. (gamma) retrovirus / adeno-associated virus e.g. tissue from bone marrow, purified / sorted, to obtain stem cells e.g. cells are grown in culture to check the ADA gene is active	**4**

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Question	Answer	Marks
4(c)	*any **three** from:* 1 expensive **;** 2 cure / long term treatment / no longer chronically ill / better quality of life **;** 3 no need for regular, injections / treatments **or** only a single treatment **;** 4 cultural / religious, objections **;** 5 no donor needed **;** 6 *ref.* more money available to health system in the long term **;** 7 may cause cancer **;** 8 stressful **;**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>phenotype</th><th>observed</th><th>expected</th><th>O – E</th><th>(O – E)^2</th><th>$\frac{(O-E)^2}{E}$</th></tr>
<tr><td>red with black spots</td><td>279</td><td>281.25</td><td>–2.25</td><td>5.0625</td><td>0.018</td></tr>
<tr><td>white with black spots</td><td>95</td><td>93.75</td><td>1.25</td><td>1.5625</td><td>0.017</td></tr>
<tr><td>red</td><td>96</td><td>93.75</td><td>2.25</td><td>5.0625</td><td>0.054</td></tr>
<tr><td>white</td><td>30</td><td>31.25</td><td>–1.25 ;</td><td>1.5625 ;</td><td>0.05(0)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>0.139 / 0.14 ;</td></tr>
</table>
one mark for each column
</td><td>3</td></tr>
<tr><td>5(b)</td><td>
any two from:

accept null hypothesis (no mark)

1 χ^2 value / 0.139 / 0.14, is lower than, the critical value / 7.815 ;

2 the observed numbers are not significantly different to the expected numbers (at p = 0.05) ;

3 any differences are due to chance ;

allow ecf from 5(a)
</td><td>2</td></tr>
</table>

Question	Answer	Marks
5(c)		4

	female gametes			
male gametes	**X^RB**	**X^rB**	**X^Rb**	**X^rb**
X^rB	**X^RX^rBB**	**X^rX^rBB**	**X^RX^rBb**	**X^rX^rBb**
	female	female	female	female
	red + black spots	white + black spots	red + black spots	white + black spots
Y^RB	**X^RY^RBB**	**X^rY^RBB**	**X^RY^RBb**	**X^rY^RBb**
	male	male	male	male
	red + black spots	red + black spots	red + black spots	red + black spots
X^rb	**X^RX^rBb**	**X^rX^rBb**	**X^RX^rbb**	**X^rX^rbb**
	female	female	female	female
	red + black spots	white + black spots	red + no spots	white + no spots
Y^Rb	**X^RY^RBb**	**X^rY^RBb**	**X^RY^Rbb**	**X^rY^Rbb**
	male	male	male	male
	red + black spots	red + black spots	red + no spots	red + no spots

;;;;

Question	Answer	Marks
5(d)	*mark as pairs* 1 allele **R** / dominant red allele, is on **Y** chromosome **;** 2 (so all) males **inherit**, dominant red allele / allele **R** **or** only $\mathbf{Y^R}$ is present in the gametes **;** 3 no, allele **r** / recessive white allele, on **Y** chromosome **or** allele **r** only exists on the **X** chromosome **;** 4 (so) males never inherit, recessive white allele / allele **r** **;**	**2**
5(e)	*any **two** from:* 1 mutation **;** 2 detail of mutation **;** 3 crossing over **;** 4 (of) the **R** allele / dominant red allele, from a **Y** chromosome to an **X** chromosome **;**	**2**

Question	Answer	Marks
6(a)	**A** – endothelial cell **;** **B** – basement membrane **;** **C** – podocyte **;**	**3**

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Question	Answer	Marks
6(b)	*any **two** from:* 1 acts as the filter **;** 2 prevents molecules more than 68 000 – 70 000 MM from passing through **; ora** 3 stops, large (plasma) proteins / red blood cells **;**	**2**
6(c)	$\frac{180-1.4}{180} \times 100$ **or** $\frac{178.6}{180} \times 100$ **;** 99.2 **;**	**2**

Question	Answer	Marks
6(d)	*any **seven** from:* 1 ADH, acts as / is, a cell signalling molecule **;** 2 ADH binds to receptors **;** 3 on cell surface membrane (of collecting duct cells) **; I** activates G protein 4 cAMP / second messenger, produced **;** 5 enzyme cascade / activation of kinase **;** 6 vesicles / aquaporins, phosphorylated / activated **;** 7 vesicles (with aquaporins) move towards cell surface membrane **;** 8 aquaporins added to (cell surface) membrane **;** 9 increases, cell / membrane, permeability to water **;** 10 water moves out (of collecting duct), by osmosis / description **;** 11 into, (collecting duct) cells / tissue fluid / blood **;** **I** water is reabsorbed as in Q	**7**

Question	Answer	Marks
7(a)	*any **three** from:* 1 opens (voltage-gated) Ca^{2+} channels in sarcoplasmic reticulum **or** calcium ions leave sarcoplasmic reticulum **;** 2 calcium ions bind to troponin **;** 3 troponin changes shape / tropomyosin moves **;** 4 exposes binding site on actin **;** 5 myosin <u>head</u>, binds to (binding) site / forms cross bridge **;** ***plus*** 6 myosin <u>head,</u> tilts / AW **;** 7 pulls actin / power stroke (so sarcomere shortens) **;**	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(b)</td><td>
any two from:

1 young mice have more (muscle fibres) that are smaller (in diameter) ; ora

2 young mice have smaller range (of diameters of muscle fibres) ; ora

3 comparative data quote ; e.g.

<table>
<tr><th></th><th>number of muscle fibres at mean diameter / μm</th><th>spread of diameters / μm</th></tr>
<tr><td>young mice</td><td>35 at 30</td><td>16–44</td></tr>
<tr><td>adult mice</td><td>16 at 50</td><td>20–80</td></tr>
</table>
plus
any two from:

young mice

4 fewer, (muscle) fibres / myofibrils / sarcomeres ; ora

5 less, muscle protein / actin and myosin ; ora

6 so, weaker contraction / AW ; ora
</td><td>4</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(a)</td><td>
<table>
<tr><th></th><th>letter</th></tr>
<tr><td>high concentration of protons</td><td>M ;</td></tr>
<tr><td>location of photosynthetic pigments</td><td>L or N ;</td></tr>
<tr><td>site of light-independent stage</td><td>K ;</td></tr>
<tr><td>site of light-dependent stage</td><td>L or N ;</td></tr>
</table>
ignore M in the last row
</td><td>4</td></tr>
<tr><td>8(b)</td><td>any four from:
1 any one named ; e.g. chlorophyll b / carotene / xanthophyll / carotenoids ;
2 act as accessory pigments / part of antenna complex / part of light harvesting system ;
3 absorb, light / photons ;
4 pass <u>energy</u> on to, chlorophyll a / primary pigment / reaction centre ;
5 absorb different wavelengths of light / wavelengths not absorbed by chlorophyll a ;</td><td>4</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(c)</td><td>1 absorption higher for (whole) chloroplasts (throughout) ;

2 comparative data quote or greatest difference at 525 / 530 nm ;

<table>
<tr><th rowspan="2">wavelength / nm</th><th colspan="2">absorbance / au ±0.05</th></tr>
<tr><th>whole</th><th>pigment</th></tr>
<tr><td>500</td><td>9.2</td><td>6.4</td></tr>
<tr><td>510</td><td>8.4</td><td>3.8</td></tr>
<tr><td>520</td><td>7.4</td><td>2.3</td></tr>
<tr><td>525</td><td>7.0</td><td>1.95</td></tr>
<tr><td>530</td><td>6.6</td><td>1.85</td></tr>
<tr><td>540</td><td>6.2</td><td>2.05</td></tr>
<tr><td>550</td><td>5.8</td><td>2.35</td></tr>
<tr><td>560</td><td>5.8</td><td>2.7</td></tr>
<tr><td>600</td><td>6.65</td><td>4.7</td></tr>
<tr><td>650</td><td>8.85</td><td>8.1</td></tr>
<tr><td>670</td><td>9.6</td><td>9.2</td></tr>
</table>

3 (because) pigments arranged for better absorption in chloroplasts / thylakoid membranes are stacked / AW ;

4 (because) chloroplasts contain more pigments ;</td><td>4</td></tr>
</table>

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Question	Answer	Marks
9(a)(i)	*any **four** from:* 1 (dopamine) diffuses across synaptic cleft **;** 2 binds to receptors **;** 3 on postsynaptic membrane **;** 4 Na^+ channels open **R** voltage gated channels **or** influx of Na^+ into post synaptic neurone **;** 5 depolarisation of postsynaptic membrane **;** 6 *ref.* threshold **;**	**4**
9(a)(ii)	dopaquinone **; A** melanin	**1**
9(b)	*any **three** from:* 1 Cl^- influx makes (inside of postsynaptic neurone) more negative / stays negative **;** 2 hyperpolarisation / remains polarised **;** 3 (not enough Na^+ enter so) less likely to reach threshold **;** 4 no depolarisation of (postsynaptic) membrane **;** 5 (so) no action potential **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)</td><td>any four from:
<table>
<tr><th></th><th>Animalia</th><th></th><th>Plantae</th><th></th></tr>
<tr><td>1</td><td>no cell walls</td><td>and</td><td>cell walls</td><td>;</td></tr>
<tr><td>2</td><td>no, chlorophyll / chloroplasts</td><td>and</td><td>chlorophyll / chloroplasts</td><td>;</td></tr>
<tr><td>3</td><td>heterotroph</td><td>and</td><td>autotroph / photosynthesis</td><td>;</td></tr>
<tr><td>4</td><td>glycogen</td><td>and</td><td>starch</td><td>;</td></tr>
<tr><td>5</td><td>nervous system</td><td>and</td><td>no nervous system</td><td>;</td></tr>
<tr><td>6</td><td>move from place to place</td><td>and</td><td>unable to move from place to place</td><td>;</td></tr>
<tr><td>7</td><td>no, permanent / central, vacuole</td><td>and</td><td>permanent / central, vacuole</td><td>;</td></tr>
</table></td><td>4</td></tr>
<tr><td>10(b)(i)</td><td>$\frac{0.86-0.28}{4}$ or $\frac{0.58}{4}$;

0.15 ;

or

$\frac{0.85-0.28}{4}$ or $\frac{0.57}{4}$;

0.14 ;

Allow ecf if divided by 5 and equals 0.12</td><td>2</td></tr>
</table>

Question	Answer	Marks
10(b)(ii)	*any **three** from:* 1 climate change / described ; 2 less food / less watermilfoil ; 3 less, snow / cover, so more predation ; 4 more hunting ; 5 increased competition ; 6 loss of habitat / deforestation ; 7 (new) disease ;	**3**

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