Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **October/November 2019**

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.

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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.

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

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Question	Answer	Marks
1(a)(i)	*any **one** from:* 1 decrease in water potential (of the blood) **; I** low water potential 2 lower blood volume **;** 3 increase in, ion / salt, concentrations (of the blood) **;**	**1**
1(a)(ii)	<u>posterior pituitary</u> (gland) **;**	**1**
1(b)	**A** – <u>receptor</u> **;** **I** G-protein **B** – <u>vesicle</u> **;** **I** aquaporin	**2**
1(c)	*any **four** from:* 1 (**B** / vesicles) moves towards **/** fuses with, cell surface membrane **;** **Ignore** aquaporins 2 aquaporins added to cell surface membrane **; A** water channels 3 cell surface <u>membrane</u> more permeable to water **;** 4 water moves from, collecting duct / lumen / filtrate, into, cell / blood / tissue fluid **;** 5 by osmosis / down water potential gradient **;** 6 water potential of blood, rises / returns to set point **;** 7 less water lost (in urine / from body) **; A** urine, more concentrated / lower volume	**4**

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Question	Answer	Marks
2(a)	*any* ***two*** *from:* 1 discrete / distinct, categories / phenotypes / morphs / groups **;** **A** (only) 3 groups 2 no range of phenotypes / no intermediates / no normal distribution **;** 3 (only) one gene / only *EDA*, involved **;** 4 not affected by environment **;**	**2**
2(b)	*any* ***one*** *from:* 1 saltwater / ocean, fish had colonised the lake **;** 2 *ref. to* protection from predators **;** 3 mutation **;**	**1**

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Question	Answer	Marks
2(c)	*any **five** from:* 1 genetic variation (in population) **;** 2 *ref. to* selective advantage / selection, for fewer armour plates **; ora** 3 (so) could, grow larger / lay more eggs / shed more sperm **or** less energy wasted making armour **; ora** 4 (they) survive / reproduce **; ora** 5 pass on, advantageous / low armour, alleles (to offspring) **; ora** 6 allele frequency of (low armour) increased **; ora** 7 directional selection **;** 8 *ref. to* low calcium supply **;** 9 reduction in numbers of predatory fish **;**	**5**

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Question	Answer	Marks
3(a)	*any **four** from:* 1 identical to human, insulin / protein **;** **R** similar 2 no, allergic reaction / immune response / side effects **;** 3 human protein may, have high(er) activity / work better / (more) rapid response **;** 4 no chance of developing tolerance (to animal insulin) **;** 5 no risk of transmitting diseases **;** 6 supply unlimited / large-scale production **;** **ora** not enough animal pancreases to meet demand 7 cost (of production) low(er) **;** 8 no ethical objections / no religious objections **; ora**	**4**
3(b)(i)	$\frac{16}{32} \cdot 100$ **or** $\frac{100}{32} \cdot 16$ **;** 50 **;** **A** ecf to two or three significant figures	**2**
3(b)(ii)	*any **two** from:* 1 (bioinformatics is) a store / database, of, base / DNA / protein / amino acid / primary, sequence data **;** 2 for comparison (of, database / base / DNA / protein / amino acid / primary, sequence data) **;** 3 (to search for base / DNA / protein / amino acid / primary, sequences) similar to human calcitonin **;** 4 *idea of* modelling / predicting, tertiary / 3D / protein, structure **;** 5 AVP **;** e.g. sequences data pooled from all over the world	**2**

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Question	Answer	Marks
3(c)(i)	<u>restriction</u>, enzyme / endonuclease **;** (DNA) <u>ligase</u> **;**	**2**
3(c)(ii)	*any **two** from:* *one mark if only two features stated without explanation* 1 small **so** can be inserted (into cells) **;** 2 replicate, independently / fast, **so**, high copy number / large number of plasmids **or** have origin of replication **so** high copy number / large number of plasmids **;** 3 has restriction site(s) / can be cut by restriction enzymes, **so** (new) gene can be added **;** 4 have, multiple cloning site / polylinker, **so** can be cut by different restriction enzymes **;** 5 have marker genes **so**, recombinants / transformed bacteria , can be recognised / AW **;** 6 circular **so** stable **;**	**2**

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Question	Answer	Marks
3(d)	*any* ***two*** *from:* 1 eukaryote and prokaryote promoter <u>sequences</u> are different **;** 2 eukaryote and prokaryote RNA polymerase enzymes are different **;** 3 prokaryotic RNA polymerase does not, recognise / bind to, eukaryotic promoter **or** prokaryotic RNA polymerase only binds to prokaryotic promoter **;** 4 so no, transcription / mRNA made / gene expression **; ora** 5 eukaryotic promoter requires binding of (many) transcription factors that are not present in prokaryotic cell **;**	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)(i)</td><td>
<table>
<tr><th>statement</th><th>meiosis</th><th>mitosis</th></tr>
<tr><td>chromosome number is maintained</td><td>×</td><td>✓</td></tr>
<tr><td>homologous chromosomes pair up</td><td>✓</td><td>×</td></tr>
<tr><td>sister chromatids separate</td><td>✓</td><td>✓</td></tr>
<tr><td>occurs in prokaryotes</td><td>×</td><td>×</td></tr>
</table>
all 4 rows correct = 2 marks
2/3 rows correct = 1 mark

A yes / no for ✓ / ×</td><td>2</td></tr>
<tr><td>4(a)(ii)</td><td>any four from:

similarities
1 (both / meiosis) produce 4 (cells) ;

2 (both / meiosis) halve chromosome number / haploid / n / one set of chromosomes ;

3 (both / meiosis) produce genetically different cells ;

Differences – must be comparative statements
4 sperm is a gamete whereas a pollen grain is, not a gamete / a gametophyte ;

5 sperm cell has one (haploid) nucleus whereas pollen grains contain two (haploid) nuclei ;

6 sperm mitosis then meiosis whereas pollen grain cells meiosis then mitosis ;

7 ref. to primary spermatocyte versus (pollen grain) mother cell ;</td><td>4</td></tr>
</table>

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Question	Answer	Marks
4(b)(i)	**RR dd PP** pale pink petals, red eye **;** **Rr Dd Pp** dark pink petals, red eye **;** **rr Dd Pp** white petals, no red eye / white centre **;** **RR dd pp** white petals, red eye **;**	**4**
4(b)(ii)	*any **four** from:* 1 base, substitution / insertion / deletion **;** 2 frameshift / described **;** 3 changes, primary structure / amino acid sequence / primary sequence **;** 4 changes, tertiary structure / 3D shape **;** 5 STOP codon **;** 6 shortened, protein / polypeptide **;** 7 (protein / enzyme) unable to bind to, substrate / receptor / DNA **;** 8 (so biosynthetic) pathway does not function / AW **;**	**4**
4(b)(iii)	*any **one** from:* 1 is a binding site **;** 2 is a, regulatory region / promoter / enhancers / stop codon / telomere **;**	**1**

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Question	Answer	Marks
5(a)(i)	thylakoid (membranes) / grana / lamellae **;**	**1**
5(a)(ii)	reduced NADP / ATP / oxygen **;** **R** reduced NAD	**1**
5(a)(iii)	*any **four** from:* 1 *ref. to* rubisco **;** 2 forms unstable 6C compound **;** 3 (splits into) two molecules of, GP / glycerate–(3)–phosphate **;** 4 GP reduced to, TP / triose phosphate **;** 5 using reduced NADP **and** ATP **;** 6 TP(s) used to form glucose **;** **Ignore** hexose 7 *ref. to* polymerisation / condensation / formation of glycosidic bonds **;**	**4**
5(b)(i)	more carbon dioxide react with RuBP / more CO_2 fixation / more carbon dioxide available to bind to rubisco **; ora** more, Calvin cycle / light independent reaction / detail **; ora**	**2**
5(b)(ii)	*any **three** from:* 1 as day length increases rate (of photosynthesis) increases / positive correlation **;** 2 data quote: two day lengths in hours **and**, two carbon dioxide concentrations / difference between two carbon dioxide concentrations **;** 3 more light is absorbed by, photosystems / pigments / named pigment **;** 4 *ref. to* more, photophosphorylation / light dependent reaction / photolysis **;** 5 more, oxygen / reduced NADP / ATP / glucose / starch, produced **;**	**3**

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Question	Answer	Marks
5(c)(i)	(pH 8.4) optimum pH of, rubisco / enzymes **;** fewer, H^+ / protons, result in higher rate of, photosynthesis / activity of enzymes **;**	**2**
5(c)(ii)	*idea of* less carbon dioxide, absorbed / fixed (so ocean acidification not reduced) **;**	**1**

Question	Answer	Marks
6(a)(i)	1 (chromosome numbers) are the same **; R** similar numbers *reasons* *any **one** from:* 2 as hybrids are fertile / described **;** 3 two identical sets of chromosomes pair up / homologous chromosomes pair up / bivalents form (in meiosis) **;** 4 meiosis occurs **;**	**2**
6(a)(ii)	*any **four** from:* 1 behavioural isolation **;** 2 reproductive isolation **;** 3 no gene flow with parent, species / populations **;** 4 (so) hybrid gene pool maintained / AW **;** 5 different mutations (occur in hybrid population to parent populations) **;** 6 natural selection **;** 7 pre-zygotic isolating mechanism **;** 8 sympatric (speciation) **;**	**4**

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Question	Answer	Marks
6(b)	*any* ***two*** *from:* 1 hybrids, are eaten / die / fail to reproduce **; ora** 2 hybrid gene pool not maintained **;** 3 parents better adapted **;** 4 *ref. to* disruptive selection **;**	**2**

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Question	Answer	Marks
7(a)	low, mineral (ions) / named mineral (ion), content of soil **; A** no minerals insects provide, mineral (ion) / named mineral (ion) / amino acids, for growth **;**	**2**
7(b)(i)	(sensory / trigger / receptor) hair **; Ignore** cells	**1**
7(b)(ii)	at least two hairs must be touched within, 35 seconds / short time period / at same time **or** one hair touched twice, within, 35 seconds / short time period **;**	**1**
7(c)	*any **three** from:* *Venus fly trap* 1 smaller change in membrane potential / smaller depolarisation **; ora** 2 longer duration of action potential / shorter duration of depolarisation **; ora** 3 shorter duration of repolarisation / longer duration of hyperpolarisation **; ora** 4 longer refractory period **; ora** 5 data quote to **support** either mp1, mp2, mp3 or mp4 **;** 6 membrane / resting, potential 0mV compared with -70mV for human **;**	**3**

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Question	Answer	Marks
7(d)	*any **five** from:* 1 action potential / depolarisation, reaches lobe (of leaf) **;** 2 *ref. to* hinge / midrib, <u>cells</u> **;** 3 H^+, pumped out of cells / pumped into cell walls **;** 4 cell wall, loosens / cross-links broken / AW **;** 5 calcium pectate, dissolves / breaks down (in middle lamella) **;** 6 Ca^{2+} (ions) enter cells **;** 7 water enters, by osmosis / down water potential gradient **;** 8 (hinge / midrib) <u>cells</u>, expand / become turgid **;** 9 leaves / lobes, become concave **;**	**5**

Question	Answer	Marks
8	NAD / FAD / coenzyme **;** intermembrane space **;** cristae / inner membrane **;** diffuse **;** ATP synthase / ATP synthetase / stalked particle **;** oxygen **;**	**6**

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Question	Answer	Marks
9(a)	*any **seven** from:* *Fungi and Animalia* 1 eukaryotic cells **;** 2 & 3 details of eukaryotic cells **;;** e.g. nucleus / linear DNA / chromosomes / histones / 80s ribosomes / (named) membrane-bound organelles 4 heterotrophic / described **;** 5 *ref. to* glycogen **;** *Fungi only* 6 some unicellular **;** 7 hyphae / mycelium **;** 8 multinucleate parts **;** 9 *ref. to* spores **;** 10 cell walls of chitin **;** *Animalia only* 11 multicellular **;** 12 specialised cells **;** 13 differentiated into, tissues / organs **;** 14 some motile **;** 15 (some cells have) cilia / flagella **;**	**7**

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Question	Answer	Marks
9(b)	*any* ***eight*** *from:* *methods* 1 provide as natural environment as possible / described **;** 2 storage of, sperm / eggs / gametes **;** **A** sperm banks 3 artificial insemination / IVF **;** 4 embryo transfer / surrogate mothers **;** 5 can monitor, health of mother / development of foetus **;** 6 (international) cooperation between zoos **;** 7 genetic records kept / 'stud' book **;** 8 release into the wild **;** *problems* 9 may be stress in captivity **;** 10 mate may be rejected **;** 11 reproductive cycles may be disrupted (in captivity) **;** 12 & 13 named problems with release **;;** e.g. difficulty in finding food / may not integrate into groups / more susceptible to disease / very little natural habitat left to release animals into	**8**

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Question	Answer	Marks
10(a)	*any* ***six*** *from:* 1 small **;** 2 water soluble **so** can move around cell **;** 3 immediate source of energy **; A** immediate energy donor 4 *ref. to* hydrolysed **;** 5 phosphate removed releases energy **;** 6 30.5 kJ mol^{-1} **; A** molecule of ATP releases 30.5 kJ 7 ATP splits to ADP and Pi **;** *note* ATP $\longrightarrow$ ADP and Pi + 30.5 kJ gains mp6 and mp7 8 reversible **;** 9 intermediate between, anabolic and catabolic reactions / energy yielding and energy requiring reactions **;** 10 high turnover **;**	**6**

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Question	Answer	Marks
10(b)	*any* ***nine*** *from:* 1 methylene blue / DCPIP, is a hydrogen acceptor (dye) **;** 2 becomes colourless when reduced **;** 3 use yeast suspension (in tube) **;** 4 add named sugar (solution) **and**, methylene blue / DCPIP **;** 5 put thin layer of oil on / put bung on, to prevent oxygen reaching yeast **;** 6 *ref. to* water bath (at set temperature) **;** 7 time how long it takes (for methylene blue / DCPIP) to go colourless **;** 8 use colorimeter **;** 9 *ref. to* 5 different temperatures **;** 10 repeat (whole) experiment at least twice more **;** 11 calculate mean values **;** 12 method to calculate rate of respiration **;** e.g. graph or $\frac{1}{T}$ 13 plot graph of rate of respiration against temperature **;**	**9**

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