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 **March 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.

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

Cambridge International is publishing the mark schemes for the March 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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.

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)
underline	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
AVP	alternative valid point

Question	Answer	Marks
1(a)(i)	*any **two** from:* 1 *idea of* stopping heat (from lamp) reaching plant ; 2 (so) temperature does not change ; 3 (because) temperature affects, the rate of photosynthesis / enzymes (involved in photosynthesis) ;	**2**
1(a)(ii)	to provide carbon dioxide ;	**1**
1(a)(iii)	oxygen ;	**1**
1(b)(i)	as light intensity increases the rate of photosynthesis increases / ora ; data quote (two values of rate of movement of air bubble plus two values of distance of lamp from pond, plus units) ;	**2**
1(b)(ii)	light intensity is no longer a limiting factor ; temperature / carbon dioxide (concentration), could be the limiting factor ;	**2**

Question	Answer	Marks
1(c)	*any **five** from:* 1 ref. to (only) photosystem 1 / P700 ; 2 light <u>energy</u> absorbed by, chlorophyll <u>*a*</u> / primary pigment / reaction centre ; 3 electrons, excited / move to higher energy level ; 4 (electron) emitted by, chlorophyll <u>*a*</u> / primary pigment / reaction centre ; 5 (to) electron, carrier / acceptor ; 6 passes along, <u>electron transport chain</u> / <u>ETC</u> ; 7 chemiosmosis / description ; 8 (leading to) ATP synthesis ; 9 electron returns to, photosystem 1 / P700 / chlorophyll <u>*a*</u> / primary pigment / reaction centre ;	**5**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
<table>
<tr><th>correct order</th><th>letter of event</th></tr>
<tr><td>1</td><td>E</td></tr>
<tr><td>2</td><td>J</td></tr>
<tr><td>3</td><td>F</td></tr>
<tr><td>4</td><td>A</td></tr>
<tr><td>5</td><td>G</td></tr>
<tr><td>6</td><td>K</td></tr>
<tr><td>7</td><td>B</td></tr>
<tr><td>8</td><td>H</td></tr>
<tr><td>9</td><td>C</td></tr>
<tr><td>10</td><td>I</td></tr>
<tr><td>11</td><td>D</td></tr>
</table>
J and F in correct position ;
A and G in correct position ;
B and H in correct position ;
C and I in correct position ;
</td><td>4</td></tr>
<tr><td>2(b)(i)</td><td>5 hours ;</td><td>1</td></tr>
<tr><td>2(b)(ii)</td><td>20 hours ;</td><td>1</td></tr>
<tr><td>2(b)(iii)</td><td><u>negative feedback</u> ;</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(b)(iv)	lipids / fatty acids ; **ignore** fats amino acids / protein ;	**2**

Question	Answer	Marks
3(a)	*any **three** from:* 1 binds to DNA ; 2 at, promoter / enhancer ; 3 allows, RNA polymerase / other transcription factors, to bind (to, DNA / gene / promoter) ; 4 regulates / initiates / inhibits, gene expression / transcription ; **A** switches genes, on / off 5 (so that genes are expressed) at the correct time / in the correct context / in the correct cell type / in the correct order ;	**3**

Question	Answer	Marks
3(b)	*any **five** from:* 1 base substitution / mis-sense mutation ; 2 changes, triplet / codon ; 3 base, deletion / insertion ; 4 (results in) frame shift / description ; 5 change in, protein primary structure / amino acid sequence ; 6 protein folds incorrectly / changes tertiary or 3-D structure ; 7 changes protein function / prevents protein function / makes protein unstable; 8 *idea of* new STOP codon ; 9 only, short / first part of / no, protein is produced ;	**5**
3(c)	*any **three** from:* 1 BLIMP-1, is not synthesised / is non-functional / has changed function ; 2 expression of the *c-Myc* gene, is not reduced / continues ; 3 synthesis / concentration, of c-Myc (protein), is maintained / increases ; 4 (B-lymphocytes continue to) divide by mitosis / proliferate ; **A** clonal expansion 5 differentiation / specialisation, prevented ;	**3**

Question	Answer	Marks
3(d)(i)	*any **four** from:* 1 mRNA extracted from cells (of interest) ; 2 (mRNA) used (as template) to synthesise cDNA ; 3 cDNA is tagged with a fluorescent dye ; 4 (fluorescent) cDNA, binds to / hybridises with, probe ; 5 each probe is unique to a different gene / AW ; 6 fluorescence indicates gene is expressed ; 7 AVP ; e.g. detail of probe / use of UV light	**4**
3(d)(ii)	*any **two** from:* 1 BCL6 / transcription factors, regulate expression of genes ; 2 (microarray) can detect expression of genes ; 3 *idea of* difference in, fluorescence / gene expression, between two samples ; 4 difference in gene expression indicates regulation by BCL6 ;	**2**

Question	Answer	Marks
4(a)	*any **four** from:* 1 frequency of, omnivore-type and carnivore-type / extreme, phenotypes remain high **or** frequency of intermediate phenotypes decreases **;** 2 <u>disruptive</u> selection **;** 3 selection pressure is food availability **;** 4 omnivore-type and carnivore-type / extreme, phenotypes, are more likely to survive / have a selective advantage **or** intermediate phenotypes, less likely to survive / selected against **;** 5 (because they are) good at / poor at, accessing available food **;** 6 ref. to competition **;** **A** omnivore-type = phenotype score 3 **A** carnivore-type = phenotype score 7	**4**
4(b)	$\frac{0.58}{1.1}$ (× 100) **;** 52.7 / 53 **;**	**2**
4(c)(i)	<u>directional</u> **;**	**1**

Question	Answer	Marks
4(c)(ii)	*any **two** from:* 1 omnivore-type, die / decrease, because they, run out of food / are eaten by carnivore-type **;** 2 carnivore-type, survive / increase, because they eat, omnivore-type / fairy shrimps **;** 3 selection pressure acts against omnivore-type / ora **;** **A** omnivore-type = phenotype score 3 **A** carnivore-type = phenotype score 7	**2**
4(d)	grow quicker so develop into adults, in shorter time **/** faster **;**	**1**

Question	Answer	Marks
5(a)(i)	*in USA unless otherwise stated* *any **two** from:* 1 can afford GM crops **;** 2 (technology) developed in USA **;** 3 more land available (to grow crops) **;** 4 fewer laws restricting GM crops / more widespread (public) approval **;** 5 climate conditions more suitable for GM crops **;**	**2**

Question	Answer	Marks
5(a)(ii)	*any **three** from:* 1 initially / in 2004–2006, India uses smaller area (than China) / ora ; 2 area in China remains (almost) constant ; 3 area in India increases (throughout) ; 4 area in India is greater (than China) after 2006 ; 5 comparative figures (one area from India and one from China for two different years plus units) ;	**3**
5(b)(i)	*any **two** from:* 1 increase yield ; 2 increase quality ; 3 less / no, pesticide / insecticide, needs to be used ; 4 (so) less / no, money spent on, pesticides / insecticides ; **A** cheaper	**2**
5(b)(ii)	1 contains gene from, *Bacillus thuringiensis* / bacterium ; 2 produces, (Bt) toxin / compound, harmful to insects ;	**2**

Question	Answer	Marks
5(c)(i)	*any **two** from:* 1 resistance (to insects) may be transferred to wild plants ; 2 contamination of food marketed as organic ; 3 may kill, useful insects / pollinators ; 4 decrease in biodiversity ; 5 potential health risks of humans (eating GM crops) ; 6 insects may become resistant (to toxin) ;	**2**
5(c)(ii)	*any **one** from:* 1 education / awareness ; 2 reasons for objections have not been proven ; 3 consumption of GM foods shows no ill effects ; 4 entire generation grown up in GM era ;	**1**

Question	Answer	Marks
6(a)	*any **four** from:* *inheritance is through mtDNA:* 1 MELAS syndrome is not inherited from affected males ; 2 **all** offspring of a female with MELAS syndrome also have MELAS syndrome ; 3 ref. to numbered individuals to support mp1 or mp2 ; *if X-linked:* 4 males more likely to be affected ; 5 (because) males inherit only one X chromosome (from mother) ; 6 (however) more females affected than males ; 7 there are no, heterozygous / carrier, females ;	**4**

Question	Answer	Marks
6(b)	*any **three** from:* *in mitochondrial DNA:* 1 mutations occur at constant rate ; 2 mutations occur at faster rate than, nuclear / chromosomal, DNA ; 3 not protected by histone proteins ; 4 no enzymes to repair DNA mutations ; 5 many copies of mtDNA per cell ; 6 no mixing of DNA at fertilisation (as only inherited from mother) **or** circular DNA, so no crossing over (all sequence changes are mutations) ;	**3**

Question	Answer	Marks
7(a)(i)	*any **three** from:* 1 because there is a faster rate of (aerobic) respiration (than in phase **A**) ; 2 (because) in phase **B**, ADP is present so oxygen concentration decreases faster ; 3 ADP is needed for ATP synthesis ; 4 oxygen used, as final electron acceptor / for oxidative phosphorylation / for aerobic respiration ;	**3**
7(a)(ii)	ADP / Pi / oxygen / pyruvate, becomes limiting / runs out ;	**1**

Question	Answer	Marks
7(b)	*any **five** from:* 1 low concentration of oxygen in water ; 2 ref. to aerenchyma / description ; 3 gases diffuses (through aerenchyma) down to root cells ; 4 allows aerobic respiration ; 5 some leaves trap air underwater due to ridges on leaves ; 6 ethanol produced from respiration under anaerobic conditions ; **A** alcoholic fermentation 7 (root cells) can tolerate ethanol ; 8 (root cells) produce, alcohol / ethanol, dehydrogenase (to break down ethanol) ; 9 some varieties of rice have high rate of respiration under anaerobic conditions to generate more ATP ;	**5**

Question	Answer	Marks
8(a)	*any **three** from:* 1 variation (with)in, ecosystems / habitats ; 2 number / variety, of (different) species ; 3 relative abundance of each species ; 4 genetic variation within each species ;	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(b)(i)</td><td>
<table>
<tr><th>species</th><th>number</th><th>$\frac{n}{N}$</th><th>$\left(\frac{n}{N}\right)^2$</th></tr>
<tr><td>Rana temporaria</td><td>10</td><td>0.042</td><td>0.002</td></tr>
<tr><td>Leucorrhinia dubia</td><td>35</td><td>0.148</td><td>0.022</td></tr>
<tr><td>Hydrometra stagnorum</td><td>50</td><td>0.212</td><td>0.045</td></tr>
<tr><td>Lymnaea stagnalis</td><td>44</td><td>0.186</td><td>0.035</td></tr>
<tr><td>Gammarus pulex</td><td>97</td><td>0.411</td><td>0.169</td></tr>
<tr><td>Total</td><td>236</td><td></td><td>0.273</td></tr>
</table>
n/N column correct ;
$(n/N)^2$ column correct ; allow ecf
Simpson’s Index of Diversity = 0.727 ; allow ecf</td><td>3</td></tr>
<tr><td>8(b)(ii)</td><td>(relatively) high value / close(r) to 1 (than 0) ;
indicates (fairly) high (species) diversity ;
allow ecf from 8(b)(i)</td><td>2</td></tr>
</table>

Question	Answer	Marks
9(a)	*any **seven** from:* 1 calcium ions released from sarcoplasmic reticulum ; 2 calcium ions bind to troponin ; 3 troponin changes shape and moves tropomyosin ; 4 exposes binding site on actin ; 5 myosin head, binds to site / forms cross bridge ; 6 myosin head tilts ; 7 pulls actin / power stroke ; 8 myosin head, has ATPase / hydrolyses ATP ; 9 myosin head lets go of actin ; 10 myosin head goes back to previous orientation / myosin head re-cocks ; 11 process repeated ; 12 sarcomere shortens ;	**7**

Question	Answer	Marks
9(b)	*any **eight** from:* 1 FSH secreted by anterior pituitary ; 2 stimulates, development / growth, of follicle (cells in ovary) ; 3 dominant / Graafian, follicle, secretes oestrogen ; 4 oestrogen stimulates repair of endometrium ; 5 oestrogen inhibits further release of FSH ; 6 (large) increase oestrogen, day 14 / midpoint ; 7 stimulates secretion of LH from anterior pituitary ; 8 LH stimulates, ovulation / release of oocyte ; 9 LH stimulates development of corpus luteum ; 10 corpus luteum secretes progesterone ; 11 progesterone continues build-up of endometrium **or** maintains endometrium ; 12 progesterone, inhibits secretion of, LH / FSH ; 13 corpus luteum degenerates so concentration of progesterone falls ; 14 endometrium breaks down ;	**8**

Question	Answer	Marks
10(a)	1 ref. to organisms change over time ; *plus any **six** from:* 2 organisms produce many offspring ; 3 more than is necessary to maintain population ; 4 (but) population size is constant (over time) ; 5 within a species there is variation (in phenotype) ; 6 due to genetic variation ; 7 caused by mutation ; 8 individuals compete for survival / survival of the fittest ; 9 ref. to selection pressure(s) ; 10 some individuals, are better adapted to survive / have advantageous alleles / have selective advantage ; 11 pass on (advantageous) alleles to offspring ; 12 changes allele frequency ; 13 ref. to speciation ;	**7**

Question	Answer	Marks
10(b)	*any **eight** from:* *meiosis (max **seven**):* 1 chiasma / crossing over ; 2 between non-sister chromatids ; 3 of, homologous chromosomes / bivalent ; 4 in prophase 1 ; 5 exchange of, genetic material / DNA ; 6 linkage groups broken ; 7 new combination of alleles ; 8 random / independent, assortment of, homologous chromosomes / bivalents (at equator) ; 9 (during) metaphase 1 ; 10 random / independent, assortment (of, sister chromatids / chromosomes) at metaphase 2 ; 11 possible (chromosome) mutation ; *fertilisation:* 12 random mating ; 13 random, fusion / fertilisation, of gametes ;	**8**