Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

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

MARK SCHEME

Maximum Mark: 100

Published

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

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

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

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

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

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.

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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