Cambridge Assessment International Education
Cambridge Pre-U Certificate

BIOLOGY **9790/01**

Paper 1 Structured **May/June 2018**

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 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **22** printed pages.

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.

Question	Answer	Marks
1	**A**	**1**

Question	Answer	Marks
2	**B**	**1**

Question	Answer	Marks
3	**D**	**1**

Question	Answer	Marks
4	**C**	**1**

Question	Answer	Marks
5	**B**	**1**

Question	Answer	Marks
6	**C**	**1**

Question	Answer	Marks
7	**B**	**1**

Question	Answer	Marks
8	**C**	**1**

Question	Answer	Marks
9	**B**	**1**

Question	Answer	Marks
10	**C**	**1**

Question	Answer	Marks
11	**A**	**1**

Question	Answer	Marks
12	**A**	**1**

Question	Answer	Marks
13	**D**	**1**

Question	Answer	Marks
14	**D**	**1**

Question	Answer	Marks
15	**A**	**1**

Question	Answer	Marks
16	**C**	**1**

Question	Answer	Marks
17	**P**	**1**

Question	Answer	Marks
18	**Q**	**1**

Question	Answer	Marks
19	**T**	**1**

Question	Answer	Marks
20	**S**	**1**

Question	Answer	Marks
21(a)	transcription blocking factor **;** **A** repressor (protein) **A** Della (protein) **A** transcription blocker	**1**

Question	Answer	Marks
21(b)(i)	*four from* **1** (general pattern is) increasing elongation with increasing concentration of gibberellin **;** *treat **B** and **F** as neutral* **2** less effect at 30×10^{-3} than at 3×10^{-3} for gibberellin **B ;** AW **3** data / manipulated data, to support, mp1 (two different concentrations for any one gibberellin) / mp2 (values at 30×10^{-3} and 3×10^{-3}) **; I** gibberellin **F** **4** difference between elongation at 0.3×10^{-3} and 3×10^{-3} is greater than between 3×10^{-3} and 30×10^{-3} , for **C**, **D** (**E**) **;** *treat **B** and **F** as neutral* **R** plateaus after 3×10^{-3} **5** greatest elongation is gibberellin **A** at 30×10^{-3} with, 18.3–18.7 mm (any value in range) / **B** at 0.3×10^{-3} and 3×10^{-3} **;** **6** less elongation than with 0 mmol dm^{-3} for gibberellin **F ;** AW **7** ref. to linear effect with gibberellin **A** **I** gibberellin **E** **8** AVP **;** e.g. ref. to similarities between gibberellins at one concentration not maintained at a different concentration ref. to results for gibberellin **F** may be a fluctuation around the same point range of results for elongation greater at 30×10^{-3} than at 3×10^{-3} ORA over the three concentrations, **A** has largest range in elongation	**4**
21(b)(ii)	*any one valid suggestion* seedlings have endogenous gibberellins **;** other, growth factor(s) / plant hormone(s), involved in, growth / elongation **;** growth would be expected to occur in a germinating seedling over 3 days without plant growth hormones **;** gibberellin is not the only, growth promoter / AW **;** AVP **;** e.g. (some) genes involved in plant growth expressed independently	**1**

Question	Answer	Marks
21(c)	male gamete / sperm nucleus / sperm cell, fertilises / fuses with, polar nuclei / diploid nucleus **;** I polar bodies **A** gamete from mitosis of generative pollen nucleus **R** pollen tube / generative pollen / generative, nucleus *plus one of* ref. (formation of) triploid (nucleus) **;** (male gamete from) pollen, grain / tube, and (polar nuclei from) embryo sac **;** part of double fertilisation process **;** vegetative fertilisation **;** primary endosperm <u>cell</u> formed **;**	**2**
22(a)	*three from* **1** mate / breed, with individuals known to be *G. gallus* **;** **2** check if offspring fertile **;** **3** genetic / DNA, sequencing and, compare / analyse **;** **A** genetic / DNA, fingerprinting / profiling / barcoding **A** compare genomes **A** DNA hybridization **4**,**5** ref. to comparing / analysing, non-external phenotypic features characteristic of *G. gallus* **;;** biochemistry internal anatomy physiology amino acid sequences (in proteins) immunological techniques (to compare proteins) **I** external morphology **6**,**7** AVP **;;** ref. to comparing / analysing, behaviour **A** examples ref. to comparing ecological niches further detail on mps 3, 4, 5 *one AVP mark only*	**3**
22(b)(i)	*(parent 1* =) PPrr, *(parent 2* =) ppRR **;** ora	**1**

Question	Answer	Marks
22(b)(ii)	PpRR walnut PPRr walnut ppRr rose pprr single ;; *allow one mark if only two or three are correct* *no marks if only one correct*	**2**

Question	Answer	Marks
22(c)	*four from* **1** chickens, endothermic / generate their own heat (via metabolism) **;** AW **2** (maintenance of constant body temperature by) negative feedback mechanisms **;** **A** relevant examples **3** ref. (relatively large) range in (normal) body temperature despite homeostatic mechanisms **;** **4** represents large surface area (: volume) <u>and</u> ref. heat loss / body cooling **;** **A** loss of comb decreases surface area over which heat is lost ORA **5** no feathers so no insulation **;** AW **6** well vascularised / AW, and body heat lost (more easily) **;** *two features with no / poor explanation = 1 mark* **7** ref. to consequence to poultry owner / chicken **;** (in cold weather) require more food ORA have lower egg production ORA have lower growth rate ORA **8** (in cold weather) removal of comb, to prevent frostbite / avoids problem of blood flow to extremity **;** **I** prevents death **9,10,11** AVP **;;;** e.g. ref. to comb evolved as a sexual attraction and by chance advantageous physiologically ref. to animal welfare suggestion that evolved from ancestral species in hot climates **A** ref. to (high) temperature as a selection pressure **I** adaptation for hot weather suggestion that enzymes optimum temperature in 39.8–43.6 °C range **I** need to maintain constant temperature for optimum enzyme functioning comb is not essential for survival (as can be cut off)	**4**
22(d)	(DNA sequence changed by) addition of, many / AW, nucleotides / bases **;** **A** addition of length of DNA / AW **I** insertion	**1**

Question	Answer	Marks
22(e)	*allow protein for signalling protein throughout* *four from* **1** percentage reduction for *na na* is zero as comparing with, self / *na na* **;** **2** increased quantity of protein, increases inhibition of feather development **;** **or** the greater the inhibition, the lower the quantity of feathers **;** **3** *Na na* / *Na Na* / naked neck chickens, produce more signalling protein than, normal-feathered / *na na* **;** **4** *Na Na* produce more signalling protein than, heterozygotes / *Na na* **;** ORA **A** in terms of greater increase in expression of *BMP* *if mp 3 and 4 not gained allow one mark for effect of, mutation / insertion / Na allele, and expression of, BMP12 / signalling protein* **5** (may be) example of codominance / not an example of dominance and recessiveness **;** **A** incomplete dominance **6** quantitative explanation of codominance from Table 2.2 **;** e.g. codominant because heterozygotes / *Na na,* half the, effect / percentage reduction in feathers, of the homozygote *Na / Na* ORA	**4**

Question	Answer	Marks
22(e)	**7** codominance because heterozygote shows different feather development phenotype to both homozygous genotypes **;** AW *qualitative, evidence for / explanation of, codominance* **8** suggested explanation for range of reductions (for each genotype) **;** e.g. could be due to, male / female differences other factors / environmental variation, play(s) a role ref. differences in moulting **9, 10** valid suggestions for molecular responses **; ;** e.g. consequence of mutation could be, an activator of transcription removal of, repressors / transcription blockers, stimulate action of transcription factors enhance binding of RNA polymerase activate promoter activate enhancer neck cells more sensitive to protein protein specific to, receptors on neck cells / target cells in neck binding of protein sets off a cascade of reactions leading to inhibition of feather development	

Question	Answer		Marks
23(a)(i)	progesterone **;**	progesterone <u>and</u> inhibit **;**	**7**
	steroid **;**	LH / FSH / FSH and LH **;**	
	HPL / human placental lactogen **;** insulin **;**	CG / chorionic gonadotrophin **;**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>23(a)(ii)</td><td>two from
ref. ability to pass through, fatty acid tail / hydrophobic, region / core / AW (of phospholipid bilayer) ;

steroids are, non-polar / lipid- soluble / hydrophobic
or
protein hormones are polar / non-lipid soluble / hydrophilic ; AW

proteins are too large / steroids are small enough, to, pass / diffuse, through ;

AVP ; e.g. suggestion that no (specific) transport proteins are present (for protein hormones)
A require transport proteins</td><td>2</td></tr>
<tr><td>23(b)(i)</td><td>three correct rows ;;;

<table>
<tr><th>name of enzyme</th><th>products formed</th></tr>
<tr><td>(α) amylase</td><td>maltose; A other sugars from starch digestion (glucose / triose / (limit) dextrins)</td></tr>
<tr><td>lipase</td><td>fatty acids and, glycerol / monoglycerides</td></tr>
<tr><td>trypsin
A trypsinogen</td><td>peptides ; I amino acids</td></tr>
<tr><td>chymotrypsin
A chymotrypsinogen</td><td>peptides ; I amino acids</td></tr>
</table>

allow one mark for all correct enzymes if product column, all incorrect / blank

A endopeptidase producing peptides only if trypsin / chymotrypsin not named as an example
A exopeptidase dipeptides / amino acids ;
I protease / peptidase

allow other correct examples e.g.
nuclease nucleotides ;</td><td>3</td></tr>
</table>

Question	Answer	Marks
23(b)(ii)	releases bile / bile arrives in duodenum **;** **A** bile salts *any one use of bile in digestion e.g.* *(bile salts),* emulsify lipids / increase surface area (of lipid) for digestion (by lipase) **;** *(potassium / sodium, hydrogen carbonate)* neutralisation of / protects against damage by, acid, (for enzyme action) **;** provides correct pH for intestinal enzymes **;**	**2**

Question	Answer	Marks
24(a)(i)	**A** CH_30 for CH_2OH **I** numbers on carbons hexose ring with oxygen shown and CH_2OH group in correct position **;** positions of all other, hydroxyl / OH groups correct **;** (C1 to C4)	**2**
24(a)(ii)	*four from* **1** (β) 1–4 (glycosidic) bond / (glycosidic) bond between carbon 1 and carbon 4 **;** **R** if also 1–6 between molecules but **I** ref. to bonds between layers **2** adjacent (β-glucose), residues / monomers, at 180° / inverted **;** AW **A** β-glucose molecules **3** ref. arrangement means that resulting polysaccharide, is a straight chain / is not coiled / not helical **;** **A** linear **R** branched **4** allows cellulose molecules to lie parallel to each other **;** AW **5** hydrogen bonds form between molecules / cross-linking by H bonds **;** **6** many H bonds give strength **or** microfibrils / fibres / many linked chains, high tensile strength **;** **R** strong hydrogen bonds **7** AVP **;** e.g. ref. intramolecular H-bonds ref. to insoluble ref. resistance to (acid / enzyme) hydrolysis	**4**

Question	Answer	Marks
24(b)	*five from* **1** hydrogen ions / H^+ / protons, pumped / AW, out of companion cell **;** **2** into, cell wall / apoplast **;** **3** ATP, hydrolysed / used **; A** active transport **4** proton gradient builds up (in, cell wall / apoplast)**;** AW *mps 1–4 in context of between companion cell and, mesophyll / source, cell* **5** sucrose co-transported with hydrogen ions, into companion cell **;** **A** ref. to secondary active transport or symport, with hydrogen ions **A** describe via, cotransport(er) / symport, protein **6** ref. hydrogen ion movement in cotransport by facilitated diffusion **;** **7** sucrose moved in cotransport against the concentration gradient **;** **8** (sucrose) enters (phloem) sieve tube by (simple) diffusion **;** AW **R** facilitated diffusion **9** via, plasmodesmata / cytoplasmic connections **;**	**5**

Question	Answer	Marks
24(c)	*movement to max four* **1** movement down water potential gradient **;** *in context of overall movement* **A** ref. to (hydrostatic) pressure gradients **2** correct use of terms to describe the <u>two</u> main pathways of water movement in leaf from xylem to mesophyll **;** e.g. apoplast / apoplastic, <u>and</u>, symplast / symplastic **I** list of pathways with no extra qualification *apoplast and symplast statements must be in context of <u>separate</u> pathways apoplast pathway is* **3** cell wall to cell wall / AW **;** **A** through cell walls *in correct context* **4** (and), intercellular spaces / spaces between cells *allow extracellular space if mp3 and 4 not gained* *symplast pathway is* **5** movement through cytoplasm **;** **A** cytosol **6** via vacuoles / vacuolar pathway **;** **7** via plasmodesmata / cytoplasmic connections (between adjacent cells) **;** **8** across, cell surface membrane (of first cell) / tonoplast **;** AW **9** by osmosis **;** *in context of through membranes*	**5**

Question	Answer	Marks
24(c)	*properties water to max 4* **10** polar molecules **;** **A** dipolar **11** hydrogen bonding between molecules **;** **12** cohesion (between water molecules) / water is cohesive **;** **13** adhesion to, cellulose / cell walls **;** *in context of mesophyll cells* **R** if only in, roots / xylem *allow 1 mark for cohesion and adhesion if no explanations given* **14** evaporation / water to water vapour **;** **I** high latent heat of vapourisation *in context of from surfaces of mesophyll cells* **R** evaporation, from leaf surfaces / through stomata	

Question	Answer	Marks
25(a)	5 (μm) **;;** *one mark if not to nearest whole number but calculation correct* *one mark if measurement and formula correct but incorrect conversion used*	**2**
25(b)(i)	Prokaryotae **;** **A** Prokaryote **A** Monera **I** bacteria	**1**

Question	Answer	Marks
25(b)(ii)	*four from* **1** large number of different organisms / AW **;** **2** highlights, key features within a group / differences between groups **;** **A** ref. to putting into groups based on key features **3** ref. evolutionary relationships **;** e.g. relationships to other organisms / similarities by descent / look for evolutionary patterns / phylogenetic classification **4** easier to study / less time-consuming, qualified **;** e.g. ref. to classifying newly discovered species **5** allows, universal / global, conformity **;** AW **A** better communication between taxonomists / AW **A** examples e.g. use of Latin for naming species **6** important for, quantifying / measuring / assessing, biodiversity **;** **7** ref. to conservation efforts e.g. where to focus, efforts / funds **;** *important for conservation and biodiversity = 1 mark* AVP **;;;** ref. to utilitarian methods of classification / classification based on usefulness to people **A** examples e.g. useful in, animal / plant, breeding useful in planning drug treatment for diseases ref. human nature e.g. humans like to put things into groups makes better sense of the world learning by association desire to extend knowledge idea of hierarchical ordering useful for making predictions of, behaviour / morphology / physiology, for newly discovered species	**4**

Question	Answer	Marks
25(c)	*max 1 if all diagrams drawn show stages of mitosis* *five from* *suitable sequence of diagrams covering mps 1–10 (some mps may not require labels and annotations if clear on diagram)* **1** cell, size / volume / length, increase **;** **2** plasmid replication **;** **3** increase in number / synthesis, of ribosomes **;** *must label and annotate* **4** semi-conservative (DNA) replication **; A** two new DNA molecules drawn, each containing one original strand and one newly synthesised strand e.g. use of dotted and continuous lines **A** description involving template strands, resulting in DNA molecules with one original and one newly synthesised strand **5** separation of replicated DNA molecule by, use of enzymes to separate point of attachment of two molecules / attachment points on membrane moving apart **;** **6** septum forms **;** **7** cell wall forming or murein / peptidoglycan, laid down between newly forming cells **;** **8** cell membrane forms between newly forming cells **;** **9** cytoplasmic division followed by cells separating **;** **10** AVP **;** e.g. plasmid replication independent of nuclear zone replication / AW membrane invaginates additional detail of DNA replication e.g. ref. origin of replication / replication origin bidirectional DNA replication replication forks	**5**

Question	Answer	Marks
25(d)	*assume reference to mitosis unless told otherwise* *any three from* **1** spindle, qualified **;** e.g. formation / organisation of spindle fibres / microtubule assembly orientation of chromosomes at, spindle equator / metaphase plate chromosomes / centromeres, attached to, spindle fibres / (spindle) microtubules / kinetochore **2** sister chromatids / daughter chromosomes, separated **;** **3** nuclear envelope, disassembly / reassembly **; A** nucleolus / nucleoli, disappear(s) / AW **4** formation of cell wall begins with cell plate **; A** phragmoplast forms **5** cellulose laid down **;** **6** role of Golgi vesicles in bringing cellulose **;** **7** cells stay joined together by middle lamella **;** **8** DNA replication has already occurred (in, S phase / interphase) **;** **9** DNA, condensing / decondensing **;** AW **10** replication of organelles has already occurred **;** **11** cytokinesis without, cell membrane invagination / AW **;** **12** AVP **;** e.g. ref. to control of cell cycle e.g. extracellular growth factors / cell signalling pathways) ref. to sharing of, mitochondria / other named organelle, between daughter cells during cytokinesis	**3**

Question	Answer	Marks
25(e)	passive natural / natural passive **;** active artificial / artificial active **;** passive artificial / artificial passive **;** *if no marks gained, allow one mark for passive, active, passive* ***or** natural, artificial, artificial*	**3**

Question	Answer	Marks
26(a)		**3**

region of sarcomere	change occurring during muscle contraction		
	increases	decreases	stays the same
1		✓	
2			✓
3		✓	
4	✓		
5			✓

*mark by row – all correct **;;;** 4 rows = **;;** 3 or 2 = **;** 1 = 0*

Question	Answer	Marks
26(b)	*check diagrams and equations* **1** glycolyis (anaerobic / aerobic, conditions) generates (net) 2 ATPs **;** *respiration in anaerobic conditions* **2** pyruvate to lactate **/** $CH_3COCOOH \longrightarrow CH_3CHOHCOOH$ **;** **3** pyruvate accepts, hydrogen / hydrogen atoms, from, reduced NAD / NADH **;** **A** NADH, (re) oxidised / regenerated (for use in glycolysis) **4** (enzyme) lactate dehydrogenase **;** *less energy released in anaerobic conditions because no* **5** Krebs cycle and, (additional), ATP production / substrate level phosphorylation **;** **A** GTP **6** oxidative phosphorylation **; A** chemiosmosis / electron transport chain *in context of generating additional ATP* **7** link reaction / Krebs cycle, to produce, NADH / reduced coenzyme (for oxidative phosphorylation) **;** **A** FADH for Krebs cycle	**4**
26(c)	*two from* narrowed lumen of coronary arteries **;** (owing to) atheroma / atherosclerosis / atheromatous plaque **;** ref. thrombus / clots (associated with atheroma) **;** reduced blood flow **;** *in context of coronary blood supply* **A** reduces the number of erythrocytes that can pass through **I** less blood reaches heart unless qualified with ref. to coronary blood supply	**2**