Cambridge Assessment International Education
Cambridge Pre-U Certificate

BIOLOGY **9790/04**

Paper 4 Practical **May/June 2019**

MARK SCHEME

Maximum Mark: 80

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.

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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.

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.

Notes:
The following abbreviations may be used in mark schemes:

;	separates marking points
/	alternative and acceptable answers for the same marking point
allow / accept / **A**	answers that can be accepted
not / reject / **R**	answers that are not worthy of credit
ignore / **I**	statements that are irrelevant – applies to neutral answers
AW / owtte	credit alternative wording / or words to that effect
ecf	error carried forward
(words)	bracketed words that are not essential to gain credit
<u>words</u>	underlined words must be present in answer to gain credit
max	indicates the maximum number of marks that can be given
ORA	or reverse argument
AVP	any valid point – marking points not listed on the mark scheme but which are worthy of credit

Question	Answer	Marks	Guidance
1(a)	*Drawing* **1** two lines to indicate cell wall **;** **2** plasmolysis shown clearly **;** *labels to max 3* **3** cell wall **;** **4** cell (surface / plasma) membrane / edge of cytoplasm **;** **5** cytoplasm / protoplast / protoplasm / cytosol **;** **6** nucleus / nucleolus **;** **7** plasmodesmata **;** *annotations to max 3 - accept as a paragraph below drawing* **8** cells, are plasmolysed / described / less turgid / flaccid / ora **;** **9** cells are smaller *or* less volume of, cytoplasm / vacuole **;** **10** space, inside cell wall / filled with potassium nitrate solution **;** **11** strands of cytoplasm **;** **12** intensity of pigment in the two cells described **;** **13** AVP **;** e.g. fragmentation of protoplasm / 'collapse' of cell wall	**max 6**	*ignore drawing and labelling of slide B* width of cell wall is approximately the same all the way around the cell **MP4 R** if two lines for membrane **MP6 R** if outside cytoplasm **R** incipient plasmolysis
1(b)	**1** gaps between cell membrane and cell wall disappear **;** **2** volume of, protoplasm / cytoplasm / vacuole / cell contents, increases **;** **3** not all cells show deplasmolysis **;** *max 3 for explanation* **4** water enters cells, by osmosis / down a water potential gradient **;** **5** (epidermal) cells have a lower water potential than, bathing solution / distilled water **;** **6** movement of water through tonoplast into vacuole **;** **7** ref to partially permeable membranes **;** **8** AVP **;**	**max 5**	**MP1 A** recovery from plasmolysis / less plasmolysed, **A** cells become turgid **MP5 R** concentration gradient **MP8** e.g. appropriate ref to pressure potential / solute potential

Question	Answer	Marks	Guidance
1(c)	**1** range of at least five concentrations including 0 and 1.0 mol dm^{-3} **;** **2** concentration of mannitol calculated correctly **; A** % **3** proportional dilution used **;** **4** dilution table has suitable headings with units **;** concentration of mannitol / mol dm^{-3} volumes of water and stock solution / cm^3	**4**	**R** if units in body of the table
1(d)	**1** data recorded as a single table with proper alignment of cells **;** **A** second table for processing data / summary of results **2** informative headings with correct units in headings **;** e.g. concentration of mannitol / mol dm^{-3} and mass (of potato) / g **3** initial and final and change in mass **;** **4** all masses to at least one decimal place **and** used consistently **;** **5** percentage changes calculated and expressed to same sig figs with + and – signs **;** **6** results show expected trend **;** *increase in mass at low concentration to decrease in mass at high concentration of mannitol* **7** repeat results recorded and mean percentages calculated **;**	**7**	**A** weight for mass minimum is line beneath headings *if change in length, accept ECF for MP 5, 6 and 7* **A** one anomaly **A** mean masses shown if percentages not calculated

Question	Answer	Marks	Guidance
1(e)	**A** ECF from table of results axes with correct titles and units to match data in table of results **;** axes scaled with ascending linear scales using at least half the space available for plotted points **;** *y*-axis shows positive and negative changes **;** points plotted accurately ±½ small square **;** points joined clearly with smooth line of best fit or straight lines **;**	**5**	**A** M for mol dm^{-3} **R** extrapolation

Question	Answer	Marks	Guidance
1(f)	**1** suitable method for mixing solutions **;** **2** ref to an appropriate technique for using syringes **;** **3** cylinders trimmed to remove 'skin' **;** **4** method for trimming cylinders so all the same length **;** **5** both ends of cylinders, trimmed at 90^{o} / cut vertically / cut so not slanted **;** **6** cylinders dried with paper towel before they are weighed **;** **7** standardised method for drying potato pieces described **;** **8** clean weigh boats / wipe balance / tare balance, between weighings **;** **9** waiting for balance to settle before taking readings **;** **10** potato pieces weighed twice to ensure no variability in weighing **;** **11** method for standardising immersion time described **;** **12** minimum of two test-tubes at each concentration (for repeatability) **;** **13** AVP **;** **14** AVP **;** e.g. prepare more cylinders than needed and choose best cover cylinders between weighing and immersion prepare more of solution to decrease percentage error in syringes method to cover each cylinder with solution - 'total immersion'	**max 4**	ref to precision / air bubbles / contamination **ignore** 'use the same balance' / 'wash in water first' **A** staggered start if described **ignore** two cylinders per tube

Question	Answer	Marks	Guidance
1(g)	*water potential of potato tissue estimated by interpolation at 0%* concentration of mannitol at, zero percentage change / zero mass change, taken correctly from graph **;** at 0% / no change in mass **;** *idea that* no net movement of water between potato and mannitol solution **;**	**3**	
1(h)(i)	answer for water potential calculated correctly from figure given in (g) **;** negative sign and unit **;**	**2**	(g) × –3510 = …kPa
1(h)(ii)	correct comparison between own value and reported values **;** any relevant ref. to either study or both studies **;** any suitable suggestion for any difference **;** temperature not at 20°C (so conversion of concentrations to water potential are inaccurate) **;**	**2**	e.g. different techniques different types of potatoes different time of the year different storage potato tissue has lower (more negative) solute potential

Question	Answer	Marks	Guidance
1(i)(i)	**1** difficult to cut cylinders to exactly 50 mm **;** **2** ref to uncertainty when measuring with a ruler **;** **3** stated error using the balance **;** **4** cylinders exposed to air for varying lengths of time **;** **5** cylinders may have come from different (types / species of) potatoes **;** **6** tissues in cylinders may vary **;** **7** different regions of same potato may have different water potentials **;** **8** any error from having two cylinders in the same test-tube **;** **9** not all of the potato immersed in solution **;** **10** concentration of mannitol solutions changes during 15 minutes **;** **11** variation in blotting **;** **12** AVP **;** **13** AVP **;** e.g. potatoes may not have been stored prior to investigation in, similar conditions / for different lengths of time potatoes may have been, damaged / bruised cutting through different numbers of cells difficult to use syringes to deliver known volume variation in initial mass not enough repeats to identify anomalous results	**max 5**	**MP3** 'air movement' /'bench shake' **R** ref to 'precision of balance'

Question	Answer	Marks	Guidance
1(i)(ii)	*any suitable improvements that are not simply the reverse of errors, e.g.* **1** carry out a pilot investigation (to perfect procedure) **;** **2** use, calipers / a rule, to measure the potato cylinders / AW **;** **3** repeat and calculate mean **;** **4** repeat with solutions either side of zero change in mass **;** **5** use a stated way to ensure cylinders are fully immersed **;** **6** leave cylinders in solutions, for longer time / until no change in final mass **;** **7** use longer cylinders **;** **8** use, same potato / same variety of potato / potato stored for same length of time / AW **;** **9** AVP **;** **10** AVP **;** e.g. use constant humidity when weighing use graduated pipette / burette use larger volume to reduce percentage error use gloves for handling potato cylinders (not forceps) calculate percentage change (if not done - see table of results) use weighing boat(s) repeat at standardised temperature	**max 2**	**MP2 R** ruler **A** use a cutting machine / chip cutter **MP3 R** if in same, test-tube / beaker **MP4 ignore** 'more intermediates across the range'

Question	Answer	Marks	Guidance
2(a)(i)	*drawing to max 3* **1** drawing fills at least half the space available **;** length of drawing is at least 100 mm **2** correct shape of the outline of the section with appropriate detail **;** i.e. two lines around ovary to show germinal epithelium, one large circle with detail and at least two small circles **3** outlines drawn clearly with thin lines and without feathering and without shading or stippling **;** *correct labels to max 5* **4** germinal epithelium **;** **5** primary follicle **;** **R** if more than one circle inside **6** Graafian follicle **;** **A** one large space inside / several small spaces **7** stroma / cortex / medulla **;** **8** blood vessel / vein / artery **;** **ignore** capillary **9** (internal / external) theca **;** **10** secondary follicle **;** **11** secondary oocyte **;** **12** zona pellucida **;** **13** corona radiata / cumulus oophorus **;** **14** antrum / fluid filled space **;** **15** granulosa / follicle, cells **;** **16** corpus luteum **;** **17** tunica albuginea **;** (inside germinal epithelium) **18** oolemma **;**	**max 7**	*drawing can be half of the specimen or a sector* **R** ruled outline, perfect circles

Question	Answer	Marks	Guidance
2(a)(ii)	**1** haploid, nucleus / oocyte, for fertilisation / holds DNA / AW **;** **2** (much) cytoplasm for, energy / materials, for embryo growth / AW **;** **3** (secondary oocyte) divides by meiosis II / forms ovum **;** **4** theca cells / follicle cells, produce, steroids / oestrogen / progesterone **;** **A** production of follicular fluid **5** (antrum) develops pressure for release of oocyte at ovulation **;** **A** 'fills with fluid to force oocyte out' **6** zona pellucida is, barrier to sperm / AW **;** **7** AVP **;** **8** AVP **;** e.g. oocyte releases chemoattractants e.g. binding (glyco)proteins in zona pellucida e.g. corona radiata provides nutrients	**max 4**	
2(a)(iii)	measurement of drawing on **L1** shown clearly in mm **;** measurement of section shown in mm / μm **;** correct magnification within acceptable range **;**	**3**	 ×15 – ×80 **A** ECF

Question	Answer	Marks	Guidance
2(b)	*labels on Fig. 2.1* **1** granulosa / follicle, cells **;** **2** primary oocyte (pink and green areas) **;** **3** cytoplasm / ooplasm **;** **4** nucleus / nuclear membrane (of oocyte or follicle cells) **;** **5** nucleolus / nucleoli (of oocyte or follicle cells) **;** **6** heterochromatin / euchromatin / chromatin **;** **7** mitochondrion / mitochondria (follicle cells only) **;** **8** (rough / smooth) endoplasmic reticulum **;** **9** vesicle / vacuole **;** **10** (lipid / glycogen) droplet(s) / granule(s) **;** **11** AVP **;** e.g. cell (surface) membrane / oolemma e.g. glycogen granules	**max 5**	

Question	Answer	Marks	Guidance
3(a)	**A** **G** **C** **H** **J** **K** **B** **F** **D** **E**	**Max 5**	*all 10 correct = 5 marks* *9 or 8 correct = 4 marks* *6 or 7 correct = 3 marks* *4 or 5 correct = 2 marks* *2 or 3 correct = 1 mark*
3(b)(i)	*example of a null hypothesis* there is no correlation between altitude and the percentage of people with malaria **;**	**1**	*minimum acceptable answer* *there is no relationship between the altitude and percentage* **R** 'difference between altitude and percentage' (as per chi-squared test)

Question	Answer	Marks	Guidance
3(b)(ii)	*see next page for calculation* two variables (altitude and percentage) ranked consistently **and** correctly **;** e.g. highest in each case is 1 calculation of differences between rankings is correct **;** correct calculation of $\sum D^2$ **;** correct substitution of numbers into formula **;** e.g. $r_s = 1 - 1.96853$(5 dp) $r_s = -0.969$ (3 dp) **;**	**5**	**MP5** check for minus sign
3(b)(iii)	**ECF** from 3 (b)(ii) **1** *either* critical value for $p = 0.05\% = 0.587$ *or* critical value for $p = 0.01\% = 0.727$ **;** **2** value for r_s is > than critical value **;** **3** null hypothesis is rejected / accept the alternative hypothesis **;** **4** there is a <u>significant correlation</u> between altitude and percentage of people with malaria **;** **ora** only 5% probability that correlation is due chance **5** there is a negative correlation (between altitude and percentage of people with malaria) **;** **A** described but must match value of r_s **6** there is a strong correlation **;**	**max 5**	**A** significant relationship / AW **A** a description of the relationship, i.e. as altitude increases people infected with *Plasmodium* decreases **MP6 A** 'very high correlation'

Question	Answer	Marks	Guidance

altitude / m	Rank (1)	percentage malaria	Rank (2)	$D = 1 - 2$	D^2
1845	1	0	11.5	–10.5	110.25
1279	5	17	7.5	–2.5	6.25
1425	4	17	7.5	–3.5	12.25
1523	3	4	10	–7	49
662	9	25	4	5	25
1685	2	0	11.5	–9.5	90.25
432	10	34	3	7	49
196	12	61	1	11	121
416	11	55	2	9	81
1176	7	19	6	1	1
1049	8	22	5	3	9
1216	6	12	9	–3	9
				$\sum D^2 =$	563
				$\sum D^2 \times 6$	3378
				n^3	1728
				$n^3 - n$	1716
					1.968531469
				$r_s =$	–0.968531469