Cambridge Assessment International Education
Cambridge Pre-U Certificate

BIOLOGY **9790/04**

Paper 4 Practical **May/June 2018**

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.

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.

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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.

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
1(a)	appropriate descriptions of colours ; one colour difference over test-tubes 1 to 3 ; two colour differences over test-tubes 1 to 3 ; similar description for 4 and 5, e.g. yellow ; clear / colourless / transparent / slightly cloudy, for test-tube 6 ;	**max 4**
1(b)	**1** no reaction without the enzyme (in the time span) / ref to no non-enzymic reaction (4) ; **2** no reaction if denatured enzyme is used / explanation using active site (5) ; **3** substrate is required for reaction to occur (6) ; **4** banana extract contains, no / very little, substrate / L-dopa (6) ; **5** the <u>optimum pH</u> (of those used) is, pH 7 / pH 5 (3 or 2) ; **6** actual optimum pH is, between / above / below, pH values used ; **7** change in tertiary structure of enzyme with pH ; **8** effect on hydrogen, and / or, ionic bonding ; **9** further detail of bonding / ref to R groups ; **10** AVP ; e.g. any ref to, limited time span (5 minutes) / changes after 5 minutes	**max 5**

Question	Answer	Marks
1(c)	ref to range of pH values (3–7) ; use buffer solutions of pH > 7 ; find out if dopa oxidase is active in alkaline conditions / AW ; ref to wide intervals in pH range (3–5 and 5–7) ; use buffer solutions at intermediate pH values ; identification of optimum pH / improved precision ; qualitative results / results are subjective / take quantitative results if no further qualification given about how to do this ; use, an arbitrary scale / colour comparators / colorimeter / measure the mass of precipitate ; determine the, rate of reaction / quantity of product (dopachrome) ; recording result at one time point only (for each test-tube) ; take results at, intermediate times / more times ; determine the initial rate of reaction / find a standard end point ; reaction might have reached end point within 5 minutes ; take results, within the first minute / every 10 seconds ; record initial rate before substrate concentration decreases ; no controls for pH 3 and pH 5 ; use water instead of dopa oxidase ; find out if any non-enzymic reaction at pH lower than 5 ; AVP ;;	**max 3**

Question	Answer	Marks
1(d)	**1** data recorded in a tabular form **;** **2** concentration of L-dopa shown in table **;** **3** actual concentration = 2/5 provided (2, 4, 8, 12, 16, 20) **; A** half provided (2.5, 5, 10, 15, 20, 25) **4** informative column headings with correct units e.g. *concentration of L-dopa / mmol d* $^{-3}$*, time / s* **;** **5** results recorded in seconds **;** **6** results for change in concentration in both **P** and **X** agree with expected trend **;** **7** results for substance **X** agree with expected trend **;**	**max 5**
	8 rates of reaction calculated correctly **;** **9** rates shown to consistent number of, decimal places / significant figures **;** **10** column(s) headed with the unit s^{-1} **;**	**3**
1(e)	axes with correct titles and units **;** concentration of L-dopa / mmol dm^{-3} rate of reaction / s^{-1} axis / axes, scaled with ascending linear scale so plots cover at least half the grid **;** points plotted accurately **;** points joined, clearly / neatly, by straight lines **;** lines labelled / key given, e.g. with and without **X** **;**	**5**
1(f)	**1** increasing concentration of L-dopa increases the rate **;** **2** further description of trend **;** **3** substrate concentration is limiting (factor) **;** *as concentration of L-dopa increases* **4** increase in (successful) collisions between, substrate / L-dopa, and, enzyme / dopa oxidase **;** **5** more enzyme-substrate complexes (per unit time) **;** **6** at high L-dopa concentrations, substrate concentration becomes less of a limiting factor / another factor becomes limiting **;** **7** all active sites are filled continuously above a certain L-dopa concentration **;** **8** comparative data quote <u>with both units used at least once</u> **;** **9** AVP **;** e.g. correct ref to V_{max}	**max 4**

Question	Answer	Marks
1(g)	**1** (initial) rate increases with and without, X / inhibitor **;** **2** rate of reaction is lower with, X / inhibitor **;** **3** comparative data quote to illustrate effect of X **;** **4** *idea that* need to use higher concentrations of L-dopa / substrate to see if it is a competitive inhibitor **;** *if X is a competitive inhibitor* **5** X combines (temporarily) with <u>active site</u> **;** **6** at high concentrations L-dopa competes successfully with X / V_{max} is *or* becomes the same as without X **;** **7** comment on results for X vs expected if it is a competitive inhibitor / K_m is higher *or* different than without X **;** **8** ref to possibility that X is a non-competitive inhibitor **;** **9** AVP **;**	**max 5**
1(h)	**1** use smallest syringe appropriate for volume dispensed **;** **2** label, syringes / test-tubes **;** **3** wash out syringes between use / use fresh syringes **;** **4** use same syringe for L-dopa solutions of different concentrations without washing **;** **5** wipe stirring rod / wipe syringe(s) (on outside to remove water) **;** **6** stir the, enzyme / L-dopa / X, solution before using **;** **7** use indicator paper to check pH **;** **8** use indicator paper with colour chart **;** **9** use a white background to make comparisons **;** **10** keep the stopwatch running / AW, and use a staggered start **11** not rinsing syringe between adding increasing concentrations of L-dopa **;** **12** ref to monitoring temperature **;** **13** use a beaker of water as a water bath **;** **14** AVP **;**	**max 5**

Question	Answer		Marks
1(i)	**Discuss the limitations of the investigation in Part 2 and the ways in which the procedure could be changed to improve the quality of results**		**max 6**
	repeatability	**1** no, pilot / trial, experiment to practise determining the end point **;**	
		2 only one result for each concentration so, repeat whole investigation at least twice and calculate, means / standard deviation **;**	
		3 difficult to identify anomalous result(s) if not repeated, at least twice / to give 3 results **;**	
	independent variable – L-dopa	**4** not enough intermediate concentrations of, L-dopa / substrate, to be confident about showing trend on graph / comparing trends for X and P **;**	
		5 use higher concentration of, L-dopa / substrate, to find out if **X** is competitive or not **;**	
	independent variable – X	**6** use lower concentration of X to find if **X** is competitive or not (reaches plateau at lower concentration of L-dopa) **;**	
	dependent variable	**7** *idea that* end point is, difficult to determine / subjective, so timings are, under / over, estimates **;**	
		8 colour of the comparator (tube **C**) may change / put tube **C** into an ice bath / take a photo of tube **C** at 2 minutes / make a new tube **C** for tubes with **X** / take a video of each tube **;**	
		9 results are not a measure of the initial rate of the reaction / rate changes during the time taken to reach end point **;**	
		10 *either* use a colorimeter to determine rate of change in, absorbance / transmission **;** *or* use a colorimeter to determine when a particular absorbance is reached **;** **A** any method to quantify precipitate, e.g. filter / spin in a centrifuge, and measure	
	other variables	**11** temperature not controlled (if no water bath used in (h)) / use a thermostatically-controlled water bath **;**	
		12 syringes are not very precise / large percentage error / use micropipette / use graduated pipette / use a mechanical pipette / use a burette **;** **A** use a syringe with more, calibrations / finer scale **;**	
		13 pH papers not a very accurate way to measure pH / use a pH meter **;**	
		14 Part A showed that optimum pH was, at / near, pH 7 so use buffer at this pH **;**	

Question	Answer	Marks
2(a)	*drawing(s) to max 5* • drawing(s) life size or larger ; • clear outlines without feathery lines ; • different shapes of petals and sepals ; • the three petals (inner whorl) have pointed tips / the sepals are wider than the petals ; • patterning on at least one petal ; • a separate stamen ; • a separate carpel showing style and stigma ; *labels and annotations to max 5* • sepals and / or petals, brightly coloured ; • sepals / petals, landing site / platform ; • honey guides, labelled or described ; • stamens / AW, and, carpels / AW, inside the petals ; • *either* stamens longer than, style / stigma / carpel *or* pollen easily brushed off stamen / brushed onto stigma ; • loosely attached anthers ; • ref to, nectar / nectary ; • ref to, odour / scent ; • strong, pedicel / stem ; • ref to function of protective cap over anthers ;	**max 9**
	suitable scales shown on all drawings (max 3 drawings) ; **A** magnification	**1**

Question	Answer	Marks

Question	Answer	Marks
2(b)	**1** study the flower under UV light **;** **A** different light wavelengths **2** to see how the flower(s) appear to pollinating insects **;** **3** investigate the importance of scent, e.g. by disguising scent from the flowers **;** **4** change the appearance of the, flowers / sepals and / or petals **;** **5** study flower for, nectaries / secretions from base of petals **;** **6** video / camera, to monitor visiting insects **;** **7** identify the types of insects that visit the flowers **;** **8** mark-release-recapture to see how many times a pollinator visits a flower **;** **9** use of non-toxic / safe, marker **;** **10** to track, pollinator / pollen **;** **11** study pollen loads of bees to see what proportion of visits are made to *Alstroemeria* flowers **;** **12** look at flowers of different ages to see if anthers and stigma are ripe at the same time or at different times **;** **13** study pollen structure with (light / scanning electron) microscope **;** **14** measure of length of time between appearance of flowers and fertilisation **;** **A** time from flower appearance to pollination **15** ref to, self-pollination / cross-pollination **;** **16** use of secondary source(s) / described **;** **17** AVP **;** **18** AVP **;** **19** AVP **;**	**max 5**

Question	Answer	Marks
2(c)	*drawing* low power plan with no cell detail (ignore pollen grains) **;** drawing shows at least one pollen sac **;** lines used to indicate the epidermis and tapetum (2 lines each) **;** additional line(s) to show middle layer(s) **;** tapetum is drawn wider than epidermis **;** *labels* epidermis **;** pollen sac **;** region where pollen grains develop / pollen grains **;** tapetum / nutritive layer / columnar cells **;**	**max 6**
	suitable scale shown on drawing **;** **A** magnification	**1**
2(d)(i)	**1** meiosis 1 **;** **A** 1 after each stage **2** **A** prophase, **B** metaphase, **C** anaphase **;** **3** **A** – condensed chromosome(s) and, nuclear membrane / nucleus **;** **4** **A** – pairing of homologous chromosomes **;** **A** ref to bivalent(s) / synapsis **5** **A** – crossing over **;** **6** **B**/**C** – no nuclear, membrane / envelope **;** **7** **B** – arrangement of (homologous) chromosomes on, equator(ial plate) / AW **;** **8** **B**/**C** – ref to spindle **;** **9** **C** – (homologous) chromosomes move to opposite poles **;**	**max 6**

Question	Answer	Marks
2(d)(ii)	*Photo A* **1** crossing over **; R** if in metaphase **2** between non-sister chromatids **; A** maternal and paternal **3** exchange between homologous chromosomes **;** **4** gives different combinations of, allelic pairs / AW **;** *Photo B* **5** independent / random, assortment **;** **6** (during metaphase) when homologous chromosomes arrange themselves on the, equatorial / metaphase, plate **;** **7** ref to, anchoring / movement, by spindle fibres **;** **8** gives different combinations of maternal and paternal chromosomes **;** *Photo C* **9** segregation of allelic pairs / AW **;** **10** (during anaphase) when chromosome, separate / move to poles **;** **11** gives different combinations of alleles at fertilisation / allows recessive alleles to be expressed **;** **12** ref to chromosome mutation **;** **13** AVP **;** e.g. ref to chiasma(ta)	**max 7**