Cambridge International Examinations
Cambridge Pre-U Certificate

BIOLOGY **9790/04**

Paper 4 Practical **May/June 2017**

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.

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

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)	*MMO collection of data* (dark) brown, greater than (or equal to) 20(.0) g dm^{-3} **;**	**1**
1(b)	*any three from* *ADC interpretation* (test strips contain immobilised) glucose oxidase / peroxidase **;** (glucose oxidase catalyses) oxidation of glucose / glucose to gluconic acid / glucose to hydrogen peroxide **;** (peroxidase catalyses) reaction between hydrogen peroxide and, dye / chemical (in the pad to give a colour change) **;** degree of colour change indicates the concentration of glucose / AW **;** details of the chemistry of the colour change **;**	**Max 3**
1(c)	*MMO collection of data* ≤ 60 s(econds) **; R** decimal places	**1**
1(d)	*MMO decision making* preparation of a suitable <u>range</u> of glucose concentrations shown in a dilution table **using** 10 g dm^{-3} and 100 g dm^{-3} solution **;** suitable <u>number</u> of different concentrations (minimum of 4 different dilutions) **; ignore** 0 g dm^{-3} and 100 g dm^{-3} total volume of each glucose solution is ≥ 5 cm^3 **;** dilution table has suitable headings with units **;** concentration (of glucose) in, g dm^{-3} / g 100 dm^{-3} / % volumes of water and glucose solution in cm^3 **R** if wrong concentrations given	**4**
1(e)	*any five from* *PDO recording data* data recorded as a single table **;** concentration of glucose in left hand column **; R** if units in body of column 1 0, 10 and 100 g dm^{-3} included informative column headings, correct units in column headings **;** e.g. concentration <u>of glucose</u> / g dm^{-3} time taken to reach end point (with Benedict's solution) / s concentration of glucose with <u>Diastix®</u> / g dm^{-3} *MMO successful collection of data and observations* results with Benedict's show increasing time with decreasing concentration **;** at least one Diastix® result expressed as a range **; A** ≥ 20 replicates recorded (for either test) **;** mean times calculated and shown consistently to max 1 dp **;**	**Max 5**

Question	Answer	Marks
1(f)	*PDO graph and charts* *x*-axis = concentration of glucose, *y*-axis = time taken (to reach end point)**;** axis / axes, scaled with ascending scales starting at 0 g dm^{-3} using at least half the space available for plotted points **;** axes with correct titles and units **; R** Diastix® data e.g. concentration of glucose / g dm^{-3} and time taken / s points plotted accurately ± ½ small square **;** points joined clearly with straight lines or smooth line of best fit **;**	**5**
1(g)	*ADC pattern* time taken decreases as concentration increases *or the reverse* **;** relationship described **;** e.g. linear / not linear / peak / constant **ignore** proportional use of any manipulated figures **;** e.g. gradient	**3**
1(h)	*Diastix®* *ADC interpretation* (colour and) concentration = 2.5 g dm^{-3} or less **;** range of concentrations given / repeats used **;** *Benedict's solution* *MMO collection of data* time is in range 10 – 60 s / concentration read correctly from graph within this range **;**	**3**
1(i)	*ADC conclusions* use of intercept on graph described **;** **A** ref to extrapolation time from (h) used correctly to derive concentration **;** t*ake from (h) if not stated in (i)*	**2**
1(j)	colour of Diastix® or time recorded for end point **;** *colour / time must match the concentration* concentration with Diastix® greater than in (h) but ≤ 10 g dm^{-3} **;** concentration with Benedict's solution **;** *time is lower than result in (h)* *concentration is greater than result in (h)* *idea that* content indicated by Benedict's solution includes *both* reducing sugar and non-reducing sugar (unless result for (h) is subtracted from results for (j)) **;**	**Max 3**

Question	Answer	Marks
1(k)	*any four from* *EPD improvements* **A** labelled test-tubes to avoid misidentification of concentrations **;** **B** used both stock solutions to prepare dilutions to, avoid using very small volumes / ensure greater accuracy **;** **C** further detail, e.g. using 10 g dm^{-3} for low concentrations **;** **D** used (stated) intermediate concentrations **;** **E** used serial dilution, to reduce measurement errors / AW **;** **F** used syringes of appropriate volume to reduce percentage error **;** **G** stated precaution to avoid having bubbles in syringes **;** **H** stirred / inverted, test-tubes, to ensure thorough mixing **;** **I** used stated precaution to take the same end-point **;** e.g. white background / line behind the test-tube **J** took, replicates / repeats, (at specific concentration(s)), to, calculate mean / identify anomalies / check for concordance **;** **K** used stated method to avoiding contamination when preparing the solutions **;** e.g. wiped, glass rod / bung *or* washing out syringe with glucose solution **L** maintained water bath at, boiling / temperature above 80 °C **;** **M** maintained volume of water in water bath to level of liquid in test-tubes **;** **N** used a staggered start for accurate timing **;** **O** held each test-tube with a test-tuber holder to make it easier to see change to Benedict's solution **;** **P** use same volume of hydrochloric acid for non-reducing sugar test to standardise this variable **;** **Q** used Universal Indicator paper to check that sample was a neutral pH after hydrolysis **;**	**Max 4**

Question	Answer	Marks
1(l)	*any four from* *ADC conclusions* *max 2 for any suggestions for results being inaccurate* **A** results depend on judgement at determining end-point / ref to subjectivity in taking results **;** **B** Diastix® does not have even intervals **;** **C** AVP **;** **D** AVP **;** e.g. evaporation of coconut water *max 4 for conclusions* **E** 10% coconut water has both reducing and non-reducing sugar **;** **F** compare results with concentration in (j) as this is all reducing and non-reducing sugars **;** **G** results for Diastix® (in (j)) are lower because it is sensitive only to glucose **;** **H** not all non-reducing sugars are formed, from / entirely from, glucose / by hydrolysis to glucose **;** **I** Diastix® does not detect fructose from hydrolysed sucrose **;** **J** non-reducing sugar is likely to be sucrose **;** **K** Benedict's test detects the presence of reducing sugars **;** **L** not all the non-reducing sugar has been hydrolysed **;** **M** ref. to reducing sugars other than glucose may be present **;** **A** any named example of a reducing sugar e.g. fructose / maltose / lactose / galactose **N** may be sugars that aren't detected by Diastix® and Benedict's solution **;** **O** tests are semi-quantitative **;** **P** ref. to a different method to measure sugar content **;** e.g. colorimetry / weighing precipitate / use of colour standards **Q** there are reducing agents in coconut water other than reducing sugars ; **R** ref. to different type of coconut water **;** **A** a reason for different type, e.g. variety of coconut / age / source	**Max 4**

Question	Answer	Marks
1(m)	*any seven from* *EPD limitations and errors* *advantages of Benedict's test* **A** can determine actual concentrations across the range / can find intermediate concentrations **;** **B** determines reducing sugar concentration not just glucose **;** **C** can discriminate to a higher concentration (than Diastix) / concentrations above 20 g dm^{-3} **;** *disadvantage of either test* **D** tests are not sensitive enough to detect low concentrations of, reducing sugars / glucose **;** **E** Diastix has a maximum concentration of 20 g dm^{-3} / Benedict's cannot discriminate between higher concentrations **;** **F** difficult to use to assess non-reducing sugar content in fruit juices that also contain reducing sugars **;** **G** not reusable / can only be used once **;** *disadvantages of Benedict's solution ORA for Diastix®* **H** stated problem with determining concentration of reducing sugar using intercept on calibration graph **;** **I** difficult to judge end-point with Benedict's test **;** **R** subjective unqualified **A** difficult to judge the end point each time **J** limited application of Benedict's test for fruit juices that have colour **;** e.g. orange juice **K** (more) difficult to standardise the test **;** *advantage of Diastix®, ORA for Benedict's* **L** simple / easy / quick, to carry out with appropriate reason **;** e.g. no lab equipment needed **M** only needs small volumes **;** **N** no safety implications **;** *disadvantages of Diastix®* **O** difficult to match colours to Diastix® colour card **;**	**Max 7**

Question	Answer	Marks
	P (some / all) colours were intermediate between colours on the colour card / intervals are not equal **;** **Q** difficult to use if colour blind **;** **R** ref to cost **;**	

Question	Answer	Marks
2(a)(i)	*MMO decision making* drawing fills at least half the space available **;** length of drawing is at least 120 mm correct shape of the outline with appropriate detail **;** i.e. distance between dorsal and ventral surfaces is greater than distance across **and** with irregular outline outlines drawn clearly with thin lines, without 'feathering' and without shading **;** *MMO collection of data* outlines for heart, 2 lungs and spinal cord **;** organs are the correct shapes and positions **;** *PDO recording data* spinal cord **;** lung(s) and heart **;**	**7**
2(a)(ii)	*MMO collection of data* vertebral column is correct shape and position **;** sternum is more angular shaped than ribs and is below heart **;** ribs are circular or ovoid (not angular) **;** *PDO recording data, labels* vertebral column / vertebra **;** sternum / breast bone **;** rib(s) **;**	**6**
2(a)(iii)	*MMO collection of data* oesophagus shown and labelled immediately below vertebral column **;** correct outlines of oesophagus and its lumen **;**	**2**
2(a)(iv)	*ADC display* correct size of scale bar or magnification within agreed limits **; ;** acceptable range = ×2 – ×24 if magnification is not correct, allow one mark for correct working if units are given (e.g. mm) 1 mark for correct working	**2**

Question	Answer	Marks
2(b)	*any five from* *MMO collection to max 4* *features of the embryo* **A** smaller air spaces in embryo **;** **A** greater density of cells in embryo **B** thicker alveolar walls in embryo **;** **A** lined by several layers of cells **C** alveoli lined by, cuboidal cells in embryo / squamous cells in adult **;** **D** more blood in embryo **; A** better blood supply in embryo **E** blood inside, alveoli / bronchi, in embryo only **;** **F** two features of the embryo lung that is less well developed than the adult lung **; ;** e.g. ref. to cartilage / cilia / goblet cells **G** nuclei are more darkly stained / AW, in embryo **;** **H** nuclei larger compared to size of cells in embryo **;** **I** nuclei / cells, in stages of mitosis **;** *ADC interpretation to max 2* **J** no gas exchange (in lungs) **;** **K** gas exchange occurs across placenta **;** **L** no need for thin walls for <u>diffusion</u> **;** **A** less diffusion **M** no need for large surface area **;** **N** tissue occupies smaller space **;** **O** walls of airways easily damaged in embryo (so blood in air spaces) **;** **P** lungs are still developing **;** **Q** AVP **;** *for structure or reason* **R** AVP **;**	**Max 5**

Question	Answer	Marks
3(a)	*labels (internal max 4)* *ADC display – zones with brackets* sarcolemma / plasma membrane / cell (surface) membrane **;** mitochondrion / mitochondria **;** cristae **;** sarcoplasm **; R** if inside another structure myofibril(s) **; R** muscle fibre sarcomere(s) **;** sarcoplasmic reticulum **;** Z, line / disc **; R** intercalated disc **R** Z bands H zone **;** M line **;** thin / actin, filaments **;** only in yellow zone in Fig. 3.2 **R** actin unqualified thick / myosin, filaments **; R** myosin unqualified A / dark, band **;** I / light, band **;** *functions (internal max 4) apply ECF if structure labelled incorrectly* *ADC interpretation* sarcolemma, provides surface receptors / is a barrier / is attached to neighbouring cells / AW **;** sarcoplasm, glycolysis / protein synthesis / AW **;** mitochondria synthesise ATP, for contraction / by aerobic respiration / AW **;** cristae, provide surface for electron transport chain / AW **;** sarcomere is, contractile / functional, unit **;** sarcoplasmic reticulum, stores / releases, calcium ions **;** myofibrils have sliding filaments for contraction **; A** ref to filaments for contraction Z disc, anchors the, thin / actin, filaments **;** M line anchors the, thick / myosin, filaments **;** A band, interaction / overlap, between actin and myosin **;** I band, provide space for, thick / myosin, filaments to move into **;**	**Max 8**
3(b)(i)	*any two from* *ADC conclusions* *adrenaline / noradrenaline* water soluble / not lipid soluble / polar / hydrophilic **;** too large **;** no, channel / carrier / transport, proteins **;** ref. to, secondary messenger(s) / enzyme cascade **;** allows faster communication **;** e.g. compared with entering cytoplasm and locating receptor less required (compared with entering cell) **;** allows stimulation of many cells by single molecule **;**	**Max 2**

Question	Answer	Marks
3(b)(ii)	*any three from* *EPD improvements* more / highly, specific **;** (since) antibodies are specific for one, antigen / epitope **;** ref to, variable region / antigen-binding region **;** reveals more (biochemical) detail **;** (since) detect / locate, specific molecules in tissues **; A** differentiate *idea that* huge range of antibodies can be produced **;** e.g. antibodies can be generated for almost any, antigen / epitope, as required **;** can use many different antibodies, at the same time / on the same tissue **;** less risk of getting artefacts / ORA **;** can be used on live organisms / AW **;** can follow a process over time **;** e.g. a pathway useful for diagnosis **;** ref to infectious diseases **;** ref to cancers **;** AVP **;** e.g. location of mutant cell surface markers	**Max 3**