Cambridge International Examinations
Cambridge Pre-U Certificate

BIOLOGY **9790/04**

Paper 4 Practical **May/June 2017**

MARK SCHEME

Maximum Mark: 80

Published

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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

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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**