**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Pre-U Certificate**

# MARK SCHEME for the May/June 2013 series

## 9790 BIOLOGY

**9790/03** Paper 3 (Practical), maximum raw mark 80

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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## Section A

| Question | Sections | Indicative Material | Mark |
|---|---|---|---|
| 1 (a) | ADC<br>Interpretation of data | *label lines to:*<br>(chloroplast) envelope / inner and/or outer membranes ;<br>**accept** chloroplast membrane(s)<br>stroma ;<br>thylakoids / lamellae ;<br>**accept** grana<br>(70S) ribosomes ;<br>starch (grain) ; | **max 3** |
| (b) | EPD<br>Identifying limitations and sources of error | ice-cold to, prevent / reduce, (hydrolytic) enzyme action ;<br>that would, destroy / damage, the chloroplasts ;<br><br>buffer solution to maintain constant pH ;<br>keep enzyme activity constant / prevent denaturation ;<br>ref. to *pH and chemiosmosis* ;<br><br>sucrose solution has same water potential as, cell / cytoplasm / stroma / chloroplast ;<br>so chloroplasts remain intact / prevent chloroplasts bursting ;<br>**ignore** plasmolysis<br>ref. to osmosis and water movement into the chloroplast (if suspended in water) ; | **max 4** |
| (c) | MMO<br>Decisions<br><br>EPD<br>Improvements | DCPIP solution without any, leaf extract / chloroplasts ;<br>DCPIP may decolourise in the light / AW ;<br>to show, leaf extract containing chloroplasts is needed for colour change / DCPIP does not decolourise in light without chloroplasts / AW ;<br><br>boiled leaf extract ;<br>to show decolourising involves, enzymes / proteins ;<br><br>use, folded black card / aluminium foil, with DCPIP and leaf extract ;<br>**accept** 'put in the dark'<br>to show light is necessary for colour change ;<br><br>AVP ;<br>e.g. further control(s)<br>AVP ;<br>e.g. explanation for any extra control(s) | **max 4** |

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| **(d)** | PDO<br>Recording | data recorded as a single table with percentage transmission in left hand column **;**<br>**accept** light intensity<br>**ignore** filter number<br>informative column headings, correct units in column headings only **;**<br>*percentage transmission, time to decolourise (s), rate of photosynthesis / reduction of DCPIP ($s^{-1}$)*<br>**reject** time unqualified<br>results recorded to same degree of precision in each column **;**<br>replicate(s) included and mean calculated and included **;**<br>time recorded in seconds (not minutes and seconds) **;** | |
| | MMO<br>Collection | control(s) recorded in table **;**<br>results show expected trend **;** | **7** |
| | ADC<br>Display of calculation and reasoning | rate calculated correctly as 1 / t ($\times$ 1000) **;**<br>**accept** alternatives, e.g. a constant figure divided by the time taken | **1** |
| **(e)** | PDO<br>Graph | axes correctly positioned (*x*-axis = percentage transmission, *y*-axis = rate of photosynthesis) **;**<br>**accept** time as ecf from **1 (d)**<br>axes scaled with ascending scales starting at 0,0 **;**<br>**accept** time / rate, only if filter number given<br>axes with full titles and units **;**<br>*ecf if filter number and/or time*<br>points plotted accurately **;**<br>result for control in dark (0%) plotted **;**<br>points joined, clearly / neatly, by straight lines (unless conform to line/curve of best fit) **;**<br>**reject** if line goes beyond last plotted point | **max 5** |

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| **(f)** | ADC<br>Description of patterns and trends | description of pattern from graph ;<br>*e.g. rate increases as percentage transmission increases*<br>use of comparative data from, table / graph, to illustrate ;<br>*ecf if time* | **2** |
| | ADC<br>Interpretation of data<br>Making conclusions | light provides <u>energy</u> for, photosynthesis / LD stage ;<br>absorption of light by (named) chloroplast pigments ;<br>electrons / $e^-$ , are, energised / excited, and, leave, chlorophyll / photosystem II / reaction centre ;<br>ref. to electron carrier system in context ;<br>photolysis produces $H^+$ ions (and electrons) ;<br>electrons / hydrogen ions ($H^+$) / protons, reduce DCPIP ;<br>independent variable is light intensity ;<br>light <u>intensity</u> is limiting factor ;<br>(if a plateau / levelling off) light intensity is no longer the limiting factor / some other factor is limiting ;<br>named factor(s) ;<br>explanation of effect of named factor ;<br>e.g. temperature and damage to, proteins / carriers<br>**accept** enzymes<br>e.g. concentration of, pigments / chloroplasts<br>**reject** 'amount'<br>AVP ; | **max 6** |
| **(g)** | ADC<br>Making conclusions | *any one of the following methods for disrupting membranes to max 1:*<br>suspend chloroplasts in, water / dilute solution / solution with a higher water potential ;<br>**reject** water<br>ultrasound ;<br>named enzyme to digest, protein / phospholipid ;<br>heat shock ;<br>electric shock / electroporation ;<br>freeze-thawing ;<br>detergent ;<br>ethanol / organic solvent ;<br>acid / alkali ;<br><br>*explanation to max 1 in terms of:*<br>envelopes / chloroplasts, break down (to release thylakoids) ;<br>envelopes / chloroplast membranes, become more permeable (to allow electron acceptor into organelles) ; | **2** |

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| **(h)** | ADC<br>Making conclusions | *penalise NAD once only*<br><br>ref. to small quantity of NADP so is continually recycled **;**<br><br>if all, / most / many, electrons flow to DCPIP **;**<br>none / few, available to reduce NADP **;**<br><br>no requirement for oxidised NADP **;**<br>not dependent on Calvin cycle to recycle oxidised NADP **;**<br>ref. to, non-cyclic photophosphorylation / ETC to NADP **;**<br>no production of ATP as no electron flow between PSII and PSI, so no energy for Calvin cycle **;**<br>reduced NADP / AW, is required for <u>reduction</u> stage of Calvin cycle **;**<br>**accept** if no reduced NADP no Calvin cycle<br>(if no reduced NADP) no conversion of PGA to, PGAL / GP / TP / AW **;** | **max 3** |

| (i) Evaluation of procedures and data | | |
|---|---|---|
| | **Identifying limitations and sources of error** | **Suggesting improvements** |
| *reliability repeatability* | only one result per light intensity ; **accept** ref. to number of replicates / 'do (more) repeats' | repeat at least three times and calculate mean (and SD) ;<br>ref. to appropriate stats test, to test for correlation ; |
| | ref to anomalous results ;<br>e.g. not able to check for them | repeat results that do not fit the trend ; **accept** ref. to actual results |
| *end point / timing* | end point is subjective / AW ; | use apparatus that allows measurement of light transmitted through ; **reject** 'use a colorimeter' unqualified |
| | difficult to make sure the **same** end point is used each time ; | better if can use a quantitative end point ; |
| | colour standard may have changed over time ; | set up fresh colour standard each time ; |
| | low light intensities changing colour but slowly ; | leave for longer than 10 minutes ; |
| | stated problem with start time ; | standardise method for starting the timer ; |
| *preparation of suspension* | density of chloroplasts may not be the same in each tube ; | method to standardise ;<br>e.g. stirring same number of times before taking each sample in melting point tubes / use magnetic stirrer |
| | no stated volume of DCPIP ; | standardise blue-green colour ; |
| | tubes set up at different times ; | use a fresh mixture of chloroplast suspension (and DCPIP) each time ; |
| | denaturation / destruction, of proteins / AW (as temperature increased) ; | |
| | not a pure suspension of chloroplasts ; | centrifuge ; |
| | very small volume in tubes ; | use, test-tubes / specimen tubes / micropipettes ; |

| (i) Evaluation of procedures and data (continued) | | |
|---|---|---|
| | **Identifying limitations and sources of error** | **Suggesting improvements** |
| *independent variable* | external / stray / ambient, light ; **accept** difficult to keep fixed distance for lamp | any suitable suggestion for keeping out stray light ; e.g. dark chamber with single light source |
| | dark filter is lifted / light filter is not ; | standardise checking of colour / cover lamp with filter ; |
| | do not know actual light intensity ; | use a light meter ; |
| *uncontrolled variable* | temperature was not constant / heat from bench lamp ; | any suitable suggestion for maintaining constant temperature ; e.g. heat screen / LED lamp |
| | ref. to actual temperature(s) ; | |
| *results* | not enough / only six, filters / light intensities ; | intermediate light intensities stated ; **reject** ref. to range (as 0 to 100% included) |
| | ref. to, number of points on the graph / pattern of results, in support ; | |
| | | **max 8** |
| | | **[Total: 45]** |

**Section B**

| Question | Sections | Indicative Material | Mark |
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| **2 (a)** | MMO<br>Decisions<br>Collection<br><br>PDO<br>Recording | *drawing:*<br>large drawing that fills the space available with clear, unbroken lines ;<br>V-shape ;<br>primary lamellae shown clearly at least in part of drawing or as an inset ;<br>primary lamellae not all same length ;<br>and other detail, e.g. 'segmented pattern' of gill arch ;<br><br>*annotations – suitable comments on shape / texture / colour / surface area of:*<br>gill arch ;<br>primary lamellae ;<br>secondary lamellae ; | **max 6** |
| | | scale indicated e.g. × 2, × 3 ; | **1** |
| **(b)** | PDO<br>Recording<br><br><br>MMO<br>Collection | *drawing*<br>large drawing to fill the space available ;<br>clear, unbroken lines ;<br><br>drawing to show secondary lamellae ;<br>label any two of the following ; ;<br>secondary lamella(e)<br>epithelium<br>blood cells<br>pillar cells<br>cartilage<br>endothelium / capillary<br>nuclei | **max 4** |
| | ADC<br>Interpretation of data<br>Display of calculation and reasoning | magnification correctly calculated from measurements given ;<br><br>*explanation:*<br>calibration of eyepiece graticule ;<br>*maybe stated (as already known) and/or explained using stage micrometer*<br><br>measurement from slide using eyepiece graticule ;<br>measurement indicated on drawing ; | **4** |

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| **(c)** | MMO<br>Decisions | take sections of gill to give LS of secondary lamellae / AW ;<br>dissect out secondary lamellae ;<br>measure (length and width) with, graticule / grid ;<br>measure maximum length of secondary lamella ;<br>measure depth ;<br>use radius to measure surface area ;<br>double for both sides ; | **max 3** |
| **(d) (i)** | ADC<br>Interpretation of data | *idea that:*<br>standardise measurements to make valid comparisons between different fish (species) ; | **1** |
| **(ii)** | ADC<br>Making conclusions | mackerel is most active of these species / AW ;<br>relatively more, muscle / active tissues ;<br>high rate of <u>aerobic respiration</u> ;<br>to provide, energy / ATP, required for swimming ;<br>needs high rate of uptake of oxygen ;<br><br>ref. to different concentrations of oxygen in water ;<br>any reason ;<br>e.g. different temperatures / depths / effects of currents / AW<br><br>monkfish, is relatively inactive / maybe bottom dweller ;<br>uses anaerobic respiration for short bursts of activity ;<br><br>use of comparative figures from Table 2.1 in support of explanation ;<br>AVP ; | **max 3** |
| **(e)** | MMO<br>Decisions<br>Collection | table with a column for features ;<br><br>*comments on the following for each structure:*<br>qualitative comparison of width (of lumen) ;<br>measurements of two or three taken from slide ;<br>qualitative comparison of thickness of walls ;<br>measurements of two or three taken from slide ;<br>relative numbers ;<br>shape ;<br><br>*comparison of lining:*<br>presence / absence of ciliated epithelium ;<br>presence / absence of, endothelium / squamous epithelium ;<br>ref. to goblet cells / described ;<br>presence / absence, of other tissues in walls ; ;<br>e.g. <u>smooth</u> muscle, cartilage, elastic tissue, blood capillaries<br>presence / absence of blood (cells) in lumen ;<br>AVP ;<br>e.g. position in the slide | **max 7** |

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| **(f)** | MMO<br>Decisions<br>Collection | use of a table for comparisons ;<br><br>*comments on the following:*<br>position of gas exchange surface ;<br>e.g. deep inside mammalian body vs in gill chamber / AW<br>movement of respiratory medium ;<br>e.g. air travels through airways in mammalian lung vs water flows directly over gills in fish<br>air flows tidally, water flow is unidirectional ;<br>both have a gas exchange surface with large surface area ;<br>gaseous exchange surfaces are alveoli and secondary lamellae ;<br>both have thin epithelium ;<br>both have short diffusion pathway ;<br>both are well supplied with, capillaries / blood (vessels) ;<br>blood flows around alveoli ;<br>countercurrent flow in gills ;<br>both are moist ;<br>AVP ;<br>e.g. ref. to surfactant<br>AVP ; | **max 6** |
| | | | **[Total: 35]** |