**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge Pre-U Certificate**

# MARK SCHEME for the May/June 2015 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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**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 |

## Section A

| Question | Indicative material | Marks |
|---|---|---|
| 1 (a) | test-tube **B** is, clear / not cloudy / slightly cloudy **;**<br>**A** less clear than test-tube **A**<br>**A** colourless | **[1]** |
| (b) | 1 preparation of a suitable range of protease concentrations,<br>e.g. with a dilution table **;**<br>minimum range = 0.25 to 1.0%<br><br>2 suitable number of different concentrations **;**<br>minimum of 6 including 0%<br>*0 not really needed as that is test-tube **B***<br><br>3 total volume of each protease solution is greater than 5 $cm^3$ **;**<br><br>4 method for avoiding contamination **;**<br>e.g. wiping glass rods<br>using specific syringes for each solution<br>washing out syringes<br><br>5 leave tubes with protease and milk solution in water-bath at target temperature, for at least three minutes / until contents reach target temperature **;**<br><br>6 thermometer put into contents of test-tube **;**<br><br>7 standardised way of adding enzyme to milk and starting the timer **;**<br><br>8 standardised way of, stirring / shaking, tube, before / during, each reaction **;**<br><br>9 way in which the temperature of the water-bath(s), was / were, maintained / monitored **;**<br><br>10 use of, control / comparator, to standardise determination of end-point **;**<br><br>11 minimum of three replicates used for each concentration (planned or done), check for anomalies / calculate means **;**<br><br>12 calculate (mean) rate as 1 / t **;**<br><br>13 any suitable modification(s) with justification **; ;**<br><br>14 another set of results in different conditions **;**<br>e.g. different, temperature / volumes / substrate concentration<br><br>15 safety hazard and precaution **;** | **[max: 8]** |

| Question | Indicative material | Marks |
|---|---|---|
| **(c)** | 1 data recorded as a single table **;**<br><br>2 informative column headings, correct units in column headings **;**<br>percentage concentration of protease<br>time to reach end-point / s<br>rate of hydrolysis / $s^{-1}$<br>**A** minutes as a unit in the table<br>**R** if any units are in the body of the table<br><br>3 time recorded in seconds (not minutes and seconds) **;**<br><br>4 results recorded to same degree of precision in each column **;**<br>*expect to the nearest second*<br><br>5 at least three sets of results included **;**<br><br>6 means calculated correctly **;**<br>*expressed as whole numbers or same number of decimal places*<br><br>7 control(s) recorded in table **;** e.g. test-tube **B** | **[max: 6]** |
| | 8 rates calculated correctly as 1 / t **;**<br><br>9 all rates calculated to same number of significant figures as raw data or to one more **;** | **[2]** |
| **(d)** | 1 axes correctly orientated **;**<br>*x*-axis = concentration<br>*y*-axis = rate of hydrolysis<br>**A** time as ecf if rates not calculated<br><br>2 axes scaled with ascending scale starting at 0, 0 **;**<br>**A** broken axis but 0,0 must be present<br><br>3 axes with correct titles and units **;**<br>e.g. percentage enzyme concentration<br>rate of hydrolysis of protein / $s^{-1}$<br>**A** ecf from table<br><br>4 all points plotted accurately **;**<br><br>5 points joined, clearly / neatly, by straight lines (unless conform to line / curve of best fit) **;**<br>ecf if no 0, 0<br><br>6 results show expected trend **;**<br>linear / levelling at highest concentration | **[5]** |

| Question | Indicative material | Marks |
|---|---|---|
| **(e)** | 1 endopeptidase / not an exopeptidase ;<br><br>2 hydrolyses / AW, peptide bond within, protein / polypeptide ;<br><br>3 peptides are, small chains of amino acids / not the smallest molecules (in protein hydrolysis) ;<br><br>4 products of complete breakdown are amino acids ;<br><br>5 ref. to substrate and active site ; | **[max: 3]** |
| **(f)** | 1 description of trend ;<br>e.g. linear / directly proportional / AW<br><br>2 use of comparative data with units from table and / or graph to illustrate ;<br>**A** ecf from table for units<br><br>3 ref. to any anomalous results in the, table / graph ;<br>**A** 'there are no anomalous results'<br><br>4 more active sites are available *with increase in enzyme concentration* / ORA ;<br><br>5 more enzyme-substrate complexes (per unit time) ;<br><br>6 ref. to increase in collisions between substrates and enzymes ;<br><br>7 enzyme concentration is limiting factor (when linear) ;<br><br>8 ref. to other limiting factor if results, show a plateau / begin to show a plateau ;<br>e.g. substrate concentration / temperature<br><br>9 AVP ; e.g. active site is saturated<br><br>10 AVP ; | **[max: 8]** |

| Question | Indicative material | Marks |
|---|---|---|
| **(g)** | *ignore colour for description of end point – look for turbidity / cloudiness / clarity*<br><br>judgment of end-point as, degree of cloudiness / AW, is difficult<br>*or*<br>not easy to ensure that the same end-point is used each time **;**<br><br>end-point using the milk solution is not the completion of the reaction / some protein still remains **;**<br><br>easier to use a comparator than waiting for contents to go completely clear **;**<br><br>at the end of the reaction the substrate concentration is very low **;**<br><br>this limits the rate of each reaction **;**<br><br>maximum rate of reaction occurs at the very beginning / ref. to not finding the initial rate **;**<br><br>would be better to use a more concentrated milk solution as a comparator **;**<br><br>AVP **;** e.g. not a very distinct end point<br><br>AVP **;** e.g. ref. to valid way as loss of cloudiness = hydrolysis of protein | **[max: 3]** |

**(h)** Evaluation of procedures and data

*Do not credit points already made in (g) as limitations, but allow suitable improvements.*

| | Identifying limitations and sources of error | Suggesting improvements |
|---|---|---|
| *repeatability* | limited number of results for each concentration **;**<br>**A** ref to number of replicates | repeat results at least three times **;**<br>*check against* ***(c)*** |
| | | repeat and use last set of results after becoming confident with judging end-point **;** |
| | | have results checked by someone else (idea of reproducibility) **;** |
| | ref. to any anomalous result(s) **;**<br>**A** lack of anomalous results | repeat results that do not fit the trend / eliminate anomalous results **;**<br>**A** ref. to actual results<br>**R** calculate SDs to assess quality of results |

**(h)** Evaluation of procedures and data

*Do not credit points already made in (g) as limitations, but allow suitable improvements.*

| | **Identifying limitations and sources of error** | **Suggesting improvements** |
|---|---|---|
| *independent variable* | not enough (intermediate) concentrations ; | specified concentrations within the range used ; |
| | range of concentrations not wide enough ; | specified concentrations above the highest used ; |
| | justification for using more concentrations with respect to shape of curve ; | |
| *dependent variable (timing)* | test-tube needs to be removed from the water-bath to check for end-point ; | repeat at room temperature ; |
| | ref. to random errors in timing / ref. to reaction time / not able to mix solutions and start timer simultaneously ; | start timer before adding the solutions ; **A** use a back-up timer / use video |
| *uncontrolled variable* | pH, not controlled / not measured ; | use a buffer solution / make up the milk solution in a buffer solution ; |
| *controlled variables* | difficult to keep temperature constant ; | use a thermostatically-controlled water-bath ; |
| | do not know the optimum temperature ; | repeat at different temperatures to find the optimum temperature ; |
| | substrate concentration was limiting (if a plateau on the graph) ; | repeat at higher substrate concentration ($> 10\,g\,dm^{-3}$) ; |
| | substrate concentration decreases *in each reaction mixture* ; | take initial rate measurements ; |
| | | use higher concentration of milk solution for judging end-point ; |
| | syringes are, imprecise / inaccurate ; | use a, graduated pipette / burette ; |
| | large percentage error in measuring small volumes in syringes ; | use specified larger volumes ; e.g. $10\,cm^3$ |
| | change in consistency / settling of protein in milk ; | stir at intervals / use a magnetic stirrer ; |

**[max: 9]**

**[Total: 45]**

**Section B**

| Question | Indicative material | Marks |
|---|---|---|
| **2 (a)** | *assume answers are about the acinar cells unless told otherwise*<br><br>1 staining (of cytoplasm) is more intense **;**<br><br>2 position of nuclei is central (vs basal) **;**<br><br>3 cells are wedge-shaped / AW (vs cuboidal / columnar) **;**<br>**A** circular / rounded<br><br>4 larger cells **;**<br><br>5 only a small region of cell in contact with duct (vs a free surface in contact with branch of pancreatic duct) **;**<br><br>6 staining (of cytoplasm) is uneven / light and dark areas **;**<br>**A** cytoplasm is granular<br><br>7 nuclei are relatively smaller / nuclei do not occupy most of the cell / cytoplasm occupies most of the cell **;**<br><br>8 less prominent edge to cells (vs very clear edge to cells as they border a large(r) lumen) **;**<br><br>9 spaces between cells (vs no spaces between cells) **;**<br><br>10 AVP **;** | **[max: 5]** |

| Question | Indicative material | Marks |
|---|---|---|
| **(b)** | *marks may be taken from annotations*<br><br>1 large quantity of <u>rough</u> endoplasmic reticulum **;**<br><br>2 with many ribosomes for, protein synthesis / translation **;**<br>**R** translation of proteins<br>**Ignore** free ribosomes<br>**A** production of proteins<br><br>3 transport of protein inside, cisternae / vesicles to Golgi (apparatus) **;**<br><br>4 Golgi (apparatus) site of modification of protein **;**<br><br>5 any example **;** e.g. glycosylation<br><br>6 packaging of, trypsinogen / protein / enzymes **;**<br><br>7 formation of <u>vesicles</u> that travel to, plasma / AW, membrane **;**<br><br>8 ref. to exocytosis (to intercalated duct) **;**<br><br>9 mitochondria to provide, energy / ATP **;**<br>**R** produce energy<br><br>10 AVP **;** e.g. large nucleus, for transcription / site of rRNA synthesis / <u>vesicles</u> fuse | **[max: 6]** |
| **(c)** | 1 can only sample very small regions of cells **;**<br><br>2 can only see very thin sections / no idea of 3-D, shape / structure **;**<br><br>3 cannot follow any living process / AW **;**<br><br>4 ref. to artefacts **;**<br><br>5 ref. to limitation(s) of resolution of TEM **;**<br><br>6 AVP **;** e.g. electrons degrade samples | **[max: 2]** |
| **(d)** | controls, when / where, enzyme is, active / breaks down protein **;**<br>e.g. enzyme is only active where needed<br><br>if active, enzyme will digest protein in membrane / other enzymes (in the vesicles) **;**<br><br>avoids, autodegradation / autodigestion / pancreatitis / cell lysis / AW **;**<br><br>AVP **;** | **[max: 2]** |
| | | **[Total: 15]** |

| Question | Indicative material | Marks |
|---|---|---|
| 3 (a) | *drawing marks to max 2:*<br>outline drawn with clear, unbroken lines ;<br>heart shape of the fruit ;<br>pedicel and remains of style drawn ;<br><br>*labels and annotations to max 3:*<br>pedicel ;<br>remains of style ;<br>pericarp / ovary wall (labelled or described) ;<br>placenta ;<br>flattened / thin, shape ;<br>colour(s) of fruit ;<br>position of seeds (through ovary wall) ;<br><br>*magnification / scale bar is 1 mark:*<br>correct, scale bar / magnification ; | **[max: 5]** |
| (b) | *drawing marks to max 2:*<br>outlines drawn with clear, unbroken lines ;<br>correct shape of the seed ;<br>correct shape of the embryo ;<br>complete embryo showing cotyledon, radicle and plumule ;<br><br>*labels to max 3:*<br>testa / integuments / seed coat ;<br>embryo ;<br>radicle ;<br>plumule ;<br>cotyledon(s) ;<br>endosperm ;<br><br>*magnification / scale bar is 1 mark:*<br>correct, scale bars / magnifications ; | **[max: 6]** |
| (c) | *drawing marks:*<br>at least two named views of the maize fruit ;<br>*external and one or two section(s)*<br>distribution of starch shown or described ;<br><br>*labels / annotations – to max 5:*<br>fused pericarp and testa ; **A** ectocarp<br>style scar / attachment scar / site of attachment ;<br>(single) cotyledon ;<br>aleurone layer / scutellum ;<br>endosperm ;<br>radicle and plumule ;<br><br>correct, scale bar(s) / magnification(s) ; | **[max: 5]** |

| Question | Indicative material | Marks |
|---|---|---|
| **(d)** | *features:*<br>shape of fruit **;**<br>pericarp in both **;**<br>thickness **;**<br>number of seeds (many vs one) **;**<br>colour **;** **A** chlorophyll in *C. bursa-pastoris*<br><br>any dimension with units **;**<br>e.g. length 5–7 mm v 10–20 mm<br>starch, presence / absence **;**<br>**A** very little in *C. bursa-pastoris*<br>texture / hardness, of outer layer **;**<br><br>AVP **;** e.g. size in relation to fruit<br>sites of attachment to stem<br>AVP **;**<br><br>**Ignore** references to seed structures | **[max: 4]** |
| | | **[Total: 20]** |