

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper
for the guidance of teachers

9700 BIOLOGY

9700/33

Paper 31 (Advanced Practical Skills 1),
maximum raw mark 40

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 must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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Mark scheme abbreviations:

| | |
|-------------------------|---|
| ; | separates marking points |
| / | alternative answers for the same point |
| R | reject |
| A | accept (for answers correctly cued by the question, or by extra guidance) |
| AW | alternative wording (where responses vary more than usual) |
| <u>underline</u> | actual word given must be used by candidate (grammatical variants excepted) |
| max | indicates the maximum number of marks that can be given |
| ora | or reverse argument |
| mp | marking point (with relevant number) |
| ecf | error carried forward |
| I | ignore |
| AVP | Alternative version possible |
| ACE | Analysis, Conclusions and Evaluation (skills) |
| PDO | Presentation of Data and Observations (skills) |
| MMO | Manipulations, Measurement and Observation (skills) |

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| 1 | (a) (i) | Complete Fig. 1.1 to show how you will make a <i>serial</i> dilution to reduce the concentration by <i>half</i> between each concentration. [3] | |
| | | MMO decisions 1 | [1] (labels under correct sequence of beakers either left to right or right to left-) 2.5 AND 1.2(5) AND 0.6(25); Additional guidance Must have <ul style="list-style-type: none"> • % once • concentrations to at least 1 decimal place |
| MMO decisions 2 | [1] | (uses serial dilution to complete three unlabelled) (adds previous concentration of E to each of three beakers and same volume) <u>5</u> (%) with volume or shown by arrow from (5%) with volume Additional guidance Must have <ul style="list-style-type: none"> • cm³ once • if mp1 incorrect ecf | AND the same volume transferred from first beaker to second and from second beaker to third beaker); |
| | [1] | (adds (distilled) water/W to each of three beakers) Additional guidance Must have <ul style="list-style-type: none"> • cm³ once • if mp1 incorrect • if mp2 incorrect BUT MUST add previous concentration to second and third beakers | |
| ACE improvement 1 | (ii) | Describe how you will set up this control using the apparatus provided. [1] [1] (may answer in terms of setting up test-tubes) boil enzyme Or replace enzyme/E with water/W Or use water/W instead of enzyme/E Or use urea/U and water/W (Ignore equal volume or 2 cm ³ of each) | |

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| (iii) Prepare the space below and record your results. | | [5] |
|--|--|--|
| PDO recording 2 | [1] table with all cells drawn | AND heading (top or left) percent(age) conc(entrations); |
| | Additional guidance | <p>Can have</p> <ul style="list-style-type: none"> • no outer boundary • % • solution % or enzyme % or percentage solution or percentage enzyme <p>Do not give mark if</p> <ul style="list-style-type: none"> • % in cells of the headed column/row • other units e.g. mol dm³ |
| MNO collection 3 | [1] (heading on any one time column/row including mean) <u>time</u> with s or sec(onds); | Additional guidance |
| | Additional guidance | <p>Do not give mark if</p> <ul style="list-style-type: none"> • units in cells of the headed column/row • min(utes) • additional columns/rows for volumes of enzyme or urea • t or T |
| MNO collection 3 | [1] (in concentration column) lowest concentration of E first to highest concentration minimum of three; | Additional guidance |
| | Additional guidance | <p>Ignore</p> <ul style="list-style-type: none"> • control or 0% or W before or after or not present but not in middle <p>Can have</p> <ul style="list-style-type: none"> • ecf any lowest recorded concentration |
| MNO collection 3 | [1] records whole seconds (numbers) less than 601 for 5 concentrations and control (6); (mark first column/row of recorded time taken) | Additional guidance |
| | Additional guidance | <p>Must have</p> <ul style="list-style-type: none"> • whole seconds only • no value over 600 |
| MNO collection 3 | [1] highest concentration recorded is shorter time than next concentration; (mark first column/row of recorded time taken) | Additional guidance |
| | Additional guidance | <p>Must have</p> <ul style="list-style-type: none"> • whole seconds only • no value over 600 |

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| (iv) Calculate the rate of reaction for the 10% E concentration. | | [1] |
| ACE interpretation 1 | [1] (from results or mean) correct answer (1 divided by the result for 10%) with units s ⁻¹ ; Additional guidance Can have <ul style="list-style-type: none"> • sec(onds)¹ Do not give mark if <ul style="list-style-type: none"> • no result for 10%. • more than 3 significant figures. E.g. 0.00345 ✓ (3 sig. figs) NOT 0.003456 X (4 sig. figs) | [1] |
| (v) Identify one significant sources of error in your investigation. | | [1] |
| ACE interpretation max 1 | Mark as incorrect ideas temperature pH evaporation any errors which affect all test-tubes equally Cause of error | WITH idea of error |
| | 1. (dependent) colour change / red to blue / end-point litmus colour | difficult to judge see or identify determine is subjective may be different too quick; |
| | 2. timing reaction starts | not same or describes only starts when added to all test-tubes or delayed or not added at same time too quick or describes more concentrated goes quickly or after reaction starts before timing; |
| | 3. (standardised) litmus paper enzyme | sticks to sides/bottom not dissolved; |

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| | Additional guidance | Do not give mark if (count as an idea) |
| | | <ul style="list-style-type: none"> • human reaction time • just have cause and no idea of error • give improvement or correction of error e.g. should have timed each one separately • contamination |
| | (vi) Suggest how you would make two improvements to this investigation. [2] | |
| ACE improvements max 2 | max 2 | 1. (dependent) use pH meter use datalogger and pH sensor liquid litmus or indicator and colorimeter; |
| | | Additional guidance |
| | | Do not give mark if (count as an idea) |
| | | <ul style="list-style-type: none"> • only colorimeter (litmus paper!) • only universal indicator • use of colour charts |
| | 2. stagger start or do individually or use more stop clocks or use help; | |
| | 3. replicate; | |
| | Additional guidance | Can have |
| | | <ul style="list-style-type: none"> • repeat or more trials or more readings Ignore <ul style="list-style-type: none"> • mean |
| | 4. (standardised variables) dry test-tubes (dissolve enzyme with idea of how) leave for longer or use stirrer or warm; | |
| | Additional guidance | Do not give mark if |
| | | <ul style="list-style-type: none"> • ref. to separate syringes • use larger volumes • put covers or lids on |
| | 5. (independent variable) more / wide / narrow(er) / different / high(er) / low(er) / examples range of concentrations / dilutions / solutions; | |
| | Additional guidance | Do not give mark if |
| | | <ul style="list-style-type: none"> • use burette or graduated pipette or smaller syringe or with smaller divisions |

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| (b) (i) Plot a chart of the data shown in Table 1.1. | | [4] | |
| [1] | x-axis method | AND y-axis nitrogen/N (/) millions ton(ne)s per year; | |
| | Additional guidance | Do not give mark if | |
| | | <ul style="list-style-type: none"> any units e.g. arbitrary units on x-axis Must have <ul style="list-style-type: none"> units on y-axis | |
| [1] | scale as x-axis even widths to up to 2 cm | AND y-axis 20 to 2 cm and must label each 2 cm | AND start at 0; |
| | Additional guidance | Do not give mark if | |
| | | <ul style="list-style-type: none"> awkward scale e.g. 25 or 40 to 2 cm. Or bars drawn outside grid | |
| [1] | correct plotting of each bar; | | |
| | Additional guidance | ecf if y-axis not 0 if scale 20 to 2 cm. Horizontal top line must be clear, sharp and ruled to show plot. Do not give mark if <ul style="list-style-type: none"> awkward y-axis scale bars arranged differently from order of table horizontal lines too thick – 1 mm/half square or not clear | |
| [1] | each bar separate and must be 5 | AND bars – | |
| | | <ul style="list-style-type: none"> quality – ruled vertical lines and labelled clearly with method; | |
| | Additional guidance | Must have | |
| | | <ul style="list-style-type: none"> thinner than half square vertical lines to horizontal must meet exactly any clear labels e.g. I/A/D/N/F – underneath, must be directly below correct bar or inside bar Do not give mark if <ul style="list-style-type: none"> solid shading or line shading outside a bar any feathery line irregular thickness OR not possible to see drawn line | |

PDO layout 4

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| (ii) Calculate the percentage decrease from 1840–1850 to 1990–2000. | | [2] | |
| [1] | 123 – 108 | OR 108/123X100 | |
| | Additional guidance Must have | | |
| | <ul style="list-style-type: none"> minus sign or minus | | |
| [1] | (123 – 108) or 15 must have (123 – 108) or decrease 15 or (answer from any subtraction) Can have 10 ⁶ or (15) 000 000 | divided by /123 and multiplied by X 100 AND answer rounded to whole number (12) or 3 sig. figs. i.e. one decimal place (12.2); | AND answer rounded to whole number (12) or 3 sig. figs. i.e. one decimal place (12.2); |
| | Additional guidance Must have | | |
| | <ul style="list-style-type: none"> answer from a subtraction, division and multiplication signs/wording | | |
| (iii) Suggest one reason for the difference in the natural fixation between 1840–1850 and 1990–2000. | | [1] | |
| ACE conclusions 1 | [1] | IDEA OF less uncultivated land or more cultivated OR more crops grown OR (more) deforestation or loss of habitat or desertification OR building or urbanisation OR less leguminous plants or Rhizobium or organisms involved in N fixation OR more fertilisers so eutrophication AVP; | |
| | Additional guidance | | |
| | Do not give mark if | | |
| | <ul style="list-style-type: none"> more pollution unqualified | | [Total: 20] |

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| 2 | (a) (i) | Draw a large plan diagram of the part of the leaf indicated by the shaded area Fig. 2.1. Label the vascular bundle and the palisade layer. [5] | |
| | | clear, sharp, unbroken lines | AND larger than 60 mm across widest point top to bottom; |
| PDO layout 1 | [1] | <p>AND no shading</p> <p>Must have</p> <ul style="list-style-type: none"> • three or more hand-drawn (not ruled) lines and one or more 'enclosed areas' <p>Do not give mark if</p> <ul style="list-style-type: none"> • drawn over the print of question • any feathery or broken or overlaps in lines • any 'tail' or overlap or gap in the outline of enclosed areas <p>Can have</p> <ul style="list-style-type: none"> • 1 'tail' or overlap or gap in the outline of 2/3 enclosed areas • only lines less than 1 mm | |
| | [1] | no cells drawn | AND outline of bulge at each side turns parallel to top layer; |
| MMO collection 2 | [1] | (upper epidermis and palisade layer above vascular bundle or bulge (if no vascular bundle)) drawn as three lines which continue into lamina; | |
| MMO decision 2 | [1] | vascular bundle divided into at least two regions If not an enclosed area must be within bulge layer; | AND epidermal layer at lowest point of bulge thinner than opposite epidermal layer; |
| | [1] | correct label with label lines to vascular bundle (area inside bulge) and palisade layer (any area closer to opposite epidermal layer to vascular bundle); | Additional guidance |
| MMO decision 2 | | | <p>Do not give mark if</p> <ul style="list-style-type: none"> • any label which is biologically incorrect e.g. from incorrect organ or animal • label within drawn area |

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| (ii) Make a high-power drawing of one epidermal cell with one attached, whole trichome (hair). Label epidermal cell and trichome. [5] | | | |
| PDO layout 1 | [1] | clear, sharp, unbroken lines | AND no shading or stippling AND trichome longer than 30 mm; |
| | | Additional guidance Do not give mark if <ul style="list-style-type: none"> drawn over the print of question any feathery or broken line in outline of enclosed areas any feathery line or squiggle for trichome 2 'tails' or overlaps or gaps if two lines for cell wall in epidermal cell 0 'tails' or overlaps or gaps if one line for cell wall in epidermal cell Can have <ul style="list-style-type: none"> only lines less than 1 mm | |
| MMO collection 2 | [1] | only one epidermal cell drawn | AND one whole attached trichome drawn; |
| | [1] | (Trichome(s) wide enough to see clearly) rounded or pointed end | AND only one cell in each trichome; |
| PDO recording 1 | [1] | cell walls drawn as double lines for whole of epidermal cell; | |
| MMO decision 1 | [1] | correct label with label lines to <u>epidermal cell</u> and <u>trichome</u> ; | Additional guidance Do not give mark if <ul style="list-style-type: none"> any label is biologically incorrect e.g. from incorrect organ or animal, chloroplast, stoma(ata) or e.g. Golgi or mitochondria label within drawn area |

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| <p>(iii) State two observable features of K1 which support the conclusion that this is a leaf from a plant growing in a dry habitat. Explain how these features reduce water loss. [2]</p> | | |
| <p>max 2</p> <p>ACE conclusions max 2</p> | <p>1 mark for 2 features mp1</p> <p>leaf curled/rolled</p> | <p>Then 1 mark (mp2 to 5) for one correct reason with the correct feature</p> |
| | <p>mp 2 Idea of reduces evaporation/diffusion or traps moist(ure)/water or humidity increases;</p> | |
| | <p>mp 3 Idea of absorb or trap water/moist(ure) or prevent diffusion or evaporation;</p> | |
| | <p>mp 4 Idea of prevents or reduces evaporation or described;</p> | |
| | <p>mp 5 Idea of prevents diffusion or reduces evaporation or described;</p> | |
| | <p>stomata on lower epidermis/not on upper epidermis or sunken or few</p> | |
| <p>Additional guidance</p> <p>Ignore</p> <ul style="list-style-type: none"> • refs. to water potential • reduces <u>transpiration</u> (rate); | | |

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| (b) (i) Use the magnification to calculate the actual length of line Y in μm. | | [3] |
| MMO collection 1 | measures line X correctly in mm; 87 87.5 88 88.5 89 <u>mm</u> | |
| | Additional guidance Must have | |
| | <ul style="list-style-type: none"> only those values given and units Ignore <ul style="list-style-type: none"> use of metres | |
| MMO decision 1 | <p>EITHER (uses any measurement and converts to μm) (mm) measurement $\times 1000$ OR $\times 10^3$</p> <p>OR cm to μm (cm) $\times 10\,000 \times 10^4$</p> <p>OR gives only answer e.g. 87,000 or 87,500 88,000 or 88 500 or 89,000</p> | <p>OR (uses any measurement and divides by 350) measurement mm/350 e.g. 87/350</p> <p>OR measurement cm/350 e.g. 8.7/350</p> <p>OR gives only answer e.g. 0.2485 or 0.02485</p> |
| | Additional guidance | |
| | Do not give mark if | |
| | <ul style="list-style-type: none"> use metres anywhere | |
| ACE Interpretation 1 | <p>correct answer; any whole number 248 to 254 OR answer up to two decimal places</p> | <p>between 248.56 and 254.30</p> |

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| (ii) Prepare the space below so that it is suitable for you to record the observable similarities and differences between the specimens on K1 and that in Fig. 2.2. [5] | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|----|----------|----------|-------------------------------|--|----|---|--|----|---------------------|-------------------------|----|----------|--------------|----|--------------------|--------------------|----|----------------------|--------------------------|----|--------------------|-----------------------|----|--------------------|-----------------------------------|
| PDO recording 1 | [1] organise as a table/Venn diagram/ruled boxes AND headed <u>K1</u> and <u>Fig. 2.2</u> AND first difference opposite each other; Additional guidance <u>K1</u> <u>Fig. 2.2</u> OR <u>Fig. 2.2</u> <u>K1</u> | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MMO decision 1 | [1] attempted one similarity; | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACE interpretation max 3 | [internal max 2 for similarities (S1–S2) and max 2 for differences (D1–D7)] <table border="1"> <thead> <tr> <th>feature</th> <th>K1</th> <th>Fig. 2.2</th> </tr> </thead> <tbody> <tr> <td>S1 S2</td> <td>single cell; nucleus present;</td> <td>epidermal cells/epidermis/epidermal layer;</td> </tr> <tr> <td>D1</td> <td>on surface/ not in pits/ not sunken</td> <td>below surface/ in pits/dip/ sunken</td> </tr> <tr> <td>D2</td> <td>separate or few(er)</td> <td>close together or more;</td> </tr> <tr> <td>D3</td> <td>straight</td> <td>curled/bent;</td> </tr> <tr> <td>D4</td> <td>not seen absent</td> <td>visible present</td> </tr> <tr> <td>D5</td> <td>present or thin(ner)</td> <td>none/absent or thick(er)</td> </tr> <tr> <td>D6</td> <td>loosely/air spaces</td> <td>tightly/no air spaces</td> </tr> <tr> <td>D7</td> <td>present or visible</td> <td>absent or not visible or not seen</td> </tr> </tbody> </table> | feature | K1 | Fig. 2.2 | S1 S2 | single cell; nucleus present; | epidermal cells/epidermis/epidermal layer; | D1 | on surface/ not in pits/ not sunken | below surface/ in pits/dip/ sunken | D2 | separate or few(er) | close together or more; | D3 | straight | curled/bent; | D4 | not seen absent | visible present | D5 | present or thin(ner) | none/absent or thick(er) | D6 | loosely/air spaces | tightly/no air spaces | D7 | present or visible | absent or not visible or not seen |
| feature | K1 | Fig. 2.2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S1 S2 | single cell; nucleus present; | epidermal cells/epidermis/epidermal layer; | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D1 | on surface/ not in pits/ not sunken | below surface/ in pits/dip/ sunken | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D2 | separate or few(er) | close together or more; | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D3 | straight | curled/bent; | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D4 | not seen absent | visible present | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D5 | present or thin(ner) | none/absent or thick(er) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D6 | loosely/air spaces | tightly/no air spaces | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D7 | present or visible | absent or not visible or not seen | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| | | <p>Additional guidance</p> |
| | | <p>Ignore</p> <ul style="list-style-type: none"> • tick and cross without a key • refs. to size • 3-D descriptions such as spherical • colours/staining |
| | | [Total: 20] |