

# UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary and Advanced Level

## MARK SCHEME for the November 2005 question paper

### 9709/0390 MATHEMATICS

9709/06, 0390/06 Paper 6 maximum raw mark 50

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the *Report on the Examination* for this session.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the November 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



## Mark Scheme Notes

Marks are of the following three types:

**M** Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

**A** Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

**B** Mark for a correct result or statement independent of method marks.

- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep\*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- The symbol  $\surd$  implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.
- Note: B2 or A2 means that the candidate can earn 2 or 0.  
B2/1/0 means that the candidate can earn anything from 0 to 2.

The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.
- For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking  $g$  equal to 9.8 or 9.81 instead of 10.



The following abbreviations may be used in a mark scheme or used on the scripts:

|     |   |
|-----|---|
| AEF | Any Equivalent Form (of answer is equally acceptable)   |
| AG  | Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)   |
| BOD | Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)  |
| CAO | Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)   |
| CWO | Correct Working Only – often written by a 'fortuitous' answer   |
| ISW | Ignore Subsequent Working   |
| MR  | Misread   |
| PA  | Premature Approximation (resulting in basically correct work that is insufficiently accurate)   |
| SOS | See Other Solution (the candidate makes a better attempt at the same question)  |
| SR  | Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance) |

## Penalties

|       |   |
|-------|---|
| MR -1 | A penalty of MR -1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through $\sqrt{}$ " marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy. An MR-2 penalty may be applied in particular cases if agreed at the coordination meeting. |
| PA -1 | This is deducted from A or B marks in the case of premature approximation. The PA -1 penalty is usually discussed at the meeting.   |



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|  |   |   |
|--|---|---|
| <b>1</b><br>two pie charts or 2 bars (m and f)<br>3 different age categories in each group<br>correct height or angle<br>labels m and f, percentage, drivers, y, m elderly   | M1<br>A1<br>B1<br>B1 <b>4</b>           | 3 lots of 2 or 2 lots of 3, bars, lines or sectors<br>one category touching, not superimposed, one category not touching, bars equal width<br>accept pie chart visually correct   |
| <b>2 (i)</b> $P(T, T) = \frac{1}{3} \times \frac{6}{10} \times \frac{5}{9} + \frac{1}{3} \times \frac{5}{8} \times \frac{4}{7} + \frac{1}{3} \times \frac{3}{10} \times \frac{2}{9}$<br>$= 53/210 \quad (0.252)$   | B1<br>M1<br>A1 <b>3</b>                 | For one correct 3-factor term<br>For summing three 3-factor or 2-factor probs<br>For correct answer   |
| <b>(ii)</b> $P(A \text{ TT}) = 0.111/0.252$<br>$= 70/159 \quad (0.440)$  | M1<br>M1<br>A1 <b>3</b>                 | For choosing only their $P(A \text{ T T})$ in num or denom<br>For dividing by their (i) or what they think is $P(T, T)$<br>For correct answer using either 2 or 3-term probs<br>Constant prob B0M1A0M1M1A0 max  |
| <b>3 (i)</b> ${}_{13}P_9 = 259,459,200$ or $259,000,000$   | M1<br>A1 <b>2</b>                       | For using a permutation involving 13<br>For correct answer  |
| <b>(ii)</b> $10!$ or ${}_{10}P_9 = 3628800$  | M1<br>M1<br>A1 <b>3</b>                 | For using a 10<br>For using a 9!<br>For correct answer  |
| <b>(iii)</b> $1 - (\text{ii}) / (\text{i})$<br>$= 0.986$   | M1<br>A1ft <b>2</b>                     | For a subtraction of a suitable prob $< 1$ , from 1<br>For correct answer, ft on their (i) and (ii)   |
| <b>4 (i)</b> $(41.2 \times 10 + 46.3 \times 13) / 23$<br>$= 44.1$  | M1<br>A1 <b>2</b>                       | For multiplying by 10 and 13 respectively and dividing by 23<br>For correct answer  |
| <b>(ii)</b> $15.1^2 = \frac{\sum x_w^2}{10} - 41.2^2$<br>$\sum x_w^2 = 19254.5$<br>$12.7^2 = \frac{\sum x_m^2}{13} - 46.3^2$<br>$\sum x_m^2 = 29964.74$<br>Total $\Sigma = 49219.24$<br>$sd = \sqrt{\left( \frac{49219.24}{23} - 44.1^2 \right)} = 14.0$ | M1<br>A1<br><br>A1<br>M1<br>A1 <b>5</b> | For correct substitution from recognisable formula with or without sq rt<br>For correct $\sum x_w^2$ (can be rounded)<br><br>For correct $\sum x_m^2$ (can be rounded)<br>For using 23 and their answer to (i) in correct formula<br>For correct answer |

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|   |                          |          |  |       |    |            |     |       |       |       |                      |          |   |
|---|--------------------------|----------|--|-------|----|------------|-----|-------|-------|-------|----------------------|----------|---|
| <b>5 (i)</b> P(no orange) = $(2/3)^5$ or 0.132 or 32/243  | B1                       | <b>1</b> | For correct final answer either as a decimal or a fraction   |       |    |            |     |       |       |       |                      |          |   |
| <b>(ii)</b> P(2 end in 6) = $(1/10)^2 \times (9/10)^3 \times {}_5C_2$<br><br>= 0.0729   | B1<br>M1<br><br>A1       | <b>3</b> | For using $(1/10)^k \quad k>1$<br>For using a binomial expression with their 1/10 or seeing some $p^2 \times (1-p)^3$<br>For correct answer  |       |    |            |     |       |       |       |                      |          |   |
| <b>(iii)</b> P(2 orange end in 6) = $(1/30)^2 \times (29/30)^3 \times {}_5C_2$<br><br>= 0.0100 accept 0.01  | M1<br><br>A1             | <b>2</b> | For their (1/10)/3 seen<br><br>For correct answer  |       |    |            |     |       |       |       |                      |          |   |
| <b>(iv)</b> $n = 5, p = 1/3,$<br>mean = 5/3, variance = 10/9  | B1<br>B1 ft              | <b>2</b> | For recognising $n=5, p = 1/3$<br>For correct mean and variance, ft their $n$ and $p, p<1$   |       |    |            |     |       |       |       |                      |          |   |
| <b>6 (i)</b> \$2  | B1                       | <b>1</b> | For correct answer   |       |    |            |     |       |       |       |                      |          |   |
| <b>(ii)</b> P(MMMH) +P(MMMM)<br>= $0.8^3 \times 0.2 + 0.8^4 \times 0.2 = 0.184$ <b>AG</b>   | M1<br>A1                 | <b>2</b> | For attempting to sum P(MMMH) and P(MMMM)<br>For correct answer  |       |    |            |     |       |       |       |                      |          |   |
| <b>(iii)</b> <table border="1"><tr><td><math>x</math></td><td>4</td><td>2</td><td>0</td><td>-1</td></tr><tr><td><math>P(X = x)</math></td><td>0.2</td><td>0.288</td><td>0.184</td><td>0.328</td></tr></table> | $x$                      | 4        | 2  | 0     | -1 | $P(X = x)$ | 0.2 | 0.288 | 0.184 | 0.328 | B1<br>B1ft<br><br>B1 | <b>3</b> | For one correct prob other than 0.184<br>For another correct prob other than 0.184, ft only if the -1 ignored and their 3 <sup>rd</sup> prob is $1 - \Sigma$ the other 2<br>For correct table, can have separate 2s |
| $x$   | 4                        | 2        | 0  | -1    |    |            |     |       |       |       |                      |          |   |
| $P(X = x)$  | 0.2                      | 0.288    | 0.184  | 0.328 |    |            |     |       |       |       |                      |          |   |
| <b>(iv)</b> $E(X) = 0.8 + 0.576 - 0.328$<br>= \$1.05  | M1<br>A1                 | <b>2</b> | For attempt at $\Sigma xp$ from their table, at least 2 non-zero terms<br>For correct answer   |       |    |            |     |       |       |       |                      |          |   |
| <b>7 (i)</b> $1.282 = (5130-\mu)/ 40.6$<br><br>$\mu = 5080$ (5078) rounding to 5080   | B1<br>M1<br><br>A1       | <b>3</b> | For $\pm 1.282$ seen, or 1.28, 1.281, not 1.29 or 1.30<br>For standardising, with or without sq rt, squared, no cc<br>For correct answer   |       |    |            |     |       |       |       |                      |          |   |
| <b>(ii)</b> P(<5000) = $\Phi[(5000-5078)/ 40.6]$<br>= $\Phi(-1.921)$<br>= $1 - 0.9727$<br>= 0.0273 or 2.73%   | M1<br>M1<br><br>A1       | <b>3</b> | For standardising, criteria as above, can include cc<br>For correct area found using tables ie < 0.5ft on wrong (i)<br>For correct answer, accept 0.0274   |       |    |            |     |       |       |       |                      |          |   |
| <b>(iii)</b> $\mu = 60, \text{ var} = 54$<br>$P(\text{fewer than } 65) = \Phi(64.5 - 60) / \sqrt{54}$<br>= $\Phi(0.6123)$<br><br>= 0.730 accept 0.73  | B1<br>M1<br>M1<br><br>A1 | <b>4</b> | For 60 and 54 seen (could be sd or variance)<br>For using 64.5 or 65.5 in a standardising process<br>For standardising, must have $\sqrt{\hspace{0.5em}}$ ( their 54) in denom<br><br>For correct answer |       |    |            |     |       |       |       |                      |          |   |