

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

MARK SCHEME for the October/November 2008 question paper

9709/06

9709 MATHEMATICS

Paper 6, maximum raw mark 50

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.

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.

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

CIE is publishing the mark schemes for the October/November 2008 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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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.

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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)

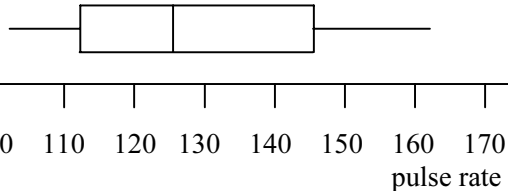
Penalties

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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<p>1 mean = 38.4 mm</p> <p>sd = 4.57 mm c.a.o</p>	<p>B1 M1 A1 [3]</p>	<p>Correct answer Correct method if shown (can be implied) must see a $\sqrt{\quad}$ sign Correct answer</p>
<p>2 mean = $200 \times 0.08 = 16$ var = 14.72</p> $P(X \geq 15) = 1 - \Phi\left(\frac{14.5 - 16}{\sqrt{14.72}}\right)$ <p>= $\Phi(0.391)$ = 0.652</p>	<p>B1 M1 M1 M1 A1 [5]</p>	<p>For both 16 and 14.7 seen</p> <p>For standardising, with or without cc, must have $\sqrt{\quad}$ in denom</p> <p>For use of continuity correction 14.5 or 15.5</p> <p>For finding a prob > 0.5 from their z, legit For answer rounding to 0.652 c.w.o</p>
<p>3 (i) $P(X > 0) = 1 - \Phi\left(\frac{0 - -15.1}{\sqrt{62}}\right)$</p> <p>= $1 - \Phi(1.918)$ = $1 - 0.9724$ = 0.0276 or answer rounding to</p>	<p>M1 M1 A1 [3]</p>	<p>Standardising, sq rt, no cc</p> <p>Prob < 0.5 after use of normal tables</p> <p>Correct answer</p>
<p>(ii) $z = -1.22$ $-1.22 = \frac{0 - \mu}{\sqrt{40}}$ $\mu = 7.72$ c.a.o</p>	<p>B1 M1 A1 [3]</p>	<p>$z = \pm 1.22$</p> <p>an equation in μ, recognisable z, $\sqrt{40}$, no cc</p> <p>correct answer c.w.o from same sign on both sides</p>
<p>4 (i) $\frac{12!}{2!2!3!4!} = 831600$</p>	<p>M1 A1 [2]</p>	<p>Dividing by 3! 4! and 2! once or twice o.e Correct final answer</p>
<p>(ii) $\frac{6!}{4!2!} \times \frac{6!}{2!3!}$</p> <p>= 900</p>	<p>B1 M1 A1 [3]</p>	<p>$\frac{6!}{4!2!}$ and $\frac{6!}{2!3!}$ seen o.e</p> <p>multiplying their numbers for group 1 with their numbers for group 2 correct final answer</p>
<p>(iii) $2 \times 3 \times {}_7C_2$ or $2 \times 3 \times 21$</p> <p>= 126</p>	<p>M1 A1 [2]</p>	<p>${}_7C_2$ seen multiplied or 5 options added correct final answer</p>

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<p>5 (i)</p> <table style="border-collapse: collapse;"> <tr><td style="padding-right: 10px;">10</td><td style="border-left: 1px solid black; padding-left: 5px;">4 4 9</td></tr> <tr><td>11</td><td style="border-left: 1px solid black; padding-left: 5px;">5 7</td></tr> <tr><td>12</td><td style="border-left: 1px solid black; padding-left: 5px;">0 4 5</td></tr> <tr><td>13</td><td style="border-left: 1px solid black; padding-left: 5px;">2 4</td></tr> <tr><td>14</td><td style="border-left: 1px solid black; padding-left: 5px;">2 5</td></tr> <tr><td>15</td><td style="border-left: 1px solid black; padding-left: 5px;">8</td></tr> <tr><td>16</td><td style="border-left: 1px solid black; padding-left: 5px;">0 8</td></tr> </table> <p>key 10 4 represents 104</p>	10	4 4 9	11	5 7	12	0 4 5	13	2 4	14	2 5	15	8	16	0 8	<p>B1</p> <p>B1</p> <p>B1 [3]</p>	<p>Correct stem</p> <p>Correct leaves, must be sorted and in columns and give correct overall shape</p> <p>Key, must have vertical line in both</p>
10	4 4 9															
11	5 7															
12	0 4 5															
13	2 4															
14	2 5															
15	8															
16	0 8															
<p>(ii) median = 125 LQ = 115 UQ = 145</p>	<p>B1</p> <p>B1 [2]</p>	<p>Any 2 correct values seen</p> <p>third correct value</p>														
<p>(iii)</p> 	<p>B1</p> <p>B1 ft</p> <p>B1 [3]</p>	<p>correct uniform scale from at least 110 to 160 with room for end points, and label or title</p> <p>correct median and quartiles on diagram fit their values (must be box ends)</p> <p>correct whiskers, no line through box, touching box in the middle not the top or bottom</p>														

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<p>6 (i)</p>	<p>B1 B1 [2]</p>	<p>Correct shape and labels Correct probabilities</p>
<p>(ii) $P(S, S, NS) = 0.4 \times 0.8 \times 0.7$ $= 0.224$ (28/125)</p>	<p>M1 A1 [2]</p>	<p>Multiplying 3 probs once and 0.7 seen Correct answer</p>
<p>(iii) $P(S, NS, S) + P(NS, S, S) + 0.224$ $= 0.392$ (49/125)</p>	<p>M1 B1 A1 [3]</p>	<p>Summing three different 3-factor terms Correct expression for $P(S, NS, S)$ or $P(NS, S, S)$ Correct answer</p>
<p>(iv) $P(\text{stops at first light} \mid \text{stops at exactly 2 lights})$ $= P \frac{(S, NS, S) \text{ or } (S, S, NS)}{0.392}$ $= \frac{0.4 \times 0.2 \times 0.3 + 0.4 \times 0.8 \times 0.7}{0.392}$ $= 0.633$ (31/49)</p>	<p>M1 M1* dep A1ft [3]</p>	<p>Summing two 3-factor terms in numerator (need not be different) (must be a division) Dividing by their (iii) if their (iii) < 1, dep on previous M ft their $E(X)$ provided $2 < E(X) < 12$</p>

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<p>7 (i) $P(\text{odd}) = 2/3$ or 0.667 $P(7) = {}_8C_7 \times (2/3)^7 (1/3)$ $= 0.156$ $P(8) = (2/3)^8 = 0.0390$ $P(7 \text{ or } 8) = 0.195$ (1280/6561)</p>	<p>B1 M1 M1 A1 [4]</p>	<p>Can be implied if normal approx used with $\mu = 5.333 (= 8 \times 2/3)$ Binomial expression with C in and 2/3 and 1/3 in powers summing to 8 Summing $P(7) + P(8)$ binomial expressions Correct answer</p>																						

<p>(ii)</p> <table border="1" data-bbox="140 629 692 734"> <tr> <td>x</td> <td>2</td> <td>4</td> <td>6</td> <td>7</td> <td>8</td> </tr> <tr> <td>$P(X=x)$</td> <td>1/36</td> <td>2/36</td> <td>5/36</td> <td>4/36</td> <td>4/36</td> </tr> </table> <table border="1" data-bbox="140 763 692 869"> <tr> <td>x</td> <td>9</td> <td>10</td> <td>11</td> <td>12</td> </tr> <tr> <td>$P(X=x)$</td> <td>4/36</td> <td>4/36</td> <td>8/36</td> <td>4/36</td> </tr> </table>	x	2	4	6	7	8	$P(X=x)$	1/36	2/36	5/36	4/36	4/36	x	9	10	11	12	$P(X=x)$	4/36	4/36	8/36	4/36	<p>B1 B2 [3]</p>	<p>Values of x all correct in table of probabilities All probs correct and not duplicated, –1 ee</p>
x	2	4	6	7	8																			
$P(X=x)$	1/36	2/36	5/36	4/36	4/36																			
x	9	10	11	12																				
$P(X=x)$	4/36	4/36	8/36	4/36																				

<p>(iii) $E(X) = \sum p_i x_i$ $= 2 \times 1/36 + 4 \times 2/36 + \dots$ $= 312/36$ (26/3) (8.67)</p>	<p>M1 A1 [2]</p>	<p>attempt to find $\sum p_i x_i$, all $p < 1$ and no further division of any sort correct answer</p>																						

<p>(iv) $P(X > E(X)) = P(X = 9, 10, 11, 12)$ $= 20/36$ (5/9) (0.556)</p>	<p>M1 A1 [2]</p>	<p>attempt to add their relevant probs correct answer</p>																						