

**MARK SCHEME for the May/June 2010 question paper**  
**for the guidance of teachers**

**9709 MATHEMATICS**

**9709/63**

Paper 63, 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, 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.

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

CIE is publishing the mark schemes for the May/June 2010 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**

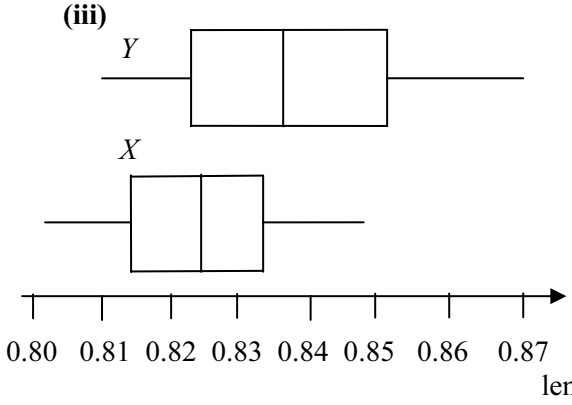
MR –1	A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become “follow through $\sqrt{}$ ” marks. MR is not applied when the candidate 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><b>1</b> <math>\frac{{}^{13}C_3 \times {}^{39}C_4}{{}^{52}C_7}</math></p> <p>= 0.176</p> <p><b>OR</b> P(RRR) =</p> $\frac{13}{52} \times \frac{12}{51} \times \frac{11}{50} \times \frac{39}{49} \times \frac{38}{48} \times \frac{37}{47} \times \frac{36}{46} \times {}^7C_3$ <p>= 0.176</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>Using combinations with attempt to evaluate product of 2 in num and only 1 in denom</p> <p>Correct numerator or denominator</p> <p>Correct answer</p> <p><b>OR</b> Multiplying 3 unequal red probs with 4 unequal non-red probs</p> <p>Multiplying a probability by <math>{}^7C_3</math></p> <p>Correct answer</p>
<p><b>2 (i)</b> <math>\bar{x} = 130 - 287/82</math></p> <p>= 126.5 (126, 127) cm</p>	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>287/82 seen added or subtr to 130</p> <p>OR 287 seen added or subtr to <math>82 \times 130</math></p> <p>Correct answer</p>
<p><b>(ii)</b> <math>\frac{\Sigma(x-130)^2}{82} - (-3.5^2) = 6.9^2</math></p> <p><math>\Sigma(x-130)^2 = 4908.5</math> cm (4910)</p>	<p>M1</p> <p>A1</p> <p>[2]</p>	<p><math>6.9^2 + (\pm \text{their coded mean})^2</math> seen or implied</p> <p>correct answer</p>
<p><b>3 (i)</b> <math>P(&gt; 5) = {}^7C_6(0.6)^6(0.4) + (0.6)^7</math></p> <p>= 0.1306 + 0.02799</p> <p>= 0.159</p>	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>Summing 2 or 3 binomial probs of the form <math>{}^7C_r(0.6)^r(0.4)^{7-r}</math></p> <p>Correct answer</p>
<p><b>(ii)</b> P(bark) = P(park, bark) + P(not park, bark)</p> <p>= <math>0.6 \times 0.35 + 0.4 \times 0.75</math></p> <p>= 0.51</p>	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>Summing two appropriate 2-factor probabilities</p> <p>Correct answer</p>
<p><b>(iii)</b> Variance (number of times) = 7.2</p>	<p>B1</p> <p>[1]</p>	<p>Correct final answer</p>

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<p>4 (i) ends cola, <math>5!/2!2! = 30</math> ends green tea, <math>5!/3!2! = 10</math> ends orange juice, <math>5!/3!2! = 10</math> total = 50 ways</p> <p>OR <math>P(\text{ends same}) = \frac{3}{7} \times \frac{2}{6} + \frac{2}{7} \times \frac{1}{6} + \frac{2}{7} \times \frac{1}{6}</math></p> $= \frac{5}{21}$ $\frac{5}{21} \times \frac{7!}{3!2!2!} = 50 \text{ ways}$	<p>M1 A1 A1  M1 A1 A1  [3]</p>	<p>Considering all three options Any one option correct Correct answer  OR Considering all three options Correct fraction Correct answer</p>										
<p>(ii) colas together, no restrictions, <math>5!/2!2! = 30</math> ways colas together and green tea together, <math>4!/2! = 12</math> ways <math>30 - 12 = 18</math> ways.</p> <p>OR<sub>1</sub> Attempt to list</p> <p>OR<sub>2</sub> <math>3 \times \frac{4 \times 3}{2} = 18</math></p>	<p>M1 A1 M1 A1 A1  M1A1 M1A1 A1  M1 A1 M1 A1 A1  [5]</p>	<p>Considering all colas together, or 5! seen Correct answer Considering all colas tog and all green tea tog, or 4! seen Correct answer Correct final answer  OR<sub>1</sub> 10 or more, 12 or more correct 14 or more, 16 or more correct 18 correct  OR<sub>2</sub> Considering all colas together, or 3! seen 3 ways for colas and orange juice Considering green teas not together <math>4 \times 3</math> or <math>(4 \times 3)/2</math> Correct final answer</p>										
<p>5 (i) <math>P(2) = P(0,2) + P(2,0)</math> <math>= \frac{6}{10} \times \frac{3}{7} + \frac{3}{10} \times \frac{4}{7}</math> <math>= \frac{30}{70} = \frac{3}{7}</math> AG</p>	<p>M1 A1  [2]</p>	<p>Summing two 2-factor probabilities Correct answer legit obtained</p>										
<p>(ii)</p> <table border="1" data-bbox="245 1554 796 1626"> <tr> <td><math>x</math></td> <td>0</td> <td>2</td> <td>4</td> <td>6</td> </tr> <tr> <td><math>P(X = x)</math></td> <td><math>\frac{24}{70}</math></td> <td><math>\frac{30}{70}</math></td> <td><math>\frac{13}{70}</math></td> <td><math>\frac{3}{70}</math></td> </tr> </table>	$x$	0	2	4	6	$P(X = x)$	$\frac{24}{70}$	$\frac{30}{70}$	$\frac{13}{70}$	$\frac{3}{70}$	<p>B1 B1  [2]</p>	<p>Correct values for rv <math>X</math> Correct probs</p>
$x$	0	2	4	6								
$P(X = x)$	$\frac{24}{70}$	$\frac{30}{70}$	$\frac{13}{70}$	$\frac{3}{70}$								
<p>(iii) <math>E(X) = \frac{13}{7}</math> <math>\text{Var}(X) = \frac{120}{70} + \frac{208}{70} + \frac{108}{70} - (\frac{13}{7})^2</math> <math>= 2.78</math></p>	<p>B1ft M1 A1  [3]</p>	<p>Using variance formula correctly with mean<sup>2</sup> subtracted numerically, no extra division Correct final answer</p>										
<p>(iv) <math>P(A2 \mid \text{Sum } 2) = \frac{\frac{3}{10} \times \frac{4}{7}}{\frac{30}{70}}</math> <math>= 0.4</math></p>	<p>M1 A1  [2]</p>	<p>Correct numerator with a <math>0 &lt; \text{denom} &lt; 1</math> Correct answer</p>										

<p>6 (i) for <math>X</math>: Median = 0.825 cm IQ range = 0.019 cm (0.833 – 0.814)</p>	<p>B1 B1 [2]</p>	<p>Correct median Correct IQ range</p>
<p>(ii) <math>q = 4</math> <math>r = 2</math>  SR <math>q = 0.824</math> and <math>r = 0.852</math></p>	<p>B1 B1 [2] B1</p>	<p>Must be 4 and 2 not 3 and 1</p>
<p>(iii)</p>  <p>0.80 0.81 0.82 0.83 0.84 0.85 0.86 0.87 length in cm</p>	<p>B1  B1 ft  B1 ft  B1 [4]</p>	<p>Labels <math>X</math>, <math>Y</math> and length/cm, linear scale from 0.80 to 0.87 and both on one diagram  Correct median and quartiles for <math>X</math> ft theirs must be a box  Correct median and quartiles for <math>Y</math> ft theirs must be a box  Whiskers correct no line through middle</p>
<p>(iv) <math>Y</math> has longer insects on average <math>Y</math> has larger range</p>	<p>B1 B1 [2]</p>	<p>Correct statement about lengths Correct statement about spreads</p>
<p>7 (i) <math>0.431 = \frac{135 - \mu}{\sigma}</math>  <math>-0.842 = \frac{127 - \mu}{\sigma}</math>  <math>\sigma = 6.29</math> <math>\mu = 132</math></p>	<p>B1  B1  M1   A1 A1 [5]</p>	<p>One <math>\pm z</math>-value correct, accept 0.430  A second <math>\pm z</math>-value correct  Solving two equations relating <math>\mu</math>, <math>\sigma</math>, 135, 127 and their <math>z</math>-values (must be <math>z</math>-values)  Correct answer accept 6.28 Correct answer</p>
<p>(ii) <math>P(X &lt; 145) = P\left(z &lt; \frac{145 - 132.3}{6.284}\right)</math> <math>= P(z &lt; 2.023)</math> <math>= 0.978</math></p>	<p>M1  M1 A1 [3]</p>	<p>Standardising no sq rt no cc  Correct use of normal tables Answer rounding to 0.978 or 0.979</p>
<p>(iii) <math>p = 1/3</math> <math>P(\text{at least } 2) = 1 - P(0, 1)</math>  <math>= 1 - [(2/3)^8 + {}^8C_1 \times (1/3)^1 (2/3)^7]</math>  <math>= 0.805</math></p>	<p>M1  A1  A1 [3]</p>	<p>Binomial expression with powers summing to 8 and <math>{}^8C_{\text{something}}</math>. (any <math>p</math>) Correct unsimplified expression  Answer rounding to 0.805</p>