

## **MARK SCHEME for the October/November 2013 series**

### **9709 MATHEMATICS**

**9709/61**

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, 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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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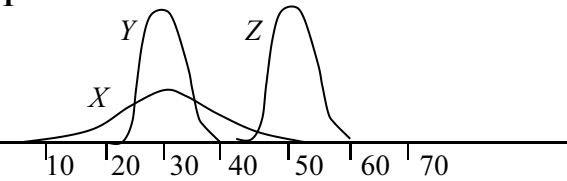
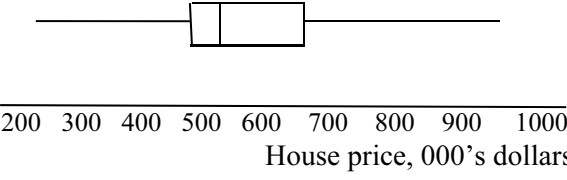
The following abbreviations may be used in a mark scheme or used on the scripts:

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” 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></p> 	<p>B1 B1 B1ft</p>	<p><i>X</i> mean at 30, roughly from 10 to 50 or 15 – 45 <i>Y</i> same mean as <i>X</i> but higher and thinner <i>Z</i> same shape as <i>Y</i> but mean at 50 ft wrong <i>Y</i></p>
<p><b>2</b> either 55/90 (11/18) or 95/160 (19/32) seen</p> <p><math>P(M \text{ and } 18 - 60) = 0.6 \times 55/90</math> <math>= 0.367 (11 / 30)</math></p> <p><math>P(18 - 60) = 0.6 \times 55/90 + 0.4 \times 95/160</math> (= 29/48 or 0.604)</p> <p><math>P(M \mid 18 - 60) = \frac{P(M \cap 18 - 60)}{P(18 - 60)}</math>  <math>= 88/145 (0.607)</math></p>	<p>B1 M1 M1 A1 A1</p>	<p>oe 0.6 mult by 55/90 seen as num / denom of a fraction Summing 2 two-factor products seen anywhere Correct unsimplified answer seen as num/denom of a fraction Correct answer</p>
<p><b>3</b> <math>\Sigma(x - 5) = 116 - 18 \times 5</math> <math>= 26</math></p> <p><math>\frac{\Sigma(x - 5)^2}{18} - \left(\frac{26}{18}\right)^2 = \frac{967}{18} - \left(\frac{58}{9}\right)^2</math></p> <p><math>\Sigma(x - 5)^2 = 257</math></p> <p>OR coded mean = <math>58/9 - 5 = 1.444</math> <math>\Sigma(x - 5) = 1.444 \times 18 = 26</math></p> <p><math>\Sigma(x - 5)^2 = \Sigma x^2 - 10\Sigma x + 25 \times 18</math> <math>= 967 - 1160 + 450 = 257</math></p>	<p>M1 A1 M1 M1 A1 M1 A1 A1</p>	<p>Obtaining <math>\Sigma x</math> and subtracting <math>18 \times 5</math> Correct answer Subst in correct var formula all coded vals Subst in correct var formula all uncoded Correct answer Subtracting 5 from true mean and mult by 18 Correct answer Expanding <math>\Sigma(x-5)^2</math> 3 terms needed Any 2 terms correct Correct answer</p>
<p><b>4 (i)</b></p> 	<p>B1 B1 B1 B1</p>	<p>Linear scale or 5 values shown and labels or in heading, need thousands of dollars, Correct median Correct quartiles Correct end points of whiskers not through box</p>
<p><b>(ii)</b> <math>1.5 \times 170 = 255</math></p> <p>Expensive houses above <math>690 + 170 \times 1.5 = 945</math> i.e. 957 and 986 thousands of dollars</p>	<p>M1 A1</p>	<p>Mult their IQ range by 1.5 Correct answers from correct wkg need thousands of dollars</p>
<p><b>(iii)</b> doesn't show all the data items</p>	<p>B1</p>	<p>Need to see 'individual items' oe</p>

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<p><b>5 (i)</b> <math>z = -1.406</math>  <math>\frac{c-14.2}{3.6} = -1.406</math>  <math>c = 9.14</math></p>	<p>B1 M1 A1</p>	<p>Rounding to <math>\pm 1.41</math> seen Standardising allow sq rt no cc Correct answer</p>
<p><b>(ii)</b> <math>P\left(\frac{15-14.2}{3.6}\right) &lt; z &lt; \left(\frac{16-14.2}{3.6}\right)</math>  <math>= \Phi(0.5) - \Phi(0.222)</math>  <math>= 0.6915 - 0.5879</math>  <math>= 0.1036</math>   <math>P(\text{at least } 2) = 1 - P(0, 1)</math>  <math>= 1 - (0.8964)^7 - (0.8964)^6(0.1036)</math>  <math>= 1 - 0.8413</math>   <math>= 0.159</math></p>	<p>M1 M1 A1 M1 M1 A1</p>	<p>2 attempts at standardising no cc no sq rt Subt two <math>\Phi</math>s (indep mark) Needn't be entirely accurate, rounding to 0.10 Binomial term with <math>{}^7C_r p^r (1-p)^{7-r}</math> seen <math>r \neq 0</math> any <math>p &lt; 1</math> <math>1 - P(0), 1 - P(1), 1 - P(0, 1)</math> seen their <math>p</math> Correct answer accept 3sf rounding to 0.16</p>
<p><b>6 (i)</b> M R O  3 1 <math>2 = {}^7C_3 \times {}^5C_1 \times {}^8C_2 = 4900</math>   3 2 <math>1 = {}^7C_3 \times {}^5C_2 \times {}^8C_1 = 2800</math>   2 2 <math>2 = {}^7C_2 \times {}^5C_2 \times {}^8C_2 = 5880</math>   Total = 13580</p>	<p>M1 M1 A1 A1</p>	<p>Summing more than one 3term option involving combs (can be added) Mult 3 combs only (indep) 1 option correct unsimplified Correct answer</p>
<p><b>(ii)</b> 4 groups in 4! ways  3 mountain in 3! ways  2 ordinary in 2! ways   <math>4! \times 3! \times 2 = 288</math></p>	<p>M1 M1 A1</p>	<p>4! seen mult by something Mult by 3! for racing or 2! for ordinary Correct answer</p>
<p><b>(iii)</b> e.g. s O x x x x O s s s  Ordinary in 2!  Rest of bikes in 4!  Bikes and spaces 5 groups in 5 ways  <math>2! \times 4! \times 5 = 240</math></p>	<p>M1 M1 A1</p>	<p>2! or 4! seen mult Mult by 5 (sssb) Correct answer</p>

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7	<b>(i)</b> if throw H then smallest score is 2 $P(T, 1) = 1/2 \times 1/4 = 1/8$ <b>AG</b>	B1 B1	<b>2</b>	Or equivalent																		
	<b>(ii)</b> $P(3)$ from two dice = $2/16$ seen  $P(H, 3) = 1/2 \times 2/16 = 2/32$ $P(T, 3) = 1/2 \times 1/4 = 1/8$ So $P(3) = 6/32 = 3/16$ <b>AG</b>	B1  M1 A1 A1	<b>4</b>	From (1, 2) and (2, 1)  Summing $P(H, 3)$ and $P(T, 3)$ One correct Correct answer must see clear reasoning																		
	<b>(iii)</b> <table border="1" style="width: 100%; text-align: center;"> <tr> <td><math>X</math></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> </tr> <tr> <td>Prob</td> <td></td> <td>5/32</td> <td></td> <td>7/32</td> <td></td> <td>3/32</td> <td></td> <td></td> </tr> </table>	$X$	1	2	3	4	5	6	7	8	Prob		5/32		7/32		3/32			B1 B1 B1	<b>3</b>	One correct prob A second correct prob A third correct prob
	$X$	1	2	3	4	5	6	7	8													
Prob		5/32		7/32		3/32																
<b>(iv)</b> $P(Q \cap R) = 0$ or 'if you throw a tail you can't get a 7'  Yes they are exclusive	M1  A1dep	<b>2</b>	Stating $P(Q \cap R) = 0$ or implying by words  Dep on previous M																			