

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

9709 MATHEMATICS

9709/62

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 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.

Cambridge is publishing the mark schemes for the May/June 2011 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)

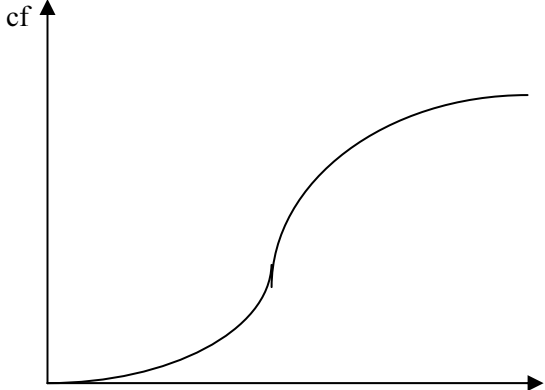
Penalties

- 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 ✓” 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 $20p = 4.8$ $p = 0.24$ or $4.8/20$ $P(0, 1, 2) = (0.76)^{20} + {}^{20}C_1(0.24)^1(0.76)^{19}$ $+ {}^{20}C_2(0.25)^2(0.76)^{18}$ $= 0.109$</p> <p>SR max 3 out of 4</p>	<p>B1 M1 A1 A1 [4] B1 M1 A1</p>	<p>Correct value for p Summing 2 or 3 binomial probs o.e., any $p, n = 5$ or 20 Correct unsimplified answer Correct answer</p> <p>As above Using $N(4.8, 3.648)$ with cc 2.5 or 3.5 0.114 seen</p>
<p>2 (i) $np = 24, npq = 4.8$</p> $z = \pm \left(\frac{24.5 - 24}{\sqrt{4.8}} \right) = 0.228$ <p>Prob = 0.590</p>	<p>B1 M1 M1 A1 [4]</p>	<p>24 and 4.8 or $\sqrt{4.8}$ seen can be unsimplified</p> <p>Standardising, need sq rt, cc not necessary Continuity correction 24.5 or 25.5 used Correct answer must be from 24.5</p>
<p>(ii) np and nq both > 5.</p>	<p>B1 [1]</p>	<p>Need both</p>
<p>3 (i) Mean = $45 - 148/36 = 40.9$ or $1472/36$ <i>EITHER</i> Var = $3089/36 - (-148/36)^2 = 68.9$ sd = 8.30</p> <p><i>OR</i> $\Sigma x^2 = 3089 - 36 \times 45^2 + 90 \times 1472 = 62669$ Var = $\left(\frac{62669}{36} - \left(\frac{1472}{36} \right)^2 \right)$ sd = 8.30</p>	<p>B1 M1 A1 [3] M1 A1</p>	<p>Correct answer</p> <p>$3089/36 - (\pm \text{their coded mean})^2$ Correct answer</p> <p>Expanding $\Sigma(x - 45)^2$ with at least 2 terms correct and solving, then substituting their Σx^2 in correct variance formula with their mean² subst numerically</p> <p>Correct answer</p>
<p>(ii) New $\Sigma(x - 45) = -148 - 16 = -164$ New $\Sigma(x - 45)^2 = 3089 + 16^2 = 3345$ New sd = $\sqrt{3345/37 - (-164/37)^2}$ = 8.41</p> <p><i>OR</i> $\Sigma x = 36 \times 45 - 148 = 1472$ New $\Sigma x = 1472 + 29 = 1501$ $\Sigma x^2 = 3089 - 36 \times 45^2 + 90 \times 1472 = 62669$ New $\Sigma x^2 = 62669 + 29^2 (= 63510)$</p> <p>New sd = $\sqrt{63510/37 - (1501/37)^2}$ = 8.41</p>	<p>M1 M1 M1 A1 [4] M1 M1 M1 A1</p>	<p>Adding their coded new value to -148 Adding their (coded value)² to 3089</p> <p>Subst in coded var formula, can have one of 29 and one of -16 here Correct answer</p> <p>Finding Σx and adding 29</p> <p>Finding Σx^2 and adding 29^2, at least 2 terms of $3089, 36 \times 45^2, 90 \times 1472$</p> <p>Subst their values in correct var formula Correct answer</p>

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<p>4 (i) 90720</p> <hr/> <p>(ii) 3 vowels together $= 3! \times 7!/2!2! = 7560$</p> <p>Prob(not together) = $\frac{90720 - 7560}{90720} = \frac{83160}{90720}$</p> <p>$= 0.917 (=11/12)$</p>	<p>B1 [1]</p> <hr/> <p>B1 B1 M1 A1 [4]</p>	<p>Not 9!/2!2!</p> <hr/> <p>3! oe seen multiplied by integer oe 7 or 6! seen multiplied as a num</p> <p>Subt from their (i) or dividing by their (i) or 1 – prob</p> <p>Correct answer from correct working</p>
<p>(iii) One S in 5C_3 ways = 10 SS in 5C_2 ways = 10 Total = 20</p> <p>OR 6C_3</p> <p>= 20</p>	<p>M1 M1 A1 [3]</p> <hr/> <p>M1 M1 A1</p>	<p>5C_3 seen added 5C_2 seen added Correct answer</p> <hr/> <p>${}^6C_3 \times 2$ or $\div 2$ or $\times 1$ seen 6C_3 only Correct answer</p>
<p>5 (i)</p> 	<p>M1 M1 M1 A1 [4]</p>	<p>Attempt at cf table (up to 200)</p> <p>Linear scale minimum 0 to 200 and 20 to 80, and labels</p> <p>Attempt to plot points at (20.5, 10), (40.5, 42), (50.5, 104), (60.5, 154), (70.5, 182), (90.5, 200), accept (20, 10), (40, 42) or (21, 10), (41, 42) etc</p> <p>All points correct and joined up, allow (0, 0) or (0.5, 0)</p>
<p>(ii) Line on graph up from 30</p> <p>$200 - 20 = 180$</p> <p>OR using lin int $10 + \frac{(30 - 20.5)}{20} \times 32 = 25.2$</p> <p>= 174.8</p>	<p>M1 A1 [2] M1 A1</p>	<p>Line or mark seen, can be implied if matches graph and in range</p> <p>Accept 174 – 180 if reading from graph</p> <p>Can have 20 or 20.5</p> <p>Accept decimals, 174 – 175 if using lin int</p>
<p>(iii) Line on graph across from 150</p> <p>59 rooms</p> <p>OR lin int $50.5 + 46/50 \times 10$</p> <p>= 59 or 60</p>	<p>M1 A1 [2] M1 A1</p>	<p>Line or mark seen, can be implied if matches graph and in range. 150 seen and line between 140 and 160</p> <p>Accept 58 – 60</p> <p>Can have 50 or 50.5</p> <p>Must be integer</p>

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<p>6 (i) $z = -1.282$</p> $P(x < 20) = P\left(z < \frac{20 - \mu}{0.8}\right)$ $-1.282 = \frac{20 - \mu}{0.8}$ $\mu = 21.0 \text{ cm (21.0256)}$	<p>B1</p> <p>M1</p> <p>A1 [3]</p>	<p>± 1.282 or ± 1.281 seen</p> <p>Standardising, no cc, must have 0.8, must be a z-value</p> <p>Correct answer</p>																
<p>(ii) $P(21.5 < x < 22.5)$</p> $= P\left(\frac{21.5 - 21.03}{0.8} < z < \frac{22.5 - 21.03}{0.8}\right)$ $= \Phi(1.8375) - \Phi(0.5875)$ $= 0.9670 - 0.7217$ $= 0.2453$ $P(< 2) = P(0) + P(1)$ $= (0.7547)^4 + (0.2453)^1(0.7547)^3 {}^4C_1$ $= 0.746$	<p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1 [6]</p>	<p>2 attempts at standardising with their mean, must have 0.8 oe</p> <p>Subtracting 2 Φs ft their mean</p> <p>Needn't be entirely accurate, rounding to 0.24 or 0.25</p> <p>Binomial term with ${}^4C_r p^r (1-p)^{4-r}$ seen $r \neq 0$, any $p < 1$</p> <p>Bin expression for $P(0) + P(1)$, any $p < 1$</p> <p>Accept 3sf rounding to 0.75</p>																
<p>7 (i) $P(6) = P(3, 9) + P(9, 3) = 2/25 = 0.08$ AG</p>	<p>B1 [1]</p>	<p>Accept 2/25 seen</p>																
<p>(ii)</p> <table border="1" data-bbox="225 1070 778 1137"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>Prob</td> <td>0.2</td> <td>0.24</td> <td>0.08</td> <td>0.08</td> <td>0.16</td> <td>0.16</td> <td>0.08</td> </tr> </table>	x	0	1	2	3	4	5	6	Prob	0.2	0.24	0.08	0.08	0.16	0.16	0.08	<p>M1</p> <p>A1 [2]</p>	<p>Values 0 – 6 seen could be in list</p> <p>All correct</p>
x	0	1	2	3	4	5	6											
Prob	0.2	0.24	0.08	0.08	0.16	0.16	0.08											
<p>(iii) Mean = $\sum xp = 2.56$ (64/25)</p>	<p>B1 [1]</p>																	
<p>(iv) $P(4, 5, 6) = 0.4(10/25)$ or $0.16 + 0.16 + 0.08$</p> $= P(\text{draw}) \times 0.4$ $= 0.2 \times 0.4 = 0.08$ (2/25)	<p>B1 ft</p> <p>M1</p> <p>A1ft [3]</p>	<p>ft their $P(4, 5, 6)$ providing $p < 1$</p> <p>Multiplying by their $P(\text{draw})$ providing $p < 1$</p> <p>Correct answer</p>																
<p>(v) $P(\text{J wins on } n\text{th go})$</p> $= (0.2)^{n-1} \times 0.4$ oe	<p>M1</p> <p>A1ft [2]</p>	<p>Mult by any p^n or p^{n-1}, $p < 1$</p> <p>ft their probs</p>																