

Cambridge International Examinations

Cambridge International Advanced Subsidiary and Advanced Level

MATHEMATICS
Paper 6
MARK SCHEME
Maximum Mark: 50

Published

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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9709	63

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
 [↑] 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.

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9709	63

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.

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9709	63

	Qu		A	Answer			Ma	rks	Guidance
1	(i)	RH	Wears specs	Not wears specs	Total 25		B1		One correct row or col including total
		Not RH	2	3	5				other than the Total row/column
		Total	8	22			B1	[2]	All correct
	(ii)	P(X) = 25x	/30, P(Y) = 3	8/30			M1		P(X) or $P(Y)$ from their table or correct from question (denom 30) oe
		` /	(Y) = 25/30 > 6/30 = 1/5 = 1/5			9	M1		Comparing their $P(X) \times P(Y)$ (values substituted) with their evaluated $P(X \cap Y)$ – not $P(X) \times P(Y)$
		Not indep	endent				A1	[3]	
2	(i)	girls					B1		Labels 'time' and 'seconds', 'boys' and 'girls' on correct plots and scaled line
		boys					B1		One box and whisker all correct on graph paper – ignore boy or girl label
		4 6	8 1			econds	B1	[3]	Second box and whisker all correct (on graph paper and ignore boy/girl label) on SAME scaled line.
	(ii)		ler range or	IQ range th	an boys /	girls	B1		Any 2 comments – MUST be a
		median <b< th=""><th>d out oe rally quicke oys median ost symmetr</th><th>(not mean)</th><th>oe</th><th>red oe</th><th>B1</th><th>[2]</th><th>comparison</th></b<>	d out oe rally quicke oys median ost symmetr	(not mean)	oe	red oe	B1	[2]	comparison
3	(i)	P(0) = 6/3	66, P(1) = 10	0/36, $P(2) =$	8/36		B1		Table oe seen with 0, 1, 2, 3, 4, 5 (6 if
							B1		P(6) = 0 Any three probs correct
		P(3) = 6/3	66, P(4) = 4/	2 36, $P(5) = 2$	2/36		M1 A1	[4]	$\Sigma p = 1$ and at least 3 outcomes All probs correct
	(ii)	mean scor	$re = (0 \times 6 + 1)$	×10 +16 +1	8 +16+10)/36	M1		Using $\sum xp$ (unsimplified) on its own – condone
		= 70/36 (3	35/18, 1.94)				A1	[2]	$\sum p \text{ not } = 1$

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9709	63

	Qu	Answer	Ma	rks	Guidance
4	(i)	1845/9 (= 205) $c = 2205 - 205 = 2000$	M1 A1		Accept (1845± anything)/ 9
		OR $\Sigma x = 2205 \times 9 \ (= 19845)$ $\Sigma x - \Sigma c = 1845$ $\Sigma c = 19845 - 1845 = 18000$	M1		For 2205 × 9 seen
		c = 2000	A1	[2]	
	(ii)	$var = \frac{477450}{9} - 205^2$ $= 11025$	M1 A1		For $\frac{477450}{9}$ – (their coded mean) ²
		OR var = $\frac{43857450}{9} - 2205^2$	M1		For their $\Sigma x^2/9 - 2205^2$ where Σx^2 is obtained from expanding $\Sigma (x-c)^2$ with
		= 11025	A1	[2]	$2c\Sigma x$ seen
	(iii)	new total = $2120.5 \times 10 = 21205$ new price = $21205 - 19845$	M1		Attempt at new total
		= 1360	A1	[2]	
5	(i)	z = 1.015	B1		Accept z between ± 1.01 and 1.02
		$1.015 = \frac{70 - 69}{\sigma}$	M1		Standardising
		$\sigma = 0.985 \ (200/203)$	A1	[3]	
	(ii)	58 + 9 = 67	M1		58 + 9 seen or implied (or 69-58 or 69-9)
		$P(>67) = P\left(z > \frac{67 - 69}{0.9852}\right)$	M1		Standardising $\pm z$ no cc allow their sd (must be $\pm ve$)
					Alt. 1 69-58 = 11, P(>9)=P $\left(z > \frac{9-11}{0.9852}\right)$
					Alt.2 69-9 =60, P(>58) =P $\left(z > \frac{58-60}{0.9852}\right)$
		= P(z > -2.03) = 0.9788	M1		Correct prob area
		300×0.9788	M1		Multiply their prob (from use of tables) by 300
		= 293.6 so 293	A1	[5]	- accept 293 or 294 from fully correct working

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9709	63

Qu	Answer	Ma	rks	Guidance
6 (i)	7560 ways	B1	[1]	
(ii)	RxxxxxxG in $\frac{7!}{4!}$	B1		7! alone seen in num or 4! alone in denom Must be in a fraction. $\frac{7!\times 2}{4!\times 2}$ gets full marks
	= 210 ways	B1	[2]	
(iii)	eg EEEExxxxx in $\frac{6!}{2!}$	B1	[2]	6! or 5! \times 6 seen in numerator or on own Can be 6! \times k but not 6! \pm k
	= 360 ways	B1	[2]	
(iv)	1 R eg RVG or RVN or RGN = 3	B1	[1]	
(v)	no Rs eg VGN or 3C3 ways = 1 2 Rs eg RRV or 3C1 ways = 3	M1		Summing at least 2 options for R
	Total = 7	A1 A1	[3]	Correct outcome for no Rs or 2 Rs – evaluated
7 (i)	$ \frac{^{12}C_{8} (\ 0.65)^{8} (0.35)^{4} + ^{12}C_{9} (0.65)^{9} (0.35)^{3} + ^{12}C_{10} }{(0.65)^{10} (0.35)^{2}} $	M1		Bin term with ${}^{12}C_r p^r (1-p)^{12-r}$ seen $r \neq 0$ any $p < 1$
	(0.03)	M1		Summing 2 or 3 bin probs $p = 0.65$ or 0.35 , $n = 12$
	= 0.541	A1	[3]	0.55, 11 12
(ii)	$P(\overline{R}\overline{R}R) = 0.35 \times 0.35 \times 0.35 \times 0.65$	M1		Mult 4 probs either $(0.35)^3(0.65)$ or
	= 0.0279	A1	[2]	$(0.65)^3(0.35)$
(iii)	P(7) = 0.2039 (unsimplified)	B1		$^{12}\text{C}_7 (0.65)^7 (0.35)^5$
	Mean = 250×'0.2039' (= 50.9798) Var = 250×'0.2039' × '(1 – 0.2039)' (= 40.5851)	B1		Correct unsimplified np and npq using 'their 0.2039' but not 0.65 or 0.35
	$P(>54) = P\left(\frac{54.5 - 50.9798}{\sqrt{40.5851}}\right)$	M1		Standardising need sq rt – must be from
		M1		working with 54 cc either 53.5 or 54.5
	$= 1 - \Phi(0.5526) = 1 - 0.7098$	M1		correct area < 0.5 i.e. $1 - \Phi$ - must be from working with 54
	= 0.290	A1	[6]	