MARK SCHEME for the October/November 2013 series

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 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 √ 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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1		$P(x < -2.4) = P\left(z < \frac{-2.4 - 1.5}{3.2}\right)$	M1		Standardising no cc can have sq
		= P(z < -1.219)	M1		Correct area, i.e. < 0.5
		= 1 - 0.8886 = 0.111	A1	[3]	Correct answer rounding to 0.111
2	(i)	P(C ∩ < 50) = $0.35 \times 0.2 = 0.07$	B1	[1]	
-	(1)	1(011 (00) 0.35 0.2 0.07	DI	[-]	
	(ii)	$P(C \mid <50) = \frac{P(C \cap <50)}{P(<50)}$	M1	[4]	Summing three 2-factor products seen anywhere (can omit the 1)
		$= \frac{0.35 \times 0.2}{0.25 \times 0.3 + 0.35 \times 0.2 + 0.4(\times 1)}$	A1		0.545 (unsimplified) seen as num or denom of a fraction
		$=\frac{0.07}{0.545}$	M1		Attempt at P(C \cap < 50) as 2-factor prod only seen as num or denom of a fraction
		= 0.128 (14/109)	A1		Correct answer
3	(i)	z = 0.878	B1		\pm 0.878, 0.88, rounding to 0.88 seen
		$\frac{190-160}{\sigma} = 0.878$	M1		$(190 - 160)/\sigma =$ something
		$\sigma = 34.2$	A1	[3]	Correct answer
	(ii)	P(at least 1) = 1 - P(0)	M1		Using $1 - P(0)$, $1 - P(0, 1)$, P(1,2 12) or P(2, 12) with $p = 0.19$ or 0.81, terms must be
		$= 1 - (0.81)^{12} = 0.920$	A1	[2]	evaluated to get the M1 Correct answer accept 0.92
4	(i)	number = $1.5 \times 50 = 75$ (AG)	B1	[1]	Must see 1.5 × 50
	(ii)	freqs are 10, 25, 50, 75, 30 (15, 15) Mean = $(10 \times 125 + 25 \times 162.5 + 50 \times 187.5 + 75 \times 225 + 30 \times 300)/190$	M1 A1 M1		Attempt at freqs not fd Correct freqs attempt at mid points not cw or ucb or lcb
		$= 40562.5/190 = 213 (213.48 \dots)$	A1		correct mean
		$sd2 = 10 \times 1252 + 25 \times 162.52 + 50 \times 187.52 + 75 \times 2252 + 30 \times 3002)/190 - (213.48)2$	M1		subst their Σfx^2 in correct variance formula
		sd = 46.5 or 46.6	A1	[6]	
	(iii)	have used the mid-point of each interval and not the raw data	B1	[1]	

Page 5		ge 5	Mark Scheme				Syllabus	Paper	
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5	(i)	P(4, 5, 6) $(0.22)^{5}(0.5)$	$= (0.22)^{4}(0.78)^{4}8C4 + (0.22)^{6}(0.78)^{2}8C6$	M1 M1		Bin term with ${}_{8}C_{r} p^{r} (1-p)^{8-r}$ seen $r \neq 0$ any $p < 1$ Summing 2 or 3 bin probs $p = 0.22$,			
		= 0.0763		A1	[3]		n = 8 Correct answer		
	(ii)	mean $= 3$	13 $00 \times 0.13 = 39$ $0 \times 0.13 \times 0.87 = 33.93$	B1 B1ft		Correct prob can be implied Correct unsimplified np and npq ft wrong 0.13			
		P(30 < x)	,	M1		Standardis	ing a value need	l sq rt	
		$\left(\frac{30.3-3}{\sqrt{33.93}}\right)$	$\frac{39}{3} < z < \frac{49.5 - 39}{\sqrt{33.93}} \right)$	M1		Cont correction 30.5 / 31.5 or 48.5/49.5 only			
		$= \Phi(1.80)$	$592 \le z \le 1.8026$) $26) + \Phi(1.4592) - 1$ + 0.9278 - 1 = 0.892	M1 A1	[6]	Correct area $\Phi_1 + \Phi_2 - 1$ oe Rounding to correct answer SC P(31,49)=300C31(0.13) ³¹ (0.87) ²⁶⁹ + +300C49 etc.) B1B1			
6	(i)	1663200		B1	[1]				
	(ii)	M xxxxx		M1		9! or 9P9 seen			
		Number	of ways = $\frac{9!}{3!2!} = 30240$	A1	[2]	Correct answer			
	(iii)		together = $8! \times 4/2!2!$ = 40320	M1 M1		8!/2!2! seen mult by something 4 oe 4!/3! or 4C1 etc. seen mult by something			
		1663200	-40320 = 1622880	B1	[3]	Correct answer SC 7!/2!2! × 8P4 or 7! × 8P4/3! Or 7!/2!2! × 8P4/3! M1			
	(iv)	Exactly 3	2 Es $4C2 = 6$ 5 Es $4C1 = 4$ = 10 ways	M1 B1 A1	[3]	Summing 2 options One option correct Correct answer			
		OR 5C2 = 10		M2 A1		M1 for k5C2 Correct ans			

GCE AS/A LEVEL – October/November 20139709627(i) options (3, 4, 4,) or (4, 3, 4) or (4, 4, 3) Probs ($4/10 \times 6/9 \times 5/8$) $\times 3C1$ = $360/720$ = $\frac{1}{2} AG$ M1 M1 A1Summing three 3-factor options oe $10 \times 9 \times 8$ seen in denom $OR \frac{6C_2 \times 4 C_1}{10 C_3} = \frac{1}{2} AG$ A1[3]Correct answer $OR \frac{6C_2 \times 4 C_1}{10 C_3} = \frac{1}{2} AG$ M1 M1 A1One of 6C2 or 4C1 seen in num $10C3$ in denom Correct answer(ii)B1[4]9, 10, 11, 12 only seen $\underline{sum} 9 10 11 12$ Prob24/720 216/720 360/720 120/720B1 $10 \times 3/9 \times 2/8 = 24/720 (1/30)$ $P(3, 3, 4) = 4/10 \times 3/9 \times 2/8 = 24/720 (1/30)$ $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ $= 216/720 (3/10)$ $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720(1/6)$ B1 Σ all 4 probs = 1(iii) $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ Not indepB1 M1 A1ft[3] $P(R \cap S) = 120/720 \notin P(R) \times P(S)$ Not indep[3] $P(R \cap S) \neq 0$ or there is an overlap between R and S (34,4)B1ft [1][1] Correct answer following correct reasoning ft wrong non zero $P(R \cap S)$	Page 6		Mark Scheme				Syllabus	Paper		
Probs $(4/10 \times 6/9 \times 5/8) \times 3C1$ M1 $= 360/720$ $= \frac{1}{2} AG$ $= \frac{1}{2} AG$ M1 $OR \frac{6C_2 \times 4 C_1}{10 C_3} = \frac{1}{2} AG$ M1 $OR \frac{6C_2 \times 4 C_1}{10 C_3} = \frac{1}{2} AG$ M1M2M1M1M1M2M1M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M3M2M4M2M3M2<		GCE AS/A LEVEL – October/November 2013				r 2013	9709	62		
Probs $(4/10 \times 6/9 \times 5/8) \times 3C1$ M1 $= 360/720$ $= \frac{1}{2} AG$ $= \frac{1}{2} AG$ M1 $OR \frac{6C_2 \times 4 C_1}{10 C_3} = \frac{1}{2} AG$ M1M2(3, 3, 3) = 4/10 \times 3/9 \times 2/8 = 24/720 (1/30)P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1= 216/720 (3/10)P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720 (1/6)M1M1M2P(R \cap S) = 120/720 \neq P(R) \times P(S)Not indepM1M1M1M1M1M1M1M1M1M2M2M3M3M4M4M4M4M4M4M4M4M4M4M4M4M4M4M4M4M4M4<										
$= 360/720$ $= \frac{1}{2} AG$ $OR \frac{6C_2 \times 4C_1}{10C_3} = \frac{1}{2} AG$ $\begin{bmatrix} \text{ii} \\ \hline \text{ii} \\ \hline \text{rescaled} \\ \hline \text{rescaled} \\ \hline \text{ii} \\ \hline \text{rescaled} \\ \hline \text{rescaled}$	7 (i)									
$= \frac{1}{2} AG$ $OR \frac{6C_2 \times 4C_1}{10C_3} = \frac{1}{2} AG$ MI MI MI MI MI MI MI MI		· · ·	· · · · · · · · · · · · · · · · · · ·	M1		$10 \times 9 \times 8$ seen in denom				
OR $\frac{6}{10} \frac{2}{2} + 1}{10} = \frac{1}{2}$ AG M1 A1 10C3 in denom Correct answer (ii) B1 B1 9, 10, 11, 12 only seen $\frac{10}{10} \frac{24}{720} \frac{216}{720} \frac{360}{720} \frac{120}{720} \frac{120}{720}$ B1 B1 One correct prob other than P(11), with or without replacement $P(3, 3, 3) = 4/10 \times 3/9 \times 2/8 = 24/720 (1/30)$ $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ = 216/720 (3/10) $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720(1/6)$ B1 Sale 14 probs = 1 (iii) $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indep B1 [3] $P(R \cap S) = 120/720 (1/6)$ Numerical attempt to compare P(R and with $P(R) \times P(S)$ provided $P(R \cap S) \neq 1/5$ Correct conclusion ft wrong $P(R \cap S) \neq 1/5$ $P(S) correct (iv) P(R \cap S) \neq 0 or there is an overlap between R B1ft [1] Correct answer following correct $			•	A1	[3]	Correct answer				
(ii)A1Correct answer(iii) $\underline{300}$ $\underline{11}$ $\underline{12}$ $\underline{900}$ $\underline{24/720}$ $\underline{216/720}$ $\underline{360/720}$ $\underline{120/720}$ $P(3, 3, 3) = 4/10 \times 3/9 \times 2/8 = 24/720$ $\underline{120/720}$ B1B1 $P(3, 3, 4) = 4/10 \times 3/9 \times 2/8 = 24/720$ $\underline{1300}$ B1One correct prob other than P(11), with or without replacement $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ B1B1S $\underline{14}$ $\underline{9}, 10, 11, 12$ only seen $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ B1B1S $\underline{14}$ $\underline{9}, 10, 11, 12$ only seen $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720(1/6)$ B1S $\underline{14}$ probs = 1(iii) $P(R) = 0.5$ P(S) = 0.4 P(R \cap S) = 120/720B1 $\underline{13}$ $P(R \cap S) = 120/720$ (1/6) $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indepA1ftA1ft $\underline{15}, P(S)$ provided $P(R \cap S) \neq 1/5$ (iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct		$_6C_2$	$\times_4 C_1 \qquad 1$			One of 6C2 or 4C1 seen in num				
(ii)A1Correct answer(iii) $\underline{300}$ $\underline{11}$ $\underline{12}$ $\underline{900}$ $\underline{24/720}$ $\underline{216/720}$ $\underline{360/720}$ $\underline{120/720}$ $P(3, 3, 3) = 4/10 \times 3/9 \times 2/8 = 24/720$ $\underline{120/720}$ B1B1 $P(3, 3, 4) = 4/10 \times 3/9 \times 2/8 = 24/720$ $\underline{1300}$ B1One correct prob other than P(11), with or without replacement $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ B1B1S $\underline{14}$ $\underline{9}, 10, 11, 12$ only seen $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ B1B1S $\underline{14}$ $\underline{9}, 10, 11, 12$ only seen $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720(1/6)$ B1S $\underline{14}$ probs = 1(iii) $P(R) = 0.5$ P(S) = 0.4 P(R \cap S) = 120/720B1 $\underline{13}$ $P(R \cap S) = 120/720$ (1/6) $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indepA1ftA1ft $\underline{15}, P(S)$ provided $P(R \cap S) \neq 1/5$ (iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct		OR —	$\frac{1}{2} = \frac{1}{2} \operatorname{AG}$			10C3 in de	enom			
sum9101112Prob24/720216/720360/720120/720P(3, 3, 3) = 4/10 × 3/9 × 2/8 = 24/720 (1/30) P(3, 3, 4) = 4/10 × 3/9 × 6/8 × 3C1 = 216/720 (3/10) P(4, 4, 4) = 6/10 × 5/9 × 4/8 = 120/720(1/6)B1B1(iii) $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ Not indepB1B1(iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct		10	<i>jc</i> ³ <i>2</i>	A1		Correct an	swer			
Prob $24/720$ $216/720$ $360/720$ $120/720$ B1P(3, 3, 3) = 4/10 × $3/9 \times 2/8 = 24/720$ (1/30) P(3, 3, 4) = 4/10 × $3/9 \times 6/8 \times 3C1$ = 216/720 (3/10) P(4, 4, 4) = 6/10 × $5/9 \times 4/8 = 120/720(1/6)$ B1B1(iii) $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ Not indepB1[3] $P(R \cap S) = 120/720 (1/6)$ Numerical attempt to compare P(R and with P(R) × P(S) provided P(R \cap S) ≠ 1/5 Correct conclusion ft wrong P(R \cap S) ≠ 1/5 (iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]	(ii)			B1	[4]	9, 10, 11,	12 only seen			
P(3, 3, 3) = 4/10 × 3/9 × 2/8 = 24/720 (1/30) P(3, 3, 4) = 4/10 × 3/9 × 6/8 × 3C1 = 216/720 (3/10) P(4, 4, 4) = 6/10 × 5/9 × 4/8 = 120/720(1/6)B1B1(iii) $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ Not indepB1[3] $P(R \cap S) = 120/720 (1/6)$ Numerical attempt to compare $P(R$ and with $P(R) × P(S)$ provided $P(R \cap S) \neq 1/5$ Correct conclusion ft wrong $P(R \cap S) \neq 1/5$, $P(S)$ correct(iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct		-		B1		One correct prob other than $P(11)$, with				
$P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ $= 216/720 (3/10)$ $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720 (1/6)$ $P(R) = 0.5 P(S) = 0.4 P(R \cap S) = 120/720$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$ $P(R \cap S) \neq 0 \text{ or there is an overlap between } R$					or without	r without replacement				
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$				B1		Another co	orrect prob			
P(4, 4, 4) = $6/10 \times 5/9 \times 4/8 = 120/720(1/6)$ B1 Σ all 4 probs = 1(iii)P(R) = 0.5 P(S) = 0.4 P(R \cap S) = $120/720$ B1INot indepB1M1B1I(iv)P(R \cap S) $\neq 0$ or there is an overlap between RB1ftIICorrect answer following correct										
$P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indepM1M1Numerical attempt to compare $P(R \text{ and with } P(R) \times P(S) \text{ provided } P(R \cap S) \neq 1/5$ Correct conclusion ft wrong $P(R \cap S) \neq 1/5$ (iv) $P(R \cap S) \neq 0$ or there is an overlap between RM1Ift(iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct				B1		Σ all 4 pro	bs = 1			
$P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indepA1ftwith $P(R) \times P(S)$ provided $P(R \cap S) \neq 1/5$ Correct conclusion ft wrong $P(R \cap S) \neq 1/5$ (iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct	(iii)	$\mathbf{P}(R)=0.$	5 P(S) = 0.4 P($R \cap S$) = 120/720	B1	[3]	$P(R \cap S) =$	120/720 (1/6)			
Not indepA1ftCorrect conclusion ft wrong $P(R \cap S) \neq 1/5$, $P(S)$ correct(iv) $P(R \cap S) \neq 0$ or there is an overlap between RB1ft[1]Correct answer following correct				M1						
(iv) $P(R \cap S) \neq 0$ or there is an overlap between R B1ft [1] Correct answer following correct										
		Not indep	p	A1ft				ng P($R \cap S$) \neq		
and S (34,4) reasoning ft wrong non zero P($R \cap S$)	(iv)	$P(R \cap S) \neq$	= 0 or there is an overlap between <i>R</i>	B1ft	[1]	Correct an	swer following	correct		
		and <i>S</i> (34	l,4)			reasoning	ft wrong non zer	ro P($R \cap S$)		
Not exclusive $\Sigma xf/\Sigma f$		Not exclu	usive $\Sigma x f / \Sigma f$							