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MATHEMATICS **9709/62**

Paper 6 **October/November 2016**

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.

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 2016 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

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.

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

AEF/OE Any Equivalent Form (of answer is equally acceptable) / Or Equivalent

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

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

SOI Seen or implied

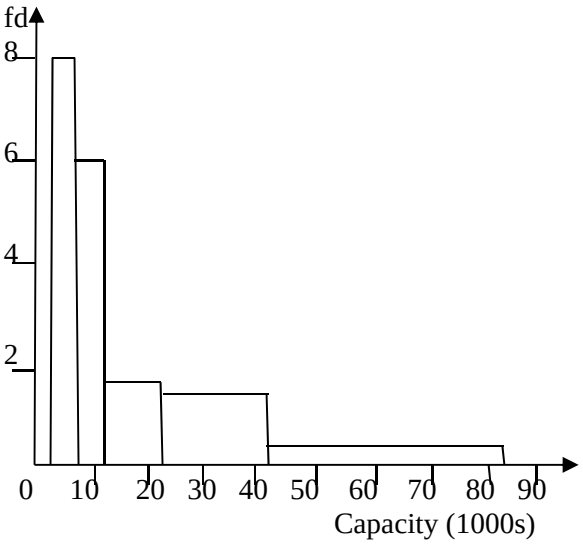
SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

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.

1	P(C given L) = $\frac{P(C \cap L)}{P(L)}$ = $\frac{0.65\times0.1}{0.65\times0.1+0.3\times0.15+0.05\times0.6}$ = $\frac{0.065}{0.14}$ = 0.464, $\frac{13}{28}$	**M1** **A1** **M1** **A1** **A1**	[5]	P($C\cap L$) seen as num or denom of a fraction Correct unsimplified P($C\cap L$) as numerator Summing three 2-factor products seen anywhere 0.14 (unsimplified) seen as num or denom of a fraction oe
2 (i)	P(1 T-shirt) = $\frac{{}^3C_1\times{}^9C_2}{{}^{12}C_3}$ = 27/55 AG **OR** 3/12×9/11×8/10×$^3C_1$oe = 27/55 AG	**B1** **B1** **B1** **M1** **M1** **A1**	[3]	Correct num unsimplified Correct denom unsimplified Answer given, so process needs to be convincing Mult 3 probs diff denoms (not a/3 x b/4 x c/5) Mult by $^3C_1$ oe Answer given, so process needs to be convincing
(ii)	X: 0, 1, 2, 3 Prob: 84/220, 27/55, 27/220, 1/220	**B1** **B1** **B1** **B1**√	[4]	0, 1, 2, 3 only seen in top line (condone additional values if Prob stated as 0) One correct prob, correctly placed in table One other correct prob, correctly placed in table One other correct prob ft $\Sigma p = 1$, 4 values in table
3 (i)	Bin (7, 0.8) P(6, 7) = $^7C_6\,(0.8)^6(0.2)^1 + (0.8)^7$ = 0.577	**M1** **M1** **A1**	[3]	$^7C_n\,p^n(1-p)^{7-n}$ seen Correct unsimplified expression for P(6,7)
(ii)	mean = 100×0.2 = 20 Var = 100×0.2×0.8 = 16 P(at most 30) = $P\left(z<\frac{30.5-20}{\sqrt{16}}\right)$ = P(z < 2.625) = 0.996	**B1** **M1** **M1** **M1** **A1**	[5]	Correct unsimplified mean and var Standardising must have sq rt, their μ, variance cc either 29.5 or 30.5 Correct area Φ , from final process
4 (i)	P(< 4.5) = $P\left(z<\frac{4.5-4.2}{0.6}\right)$ = P(z < 0.5) = 0.6915 P(< 3.5) = $P\left(z<\frac{3.5-4.2}{0.6}\right)$ = P(z< -1.167) = 1 – 0.8784 = 0.1216 0.6915 – 0.1216 = 0.570	**M1** **M1** **A1**	[3]	Standardising once no cc no sq no sq rt $\Phi_1 - (1 - \Phi_2)$ [$P_1 - P_2$, $1>P_1>0.5$, $0.5>P_2>0$] oe

(ii)	$z = 1.175$ $1.175 = \frac{t - 4.2}{0.6}$ $t = 4.91$	**B1** **M1** **A1**	[3]	±1.17 to 1.18 seen Standardising no cc, allow sq, sq rt with z – value (not ±0.8106, 0.5478, 0.4522, 0.1894, 0.175 etc.) Correct answer from $z = 1.175$ seen (4sf)
(iii)	$(0.88)^n < 0.003$ $n > \lg(0.003)/\lg(0.88)$ $n > 45.4$ $n = 46$	**M1** **M1** **A1**	[3]	Inequality or eqn in 0.88, power correctly placed using n or $(n \pm 1)$, 0.003 or $(1 - 0.003)$ oe Attempt to solve by logs or trial and error (may be implied by answer) Correct integer answer
5 (i)	cw 5, 5, 10, 20, 40 fd 8, 6, 1.8, 1.7, 0.2  	**M1** **M1** **A1** **B1** **B1**	[5]	cw either 4 or 5 etc fd or scaled freq [f/their cw attempt] fd may be ÷ 1000 Correct heights seen accurately on diagram Correct bar ends, accurately plotted on axis Labels fd and capacity (thousands) Correct horizontal scale required. Vertical scale linear from 0
(ii)	$(5\times40+10\times30+17.5\times18+32.5\times34+62.5\times8)/130$ $= 2420/130 = 18.6$ thousand	**M1** **A1**	[2]	$\Sigma fx/130$ where x is mid point attempt (value within class, not end pt or cw)
(iii)	median group = 8 – 12 thousand LQ group = 3 – 7 thousand	**B1** **B1**	[2]	Thousands not needed

6 (i)	e.g. (OAEE)(CPNHGN) or cv			
	$\frac{4!}{2!}\times\frac{6!}{2!}\times 2 = 8640$	**M1** **M1** **A1**	[3]	4!/2! or 6!/2! seen anywhere All multiplied by 2 oe
(ii)	First Method			
	Total ways = 10!/2!2! = 907200	**B1**		Total ways together correct
	EE together in 9!/2! ways = 181440	**M1**		EE together attempt alone
	EE not together = 907200 – 181440	**M1**		Considering total – EE together
	= 725760	**A1**	[4]	
	OR			
	Second Method			
	C P N H G N O A in 8!/2! ways	**B1**		8!/2! Seen
	Insert E in 9 ways	**M1**		Interspersing an E, x n where n=7,8,9. Condone additional factors.
	Insert 2nd E in 8 ways, ÷2	**M1**		Mult by 9×8(÷2), $^9C_2$ or $^9P_2$ only oe
	Total = 8!/2!×9×8÷2 = 725760	**A1**		
(iii)	First Method			
	EN** in $^6C_2$ ways	**M1**		^6C_x or $^yC_2$ seen alone or mult by $k > 1$, x<6, y>2
		M1		(1x1x) $^6C_2$ seen strictly alone or added to their EENN only
	= 15 different ways	**A1**		
	EENN in 1 way	**B1**		
	Total 16 ways	**A1**	[5]	
	OR			
	Second Method			
	Listing with at least 8 different correct options	**M1**		Value stated or implied by final answer
	Listing all correct options	**M1**		
	Total = 15 different ways	**A1**		correct value stated
	EENN in 1 way	**B1**		
	Total 16 ways	**A1**		
				Award 16 SRB2 if no method is present