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**MATHEMATICS**

**9709/06**

Paper 6

**For examination from 2017**

MARK SCHEME

Maximum Mark: 50

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**Specimen**

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This document consists of **9** printed pages and **1** blank page.

**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.

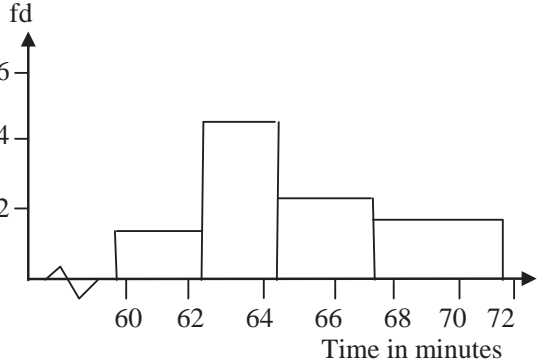
The following abbreviations may be used in a mark scheme or used on the scripts:

- 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  $\sqrt{\phantom{x}}$ ” 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.

Question	Answer	Marks	Partial Marks	Guidance
<b>1</b>	$p = 0.76$ $P(\text{fewer than } 10) = 1 - P(10, 11)$	1	<b>M1</b>	Any binomial term
	$= 1 - (0.76)^{10}(0.24)^{11}C_{10} - (0.76)^{11}$	1	<b>M1</b>	${}^{11}C_x p^x (1-p)^{11-x}, 0 < p < 1$
	$= 1 - 0.219$	1	<b>M1</b>	Any binomial term ${}^n C_x (0.76)^x (0.24)^{n-x}$
	$= 0.781$	1	<b>A1</b>	1 – P(10, 11) oe binomial expression Correct answer
		<b>4</b>		
<b>2</b>	$\mu = 54.1$	1	<b>B1</b>	Stated or evaluated
	$z = -1.11$	1	<b>B1</b>	Accept rounding to $\pm 1.1$
	$-1.11 = \frac{50.9 - 54.1}{\sigma}$	1	<b>M1</b>	Standardising no cc no sq rt
	$\sigma = 2.88$	1	<b>A1</b>	Correct answer
		<b>4</b>		
<b>3(i)</b>	$a = 9/cw$		<b>M1</b>	Using $fd = f/cw$
	$= 9/2 = 4.5$		<b>A1</b>	Correct $a$
	$1.5 = b/4$ so $b = 6$		<b>A1</b>	Correct $b$
		[3]		

Question	Answer	Marks	Partial Marks	Guidance
<p><b>3(ii)</b></p> 		1	<b>B1</b> <sup>✓</sup>	Correct heights ft their <i>b</i>
		1	<b>B1</b>	Correct widths, ie 3, 2, 3, 4 starting either 60 or 59.5
		1	<b>B1</b>	Labels fd, time or minutes and squiggle and bars from 59.5 to 71.5
		<b>3</b>		
<p><b>4(i)</b></p>	$\bar{x} = 80 - 147/30 = 80 - 4.9$	1	<b>M1</b>	For $-147/30$ oe seen
	$= 75.1$	1	<b>A1</b>	Correct answer
	$sd = \sqrt{\left(\frac{952}{30} - \left(\frac{147}{30}\right)^2\right)} = \sqrt{7.72\dots}$	1	<b>M1</b>	$952/30 - (\pm \text{their coded mean})^2$
	$sd = 2.78$	1	<b>A1</b>	Correct answer
		<b>4</b>		

Question	Answer	Marks	Partial Marks	Guidance
<b>4(ii)</b>	$P(x > 160) = P\left(z > \frac{160 - 148.6}{18.5}\right)$	1	<b>M1</b>	Standardising no cc no sq rt
	$= P(z > 0.616)$ $= 1 - 0.7310$	1	<b>M1</b>	$1 - \Phi$
	$= 0.269$	1	<b>A1</b>	Correct answer
		<b>3</b>		
<b>5(i)</b>	<b>5 (i)</b> eg <b>**(EEEE)**</b>	1	<b>M1</b>	Mult by 6! Oe
	Number of ways = $\frac{6!}{2!2!} = 180$	2	<b>M1</b> <b>A1</b>	Dividing by 2!2! oe Correct answer
		3		
<b>5(ii)</b>	<b>S*****T or T*****S</b>	1	<b>M1</b>	Mult by 7! Or dividing by one of 2! or 4!
	Number of ways = $\frac{7!}{4!2!} \times 2$	1	<b>M1</b>	Mult by 2
	$= 210$	1	<b>A1</b>	Correct answer
		<b>3</b>		

Question	Answer	Marks	Partial Marks	Guidance										
<b>5(iii)</b>	exactly one E in ${}^6C_3$ ways	2	<b>M1</b> <b>M1</b>	${}^6C_x$ as a single answer ${}^x C_3$ as a single answer										
	= 20	1	<b>A1</b>	correct answer										
		<b>3</b>												
<b>6(i)</b>		1	<b>M1</b>	3 pairs S (bank, log in, success oe) and F oe seen no extra bits.										
		1	<b>A1</b>	Exactly 3 pairs, must be labelled										
		1	<b>A1</b>	Correct diagram with all probs correct										
		<b>3</b>												
<b>6(ii)</b>	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td><math>x</math></td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Prob</td> <td>0.4</td> <td></td> <td>0.144</td> <td>0.216</td> </tr> </table>	$x$	0	1	2	3	Prob	0.4		0.144	0.216	1	<b>B1</b>	P(0) correct
		$x$	0	1	2	3								
		Prob	0.4		0.144	0.216								
		1	<b>M1</b>	Multiplying two of more factors of 0.4 and 0.6										
	1	<b>A1</b>	One more correct prob											
1	<b>B1</b>	One more correct prob												
<b>4</b>														

Question	Answer	Marks	Partial Marks	Guidance
<b>6(iii)</b>	$E(X) = 0.24 + 2 \times 0.144 + 3 \times 0.216$	1	<b>M1</b>	Using $\sum p_i x_i$
	$= 1.176$ (1.18)	1	<b>A1</b>	Correct answer
		<b>2</b>		
<b>7(i)</b>	let $P(2, 4, 6)$ all = $p$ then $P(1, 3, 5)$ all = $2p$	1	<b>M1</b>	Using $P(\text{even}) = 2P(\text{odd})$ or vice versa oe
	$3p + 6p = 1$	1	<b>M1</b>	Summing $P(\text{odd} + \text{even})$ or $P(1, 2, 3, 4, 5, 6) = 1$
	$p = 1/9$ so prob (3) = $2/9$ (0.222)	1	<b>A1</b>	Correct answer
		<b>3</b>		
<b>7(ii)</b>	$P(5, 5, 6) = 2/9 \times 2/9 \times 1/9 \times {}^3C_2$	2	<b>M1</b> <b>M1</b>	Mult three probs together Mult by 3 oe ie summing 3 options
	$= 4/243$ (0.0165)	1	<b>A1</b>	Correct answer
		<b>3</b>		



Question	Answer	Marks	Partial Marks	Guidance
7(iii)	$\mu = 100 \times 1/3 = 33.3, \sigma = 100 \times 1/3 \times 2/3 = 22.2$	1	<b>B1</b>	Unsimplified 100/3 and 200/9 seen
	$P(x \leq 37) = P\left(z \leq \frac{37.5 - \frac{100}{3}}{\sqrt{\frac{200}{9}}}\right) = P(z \leq 0.8839)$	3	<b>M1</b> <b>M1</b> <b>M1</b>	Standardising need sq rt 36.5 or 37.5 seen correct area using their mean
	= 0.812	1	<b>A1</b>	Correct answer
		<b>5</b>		

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