OCR
Oxford Cambridge and RSA

GCSE

Mathematics

Unit **J560/06**: Higher Tier Paper 6

General Certificate of Secondary Education

Mark Scheme for November 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

1. Annotations used in the detailed Mark Scheme.

Annotation	Meaning
✓	Correct
×	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign

These should be used whenever appropriate during your marking.

The **M**, **A, B** etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.
It is vital that you annotate these scripts to show how the marks have been awarded.
It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

Subject-Specific Marking Instructions

2. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.

3. Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

   Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.

4. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

   Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT 180 × (*their* '37' + 16), or FT 300 – $\sqrt{}$(*their* '$5^2 + 7^2$'). Answers to part questions which are being followed through are indicated by eg FT 3 × *their* (a).

   For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

5. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.

6. The following abbreviations are commonly found in GCSE Mathematics mark schemes.

   - **cao** means **correct answer only**.
   - **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
   - **isw** means **ignore subsequent working** (after correct answer obtained).
   - **nfww** means **not from wrong working**.
   - **oe** means **or equivalent**.
   - **rot** means **rounded or truncated**.
   - **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line,

     even if it is not in the method leading to the final answer.
   - **soi** means **seen or implied**.

7. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.

8. As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).

9. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

10. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

11. If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

    If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

    If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation **×** next to the wrong answer.

12. Ranges of answers given in the mark scheme are always inclusive.

13. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.

14. Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

Question			Answer	Marks	Part marks and guidance	
1	(a)		200	2	**B1** for 50 or 150 soi	Eg. answer 500 or 275 with (5 × 10) + … seen
	(b)		$a = \frac{2(s-ut)}{t^2}$ oe	2	**M1** for $s - ut = \frac{1}{2} at^2$	
2			30 November	3	**B2** for 21 identified as LCM or answer 30 OR **M1** for listing at least four multiples of 3 **and** at least three multiples of 7 OR **M1** for listing/identifying at least four dates for running **and** at least three dates for cycling	 3, 6, 9, 12, 15, 18, 21, … 7, 14, 21, … 12, 15, 18, 21, … 16, 23, 30, …
3	(a)		5.34	4	**B1** for 1.5, 4.5, 7.5, 10.5, 13.5 **M1FT** for 1.5×6 4.5×10 7.5×6 10.5×2 13.5×1 soi 9, 45, 45, 21, 13.5 or 133.5 **M1** for *their* 133.5 ÷ 25	At least 4 midpoints correct FT midpoints or either end of range values consistently used Allow one numerical error Four correct products or 133.5 imply **B1** and **M1**
	(b)		Exact times for each customer are not recorded oe	1		Do not accept, "Because the mid-point is used" or comments on the method used.

Question			Answer	Marks	Part marks and guidance	
4	(a)		$\frac{12}{28} = \frac{3}{7}$ or $\frac{3}{7}$ of 28 = 12 or $12 \div 28 = \frac{3}{7}$	1		Alternative $12 \div 28 = 0.428571\ldots$ and $3 \div 7 = 0.428571\ldots$
	(b)		Integer from 23000 to 23334	2	**M1** for $10\,000 \div \frac{3}{7}$ oe If **M0** then **SC1** for figs 2333… seen	Accept integer from 23000 to 24000 after **M1**
	(c)		The growing conditions on the farm may be **different** to the garden oe or Sample too small oe	1		Mere reference to factors that affect growth is insufficient
5	(a)		42	2	**M1** for $\frac{1.47 \times 10^7}{3.5 \times 10^5}$ oe If 0 scored **SC1** for figs 42 in answer	Eg. $\frac{14\,700\,000}{350\,000}$
	(b)		$4.2[3\ldots] \times 10^9$	3	**B2** for 4 233 600 000 oe as answer or **M1** for *their* $1.47 \times 10^7 \times 288$ If 0 scored **SC1** for figs 423[...] in answer	Eg. $423.[36] \times 10^7$ *their* 1.47×10^7 converted from info in (a)

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th colspan="2">Part marks and guidance</th></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>6450</td><td>3</td><td>B2 for 6447 to 6448
or
M1 for $\frac{1.47\times10^{7}}{(152\times15)}$ oe or figs 6447 in answer</td><td>May be in stages.
NB: 152 × 15 = 2280</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Each machine makes the same amount of sweets
or There are no breakdowns oe
or Machines running at same rate oe
or All machines run for the same time oe</td><td>1</td><td></td><td></td></tr>
<tr><td>6</td><td>(a)</td><td>(i)</td><td>$\frac{1}{5}$ of Bag A's counters [are red]
or
The ratio of red to yellow in Bag B is 1:3</td><td>1</td><td>Accept 1 : 4 = $\frac{1}{5}$

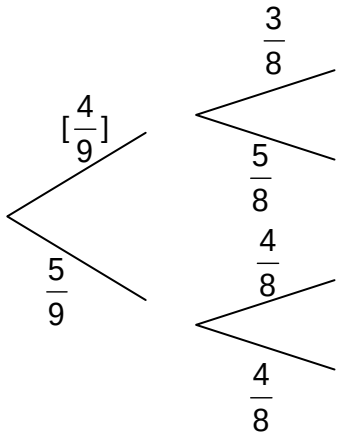
Accept $\frac{1}{4}$ = 1 : 3</td><td>Equivalents may be percentages or decimals
Eg. Bag A: 20% red, Bag B: 25% red.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Correct answer is any integer multiple of this.
<table><tr><td></td><td>Red</td><td>Yellow</td></tr><tr><td>Bag A</td><td>4</td><td>16</td></tr><tr><td>Bag B</td><td>5</td><td>15</td></tr></table></td><td>3</td><td>B1 for (Bag A) yellow = 4 × red
and A total = B total

B1 for (Bag B) yellow = 3 × red

If 0 scored SC2 for correct figures but transposed horizontally</td><td>8 32
10 30</td></tr>
</table>

Question			Answer	Marks	Part marks and guidance	
	(b)		20 nfww	**3**	**B1** for two ratios equivalent to 3:4 **M1** for *their* 15:20 reduced to (15-3):20 <u>Alternative approach</u> **B1** for two fractions equivalent to $\frac{3}{7}$ **M1** for *their* $\frac{15}{35}$ reduced to $\frac{15-3}{32}$	6:8, 9:12, 12:16, 15:20,… *their* 15:20 any ratio **but not** 3:4 using equivalent fractions: Eg $\frac{6}{14}$ *or* $\frac{9}{21}$ *or* $\frac{12}{28}$ *or* $\frac{15}{35}$ *their* $\frac{15}{35}$ any fraction but not $\frac{3}{7}$
7			3.5	**4**	**M3** for $\frac{(629.20-520)\div 6}{520}[\times 100]$ OR **B2** for 18.2[0] seen OR **B1** for 109.2[0] seen and **M1** for *their* 109.2[0] ÷ 520 [× 100]	

Question			Answer	Marks	Part marks and guidance	
8			13.7	5	**M4** for $\frac{45}{360}\times 2\times\pi\times 6$ + $\frac{45}{360}\times 2\times\pi\times 2.5$ + 2 × 3.5 oe soi OR **M3** for $\frac{45}{360}\times 2\times\pi\times 6$ oe and $\frac{45}{360}\times 2\times\pi\times 2.5$ oe soi OR **M2** for $\frac{45}{360}\times 2\times\pi\times 6$ oe or $\frac{45}{360}\times 2\times\pi\times 2.5$ oe soi or $2\times\pi\times 6$ + $2\times\pi\times 2.5$ oe soi OR **M1** for $2\times\pi\times 6$ oe or $2\times\pi\times 2.5$ oe soi If **0** scored **SC2** for $\frac{45}{360}\times\pi\times 6^2$ oe and $\frac{45}{360}\times\pi\times 2.5^2$ oe soi by 14.1… and 2.45… or by 11.6 to 11.7 OR **SC1** for $\frac{45}{360}\times\pi\times 6^2$ oe or $\frac{45}{360}\times\pi\times 2.5^2$ oe soi by 14.1… or 2.45…	by 13.67… to 13.68 by 4.71… and 1.96… or by 6.67… to 6.68 by 4.71… or 1.96…or 53.4.. by 37.699… to 37.7 or 15.7… Method marks may be awarded for multiples of π seen in correct working. Eg. $\frac{45}{360}\times 2\times\pi\times 6=\frac{3}{2}\pi$ $\frac{45}{360}\times 2\times\pi\times 2.5=\frac{5}{8}\pi$

Question			Answer	Marks	Part marks and guidance	
9			216	4	**M1** for $5b = 180$ oe and **B1** for [b =] 36 and **M1** for *their* 36 + 180 or *their* 36 × 6 provided *their* answer would be between 180 and 270	Eg. $b + 180 = 6b$ soi by final answer
10			71 000 000 to 89 000 000 in figs or words **and** people/year	2 **and** 1	**M1** for attempt to find 'gradient' using figures from the graph e.g. (7.4 – 2.6) ÷ (2015 – 1951)	Could be in billions Eg. (7 400 000 000 – 2 600 000 000) ÷ (2015 – 1951) For **M1,** condone incorrect conversion used consistently for both population figures.
11	(a)			2	**B1** for $\frac{5}{9}$ and at least one fraction with denominator 8 for second card	

Question			Answer	Marks	Part marks and guidance	
	(b)		$\frac{5}{9}$ oe	**3**	**M2FT** for $\left(\frac{4}{9}\times\frac{5}{8}\right)+\left(\frac{5}{9}\times\frac{4}{8}\right)$ oe OR **M1FT** for $\left(\frac{4}{9}\times\frac{5}{8}\right)$ or $\left(\frac{5}{9}\times\frac{4}{8}\right)$ oe soi by $\frac{20}{72}$ oe	**FT** *their* probabilities from **(a)**
12	**(a)**		5	**1**		
	(b)		(k =) 5 (r =) 1 nfww	**5**	**B1** for 206 = 41*k* + *r* and **B1** for 1031 = 206*k* + *r* and **M1** for 165*k* = 825 and **A1** for *k* = 5 or *r* = 1 If no or partial method shown, allow full marks for final answer correct	If **0** scored, allow **SC2** for final correct answers interchanged Condone attempt to reduce to one variable by sub. or elim. With max of one error
13	**(a)**		1.4355 or 1.436 or 1.44	**2**	**M1** for 16.5 × 87 possibly soi by figs 14355, 1436 or 144	

Question			Answer	Marks	Part marks and guidance	
	(b)		Yes (Trevor is correct) because Eg $220 \div 87^3 \times 100^3 = 334.[\ldots]$ or $334 \times 87^3 \div 100^3 = 219.9\ldots$ to 220	**3**	**M2** for $220 \div 87^3 \times 100^3$ or $334 \times 87^3 \div 100^3$ OR **B1** for 87^3 or 658503 or 100^3 or 1000000 soi	
14	**(a)**		$(34 \times 36) - (25 \times 45) = 99$	**2**	**M1** for either 34×36 or 25×45 soi by 1224 or 1125	

Question			Answer	Marks	Part marks and guidance	
	(b)		Eg. If $M = n$ $L = (n – 1)(n + 1) = n^2 – 1$ $T = (n – 10)(n + 10) = n^2 – 100$ $L – T = (n^2 – 1) – (n^2 – 100) = 99$	**5**	**B2** for defining relative positions algebraically Eg. $n – 1$, $n + 1$, $n – 10$, $n + 10$ or **B1** for at least two relative positions defined algebraically AND **M2** for [L =] $(n – 1)(n + 1) = n^2 – 1$ **and** [T =] $(n – 10)(n + 10) = n^2 – 100$ or **M1** for [L =] $(n – 1)(n + 1) = n^2 – 1$ **or** [T =] $(n – 10)(n + 10) = n^2 – 100$ **or** $L – T$ = (*their* $(n – 1)(n + 1)$ – (*their* $(n – 10)(n + 10)$) If **0** scored, allow **SC1** for one further numerical example	Or equivalent algebraic representation of relative positions. Condone poor notation for B marks eg **B2** for n – 1 × n + 1 – n – 10 × n + 10 For **M** marks, follow through allowed for working with *their* relative positions described algebraically as linear expressions: ie. • L = Multiplication of their left and right expressions • T = Multiplication of their top and bottom expressions **M1** could be awarded by expressing *their* L – *their* T, even if incorrectly expanded **M2** may be embedded
15			85π or 267[.0…]	**3**	**M2** for $\pi \times 5 \times 12 + \pi \times 5^2$ oe OR **B1** for 60π or 25π or 188[.4…] or 188.5 or 78[.5…] or $\pi \times 5^2$	

Question			Answer	Marks	Part marks and guidance	
16	(a)	(i)	$\mathbf{b} - \mathbf{a}$	1		
		(ii)	$\frac{1}{4}(\mathbf{b}-\mathbf{a})$ or $\frac{1}{4}\mathbf{b}-\frac{1}{4}\mathbf{a}$	1	**FT** from **(a)(i)**	
	(b)		$\overrightarrow{EF} = \overrightarrow{EB} + \overrightarrow{BF} = \frac{1}{4}(\mathbf{b}-\mathbf{a}) + \frac{1}{2}\mathbf{b}$ leading to $\frac{1}{4}(3\mathbf{b}-\mathbf{a})$ as given.	2	**M1** for *their* part **(a)(ii)** + $\frac{1}{2}\mathbf{b}$ oe	**(a)(ii)** must be in terms of **a** and **b**
	(c)		$\overrightarrow{AG} = \frac{3}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$ $\overrightarrow{AG} = 2\overrightarrow{EF}$ oe so are parallel.	3	**B2** for $\overrightarrow{AG} = \frac{3}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$ or **M1** for $\mathbf{b} + \frac{1}{2}$ (*their* part **(a)(i)**) oe	Allow vectors found in reverse throughout eg. $\overrightarrow{GA}$ instead of $\overrightarrow{AG}$ Condone "AG and EF are multiples of each other" Full marks dependent on both AG and EF in correct simplified forms
17	(a)		$x^2 + y^2 = 100$ oe	1		
	(b)		$8^2 + (-6)^2 = 100$, so it's on the circle oe	2	**M1** for $8^2 + ([-]6)^2$ seen or for substituting $x = 8$ and $y = -6$ into *their* part **(a)**	Alternative using Pythagoras $\sqrt{8^2+6^2} = 10$ *their* part **(a)** must be an equation in both x and y.

Question			Answer	Marks	Part marks and guidance	
	(c)		$3y - 4x + 50 = 0$ oe	**5**	**B2** for [tangent gradient =] $\frac{4}{3}$ oe or **M1** for $\pm\frac{6}{8}$ or $\pm\frac{8}{6}$ oe AND **M2** for $y + 6 =$ *their* $\frac{4}{3}(x - 8)$ oe or **M1** for $y =$ *their* $\frac{4}{3}x +$ 'c'	Equivalents include: $y = \frac{4}{3}x - \frac{50}{3}$ Condone decimals with at least 2 decimal places rot: Eg. $y = 1.33x - 16.67$ Equivalent for **M2** includes $y =$ *their* $\frac{4}{3}x +$ c and then attempt to find *c* by substituting in $y = -6$ and $x = 8$
18	**(a)**		$y \leq 2$ $y \geq -2x + 18$ oe	**1** **and** **3**	**B1** for ['gradient'=] -2 soi and **M1** for suitable method to find equation of line eg. $y - 8 = (their - 2) \times (x - 5)$ or $y - 2 = (their - 2) \times (x - 8)$	If **both** inequalities are wrong way round, condone once (max penalty 1 mark) Or **M1** for $y =$ *their* $-2x + c$ with a point from the line substituted in to find *c* For **M1** allow use of an inequality symbol in place of =
	(b)		$y = 6$ shown as a solid line and correct region shaded	**2**	**B1** for line drawn at $y = 6$ OR **B1** for correct squares shaded but no line	Accept dashed line for **B1**

Question			Answer	Marks	Part marks and guidance	
	(c)		$\frac{8}{5}$ oe	5	**M1** for $\frac{1}{2}\times 4\times(8+6)$ soi by 28 **M1** for $\frac{1}{2}\times 4h = \textit{their}\ 28-23$ oe **A1** for [*h* =] 2.5 AND **M1** for [*k* =] 4 ÷ *their* 2.5 oe <u>Alternative method</u> **M1** for $\frac{1}{2}\times 4\times(8+'t')$ **M1** for *their* $\frac{1}{2}\times 4\times(8+'t')$ = 23 oe **A1** for [*t* =] 3.5 AND **M1** for [*k* =] 4 ÷ (6 – *their* 3.5) oe	'*h*' is 'top of triangle' '*t*' is 'top of trapezium' Must be a trapezium

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