Cambridge IGCSE™

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/63**

Paper 6 (Extended) **October/November 2021**

MARK SCHEME

Maximum Mark: 60

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **8** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Maths-Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M	Method marks, awarded for a valid method applied to the problem.
A	Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.
B	Mark for a correct result or statement independent of Method marks.

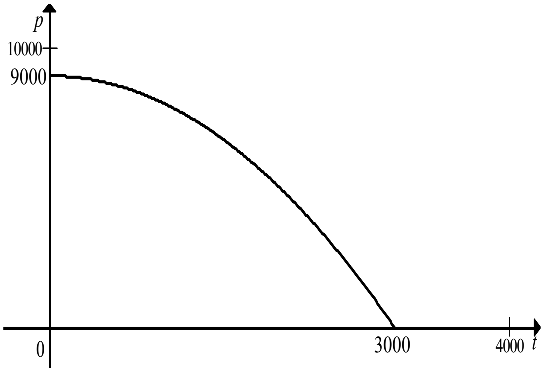
When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

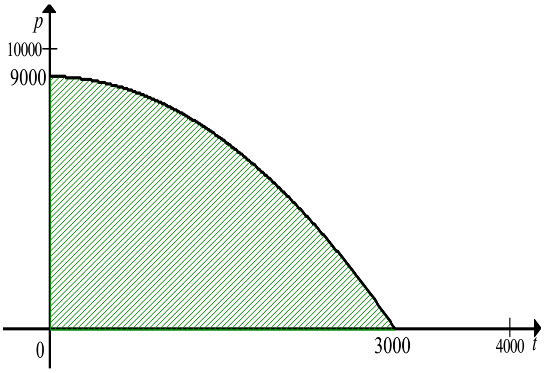
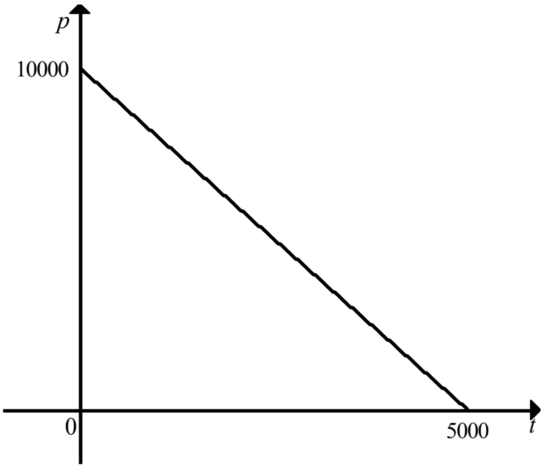
Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Partial Marks</th></tr>
<tr><td>A</td><td colspan="3">INVESTIGATION GIRARD’S SUMS</td></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>a</th><th>a^2</th><th>b</th><th>b^2</th><th>$N = a^2 + b^2$</th><th>$\frac{N}{4}$</th><th>Rem</th></tr>
<tr><td>2</td><td>4</td><td>6</td><td>36</td><td>40</td><td>10</td><td>0</td></tr>
<tr><td>18</td><td>324</td><td>10</td><td>100</td><td>424</td><td>106</td><td>0</td></tr>
<tr><td>28</td><td>784</td><td>16</td><td>256</td><td>1040</td><td>260</td><td>0</td></tr>
<tr><td>4</td><td>16</td><td>8</td><td>64</td><td>80</td><td>20</td><td>0</td></tr>
<tr><td>12</td><td>144</td><td>14</td><td>196</td><td>340</td><td>85</td><td>0</td></tr>
<tr><td>20</td><td>400</td><td>22</td><td>484</td><td>884</td><td>221</td><td>0</td></tr>
<tr><td>30</td><td>900</td><td>0</td><td>0</td><td>900</td><td>225</td><td>0</td></tr>
</table>
</td><td>5</td><td>B4 for 13, 14 or 15 correct cells
or B3 for 10, 11 or 12 correct cells
or B2 for 7, 8 or 9 correct cells
or B1 for 4, 5 or 6 correct cells</td></tr>
<tr><td rowspan="2">1(b)(i)</td><td>4 + 16 = 20 or $2^2 + 4^2 = 20$</td><td>C1</td><td></td></tr>
<tr><td>[k =] 5</td><td>1</td><td></td></tr>
<tr><td rowspan="3">1(b)(ii)</td><td>$(2m)^2 + (2n)^2$</td><td>C1</td><td></td></tr>
<tr><td>$[4k =]\, 4m^2 + 4n^2$</td><td>1</td><td></td></tr>
<tr><td>$m^2 + n^2$</td><td>1</td><td></td></tr>
<tr><td>1(c)</td><td>Shows, using an exhaustive list, that there are no values of $m^2 + n^2$ that give 11 by adding square numbers
or
Shows, using an exhaustive list, that there are no values of m^2 or n^2 that when subtracted from 11 give a square number
OR
Shows, using an exhaustive list, that adding square numbers that are multiples of 4 and less than 44 does not give 44
or
Shows, using an exhaustive list, that subtracting square numbers that are multiples of 4 and less than 44, from 44, does not produce a square number that is even and a multiple of 4</td><td>2</td><td>B1 for finding one correct example</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Partial Marks</th></tr>
<tr><td rowspan="2">2(a)</td><td><table>
<tr><th>a</th><th>a^2</th><th>b</th><th>b^2</th><th>$N = a^2 + b^2$</th><th>$\frac{N}{4}$</th><th>Rem</th></tr>
<tr><td>7</td><td>49</td><td>5</td><td>25</td><td>74</td><td>18</td><td>2</td></tr>
<tr><td>21</td><td>441</td><td>19</td><td>361</td><td>802</td><td>200</td><td>2</td></tr>
<tr><td>17</td><td>289</td><td>25</td><td>625</td><td>914</td><td>228</td><td>2</td></tr>
<tr><td>11</td><td>121</td><td>7</td><td>49</td><td>170</td><td>42</td><td>2</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>2</td><td>0</td><td>2</td></tr>
</table></td><td>3</td><td>**B2** for 9, 10, 11, 12 or 13 cells correct
or **B1** for 6, 7 or 8 cells correct</td></tr>
<tr><td>A relevant calculation</td><td>**C1**</td><td></td></tr>
<tr><td rowspan="3">2(b)(i)</td><td>$4n^2 - 2n - 2n + 1$</td><td>**C1**</td><td></td></tr>
<tr><td>$4(n^2 - n) + 1$ or $\frac{4n^2 - 4n + 1}{4}$</td><td>1</td><td></td></tr>
<tr><td>Correct statement about multiple or factor of 4 with remainder 1</td><td>1</td><td></td></tr>
<tr><td>2(b)(ii)</td><td>Shows, using an exhaustive list that each of the five values of N is a multiple of 4 + 2
OR
Valid explanation e.g.
Both a and b are odd numbers, therefore a^2 and b^2 are both multiples of 4 remainder 1 so the total is a multiple of 4 remainder 2</td><td>2</td><td>**B1** for two correct examples
OR
B1 for a partially correct explanation e.g. both are multiples of 4 remainder 1 so the total is a multiple of 4 remainder 2</td></tr>
<tr><td rowspan="3">2(c)</td><td>Four correct values of $4k + 2$ seen from<table>
<tr><td>k</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>$4k + 2$</td><td>6</td><td>10</td><td>14</td><td>18</td><td>22</td><td>26</td><td>30</td><td>34</td><td>38</td></tr>
</table></td><td>**C1**</td><td></td></tr>
<tr><td>Finds at least two of the sums of two odd squares using 1, 9, 25:
$1^2 + 1^2 = 2$, $1^2 + 3^2 = 10$, $3^2 + 3^2 = 18$, $1^2 + 5^2 = 26$, $3^2 + 5^2 = 34$</td><td>**C1**</td><td></td></tr>
<tr><td>Three from 2, 4, 6, 8</td><td>1</td><td></td></tr>
</table>

Question	Answer	Marks	Partial Marks
3(a)	$(\text{even})^2 + (\text{even})^2$ gives remainder 0 $(\text{odd})^2 + (\text{odd})^2$ gives remainder 2	**C1**	
	[Remaining case] $(\text{odd})^2 + (\text{even})^2$ gives remainder 1 and These are the only possible cases so *r* cannot be 3 oe	**2**	**B1** for $(\text{odd})^2 + (\text{even})^2$ gives remainder 1
3(b)	Two from $13 = 3^2 + 2^2$ oe $17 = 4^2 + 1^2$ oe $18 = 3^2 + 3^2$ oe $20 = 2^2 + 4^2$ oe $25 = 4^2 + 3^2$ oe $26 = 1^2 + 5^2$ oe $29 = 5^2 + 2^2$ oe	**C1**	
	13, 17, 25, 29	**2**	**B1** for any two correct
B	**MODELLING PRODUCTION BOUNDARIES**		
4(a)	Correct sketch 	**1**	correct shape
	3000 and 9000 as intercepts indicated on graph	**C1**	
4(b)	3000	**1**	
4(c)	*their* 8000 – *their* 6750 or $9000 - \frac{1000^2}{1000}$ or $9000 - \frac{1500^2}{1000}$ or vertical lines at 1000 and 1500 on sketch	**C1**	
	8000 or 6750	**1**	
	1250	**1**	
4(d)(i)	Valid explanation using graph e.g. The maximum number of A-tablets would be 2000 or It is a point beyond the curve	**1**	

Question	Answer	Marks	Partial Marks
4(d)(ii)	Correct region shaded 	**1**	**FT** *their* sketch
4(e)(i)	$160t + 100p = 964\,000$ oe	**C1**	
	$p = -1.6t + 9640$	**1**	
4(e)(ii)	sketch of graphs or suitable line drawn on graph in **4(a)** or equating models: $9640 - 1.6t = 9000 - \frac{t^2}{1000}$ oe	**C1**	
	[t =] 800 [p =] 8360	**2**	**B1** for each
5(a)(i)	Correct ruled graph 	**1**	
	5000 and 10 000 as intercepts indicated on graph	**C1**	
5(a)(ii)	$p = -2t + 10\,000$ oe	**2**	**B1** for $-2t + 10\,000$ or [p =] $-2t + c$, $c \neq 0$ or [p =] $mt + 10\,000$, $m \neq 0$
5(a)(iii)	$1000 \leqslant t \leqslant 4000$	**1**	

Question	Answer	Marks	Partial Marks
5(b)(i)	A correct valid calculation e.g. $1000 \times 200 + 8000 \times 190$	**C1**	
	1 720 000	**1**	
	For $ used with *their* numerical answer	**C1**	
5(b)(ii)	4004 nfww	**4**	**M1** for $0.733 \times$ *their* 1 720 000 or 1 260 760 seen **M1** for 2500×200 or 500 000 seen **M1** for $\frac{\textit{their}\ 1260760 - \textit{their}\ 500000}{190}$ soi
6(a)	A: $p = 2\left(9000 - \frac{t^2}{1000}\right)$ oe where $t \geqslant 0$	**1**	
	B: $p = -2.2t + 11\,000$ for $1000 \leqslant t \leqslant 4000$	**1**	
6(b)	$(-2.2 \times 1000) + 11\,000$ or 1.1×8000 or suitable sketch	**C1**	
	$[1\,830\,000 +]\ 200 \times 1000 + 190 \times 8800$	**C1**	
	3 702 000	**1**	