CAMBRIDGE
International Education

# Cambridge IGCSE™

**ADDITIONAL MATHEMATICS** **0606/11**

Paper 1 Non-calculator **May/June 2025**

MARK SCHEME

Maximum Mark: 80

**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 May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.



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## 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 descriptions 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.

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**Mathematics-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, non-integer 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 or sign 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 A or B 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.

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**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

| Annotation | Meaning |
|---|---|
|  | More information required |
|  | Accuracy mark awarded zero |
|  | Accuracy mark awarded one |
|  | Accuracy mark awarded two |
|  | Accuracy mark awarded three |
|  | Independent mark awarded zero |
|  | Independent mark awarded one |
|  | Independent mark awarded two |
|  | Independent mark awarded three |
|  | Benefit of the doubt |
|  | Communication mark |
|  | Incorrect |
|  | Follow through |
| Highlighter | Highlight a key point in the working |
|  | Ignore subsequent work |
|  | Method mark awarded zero |
|  | Method mark awarded one |
|  | Method mark awarded two |

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| Annotation | Meaning |
|---|---|
| M3 | Method mark awarded three |
| MR | Misread |
| O | Omission |
| Off-page comment | Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to. |
| On-page comment | Allows comments to be entered in speech bubbles on the candidate response. |
| Pre | Premature rounding/approximation |
| SC | Special case |
| SEEN | Indicates that work/page has been seen |
| TE | Transcription error |
|  | Correct |
| XP | Correct answer from incorrect working |

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## 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

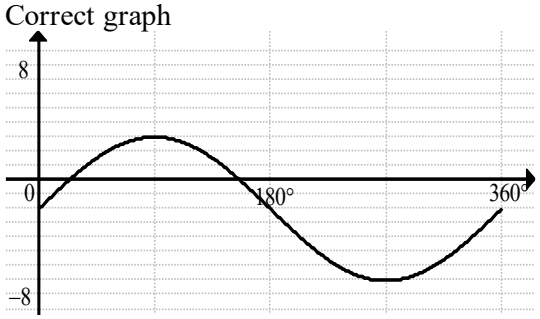
awrt answers which round to
cao correct answer only
dep dependent
FT follow through after error
isw ignore subsequent working
nfww not from wrong working
oe or equivalent
rot rounded or truncated
SC Special Case
soi seen or implied

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 1(a) | $\begin{pmatrix}-2.5\\5\end{pmatrix}$ oe | **B2** | **B1** for $-\frac{1}{4}\begin{pmatrix}-2\\8\end{pmatrix}\left[+\begin{pmatrix}-3\\7\end{pmatrix}\right]$ oe, soi |
| 1(b) | $3\alpha - 8 = 2\alpha + 5\beta$ or $18 - 2\beta = 20$ | **M1** | Equates like vectors at least once |
| | $\alpha = 3$ $\beta = -1$ | **A2** | **A1** for either value correct |
| 2 | $5x^2 - 10x - 15 * 0$ oe | **M1** | where * is any inequality sign or = |
| | Factorises *their* 3-term quadratic expression or solves *their* 3-term quadratic equation | **M1** | |
| | Critical values –1 and 3 | **A1** | |
| | $-1 \leqslant x \leqslant 3$ | **A1** | Do not accept separate inequalities unless connected with 'and' |
| 3(a) | $(3-4)^2 + (-1+3)^2 = 5$ or showing that distance between point $A$ and centre of circle = radius e.g. $\sqrt{(3-4)^2 + (-1+3)^2} = \sqrt{5}$ | **B1** | Accept if $x$-coordinate substituted to find $y$- coordinate |
| 3(b) | $\begin{pmatrix}4\\-3\end{pmatrix}+\begin{pmatrix}1\\-2\end{pmatrix}$ oe, soi<br><br>or using centre and point $A$ e.g. $\frac{3+x}{2} = 4$ and $\frac{-1+y}{2} = -3$<br>or solve simultaneously the line $y = -2x + 5$ with the circle leading to 3 term quadratic $x^2 - 8x + 15[=0]$ with an attempt to solve | **M1** | Award **M1** for the 2 equations<br><br>Award the **M1** for the quadratic |
| | (5, –5) | **A1** | |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 3(c) | gradient of radius $= \frac{-3+1}{4-3} = -2$ soi by gradient of tangent | **M1** | |
| | gradient of tangent $= \frac{-1}{their(-2)}$ | **M1** | **FT** *their* –2<br>Allow if differentiation is used e.g.: |
| | $y + 1 = \frac{1}{2}(x - 3)$ oe | **A1** | **FT** $\frac{-1}{their - 2}$<br>ISW from a correct unsimplified answer |
| | **Alternative** | | |
| | use of differentiation e.g.:<br>$(y+3)^2 = 5-(x-4)^2$<br>$y = \sqrt{-x^2+8x-11} - 3$<br>$\frac{dy}{dx} = \frac{-2x+8}{2\sqrt{-x^2+8x-11}}$ | **(M1)** | allow one error<br>or use of implicit differentiation (not on syllabus) e.g.:<br>$2x + 2y\frac{dy}{dx} - 8 + 6\frac{dy}{dx} = 0$<br>leading to $\frac{dy}{dx} = \frac{8-2x}{2y+6}$ |
| | Substitute $(3,-1)$ in *their* $\frac{dy}{dx}$<br>to get gradient $= \frac{1}{2}$ | **(M1)** | **Dep** on first **M1** |
| | $y + 1 = \frac{1}{2}(x - 3)$ oe | **(A1)** | ISW from a correct unsimplified answer |
| 4(a) | Solves or factorises $x^{\frac{1}{3}} - x^{\frac{1}{6}} - 2 = 0$ oe:<br>$\left(x^{\frac{1}{6}}+1\right)\left(x^{\frac{1}{6}}-2\right)$<br>or when substituting $y = x^{\frac{1}{3}}$ factorises to<br>$\left(y^{\frac{1}{2}}+1\right)\left(y^{\frac{1}{2}}-2\right)$ | **M1** | A substitution may be used<br>$\left(x^{\frac{1}{3}}\right)^6 - \left(x^{\frac{1}{6}}\right)^6 = 2^6$ scores 0 marks<br>$\left(x^{\frac{1}{3}}\right) - \left(x^{\frac{1}{6}}\right) = x^{\log_x 2}$ then $\frac{1}{3} - \frac{1}{6} = \log_x 2$<br>scores 0 marks |
| | $\left[x^{\frac{1}{6}} = -1\right]$, $x^{\frac{1}{6}} = 2$ | **A1** | |
| | $x = 64$ [$x = 1$] | **A1** | |
| | Rejects $x^{\frac{1}{6}} = -1$ or $x = 1$ ignored at some stage, soi | **B1** | |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 4(b) | $x+2y=1$ | **B1** | |
| | Correctly eliminates one unknown | **M1** | **Dep** on **B1**<br>allow unsimplified e.g.<br>$x=1-2y$ or $y=\frac{1-x^2}{4x+1}$ |
| | Correct quadratic in solvable form:<br>$y-4y^2\,[=0]$ oe or<br>$2x^2-3x+1[=0]$ oe | **A1** | |
| | Factorises or solves *their* quadratic to get two solutions | **M1** | **Dep** on previous **M1** |
| | $y = 0$, $x = 1$ and $y = \frac{1}{4}$ , $x = \frac{1}{2}$ | **A1** | |
| 5(a) | $2x – 1 = –3$ and $2x – 1 = 3$ | **M1** | |
| | $x = 2$, $x = –1$ | **A2** | **A1** for either correct |
| | **Alternative** | | |
| | $4x^2-4x-8=0$ oe | **(B1)** | |
| | Solves or factorises *their* 3-term quadratic | **(M1)** | |
| | $x = –1$, $2$ | **(A1)** | |
| 5(b) | Correct graph<br> | **2** | **B1** for a correct sine curve one cycle **and** with correct amplitude at 3 and –7<br><br>**B1** for a correct sine curve one cycle **and** with correct midline $y = –2$ |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 6(a) | Correct derivative<br>$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{x^2-1}{x^2+1}\right)=\frac{(x^2+1)(2x)-(x^2-1)(2x)}{(x^2+1)^2}$ or<br>$2x\left(x^2+1\right)^{-1}-2x\left(x^2-1\right)\left(x^2+1\right)^{-2}$ | **2** | **M1** for an attempt at the quotient or product rule<br>**A1** fully correct |
| | Correct derivative<br>$\frac{\mathrm{d}y}{\mathrm{d}x}=4\left(\frac{x^2-1}{x^2+1}\right)^3\left(\frac{(x^2+1)(2x)-(x^2-1)(2x)}{(x^2+1)^2}\right)$<br>or<br>$4\left(\frac{x^2-1}{x^2+1}\right)^3\left(2x\left(x^2+1\right)^{-1}-2x\left(x^2-1\right)\left(x^2+1\right)^{-2}\right)$ | **2** | **Dep M1** for $\frac{\mathrm{d}y}{\mathrm{d}x}=k\left(\frac{x^2-1}{x^2+1}\right)^3\times \mathrm{f}(x)$<br>where f($x$) is *their* attempt to differentiate<br>**A1** fully correct |
| | Correct completion to $\frac{16x(x^2-1)^3}{(x^2+1)^5}$ | **A1** | |
| | **Alternative** | | |
| | Correct derivatives<br>$u=(x^2-1)^4 \quad \mathrm{d}u=4(x^2-1)^3\times(2x)$ oe<br>and<br>$v=(x^2+1)^4 \quad \mathrm{d}v=4(x^2+1)^3\times(2x)$ oe | **(2)** | **M1** for either correct<br>OR for<br>$\mathrm{d}u=4(x^2-1)^3\times \mathrm{g}(x)$ where g($x$) is an attempt to differentiate $x^2-1$<br>and<br>$\mathrm{d}v=4(x^2+1)^3\times \mathrm{h}(x)$ where h($x$) is an attempt to differentiate $x^2+1$ |
| | Correct derivative<br>$\frac{\mathrm{d}y}{\mathrm{d}x}=$<br>$\frac{(x^2+1)^4\times4(x^2-1)^3(2x)-(x^2-1)^4\times4(x^2+1)^3(2x)}{\left((x^2+1)^4\right)^2}$<br>or<br>$4(2x)\left(x^2-1\right)^3\left(x^2+1\right)^{-4}-$<br>$4(2x)\left(x^2-1\right)^4\left(x^2+1\right)^{-5}$ | **(2)** | **M1** for an attempt at the product or quotient rule |
| | Correct completion to $\frac{16x(x^2-1)^3}{(x^2+1)^5}$ | **(A1)** | |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Partial Marks</th></tr>
<tr><td>6(b)(i)</td><td>their $16x(x^2-1)^3=0$<br>therefore $x=0,\ x^2-1=0 \rightarrow x=\pm1$ oe</td><td>B1</td><td>FT their 16<br>Allow for their $16x(x^2-1)=0$</td></tr>
<tr><td>6(b)(ii)</td><td>Any two of<br>
<table>
<tr><td>$x$</td><td>$-1<x<0$</td><td>0</td><td>$0<x<1$</td></tr>
<tr><td>$\frac{dy}{dx}$</td><td>positive</td><td>0</td><td>negative</td></tr>
</table>
<table>
<tr><td>$x$</td><td>$0<x<1$</td><td>1</td><td>$x>1$</td></tr>
<tr><td>$\frac{dy}{dx}$</td><td>negative</td><td>0</td><td>positive</td></tr>
</table>
<table>
<tr><td>$x$</td><td>$x<-1$</td><td>$-1$</td><td>$-1<x<0$</td></tr>
<tr><td>$\frac{dy}{dx}$</td><td>negative</td><td>0</td><td>positive</td></tr>
</table></td><td>M1</td><td>or equivalent. Must show change in the sign of first derivative around the stationary points<br><br>M0 only if second derivative is used</td></tr>
<tr><td></td><td>$x=1$ and $x=-1$ are minimum points</td><td>A1</td><td></td></tr>
</table>

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 7 | $2x^3 - 9x^2 + 10x - 3[= 0]$ | **B1** | |
| | Finds a correct linear factor<br>$x - 1$ or $x - 3$ or $2x - 1$ | **M1** | |
| | Finds the correct corresponding quadratic factor<br>For $(x - 1)$ gives $2x^2 - 7x + 3$ or<br>For $(x - 3)$ gives $2x^2 - 3x + 1$ or<br>For $(2x - 1)$ gives $x^2 - 4x + 3$ | **2** | **M1** for a corresponding quadratic factor with 2 terms correct |
| | Factorises *their* 3-term quadratic factor or solves *their* 3-term quadratic equation | **M1** | |
| | $x = \frac{1}{2}$, 1, 3 | **A1** | |
| | **Alternative** | | |
| | $2x^3 - 9x^2 + 10x - 3 = 0$ | **(B1)** | |
| | Finds a correct linear factor<br>$x - 1$ or $x - 3$ or $2x - 1$ | **(M1)** | |
| | Finds a second correct linear factor<br>$x - 1$ or $x - 3$ or $2x - 1$ | **(M1)** | |
| | Finds a third correct linear factor<br>$x - 1$ or $x - 3$ or $2x - 1$ | **(M1)** | |
| | $x - 1$, $x - 3$ and $2x - 1$ | **(A1)** | |
| | $x = \frac{1}{2}$, 1, 3 | **(A1)** | |
| 8(a) | $x > \frac{4}{12}$ oe | **B1** | allow $0.\dot{3}$ for $\frac{4}{12}$ |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 8(b) | $\log_x 125 = \dfrac{\log_5 125}{\log_5 x} = \dfrac{3}{\log_5 x}$<br>$\dfrac{1}{\log_x 125} = \log_{125} x$<br>or<br>$\log_5(12x-4) = \dfrac{\log_x(12x-4)}{\log_x 5}$ | **B1** | for a correct and relevant change of base seen |
| | $\log_5(12x-4) = 2\log_5 x + 1$ or<br>$\log_x(12x-4) = 2 + \log_x 5$ | **B1** | **Dep** on correct change of base |
| | $\log_5 \dfrac{12x-4}{x^2} = 1$ oe<br>or $\log_x \dfrac{12x-4}{5} = 2$ oe<br>or $\log_5(12x-4) = \log_5(5x^2)$ | **B1** | **Dep** on correct change of base |
| | $5x^2 - 12x + 4 = 0$ | **B1** | **Dep** on correct change of base |
| | $(5x-2)(x-2) = 0$ oe | **M1** | **dep** on at least one previous **B1** awarded |
| | $x = 0.4, 2$ | **A1** | |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 9 | [When $x = 2$] $y = 3$ | **B1** | |
| | $\frac{dy}{dx} = \frac{1}{2}(4x+1)^{-\frac{1}{2}} \times 4$ | **M1** | for $\left[\frac{dy}{dx} =\right] \frac{1}{2}(4x+1)^{-\frac{1}{2}} \times k$, $k \neq 0$ |
| | [gradient of tangent =] $\frac{1}{2}(4(2)+1)^{-\frac{1}{2}} \times 4$ soi | **M1** | **FT** *their* $\frac{dy}{dx}$ must be in the form $k(4x+1)^{-\frac{1}{2}}$, $k \neq 0$ |
| | $y - \textit{their}\ 3 = \textit{their}\frac{2}{3}(x-2)$ | **M1** | **Dep** on first **M1** |
| | [$x$-intercept for tangent =] $-\frac{5}{2}$ soi | **A1** | Must be from correct straight line equation |
| | $\frac{1}{2} \times \left(\frac{5}{2}+2\right) \times 3$ soi | **B1** | For area of triangle – allow unsimplified |
| | [$x$-intercept for curve =] $-\frac{1}{4}$ soi | **B1** | |
| | Area below curve: $\left[\frac{(4x+1)^{\frac{3}{2}}}{\frac{3}{2} \times 4}\right]_{-0.25}^{2}$ oe | **M1** | **M1** for integration in the form of $k(4x+1)^{\frac{3}{2}}$, $k \neq 0$ or 4 |
| | correct use of upper and lower limits: $\left(\frac{(4(2)+1)^{\frac{3}{2}}}{6} - \frac{(4(-0.25)+1)^{\frac{3}{2}}}{6}\right)$ oe | **M1** | **Dep** on previous M1 for area under the curve<br>Allow if using wrong limits but must see correct substitution |
| | Shaded area = $\frac{27}{4} - \frac{9}{2} = \frac{9}{4}$ oe | **A1** | |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 10(a) | $\frac{\sin\theta}{\sqrt{\cot^2\theta}}+\frac{1}{\sqrt{\sec^2\theta}}$ | **B1** | for correct use of the trigonometry identity $\text{cosec}^2\theta-1=\cot^2\theta$ |
| | $\sin\theta\tan\theta+\cos\theta$ oe | **B1** | |
| | $\sin\theta\times\frac{\sin\theta}{\cos\theta}+\cos\theta$ | **B1** | |
| | $\frac{\sin^2\theta+\cos^2\theta}{\cos\theta}=\frac{1}{\cos\theta}=\sec\theta$ | **B1** | **Dep** on all 3 previous marks<br>Last mark is not available if persistent missing of θ |
| | **Alternative** | | |
| | $\frac{\sin\theta}{\sqrt{\cot^2\theta}}+\frac{1}{\sqrt{\sec^2\theta}}$ | **(B1)** | for correct use of the trigonometry identity $\text{cosec}^2\theta-1=\cot^2\theta$ |
| | $\frac{\sec\theta\sin\theta+\cot\theta}{\cot\theta\sec\theta}$ | **(B1)** | |
| | $\frac{\frac{\sin\theta}{\cos\theta}+\frac{\cos\theta}{\sin\theta}}{\frac{\cos\theta}{\sin\theta}\times\frac{1}{\cos\theta}}$ | **(B1)** | |
| | $\frac{\frac{\sin^2\theta+\cos^2\theta}{\cos\theta\sin\theta}}{\frac{1}{\sin\theta}}$ leading to $\frac{1}{\cos\theta}$ | **(B1)** | **Dep** on all 3 previous marks<br>Last mark is not available if persistent missing $\theta$ |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 10(b) | $\cos x = \frac{1}{\alpha}$ | **B1** | could be implied by $\frac{1}{\alpha^2} = 1 - \sin^2 x$ |
| | $\sin^2 x + \left(\frac{1}{\alpha}\right)^2 = 1$ oe<br>OR<br>[opposite $^2$=] $\alpha^2 - 1$ soi and use of<br>$\sin x = \frac{\text{opposite}}{\text{hypotenuse}}$ at some stage leading to<br>$\sin x = [\pm]\sqrt{1 - \frac{1}{\alpha^2}}$ oe | **M1** | |
| | $\sin x = -\sqrt{1 - \frac{1}{\alpha^2}}$ oe | **A1** | |
| 11(a) | $10 - 2d$ and $10 - d$ | **B2** | **B1** for either ignore labels |
| 11(b) | Squares each term and forms a sum e.g.<br>$100 - 40d + 4d^2 + 100 - 20d + d^2 + 100$<br>$[= 140]$<br>or<br>$100 - 40d + 4d^2 + 100 - 20d + d^2 [= 40]$<br>$a^2 + \frac{a^2 + 20a + 100}{4} = 40$<br>oe | **M1** | **FT** from *their* two terms in **(a),** must be both 2 terms expression in terms of $d$ only or<br>Correct expressions in terms of $a$ only, must see substitution and expansion |
| | Correct equation in solvable form<br>$5d^2 - 60d + 160 = 0$ oe<br>$5a^2 + 20a - 60 = 0$ | **A1** | |
| | Factorises *their* 3-term quadratic expression or solves *their* 3-term quadratic equation | **M1** | |
| | $d = 8$ $d = 4$ | **A1** | |
| | Finds the first term when $d = 4$: $a = 2$ | **M1** | **FT** $10 - 2$(*their d*) |
| | $[S_{200} =] \frac{200}{2}\{4 + 199 \times 4\}$ oe | **M1** | **FT** *their a* and *their d* |
| | 80 000 | **A1** | |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 12 | $\frac{n!}{(n-5)!5!} - \frac{(n-1)!}{(n-6)!5!}$<br>$\frac{(n-1)!\times[n-(n-5)]}{(n-5)!5!}$ | **M1** | For substituting ${}^{n}C_5$ and ${}^{n-1}C_5$ |
| | $\frac{(n-1)!}{(n-6)!5!}\left(\frac{n}{n-5}-1\right)$ oe | **M1** | **dep** on previous **M1** awarded<br>For Factorising $\frac{(n-1)!}{(n-6)!5!}$ or $\frac{(n-1)!}{(n-5)!5!}$<br>Do not allow if using ${}^{n-1}C_4$ to simplify the left-hand side |
| | $\frac{(n-1)!}{(n-6)!5!}\left(\frac{5}{n-5}\right)$ oe | **M1** | **dep** on at least one previous **M1** awarded<br>Simplifying fraction |
| | Completes argument:<br>$\frac{(n-1)!}{(n-6)!5!}\left(\frac{5}{n-5}\right)=\frac{(n-1)!}{(n-1-4)!4!}={}^{n-1}C_4$ | **A1** | |
| | **Alternative 1** | | |
| | $\frac{n!}{(n-5)!5!} - \frac{(n-1)!}{(n-6)!5!}$ | **(M1)** | For substituting ${}^{n}C_5$ and ${}^{n-1}C_5$ |
| | $\frac{1}{(n-6)!}=\frac{n-5}{(n-5)!}$ or $n!=n\times(n-1)!$ | **(B1)** | **dep** on previous **M1** awarded |
| | $\frac{(n-1)!\times[n-(n-5)]}{(n-5)!5!}$ | **(M1)** | **dep** on previous **M1** awarded<br>factorising $(n-1)!$ in the fraction |
| | $\frac{(n-1)!\times5}{(n-5)!5!}=\frac{(n-1)!}{(n-5)!4!}={}^{n-1}C_4$ | **(A1)** | |
| | **Alternative 2** | | |
| | $\frac{n!}{(n-5)!5!} - \frac{(n-1)!}{(n-6)!5!}$ | **(M1)** | For substituting ${}^{n}C_5$ and ${}^{n-1}C_5$ could be implied by expansions of the factorial |
| | $\frac{n(n-1)(n-2)(n-3)(n-4)}{5!} - \frac{(n-1)(n-2)(n-3)(n-4)(n-5)}{5!}$ | **(B1)** | **dep** on previous **M1** awarded |
| | $\frac{(n-1)(n-2)(n-3)(n-4)[n-(n-5)]}{5!}$ | **(M1)** | **dep** on previous **M1** awarded<br>factorising $(n-1)(n-2)(n-3)(n-4)$ in the fraction |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 12 | Completes argument:<br>$\frac{(n-1)(n-2)(n-3)(n-4)}{4!} = \frac{(n-1)!}{4!(n-5)!} = {}^{n-1}C_4$ | **(A1)** | |