National
Qualifications
2024

X8477612

Mathematics
Paper 2

Marking Instructions

MONDAY, 13 MAY

Strictly Confidential
These instructions are **strictly confidential** and, in common with the scripts you will view and mark, they must never form the subject of remark of any kind, except to Scottish Qualifications Authority staff.

General marking principles for Higher Mathematics

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

For each question, the marking instructions are generally in two sections:

- *generic scheme — this indicates why each mark is awarded*
- *illustrative scheme — this covers methods which are commonly seen throughout the marking*

In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.

(c) One mark is available for each •. There are no half marks.

(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(e) Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.

(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example $6\times 6=12$, candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) below.

(h) If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example

$$x^2+5x+7=9x+4$$

$$x-4x+3=0$$ — This is a transcription error and so the mark is not awarded.

$$x=1$$ — This is no longer a solution of a quadratic equation, so the mark is not awarded.

The following example is an exception to the above

$$x^2+5x+7=9x+4$$

$$x-4x+3=0$$ — This error is not treated as a transcription error, as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.

$$(x-3)(x-1)=0$$

$$x=1 \text{ or } 3$$

(i) Horizontal/vertical marking

If a question results in two pairs of solutions, apply the following technique, but only if indicated in the detailed marking instructions for the question.

Example:

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

Horizontal: $\bullet^5$ $x=2$ and $x=-4$ Vertical: $\bullet^5$ $x=2$ and $y=5$
$\bullet^6$ $y=5$ and $y=-7$ $\bullet^6$ $x=-4$ and $y=-7$

You must choose whichever method benefits the candidate, **not** a combination of both.

(j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$\frac{15}{12}$ must be simplified to $\frac{5}{4}$. or $1\frac{1}{4}$ $\frac{43}{1}$ must be simplified to 43

$\frac{15}{0.3}$ must be simplified to 50 $\frac{4/5}{3}$ must be simplified to $\frac{4}{15}$

$\sqrt{64}$ must be simplified to 8*****

*The square root of perfect squares up to and including 144 must be known.

(k) Commonly Observed Responses (COR) are shown in the marking instructions to help mark common and/or non-routine solutions. CORs may also be used as a guide when marking similar non-routine candidate responses.

(l) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:

- working subsequent to a correct answer
- correct working in the wrong part of a question
- legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
- omission of units
- bad form (bad form only becomes bad form if subsequent working is correct), for example
  $(x^3+2x^2+3x+2)(2x+1)$ written as
  $(x^3+2x^2+3x+2)\times 2x+1$
  $=2x^4+5x^3+8x^2+7x+2$ gains full credit
- repeated error within a question, but not between questions or papers

(m) In any 'Show that…' question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.

(n) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate's response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.

(o) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.

(p) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Key E-marking Information

Response Overview: Before you start marking you must check every page of the candidate's response. This is to identify :

- If the candidate has written in any unexpected areas of their answer booklet
- If the script is legible and that it does not require to be re-scanned
- If there is an additional answer booklet/answer sheet, you need to check that it belongs to the same candidate
- If the candidate has continued an answer to a question at the back or in a different location in the booklet
- The presence of any non-script related objects.

No Response (NR): Where a candidate has not attempted to answer a question use No Response (NR).

Candidates are advised in the 'Your Exams' booklet to cross out any rough work when they have made a final copy. However, crossed-out work must be marked if the candidate has not made a second attempt to answer the question. Where a second attempt has been made, the crossed-out answers should be ignored.

Zero marks should only be applied when a candidate has attempted the question/item and their response does not attract any marks.

Additional Objects: Where a candidate has used an additional answer sheet this is known as an additional object. When you open a response that contains an additional object, a popup message will advise you of this. You are required to add a minimum of one annotation on every additional page to confirm that you have viewed it. You can use any of the normal marking annotations such as tick/cross
or the SEEN annotation to confirm that you have viewed the page. You will not be able to submit a script with an additional object, until every additional page contains an annotation.

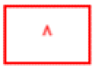
Link tool: The Link tool allows you to link pages/additional objects to a particular question item on a response.

In "Full Response View":

- Check which question the candidate's answer relates to
- Click on the question in the marks display panel
- On the left hand side, select the Link Page check box beneath the thumbnail for the page
- Once all questions have been linked, click 'Structured Response View' to start marking. When you select a linked question item in the mark input panel, the linked page(s) are displayed.

Exception	Description	Marker Action
Image Rescan request	You should raise this exception when you are unable to mark the candidate's response because the image you are viewing is of poor quality and you believe a rescan would improve the quality of the image, therefore allowing you to mark the response. Some examples of this include scan lines, folded pages or image skew.	If image is to be rescanned RM will remove the script from your work list. RM will inform you of this. No further action is required from you. If RM do not think that a rescan will improve the image then you should raise the script as an Undecipherable exception.
Offensive Content	You should raise this exception when the candidate's response contains offensive, obscene or frivolous material. Examples of this include vulgarity, racism, discrimination or swearing.	Raise this exception and enter a short report in the comments box. You should then mark the script and submit in the normal manner
Incorrect Question Paper	You should raise this exception when the image you are viewing does not correspond to the paper you are marking.	Raise script as an exception. Do not mark the image until SQA have contacted you and provided advice.
Undecipherable	You should raise this exception when you are unable to mark the candidate's response because the response cannot be read and you do not believe that a re-scan will improve the situation because the problem is with the writing and not the image. Some examples of this include poor handwriting and overwriting the original response.	Raise script as an exception to alert SQA staff. SQA will contact you to advise further action and when to close the exception.
Answer Outside of Guidance	You should raise this exception when you are unable to mark because the Marking Instructions do not cover this candidate's response.	Act on advice from Team Leader.
Concatenated Script Exception	You should raise this exception when the additional object(s) ie pages or scripts displayed **do not** belong to the candidate you are marking. You need not use this exception if the additional objects are transcriptions or additional pages submitted for the candidate.	Raise script as an exception. You can mark the correct script then review the marks once the erroneous script has been removed. SQA will contact you and advise of any actions and when to close the exception.

Exception	Description	Marker Action
Non-Script Object	You should raise this exception when the additional object displayed does not relate to the script you are marking	Raise script as an exception. Write a short report to advise the issue and continue to mark. SQA will contact you and advise of any actions and when to close the exception.
Check if Missing Pages	If you think that there is a piece of the candidate's submission missing eg because the script you are marking contains only responses to diagrams or tables and you suspect there should be a further script or word processed response or the response on the last page ends abruptly.	Raise script as an exception. Write a short report to advise the issue and continue to mark. SQA will contact you and advise of any actions and when to close the exception.
Candidate Welfare Concern	You should raise this exception when you have concerns about the candidate's well-being or welfare when marking any examination script or coursework and there is no tick on the flyleaf to identify these issues are being or have been addressed by the centre.	Telephone the Child Welfare Contact on 0345 213 6587 as early as possible on the same or next working day for further instruction. Click on the Candidate Welfare Concern button and complete marking the script and submit the mark as normal.
Malpractice	You should raise this exception when you suspect wrong doing by the candidate. Examples of this include plagiarism or collusion.	Raise this exception and enter a short report in the comments box. You should then mark the script and submit in the normal manner

Annotations		
Annotation	**Annotation Name**	**Instructions on use of annotation**
	Tick	A tick should be placed on the script at the point where a mark is awarded (or at the end of that line of working).
	Cross	A cross is used to indicate where a mark has not been awarded.
	Highlight	This is used to highlight or underline an error.
	SEEN	This annotation should be used by the marker on a blank page to show that they have viewed this page and confirm it contains no candidate response.
	Omission	An omission symbol should be used to show that something is missing, such as part of a solution or a crucial step in the working.
	Tick 1	A tick 1 should be used to indicate ‘correct’ working where a mark is awarded as a result of follow through from an error.
	Tick 2	A tick 2 should be used to indicate correct working which is irrelevant or insufficient to award any marks. This should also be used for working which is not of equivalent difficulty.
	Horizontal wavy line	A horizontal wavy line should be used to indicate a minor error which is not being penalised, for example bad form (bad form only becomes bad form if subsequent working is correct).

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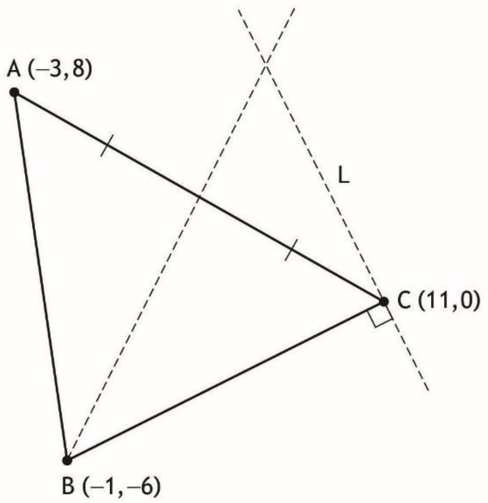
Question			Generic scheme	Illustrative scheme	Max mark
1.	(a)		Triangle ABC has vertices A(−3, 8), B(−1, −6) and C(11, 0).  (a) Find the equation of the median through B.		
			•¹ determine midpoint of AC •² determine gradient of median •³ find equation of median	•¹ (4,4) •² 2 or $\frac{10}{5}$ •³ $y = 2x - 4$	**3**

Notes:

1. •² is only available to candidates who use a midpoint to find a gradient.
2. •³ is only available as a consequence of using a ‘midpoint’ of AC and the point B
3. At •³ accept any arrangement of a candidate’s equation where the constant terms have been simplified.
4. •³ is not available as a consequence of using a perpendicular gradient.

Commonly Observed Responses:

Candidate A - perpendicular bisector of AC		**Candidate B - altitude through B**	
Midpoint = (4,4)	•¹ ✓	$m_{AC} = -\frac{4}{7}$	•¹ ^
$m_{AC} = -\frac{4}{7} \Rightarrow m_{\perp} = \frac{7}{4}$	•² ✗	$m_{\perp} = \frac{7}{4}$	•² ✗
$4y = 7x - 12$	•³ $\checkmark_2$	$4y = 7x - 17$	•³ $\checkmark_2$
For other perpendicular bisectors award 0/3			
Candidate C - median through A		**Candidate D - median through C**	
midpoint BC = $(5, -3)$	•¹ ✗	midpoint AB $(-2, 1)$	•¹ ✗
$m_{AM} = -\frac{11}{8}$	•² $\checkmark_1$	$m_{CM} = -\frac{1}{13}$	•² $\checkmark_1$
$8y = -11x + 31$	•³ $\checkmark_2$	$13y = -x + 11$	•³ $\checkmark_2$

Question			Generic scheme	Illustrative scheme	Max mark
1.	(b)		(b) Find the equation of L, the line perpendicular to BC passing through C.		
			•4 determine gradient of BC •5 determine gradient of L •6 find equation of L	•4 $\frac{6}{12}$ •5 $-\frac{12}{6}$ •6 $y=-2x+22$	3

Notes:

5. •6 is only available as a consequence of using a perpendicular gradient and C.
6. At •6 accept any arrangement of a candidate's equation where the constant terms have been simplified.

Commonly Observed Responses:

Candidate E - altitude through C

$m_{AB}=-7$	•4 ✗
$m_{\perp}=\frac{1}{7}$	•5 ✓1
$y=\frac{1}{7}(x-11)$	•6 ✓1

Question			Generic scheme	Illustrative scheme	Max mark
	(c)		(c) Determine the coordinates of the point of intersection of the median through B and the line L.		
			•7 determine x-coordinate •8 determine y-coordinate	•7 6.5 or $\frac{13}{2}$ •8 9	2

Notes:

7. For $\left(\frac{26}{4},9\right)$ award 1/2.

Commonly Observed Responses:

Candidate F - rounding decimals

(a) $4y=5x-19$	
(b) $y=-2x+22$	
(c) $x=\frac{107}{13}=8.2$	•7 ✓1
$y=5.6$	•8 ✓1

Question			Generic scheme	Illustrative scheme	Max mark
2.			A curve has equation $y=\frac{8}{x^3}$, $x>0$. Find the equation of the tangent to this curve at the point where $x=2$.		
			•[1] find y-coordinate •[2] write in differentiable form •[3] differentiate •[4] find gradient of tangent •[5] determine equation of tangent	•[1] 1 •[2] $8x^{-3}$ •[3] $8\times(-3)x^{-4}$ •[4] $-\frac{3}{2}$ •[5] $3x+2y=8$	5

Notes:

1. Only •[1] and •[2] are available to candidates who integrate. However, see Candidates E and F.
2. $8\times(-3)x^{-4}$ without previous working gains •[2] and •[3].
3. •[3] is only available for differentiating a negative power. •[4] and •[5] are still available.
4. •[4] is not available for $y=-\frac{3}{2}$. However, where $-\frac{3}{2}$ is then used as the gradient of the straight line, •[4] may be awarded - see Candidates A, B and C.
5. •[5] is only available where candidates attempt to find the gradient by substituting into their derivative.
6. •[5] is not available as a consequence of using a perpendicular gradient.
7. Where $x=2$ has not been used to determine the y-coordinate, •[5] is not available.

Commonly Observed Responses:

Candidate A - incorrect notation		Candidate B - use of values in equation	
$y=1$	•[1] ✓ - BoD	$y=1$	•[1] ✓ - BoD
$y=8x^{-3}$	•[2] ✓	$y=8x^{-3}$	•[2] ✓
$y=-24x^{-4}$	•[3] ✓	$\frac{dy}{dx}=8\times(-3)x^{-4}$	•[3] ✓
$y=-\frac{3}{2}$	•[4] ✓ - BoD	$\frac{dy}{dx}=-\frac{3}{2}$	•[4] ✓
		$y=-\frac{3}{2}$	
$3x+2y=8$	•[5] ✓	$3x+2y=8$	•[5] ✓

Candidate C - incorrect notation		Candidate D	
$y=1$	$\bullet^1$ ✓ - BoD	$y=1$	$\bullet^1$ ✓
$y=8x^{-3}$	$\bullet^2$ ✓	$y=8x^{-3}$	$\bullet^2$ ✓
$\frac{dy}{dx}=8\times(-3)x^{-4}$	$\bullet^3$ ✓	$\frac{dy}{dx}=8\times(-3)x^{-4}=0$	$\bullet^3$ ✓
$y=-\frac{3}{2}$	$\bullet^4$ ✗	$8\times(-3)(2)^{-4}=0$	
Evidence for $\bullet^4$ would need to appear in the equation of the line		$m=-\frac{3}{2}$	$\bullet^4$ ✗
		$3x+2y=8$	$\bullet^5$ $✓_1$

Candidate E - integrating in part		Candidate F - appearance of $+c$	
$y=1$	$\bullet^1$ ✓	$y=1$	$\bullet^1$ ✓
$y=8x^{-3}$	$\bullet^2$ ✓	$y=8x^{-3}$	$\bullet^2$ ✓
$\frac{dy}{dx}=-24x^{-2}$	$\bullet^3$ ✗	$\frac{dy}{dx}=-24x^{-4}+c$	$\bullet^3$ ✗ $\bullet^4$ ✗
$\frac{dy}{dx}=-6$	$\bullet^4$ $✓_1$		$\bullet^5$ ✗
$y=-6x+13$	$\bullet^5$ $✓_1$		

Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)		The coordinates of points D, E and F are given by D$(2, -3, 4)$, E$(1, 1, -2)$ and F$(3, 2, 1)$. (a) Express $\overrightarrow{ED}$ and $\overrightarrow{EF}$ in component form.		
			•[1] find $\overrightarrow{ED}$ •[2] find $\overrightarrow{EF}$	•[1] $\begin{pmatrix} 1 \\ -4 \\ 6 \end{pmatrix}$ •[2] $\begin{pmatrix} 2 \\ 1 \\ 3 \end{pmatrix}$	2

Notes:

1. For candidates who find **both** $\overrightarrow{DE}$ **and** $\overrightarrow{FE}$ correctly, award 1/2.
2. Accept vectors written horizontally.

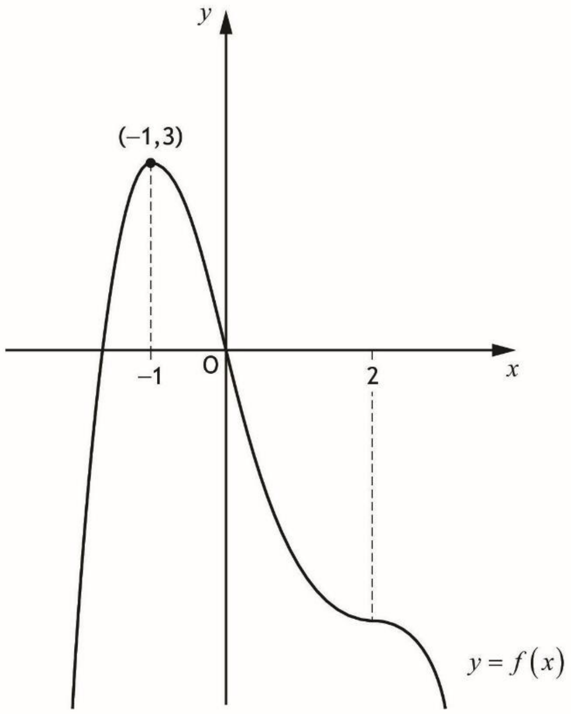
Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		(b) (i) Calculate $\overrightarrow{ED}.\overrightarrow{EF}$. (ii) Hence, or otherwise, calculate the size of angle DEF.		
		(i)	•[3] evaluate $\overrightarrow{ED}.\overrightarrow{EF}$	•[3] 16	1
		(ii)	•[4] evaluate $\lvert\overrightarrow{ED}\rvert$ •[5] evaluate $\lvert\overrightarrow{EF}\rvert$ •[6] substitute into formula for scalar product •[7] calculate angle	•[4] $\sqrt{53}$ •[5] $\sqrt{14}$ •[6] $\cos DEF = \dfrac{16}{\sqrt{53} \times \sqrt{14}}$ or $\sqrt{53} \times \sqrt{14} \times \cos DEF = 16$ •[7] 54.028…° or 0.942… radians	4

Notes:
3. Do not penalise candidates who treat negative signs with a lack of rigour when calculating a magnitude. For example accept $\sqrt{1^2+4^2+6^2}=\sqrt{53}$ or $\sqrt{1^2+-4^2+6^2}=\sqrt{53}$ for •4. However, do not accept $\sqrt{1^2-4^2+6^2}=\sqrt{53}$ for •4.
4. •6 is not available to candidates who simply state the formula $\cos\theta=\dfrac{\overrightarrow{ED}.\overrightarrow{EF}}{\lvert\overrightarrow{ED}\rvert\lvert\overrightarrow{EF}\rvert}$. However, $\cos\theta=\dfrac{16}{\sqrt{53}\times\sqrt{14}}$ and $\sqrt{53}\times\sqrt{14}\times\cos\theta=16$ are acceptable for •6.
5. Accept correct answers rounded to 54° or 0.9 radians (or 60 gradians).
6. Do not penalise the omission or incorrect use of units.
7. •7 is only available as a result of using a valid strategy.
8. •7 is only available for a single angle.
9. For a correct answer with no working award 0/4.

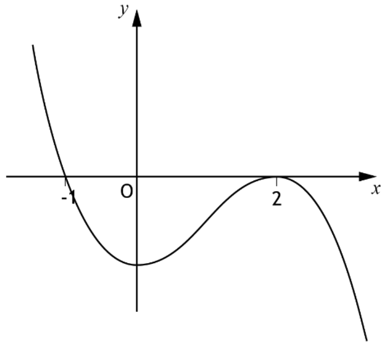
Commonly Observed Responses:

Candidate A - poor notation	Candidate B - insufficient communication
$\begin{pmatrix}1\\-4\\6\end{pmatrix}\cdot\begin{pmatrix}2\\1\\3\end{pmatrix}=\begin{pmatrix}2\\-4\\18\end{pmatrix}=16$ •3 ✗	$\lvert\overrightarrow{ED}\rvert=\sqrt{53}$ •4 ✓ $\lvert\overrightarrow{EF}\rvert=\sqrt{14}$ •5 ✓ $\dfrac{16}{\sqrt{53}\times\sqrt{14}}$ •6 ^ 54.028...° or 0.942... radians •7 ✓1
Candidate C - BEWARE $\lvert\overrightarrow{OF}\rvert=\sqrt{14}$ •5 ✗	

Question			Generic scheme	Illustrative scheme	Max mark
4.	(a)		The diagram shows the graph of a quartic function $y = f(x)$. A maximum turning point occurs at $(-1, 3)$. The graph of $y = f(x)$ also has a point of inflection at $x = 2$.  (a) Determine the coordinates of the maximum turning point on the graph of $y = f(x-4)+2$.		
			•[1] identify x-coordinate •[2] identify y-coordinate	•[1] 3 •[2] 5	**2**

Notes:

Commonly Observed Responses:

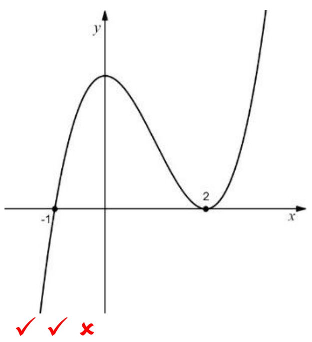
Question			Generic scheme	Illustrative scheme	Max mark
4.	(b)		(b) On the diagram in your answer booklet, sketch the graph of $y = f'(x)$.		
			•3 identify roots •4 interpret point of inflection •5 identify orientation and complete cubic curve	•3 "cubic" with roots at −1 and 2 •4 "cubic" with turning point at (2,0) •5 cubic with maximum turning point at (2,0) 	3

Notes:

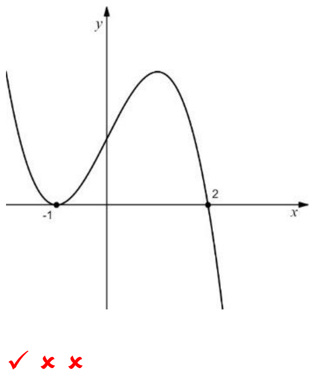
1. Note that the position of the minimum turning point of $f'(x)$ is not being assessed.
2. Where a candidate has not drawn a cubic curve or their graph does not extend outwith $-1 \le x \le 2$ award 0/3. However see Candidate D.
3. Do not penalise the appearance of an additional root outwith $-1 \le x \le 2$ (on a cubic curve) at •3.

Commonly Observed Responses:

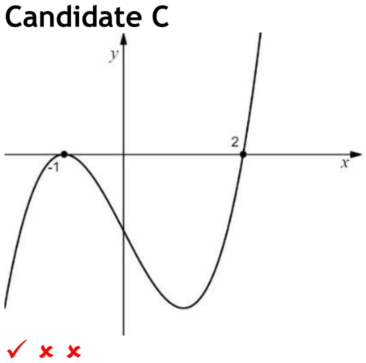
Candidate A - $-f'(x)$



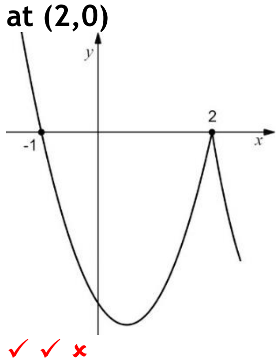
Candidate B



Candidate C



Candidate D - left derivative ≠ right derivative at (2,0)



Question			Generic scheme	Illustrative scheme	Max mark
5.			Evaluate $\int_0^{\frac{\pi}{7}} \sin 5x \, dx$.		
			•[1] integrate	•[1] $-\frac{1}{5}\cos 5x$	3
			•[2] substitute limits	•[2] $\left(-\frac{1}{5}\cos\left(5\times\frac{\pi}{7}\right)\right)-\left(-\frac{1}{5}\cos(5\times 0)\right)$	
			•[3] evaluate integral	•[3] 0.3246...	

Notes:

1. For candidates who differentiate throughout, make no attempt to integrate, or use another invalid approach (for example $\cos 5x^2$) award 0/3.
2. Do not penalise the inclusion of '$+c$' or the continued appearance of the integral sign after integrating.
3. Accept $\left(-\frac{1}{5}\cos 5\left(\frac{\pi}{7}\right)\right)-\left(-\frac{1}{5}\cos 5(0)\right)$ for •[2].
4. •[3] is only available where candidates have considered both limits within a trigonometric function.

Commonly Observed Responses:

Candidate A - integrated in part		**Candidate B - insufficient evidence of integration**	
$-\cos 5x$	•[1] ✗	$\cos 5x$	•[1] ✗
$-\cos\left(\frac{5\pi}{7}\right)-\left(-\cos(5\times 0)\right)$	•[2] ✓[1]	$\cos\left(\frac{5\pi}{7}\right)-\left(\cos(5\times 0)\right)$	•[2] ✓[2]
1.623...	•[3] ✓[1]	−1.623	•[3] ✓[2]

Candidate C - insufficient evidence of integration		**Candidate D - working in degrees before integrating**	
$\frac{1}{5}\sin 5x$	•[1] ✗	$\int_0^{25.7...} \sin 5x \, dx$	•[1] ✗
$\frac{1}{5}\sin\frac{5\pi}{7}-\frac{1}{5}\sin 0$	•[2] ✓[2]	$-\frac{1}{5}\cos 5x$	
0.156...	•[3] ✓[2]	$\left(-\frac{1}{5}\cos 128.57...\right)-\left(-\frac{1}{5}\cos 0\right)$	•[2] ✓[1]
		0.3246...	•[3] ✓[1]

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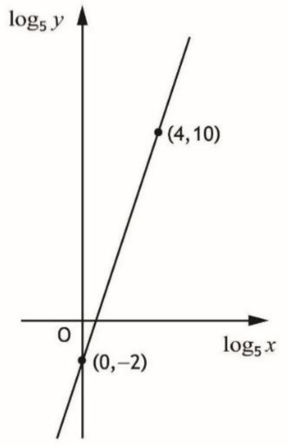
Question			Generic scheme	Illustrative scheme	Max mark
6.			Two variables, x and y, are connected by the equation $y = ax^b$. The graph of $\log_5 y$ against $\log_5 x$ is a straight line as shown. Find the values of a and b.		
			Method 1	**Method 1**	5
			•[1] state linear equation	•[1] $\log_5 y = 3\log_5 x - 2$	
			•[2] introduce logs	•[2] $\log_5 y = 3\log_5 x - 2\log_5 5$	
			•[3] use laws of logs	•[3] $\log_5 y = \log_5 x^3 - \log_5 5^2$	
			•[4] use laws of logs	•[4] $\log_5 y = \log_5 \frac{x^3}{5^2}$	
			•[5] state a and b	•[5] $a = \frac{1}{25}, b = 3$ or $y = \frac{x^3}{25}$	
			Method 2	**Method 2**	5
			•[1] state linear equation	•[1] $\log_5 y = 3\log_5 x - 2$	
			•[2] use laws of logs	•[2] $\log_5 y = \log_5 x^3 - 2$	
			•[3] use laws of logs	•[3] $\log_5 \frac{y}{x^3} = -2$	
			•[4] use laws of logs	•[4] $\frac{y}{x^3} = 5^{-2}$	
			•[5] state a and b	•[5] $a = \frac{1}{25}, b = 3$ or $y = \frac{x^3}{25}$	

			Method 3	**Method 3** **The equations at •1, •2 and •3 must be stated explicitly**	**5**
			•1 introduce logs to $y = ax^b$	•1 $\log_5 y = \log_5 ax^b$	
			•2 use laws of logs	•2 $\log_5 y = b\log_5 x + \log_5 a$	
			•3 interpret intercept	•3 $\log_5 a = -2$	
			•4 use laws of logs	•4 $a = \frac{1}{25}$	
			•5 interpret gradient	•5 $b = 3$	

Notes

1. In any method, marks may only be awarded within a valid strategy using $y = ax^b$. For example, see Candidates C and D.
2. Markers must identify the method which best matches the candidate's approach; markers must not mix and match between methods.
3. Penalise the omission of base 5 at most once in any method.
4. Where candidates use an incorrect base then only •2 **and** •3 are available (in any method).
5. Do not accept $a = 5^{-2}$.
6. In Method 3, do not accept $m = 3$ or gradient $= 3$ for •5.
7. Do not penalise candidates who score out "log" from equations of the form $\log_5 m = \log_5 n$.

Commonly Observed Responses

Candidate A - missing equations at •1, •2 and •3 in Method 3

$a = \frac{1}{25}$ •4 ✓

$b = 3$ •5 ✓

Candidate B - no working - Method 3

$b = \frac{1}{25}$ •4 ✗

$a = 3$ •5 ✗

Candidate C - Method 2

$y = 3x - 2$

$\log_5 y = 3\log_5 x - 2$ •1 ✓

$\log_5 y = \log_5 x^3 - 2$ •2 ✓

$y = x^3 - 2$ •3 ✗ •4 ✗ •5 ✗

Candidate D - Method 2

$\log_5 y = 3\log_5 x - 2$ •1 ✓

$\log_5 y = \log_5 x^3 - 2$ •2 ✓

$\frac{y}{x^3} = -2$ •3 ✗ •4 ✗ •5 ✗

Candidate E - use of coordinate pairs

$\log_5 x = 4$ **and** $\log_5 y = 10$ •1 ✓

$x = 5^4$ **and** $y = 5^{10}$ •2 ✓

$\log_5 x = 0$, $\log_5 y = -2$

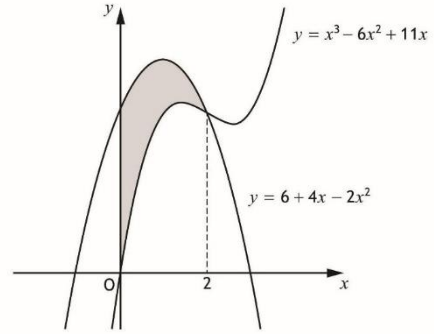
$\Rightarrow x = 1,\ y = 5^{-2}$ •3 ✓

$5^{-2} = a \times 1^b \Rightarrow a = \frac{1}{25}$ •4 ✓

$5^{10} = 5^{-2} \times 5^{4b} \Rightarrow -2 + 4b = 10$

$\Rightarrow b = 3$ •5 ✓

Candidates may use $(0,-2)$ for •1 and •2 and $(4,10)$ for •3.

Question			Generic scheme	Illustrative scheme	Max mark
7.			The diagram shows the curve with equation $y = x^3 - 6x^2 + 11x$ intersecting the curve with equation $y = 6 + 4x - 2x^2$ at $x = 2$. Calculate the shaded area.		
			Method 1 •[1] integrate using 'upper' – 'lower' •[2] identify limits •[3] integrate •[4] substitute limits •[5] evaluate area	**Method 1** •[1] $\int\left(\left(6+4x-2x^2\right)-\left(x^3-6x^2+11x\right)\right)dx$ •[2] $\int_0^2\left(\left(6+4x-2x^2\right)-\left(x^3-6x^2+11x\right)\right)dx$ •[3] $6x-\frac{7}{2}x^2+\frac{4}{3}x^3-\frac{1}{4}x^4$ •[4] $\left(6(2)-\frac{7}{2}(2)^2+\frac{4}{3}(2)^3-\frac{1}{4}(2)^4\right)-0$ •[5] $\frac{14}{3}$ (units^2)	5
			Method 2 •[1] know to integrate between appropriate limits for both equations •[2] integrate both functions •[3] substitute limits into both expressions •[4] evaluate both integrals •[5] evidence of subtracting areas	**Method 2** •[1] $\int_0^2 \ldots dx$ and $\int_0^2 \ldots dx$ •[2] $6x+\frac{4x^2}{2}-\frac{2x^3}{3}$ and $\frac{x^4}{4}-\frac{6x^3}{3}+\frac{11x^2}{2}$ •[3] $\left(6(2)+\frac{4(2)^2}{2}-\frac{2(2)^3}{3}\right)-0$ and $\left(\frac{(2)^4}{4}-\frac{6(2)^3}{3}+\frac{11(2)^2}{2}\right)-0$ •[4] $\frac{44}{3}$ and 10 •[5] $\frac{14}{3}$ (units^2)	

Notes:

1. Correct answer with no working - award 1/5.
2. Do not penalise lack of 'dx' at $\bullet^1$ in Method 1.
3. In Method 1, limits and 'dx' must appear by the $\bullet^2$ stage for $\bullet^2$ to be awarded and in Method 2 by the $\bullet^1$ stage for $\bullet^1$ to be awarded.
4. In Method 1, treat the absence of brackets at $\bullet^1$ stage as bad form only if the correct integrand is obtained. See Candidates C and D.
5. Where a candidate differentiates one or more terms, or fails to integrate, no further marks are available.
6. In Method 1, accept unsimplified expressions such as $6x+\frac{4x^2}{2}-\frac{2x^3}{3}-\frac{x^4}{4}+\frac{6x^3}{3}-\frac{11x^2}{2}$ at $\bullet^3$.
7. Do not penalise the inclusion of '$+c$'.
8. Do not penalise the continued appearance of the integral sign or dx after integrating.
9. $\bullet^5$ is not available where solutions include statements such as '$-\frac{14}{3}=\frac{14}{3}$ square units'. See Candidates A and B.
10. In Method 1, where a candidate uses an invalid strategy the only marks available are $\bullet^3$ for integrating a polynomial with at least four terms (of different degree) and $\bullet^4$ for substituting the limits of 0 and 2 into the resulting expression. However, see Candidate E.
11. At $\bullet^4$, do not penalise candidates for who reduce powers of 0. For example writing 0 in place of 0^4. Similarly, do not penalise candidates writing 0 in place of $6(0)$. However, candidates who write 0^3 in place of 0^4 or $2(0)$ in place of $6(0)$ do not gain $\bullet^4$.

Commonly Observed Responses:

Candidate A - switched limits

$\int_2^0 \left(\left(6+4x-2x^2\right)-\left(x^3-6x^2+11x\right)\right)dx$ $\bullet^2$ ✓

$=6x-\frac{7}{2}x^2+\frac{4}{3}x^3-\frac{1}{4}x^4$ $\bullet^3$ ✓

$=0-\left(6(2)-\frac{7}{2}(2)^2+\frac{4}{3}(2)^3-\frac{1}{4}(2)^4\right)$ $\bullet^4$ ✓

$=-\frac{14}{3}$

$=\frac{14}{3}$ $\bullet^1$ ✗ $\bullet^5$ ✗

Candidate B - 'lower' - 'upper'

$\int_0^2 \left(\left(x^3-6x^2+11x\right)-\left(6+4x-2x^2\right)\right)dx$ $\bullet^2$ ✓

$\int_0^2 x^3-4x^2+7x-6\,dx$

$=\frac{1}{4}x^4-\frac{4}{3}x^3+\frac{7}{2}x^2-6x$ $\bullet^3$ ✓

$\left(\frac{1}{4}(2)^4-\frac{4}{3}(2)^3+\frac{7}{2}(2)^2-6(2)\right)-(0)$ $\bullet^4$ ✓

$=-\frac{14}{3}$

$\therefore$ Area $=\frac{14}{3}$ $\bullet^1$ ✓ $\bullet^5$ ✓

Candidate C - missing brackets

$$\int_0^2 6+4x-2x^2-x^3-6x^2+11x\,dx$$

$$\int_0^2 6-7x+4x^2-x^3\,dx$$ $\bullet^1$ ✓ $\bullet^2$ ✓

Candidate D - missing brackets

$$\int_0^2 6+4x-2x^2-x^3-6x^2+11x\,dx$$ $\bullet^1$ ✗ $\bullet^2$ $\checkmark_1$

$$\int_0^2 6+15x-8x^2-x^3\,dx$$

$$6x+\frac{15}{2}x^2-\frac{8}{3}x^3-\frac{1}{4}x^4$$ $\bullet^3$ $\checkmark_1$

$$\left(6(2)+\frac{15}{2}(2)^2-\frac{8}{3}(2)^3-\frac{1}{4}(2)^4\right)-(0)$$ $\bullet^4$ $\checkmark_1$

$$\frac{50}{3}$$ $\bullet^5$ $\checkmark_1$

Candidate E - 'upper' + 'lower'

$$\int_0^2 \left(\left(6+4x-2x^2\right)+\left(x^3-6x^2+11x\right)\right)dx$$ $\bullet^1$ ✗ $\bullet^2$ $\checkmark_1$

$$6x+\frac{15}{2}x^2-\frac{8}{3}x^3+\frac{1}{4}x^4$$ $\bullet^3$ $\checkmark_1$

$$\left(6(2)+\frac{15}{2}(2)^2-\frac{8}{3}(2)^3+\frac{1}{4}(2)^4\right)-0$$ $\bullet^4$ $\checkmark_1$

$$\frac{74}{3}$$ $\bullet^5$ $\checkmark_1$

Candidate F - incorrect substitution

$$\int_0^2 \left(\left(6+4x-2x^2\right)-\left(x^3-6x^2+11x\right)\right)dx$$ $\bullet^1$ ✓ $\bullet^2$ ✓

$$\left(6x+2x^2-\frac{2}{3}x^3\right)-\left(\frac{1}{4}x^4-2x^3+\frac{11}{2}x^2\right)$$ $\bullet^3$ ✓

$$\left(6(2)+2(2)^2-\frac{2}{3}(2)^3\right)-\left(\frac{1}{4}(0)^4-2(0)^3+\frac{11}{2}(0)^2\right)$$ $\bullet^4$ ✗

$$\frac{44}{3}$$ $\bullet^5$ $\checkmark_2$

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Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		Functions f and g are defined on $\mathbb{R}$, the set of real numbers, by: • $f(x)=2x^2-18$ • $g(x)=x+1$. (a) Find an expression for $f(g(x))$.		
			•1 interpret notation •2 state expression for $f(g(x))$	•1 $f(x+1)$ or $2g(x)^2-18$ •2 $2(x+1)^2-18$	2

Notes:

1. For $2(x+1)^2-18$ without working, award both •1 and •2.

Commonly Observed Responses:

Candidate A - $g(f(x))$		Candidate B - beware of two "attempts"	
$2x^2-17$	•1 ✗ •2 ✓1	$f(g(x))=2x^2-18$ $f(x+1)=2(x+1)^2-18$	•1 ✗ •2 ✗

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		(b) Find the values of x for which $\frac{1}{f(g(x))}$ is undefined.		
			•³ apply condition •⁴ state values of x	•³ $2(x+1)^2 - 18 = 0$ •⁴ -4 and 2	2

Notes:

2. Working at •³ must be consistent with working at •².
3. Accept $2(x+1)^2 - 18 \neq 0$ for •³ only when $x = -4$ and $x = 2$ are stated explicitly at •⁴. See Candidate H
4. •⁴ is only available for finding the roots of a quadratic.
5. For subsequent incorrect working, the final mark is not available. For example $-4 < x < 2$.

Commonly Observed Responses:

Candidate C - expanding brackets in (a) **Part (a)** $f(g(x)) = 2(x+1)^2 - 18$ •¹ ✓ •² ✓ $f(g(x)) = 2x^2 + 4x - 16$ **Part (b)** $2x^2 + 4x - 16 = 0$ •³ ✓ $x = -4$ and $x = 2$ •⁴ ✓	**Candidate D - expanding brackets in (a)** **Part (a)** $f(g(x)) = 2(x+1)^2 - 18$ •¹ ✓ •² ✓ $f(g(x)) = 2x^2 - 16$ Part (b) $2x^2 - 16 = 0$ •³ ✗ $x = \pm\sqrt{8}$ •⁴ ✓₁
Candidate E - $g(f(x))$ **Part (a)** $f(g(x)) = 2x^2 - 17$ •¹ ✗ •² ✓₁ Part (b) $2x^2 - 17 = 0$ •³ ✓₁ $x = \pm\sqrt{\frac{17}{2}}$ •⁴ ✓₁	**Candidate F - equivalent condition** $2(x+1)^2 = 18$ •³ ✓
Candidate G - use of ≠ $2(x+1)^2 - 18 \neq 0$ •³ ✗ $x \neq -4$, $x \neq 2$ •⁴ ✓₁	**Candidate H - use of ≠** $2(x+1)^2 - 18 \neq 0$ $x \neq -4$, $x \neq 2$ $x = -4$, $x = 2$ •³ ✓ •⁴ ✓

Question			Generic scheme	Illustrative scheme	Max mark
9.	(a)		(a) Determine the coordinates of the stationary points on the curve with equation $y=\frac{1}{3}x^3-x^2-3x+1$.		
			•[1] differentiate two non-constant terms	•[1] eg x^2-2x	4
			•[2] complete derivative and equate to 0	•[2] $x^2-2x-3=0$	
			•[3] find x-coordinates	•[3] -1, 3 (•[3] •[4])	
			•[4] find y-coordinates	•[4] $\frac{8}{3}$, -8	

Notes:

1. For a numerical approach, award 0/4.
2. •[2] is only available if ' $=0$ ' appears at the •[2] stage or in working leading to •[3]. However, see Candidate A.
3. •[3] is only available for solving a quadratic equation.
4. •[3] and •[4] may be awarded vertically.

Commonly Observed Responses:

Candidate A

Stationary points when $\frac{dy}{dx}=0$

$\frac{dy}{dx}=x^2-2x-3$	•[1] ✓ •[2] ✓
$\frac{dy}{dx}=(x+1)(x-3)$	
$x=-1,\ 3$	•[3] ✓
$y=\frac{8}{3},\ -8$	•[4] ✓

Candidate B - derivative never equated to 0

x^2-2x-3	•[1] ✓ •[2] ^
$(x+1)(x-3)$	
$x=-1,\ 3$	•[3] ✓[1]
$y=\frac{8}{3},\ -8$	•[4] ✓

Question			Generic scheme	Illustrative scheme	Max mark
9.	(b)		(b) Hence, determine the greatest and least values of y in the interval $-1 \leq x \leq 6$.		
			•[5] evaluate y at $x=6$ •[6] state greatest and least values	•[5] 19 •[6] greatest = 19 and least = -8	**2**

Notes:

5. 'Greatest $(6,19)$; least $(3,-8)$' does not gain •[6].
6. Where $x=-1$ was not identified as a stationary point in part (a), y must also be evaluated at $x=-1$ to gain •[6].
7. •[6] is not available for using y at a value of x, obtained at •[3] stage, which lies outwith the interval $-1 \leq x \leq 6$.
8. •[6] is only available where candidates have attempted to evaluate y at $x=6$.

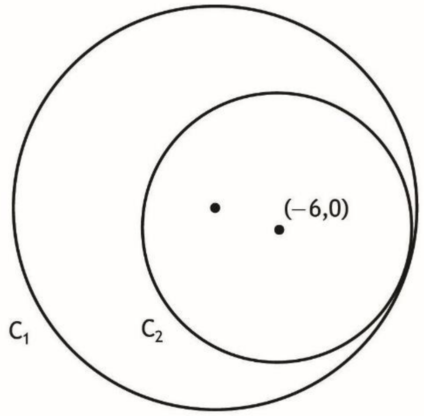
Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		The circle C_1 has equation $x^2 + y^2 + 18x - 2y - 8 = 0$. (a) Find the centre and radius of C_1.		
			$\bullet^1$ state centre $\bullet^2$ calculate radius	$\bullet^1$ $(-9,1)$ $\bullet^2$ $\sqrt{90}$ or $3\sqrt{10}$ or 9.48…	**2**

Notes:

1. Accept $x = -9,\ y = 1$ for $\bullet^1$.
2. Do not accept '$g = -9,\ f = 1$' or '$-9,1$' for $\bullet^1$.
3. Do not penalise candidates who treat negative signs with a lack of rigour when calculating the radius. For example accept $\sqrt{9^2 + -1^2 + 8} = \sqrt{90}$ or $\sqrt{9^2 + 1^2 + 8} = \sqrt{90}$ or $\sqrt{-9^2 + 1^2 + 8} = \sqrt{90}$ for $\bullet^2$. However, do not accept $\sqrt{9^2 - 1^2 + 8} = \sqrt{90}$ for $\bullet^2$.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
10.	(b)		A second circle, C_2, touches C_1 internally. The centre of C_2 is $(-6, 0)$.  (b) Determine the equation of C_2.		
			$\bullet^3$ determine the distance between the centres and subtract to find a numerical expression for the radius of C_2 $\bullet^4$ determine equation of C_2	$\bullet^3$ eg $\sqrt{90}-\sqrt{10}$ $\bullet^4$ $(x+6)^2+y^2=40$	2

Notes:

4. Do not penalise the use of decimals.
5. The distance between the centres, and the radius of C_2 must be consistent with the sizes of the circles in the original diagram ($d < r_{C_2} < r_{C_1}$).
6. Where a candidate uses an incorrect radius without supporting working, $\bullet^4$ is not available.

Commonly Observed Responses:

Candidate A - follow-through marking	Candidate B - using line through centres
Part (a) $r=\sqrt{74}$ $\bullet^2$ ✗ **Part (b)** $d=\sqrt{10}$ radius $=\sqrt{74}-\sqrt{10}$ $\bullet^3$ ✓1 $(x+6)^2+y^2=5.44...^2$ $(x+6)^2+y^2=29.59...$ (or $84-4\sqrt{185}$) $\bullet^4$ ✓1	Equation of radius: $3y=-x-6$ $(-3y-6)^2+y^2+18(-3y-6)-2y-8=0$ $10y^2-20y-80=0$ ~~$y=4$~~ $y=-2$ ~~$x=-18$~~ $x=0$ Radius = distance between $(-6,0)$ and $(0,-2)$ Radius = $\sqrt{40}$ $\bullet^3$ ✓ $(x+6)^2+y^2=40$ $\bullet^4$ ✓

Question			Generic scheme	Illustrative scheme	Max mark
11.	(a)		The number of electric vehicles worldwide can be modelled by $$N = 6.8e^{kt}$$ where: • N is the estimated number of vehicles in millions • t is the number of years since the end of 2020 • k is a constant. (a) Use the model to estimate the number of electric vehicles worldwide at the end of 2020.		
			$\bullet^1$ state number of vehicles	$\bullet^1$ 6.8 million	**1**

Notes:

1. Accept 6.8 or $N = 6.8$ million for $\bullet^1$.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
11.	(b)		At the end of 2030, it is estimated there will be 125 million electric vehicles worldwide. (b) Determine the value of k.		
			•² substitute for N and t	•² $125 = 6.8e^{10k}$ stated or implied by •³	4
			•³ process equation	•³ $\frac{125}{6.8} = e^{10k}$	
			•⁴ express in logarithmic form	•⁴ $\log_e\left(\frac{125}{6.8}\right) = 10k$	
			•⁵ solve for k	•⁵ 0.2911...	

Notes:

2. Accept answers which round to 0.29.
3. Do not penalise rounding or transcription errors (which are correct to 2 significant figures) in intermediate calculations.
4. •³ may be assumed by •⁴.
5. Any base may be used at •⁴ stage. See Candidate A.
6. At •⁴ all exponentials must be processed.
7. Accept $\log_e \frac{125}{6.8} = 10k \log_e e$ for •⁴.
8. The calculation at •⁵ must follow from the valid use of exponentials and logarithms at •³ and •⁴.
9. For candidates with no working, or who adopt an iterative approach to arrive at $k = 0.29$, award 1/4. However, if, in the iterations N is calculated for $k = 0.295$ and $k = 0.285$, then award 4/4.

Commonly Observed Responses:

Candidate A - use of alternative base

$125 = 6.8e^{10k}$	•² ✓
$\frac{125}{6.8} = e^{10k}$	•³ ✓
$\log_{10}\left(\frac{125}{6.8}\right) = 10k \log_{10} e$	•⁴ ✓
$k = 0.2911...$	•⁵ ✓

Candidate B - missing lines of working

$125 = 6.8e^{10k}$	•² ✓
$k = 0.2911...$	•³ ^ •⁴ ^ •⁵ ✓

Candidate C - errors in substitution

$125\,000\,000 = 6.8e^{10k}$	•² ✗
$\frac{125\,000\,000}{6.8} = e^{10k}$	•³ $✓_1$
$16.726... = 10k$	•⁴ $✓_1$
$k = 1.6726...$	•⁵ $✓_1$

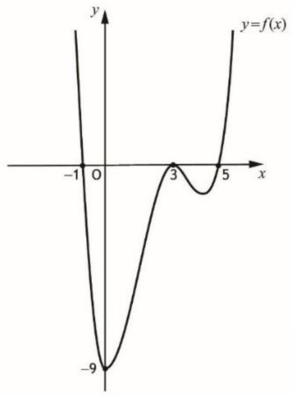
Question			Generic scheme	Illustrative scheme	Max mark
12.			Solve the equation $2\sin 2x° - \sin^2 x° = 0$, $0 \le x < 360$.		
			•1 substitute appropriate double angle formula •2 factorise •3 solve for $\tan x°$ •4 solve $\tan x° = 4$ •5 solve $\sin x° = 0$	•1 $2(2\sin x° \cos x°) - \sin^2 x° (= 0)$ •2 $\sin x°(4\cos x° - \sin x°) = 0$ •3 $\tan x° = 4$ (since $x = 90, 270$ are not solutions) (•4 •5) •4 76, 256 •5 0, 180	5

Notes:

1. •1 is still available to candidates who correctly substitute for $\sin^2 x$ in addition to $\sin 2x$.
2. Substituting $2\sin A\cos A$ for $\sin 2x°$ at the •1 stage should be treated as bad form provided the equation is written in terms of x at the •2 stage. Otherwise, •1 is not available.
3. '$=0$' must appear by the •2 stage for •2 to be awarded.
4. Award •2 for '$S(4C - S) = 0$' only where $\sin x° = 0$ and $4\cos x° - \sin x° = 0$ appear.
5. Do not penalise the omission of degree signs.
6. At •3 stage, candidates are not required to check that 90 and 270 are not solutions before dividing by $\cos x°$. Where candidates have divided by $\sin x$ at the •2 stage without considering $\sin x = 0$, •3 and •4 are still available.
7. At •3 stage, candidates may use the wave function and arrive at $\sqrt{17}\cos(x+14)° = 0$, or an equivalent wave form, instead of $\tan x° = 4$.
8. •4 is only available where the working at the •3 stage is of equivalent difficulty to reaching $\tan x° = 4$.
9. •5 is not available where $\sin x = 0$ comes from an invalid strategy.
10. For candidates who work only in radians, •5 is not available.
11. •4 and •5 may be awarded vertically. See also Candidate B.
12. Do not penalise solutions outwith $0 \le x < 360$.

Commonly Observed Responses:

Candidate A - working in radians		Candidate B - partial solutions	
⋮	•1 ✓ •2 ✓	$2(2\sin x° \cos x°) - \sin^2 x° = 0$	•1 ✓
$\tan x° = 4$	•3 ✓	$\sin x°(4\cos x° - \sin x°) = 0$	•2 ✓
1.326, 4.468	•4 ✓1	$\sin x° = 0$	
$0, \pi$	•5 ✓2	$x = 180$	
		$\tan x° = 4$	•3 ✓
		$x = 76$	•4 ✓ •5 ^

Question			Generic scheme	Illustrative scheme	Max mark
13.			The diagram shows the graph of $y = f(x)$, where $f(x)$ is a quartic function.  Express $f(x)$ in the form $f(x) = k(x+a)^2(x+b)(x+c)$.		
			•1 state repeated factor	•1 $(x-3)^2(\ldots)(\ldots)$	3
			•2 state non-repeated linear factors	•2 $(\ldots)^2(x+1)(x-5)$	
			•3 calculate k and express in required form	•3 $f(x) = \frac{1}{5}(x-3)^2(x+1)(x-5)$	

Notes:

1. Do not penalise the omission of $f(x) =$ or the inclusion of $y =$.
2. Accept $f(x) = \frac{1}{5}(x+-3)^2(x+1)(x+-5)$ for •3.

Commonly Observed Responses:

Candidate A - incorrect signs $f(x) = k(x+3)^2(x-1)(x+5)$ •1 ✗ •2 $\checkmark_1$ $f(x) = \frac{1}{5}(x+3)^2(x-1)(x+5)$ •3 $\checkmark_1$	**Candidate B - incorrect repeated root** $f(x) = k(x+1)^2(x-3)(x-5)$ •1 ✗ •2 $\checkmark_1$ $f(x) = -\frac{3}{5}(x+1)^2(x-3)(x-5)$ •3 $\checkmark_1$
Candidate C - incorrect repeated root $f(x) = k(x-5)^2(x+1)(x-3)$ •1 ✗ •2 $\checkmark_1$ $f(x) = \frac{3}{25}(x-5)^2(x+1)(x-3)$ •3 $\checkmark_1$	**Candidate D - incorrect signs and repeated root** $f(x) = k(x+5)^2(x-1)(x+3)$ •1 ✗ •2 ✗ $f(x) = \frac{3}{25}(x+5)^2(x-1)(x+3)$ •3 $\checkmark_1$
Candidate E - incorrect signs and repeated root $f(x) = k(x-1)^2(x+5)(x+3)$ •1 ✗ •2 ✗ $f(x) = -\frac{3}{5}(x-1)^2(x+5)(x+3)$ •3 $\checkmark_1$	**Candidate F - use of a, b and c** $a = -3$ •1 ✓ $b = 1,\ c = -5$ (or $b = -5,\ c = 1$) •2 ✓ $k = \frac{1}{5}$ •3 ^

[END OF MARKING INSTRUCTIONS]