SCOTTISH QUALIFICATIONS AUTHORITY

2004 Mathematics

Higher

Finalised Marking Instructions

1. Marks must be assigned in accordance with these marking instructions. In principle, marks are awarded for what is correct, rather than marks deducted for what is wrong.
2. Award one mark for each 'bullet' point. Each error should be underlined in RED at the point in the working where it first occurs, and not at any subsequent stage of the working.
3. The working subsequent to an error must be followed through by the marker with possible full marks for the subsequent working, provided that the difficulty involved is approximately similar. Where, subsequent to an error, the working is eased, a deduction(s) of mark(s) should be made.
   This may happen where a question is divided into parts. In fact, failure to even answer an earlier section does not preclude a candidate from assuming the result of that section and obtaining full marks for a later section.

4. Correct working should be ticked (✔).This is essential for later stages of the SQA procedures. Where working subsequent to an error(s) is correct and scores marks, it should be marked with a crossed tick (✗). In appropriate cases attention may be directed to work which is not quite correct (e.g. bad form) but which has not been penalised, by underlining with a dotted or wavy line.
   Work which is correct but inadequate to score any marks should be corrected with a double cross tick (✗✗).

5. • The total mark for each section of a question should be entered in red in the **outer** right hand margin, opposite the end of the working concerned.
   • Only the mark should be written, **not** a fraction of the possible marks.
   • These marks should correspond to those on the question paper and these instructions.

6. It is of great importance that the utmost care should be exercised in adding up the marks. Where appropriate, all summations for totals and grand totals must be carefully checked.
   Where a candidate has scored zero marks for any question attempted, "0" should be shown against the answer.

7. As indicated on the front of the question paper, full credit should only be given where the solution contains appropriate working. Accept answers arrived at by inspection or mentally where it is possible for the answer so to have been obtained. Situations where you may accept such working will be indicated in the marking instructions.

cont/

8. Do not penalise:
   - working subsequent to a correct answer
   - omission of units
   - bad form
   - legitimate variations in numerical answers
   - correct working in the "wrong" part of a question

9. No piece of work should be scored through - even where a fundamental misunderstanding is apparent early in the answer. Reference should always be made to the marking scheme - answers which are widely off-beam are unlikely to include anything of relevance but in the vast majority of cases candidates still have the opportunity of gaining the odd mark or two provided it satisfies the criteria for the mark(s).

10. If in doubt between two marks, give an intermediate mark, but without fractions. When in doubt between consecutive numbers, give the higher mark.

11. In cases of difficulty covered neither in detail nor in principle in the Instructions, attention may be directed to the assessment of particular answers by making a referal to the P.A. Please see the general instructions for P.A. referrals.

12. No marks should be deducted at this stage for careless or badly arranged work. In cases where the writing or arrangement is very bad, a note may be made on the upper left-hand corner of the front cover of the script.

13 **Do not write any comments on the scripts**. A summary of acceptable notation is given on page 4.

Summary

Throughout the examination procedures many scripts are remarked. It is essential that markers follow common procedures:

1 **Tick** correct working.
2 Put a mark in the **right-hand margin to match the marks allocations on the question paper.**
3 Do **not** write marks as fractions.
4 Put each mark **at the end** of the candidate's response to the question.
5 **Follow through** errors to see if candidates can score marks subsequent to the error.
6 Do **not** write any comments on the scripts.

1 The point A has coordinates (7, 4). The straight lines with equations $x + 3y + 1 = 0$ and $2x + 5y = 0$ intersect at B.

(a) Find the gradient of AB. **3**

(b) Hence show that AB is perpendicular to only one of these two lines. **5**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
1	a	3	C	1.1.1	CN	04/15
	b	5	C	1.1.9, 1.1.10		

The Primary Method m/s is based on the following generic m/s. THIS GENERIC M/S MAY BE USED AS AN EQUIVALENCE GUIDE BUT ONLY WHERE A CANDIDATE DOES NOT USE THE PRIMARY METHOD OR ANY ALTERNATIVE METHOD SHOWN IN DETAIL IN THE MARKING SCHEME.

- $\bullet^1$ ss : strategy for solving sim. equations
- $\bullet^2$ pd : process
- $\bullet^3$ pd : calculate gradient
- $\bullet^4$ ss : use $m_1.m_2 = -1$
- $\bullet^5$ ss : arrange in standard form
- $\bullet^6$ ic : state gradient
- $\bullet^7$ ic : state gradient
- $\bullet^8$ ic : complete proof

Notes

1 For $\bullet^1$
Elimination may be used instead of substitution
Evidence of a start to elimination would be the appearance of equal coefficients of x or y.

2 For (a) equating the zeros, neither of the first two marks are available.

3 (5,–2) may be obtained by inspection or trial and improvement. If it is justified by checking in both equations, $\bullet^1$ and $\bullet^2$ may be awarded. If is not justified in both equations, award neither of the first two marks.

4 A general statement about perpendicular lines must have $m_1.m_2 = -1$ earns no marks

5 Candidates who make a mistake in (a) may have to show in (b) that neither line is perpendicular to AB. All five marks are available.

Primary Method : Give 1 mark for each •

- $\bullet^1$ $x = -3y - 1$ *and attempt to substitute*
  e.g. $2(-3y - 1) + ... = 0$
- $\bullet^2$ $B(5, -2)$
- $\bullet^3$ $m_{AB} = 3$

3 *marks*

- $\bullet^4$ $m_{AB} = 3 \Rightarrow m_{perp} = -\frac{1}{3}$
- $\bullet^5$ $y = -\frac{1}{3}x.....$ *stated / implied by* $\bullet^6$
- $\bullet^6$ $m_{l_1} = -\frac{1}{3}$
- $\bullet^7$ $m_{l_2} = -\frac{2}{5}$
- $\bullet^8$ so only the 1st line is perpendicular to AB

5 *marks*

1 Alternative Method for •4 to •8

- $\bullet^4$ $y = -\frac{1}{3}x...$ may be implied by $\bullet^5$
- $\bullet^5$ $m_{l_1} = -\frac{1}{3}$
- $\bullet^6$ $m_{l_2} = -\frac{2}{5}$
- $\bullet^7$ $l_1 : 3 \times -\frac{1}{3} = -1$ *so* $AB \perp l_1$
- $\bullet^8$ *and* AB *is not* $\perp l_2$

5 *marks*

2 Alternative Method for •4 to •8

- $\bullet^4$ $m_{AB} = 3 \Rightarrow m_{perp} = -\frac{1}{3}$
- $\bullet^5$ $y = -\frac{2}{5}x$ *stated / implied by* $\bullet^6$
- $\bullet^6$ $m_{l_1} = -\frac{2}{5}$
- $\bullet^7$ $m_{l_2} = -\frac{1}{3}$
- $\bullet^8$ so only the 2nd line is perpendicular to AB

5 *marks*

Continued on page 6

1 The point A has coordinates (7, 4). The straight lines with equations $x + 3y + 1 = 0$ and $2x + 5y = 0$ intersect at B.

(a) Find the gradient of AB. **3**

(b) Hence show that AB is perpendicular to only one of these two lines. **5**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
1	a	3	C	1.1.1	CN	04/15
	b	5	C	1.1.9, 1.1.10		

continued from page 5

3 Alternative Method for •4 to •8

- $\bullet^4$ $m_{perp} = -\frac{1}{3}$
- $\bullet^5$ strat: find equ. thr' B with gradient $-\frac{1}{3}$
- $\bullet^6$ $y-(-2) = -\frac{1}{3}(x-5)$
- $\bullet^7$ *leading to* $3y + x + 1 = 0$
- $\bullet^8$ the first line is the ONLY line perp. to AB

5 *marks*

4 Alternative Method for •4 to •8

- $\bullet^4$ $y = -\frac{1}{3}x...$ may be implied by $\bullet^5$
- $\bullet^5$ $m_{l_1} = -\frac{1}{3}$
- $\bullet^6$ $m_{l_2} = -\frac{2}{5}$
- $\bullet^7$ $l_1 : 3 \times -\frac{1}{3} = -1$ *so AB is the* **ONLY** *line* $\perp l_1$
- $\bullet^8$ *implied by the* "**ONLY**" *at* $\bullet^7$.

5 *marks*

5 A "Poor" illustration

$y = -\frac{1}{3}x...$
$y = -\frac{2}{5}x$ — 1 *mark*

1st equ is perp. to AB
2nd equ is not perp to AB — 1 *mark*

6 Further illustrations

AB is perp. to $x + 3y + 1 = 0$
because $3 \times -\frac{1}{3} = -1$ $\bullet^4$ *only*
[*end*!]

AB is perp. to $x + 3y + 1 = 0$
as its gradient is $-\frac{1}{3}$ $\bullet^4$ (& $\bullet^5$)
and AB is $3 \Leftrightarrow 3 \times -\frac{1}{3} = -1$
all of the above writing $\bullet^7$

AB is perp. to the line $y = -\frac{1}{3}...$ $\bullet^5$
because $3 \times -\frac{1}{3} = -1$ $\bullet^4$
all of the above writing $\bullet^7$

2 $f(x) = x^3 - x^2 - 5x - 3$.

(a) (i) Show that $(x + 1)$ is a factor of $f(x)$.

(ii) Hence or otherwise factorise $f(x)$ fully. **5**

(b) One of the turning points of the graph of $y = f(x)$ lies on the x-axis.

Write down the coordinates of this turning point . **1**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
2	a	5	C	2.1.3	NC	04/58
	b	1	C	2.1.3		

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- $\bullet^1$ ss : know to find $f(-1)$
- $\bullet^2$ ss : start eg synthetic division
- $\bullet^3$ pd : complete to zero remainder
- $\bullet^4$ ic : extract quadratic
- $\bullet^5$ ic : fully factorise
- $\bullet^6$ ic : state coordinates

Primary Method : Give 1 mark for each •

$\bullet^1$ *know to find* $f(-1)$

$\bullet^2$ -1 | 1 -1 -5 -3 / -1

. 1

$\bullet^3$ -1 | 1 -1 -5 -3 / -1 2 3

. 1 -2 -3 0

$\bullet^4$ $x^2 - 2x - 3$

$\bullet^5$ $(x+1)(x+1)(x-3)$

5 *marks*

$\bullet^6$ $(-1,0)$

1 *mark*

1 Alternative Method 1 for •1 , •2 and •3

- $\bullet^1$ *know to find* $f(-1)$
- $\bullet^2$ $f(-1) = (-1)^3 - (-1)^2 - 5(-1) - 3 = 0$
- $\bullet^3$ *a strategy for finding the quadratic factor eg inspection, long division, synthetic division*

Notes

1 Treat $f(x) = (x+1),(x+1),(x-3)$ as bad form

2 $\bullet^6$ is not available for

"(–1,0) or (3, 0)"

"$x = -1$"

an unsupported "(0,–1)"

3 Treat
$x = -1$
$y = ... = 0$
so point $= (0,-1)$
as bad form

3	Find all the values of x in the interval $0 \le x \le 2\pi$ for which $\tan^2(x) = 3$.	**4**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
3		4	C	1.2.9, 1.2.11	NC	04/85

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- $\bullet^1$ ss : know to get the square root
- $\bullet^2$ pd : solve trig equation
- $\bullet^3$ pd : solve trig equation
- $\bullet^4$ ic : know there is $+\surd$ and $-\surd$

Primary Method : Give 1 mark for each •

- $\bullet^1$ $\tan x = \sqrt{3}$
- $\bullet^2$ $x = \dfrac{\pi}{3}$
- $\bullet^3$ $x = \dfrac{4\pi}{3}$
- $\bullet^4$ $\tan x = -\sqrt{3}$ stated explicitly
  and $x = \dfrac{2\pi}{3}, \dfrac{5\pi}{3}$

4 *marks*

1 Alternative Method for •1 and •2

- $\bullet^1$ $\tan x = \sqrt{3}$
- $\bullet^2$ $x = \dfrac{\pi}{3}$
- $\bullet^3$ $\tan x = -\sqrt{3}$ ***and*** $x = \dfrac{2\pi}{3}$
- $\bullet^4$ $\dfrac{4\pi}{3}$ ***and*** $\dfrac{5\pi}{3}$

4 *marks*

Notes

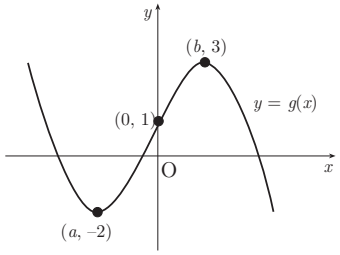
1 Candidates must produce final answers in radians. If their final answer(s) are in degrees then deduct one mark.

2 **Cave**
Candidates who produce the four correct answers from $\tan(x) = \sqrt{3}$ can only be awarded $\bullet^1$ and $\bullet^2$.

3 Do not penalise "correct" answers outside the range $0 \le x \le 2\pi$

4 Do **NOT** accept $\pi + \dfrac{\pi}{3}$ for $\dfrac{4\pi}{3}$.

4 The diagram shows the graph of $y = g(x)$.



(a) Sketch the graph of $y = -g(x)$. **2**

(b) On the same diagram sketch the graph of $y = 3 - g(x)$. **2**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
4	a	2	C	1.2.4	CN	04/6
	b	2	C	1.2.4		

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- $\bullet^1$ ic : sketch transformed graph
- $\bullet^2$ ic : show new coordinates
- $\bullet^3$ ic : sketch transformed graph
- $\bullet^4$ ic : show new coordinates

Primary Method : Give 1 mark for each •

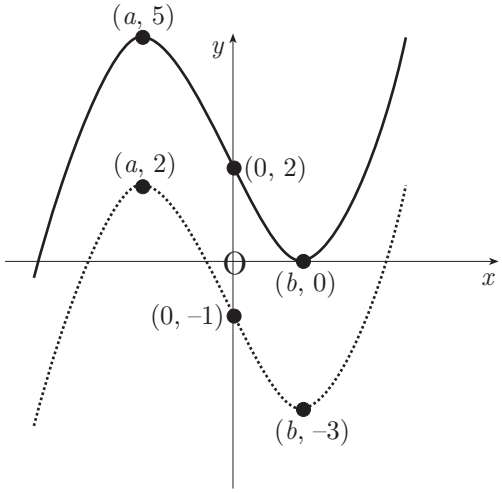
- $\bullet^1$ reflection in x-axis and any one from $(0,\text{-}1),(a,2),(b,-3)$ clearly annotated
- $\bullet^2$ the remaining two from the above list

2 *marks*

- $\bullet^3$ translation and any one from $(0,2),(a,5),(b,0)$ clearly annotated
- $\bullet^4$ the remaining two from the above list

2 *marks*

solution



Notes

1 For (a), reflection in the y-axis earns a maximum of 1 out of 2 with all 3 points clearly annotated

2 For (b), a translation of $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ earns a maximum of 1 out of 2 with all 3 points clearly annotated

3 For (b), a translation of $\begin{pmatrix} \pm 3 \\ 0 \end{pmatrix}$ earns no marks.

4 For the annotated points in (a) and (b), accept a superimposed grid.

5 $g(x)$ needs to retain its cubic shape for $\bullet^1$ and $\bullet^2$

6 In (b) $\bullet^3$ and $\bullet^4$ are only available for applying the translation to the resulting graph from (a).

5 A,B, and C have coordinates (–3, 4, 7), (–1, 8, 3), and (0, 10, 1) respectively.

(*a*) Show that A, B, and C are collinear. **3**

(*b*) Find the coordinates of D such that $\vec{AD} = 4\vec{AB}$. **2**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
5	a	3	C	3.1.7	CN	04/n
	b	2	B	3.1.6		

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- $\bullet^1$ ss : use vector approach eg for $\vec{AB}$
- $\bullet^2$ ic : compare two vectors
- $\bullet^3$ ic : complete proof
- $\bullet^4$ pd : find multiple of vector
- $\bullet^5$ ic : interpret vector

Primary Method : Give 1 mark for each •

- $\bullet^1$ $\vec{AB} = \begin{pmatrix} 2 \\ 4 \\ -4 \end{pmatrix}$
- $\bullet^2$ $\vec{AC} = \begin{pmatrix} 3 \\ 6 \\ -6 \end{pmatrix} = \frac{3}{2} \times \vec{AB}$
- $\bullet^3$ $\vec{AB}$ & $\vec{AC}$ have common direction and common point
  Hence A,B and C collinear

3 *marks*

- $\bullet^4$ $\vec{AD} = \begin{pmatrix} 8 \\ 16 \\ -16 \end{pmatrix}$
- $\bullet^5$ $D = (5, 20, -9)$

2 *marks*

2 Alternative Method for •1 and •2

eg

- $\bullet^1$ $\vec{AB} = \begin{pmatrix} 2 \\ 4 \\ -4 \end{pmatrix} = 2\begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$
- $\bullet^2$ $\vec{AC} = \begin{pmatrix} 3 \\ 6 \\ -6 \end{pmatrix} = 3\begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$

1 Alternatives Method for •1 and •2

- $\bullet^1$ $\vec{BC} = \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$ $\quad$ $\bullet^1$ $\vec{AB} = \begin{pmatrix} 2 \\ 4 \\ -4 \end{pmatrix}$
- $\bullet^2$ $\vec{AC} = \begin{pmatrix} 3 \\ 6 \\ -6 \end{pmatrix} = 3 \times \vec{BC}$ $\quad$ $\bullet^2$ $\vec{BC} = \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix} = \frac{1}{2} \times \vec{AB}$

3 Alternative Method for •4

- $\bullet^4$ $\boldsymbol{d} - \boldsymbol{a} = 4(\boldsymbol{b} - \boldsymbol{a}) \Rightarrow \boldsymbol{d} = 4\boldsymbol{b} - 3\boldsymbol{a}$

or

- $\bullet^4$ $\boldsymbol{d} - \boldsymbol{a} = 4(\boldsymbol{b} - \boldsymbol{a}) \Rightarrow \boldsymbol{d} - \boldsymbol{a} = \begin{pmatrix} 8 \\ 16 \\ -16 \end{pmatrix}$

Notes

1 Treat D= $\begin{pmatrix} 5 \\ 20 \\ -9 \end{pmatrix}$ as bad form.

2 For $\bullet^3$ accept **ONLY** "parallel" in lieu of "common direction"

6 Given that $y = 3\sin(x) + \cos(2x)$, find $\frac{dy}{dx}$. **3**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
6		3	B	3.2.1	CN	04/n

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- $\bullet^1$ pd : process simple derivative
- $\bullet^2$ pd : start to process compound derivative
- $\bullet^3$ ic : complete compound derivative

Primary Method : Give 1 mark for each •

- $\bullet^1$ $3\cos(x)$
- $\bullet^2$ $-\sin(2x)$
- $\bullet^3$ $\times 2$

3 *marks*

1 Alternative Methods

e.g.

$y = 3\sin(x) + 2\cos^2(x) - 1$

- $\bullet^1$ $3\cos(x)$
- $\bullet^2$ $4\cos(x)$
- $\bullet^3$ $\times -\sin(x)$ and no further terms

3 *marks*

Notes

1 For differentiating incorrectly:
For $y' = -3\cos(x) + 2\sin(2x)$,only $\bullet^3$ may be awarded.

2 For $y' = 3\cos(x) - 2\sin(2x) + c$, treat the "+c" as bad form.

3 For clearly integrating correctly or otherwise:
Award no marks.

4 If you cannot decide whether a candidate has attempted to differentiate or integrate, assume they have attempted to differentiate.

7 Find $\int_0^2 \sqrt{4x+1}\ dx$. **5**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
7		5	AB	3.2.3	CN	04/52

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- $\bullet^1$ ic : express in integrable form
- $\bullet^2$ pd : integrate a composite fractional power
- $\bullet^3$ ic : interpret the '4'
- $\bullet^4$ ic : substitute limts
- $\bullet^5$ pd : evaluate

Primary Method : Give 1 mark for each •

- $\bullet^1$ $\left(4x+1\right)^{\frac{1}{2}}$
- $\bullet^2$ $\frac{1}{\frac{3}{2}}\left(4x+1\right)^{\frac{3}{2}}$
- $\bullet^3$ $\div 4$
- $\bullet^4$ $\frac{1}{6}\left(4\times 2+1\right)^{\frac{3}{2}}-\frac{1}{6}\left(4\times 0+1\right)^{\frac{3}{2}}$
- $\bullet^5$ $\frac{13}{3}$ *or equivalent fraction or mixed number*

5 *marks*

1 Common wrong solution

- $\bullet^1$ $\surd$ $\int \left(4x+1\right)^{\frac{1}{2}}\ dx$
- $\bullet^2$ $\times$ $\int \left(4x^{\frac{1}{2}}+1^{\frac{1}{2}}\right)dx$
- $\bullet^3$ $\times$ $\frac{4x^{\frac{3}{2}}}{\frac{3}{2}}+x$
- $\bullet^4$ $\surd$ $\left(\frac{4.2^{\frac{3}{2}}}{\frac{3}{2}}+2\right)-\left(\frac{4.0^{\frac{3}{2}}}{\frac{3}{2}}+0\right)$
- $\bullet^5$ $\surd$ $\frac{16\sqrt{2}}{3}+2$

3 *marks awarded*

Notes

1 $\bullet^4$ is available for substituting the limits correctly into any function except the original one.

eg
$$\int_0^2 \left(4x+1\right)^{\frac{1}{2}}dx$$
$$=\left[\left(4x+1\right)^{\frac{1}{2}}\right]_0^2$$
$$=\left(4\times 2+1\right)^{\frac{1}{2}}-\left(4\times 0+1\right)^{\frac{1}{2}}$$
$$=3-1$$
$$=2$$

may be awarded $\bullet^1$, not $\bullet^2$ (no integration)
not $\bullet^3$ (not dealing with $f(g(x))$)
not $\bullet^4$ (original function)
not $\bullet^5$ (working eased)

2 For $\bullet^5$, **DO NOT accept** answers like $\frac{\sqrt{729}}{6}-\frac{1}{6}$.

8 (*a*) Write $x^2 - 10x + 27$ in the form $\left(x+b\right)^2 + c$. **2**

(*b*) Hence show that the function $g(x) = \frac{1}{3}x^3 - 5x^2 + 27x - 2$ is always increasing. **4**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
8	a	2	C	1.2.8	NC	04/37
	b	4	B	1.3.11		

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- $\bullet^1$ pd : deal with the 'b'
- $\bullet^2$ pd : deal with the 'c'
- $\bullet^3$ ss : use differentiation
- $\bullet^4$ pd : differentiate
- $\bullet^5$ ss : use previous working
- $\bullet^6$ ic : complete proof

Primary Method : Give 1 mark for each •

- $\bullet^1$ $\left(x-5\right)^2 \ldots$
- $\bullet^2$ $\left(x-5\right)^2 + 2$

2 *marks*

- $\bullet^3$ $g'(x) =$ *STATED EXPLICITLY*
- $\bullet^4$ $x^2 - 10x + 27$
- $\bullet^5$ $\left(x-5\right)^2 + 2$
- $\bullet^6$ $g'(x) > 0$ for all x
  and so $g(x)$ increasing

4 *marks*

1 Alternative Method for •3 to •6

- $\bullet^3$ $g'(x) =$ *STATED EXPLICITLY*
- $\bullet^4$ $x^2 - 10x + 27$
- $\bullet^5$ $b^2 - 4ac = 100 - 108 = -8$
- $\bullet^6$ no roots, concave up, $g'(x) > 0$
  and thus $g(x)$ increasing

4 *marks*

Notes

1 For $\bullet^6$, accept $g'(x) > 2$ in lieu of $g'(x) > 0$

2 Evaluating $g(1)$, $g(2)$ *etc or* $g'(1), g'(2)$ *etc* gains no credit.

9 Solve the equation $\log_2(x+1) - 2\log_2(3) = 3$. **4**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
9		4	AB	3.3.4	NC	04/57

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- $\bullet^1$ ic : use log laws
- $\bullet^2$ ic : use log laws
- $\bullet^3$ ic : express in exponential form
- $\bullet^4$ pd : process

Primary Method : Give 1 mark for each •

- $\bullet^1$ $-\log_2 3^2$
- $\bullet^2$ $\log_2\left(\dfrac{x+1}{3^2}\right) = 3$
- $\bullet^3$ $\dfrac{x+1}{3^2} = 2^3$
- $\bullet^4$ $x = 71$

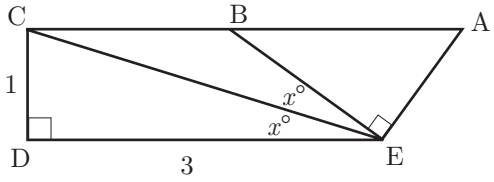
4 *marks*

1 Alternative Method

- $\bullet^1$ $\log_2\left(x+1\right) - 2\log_2 3 = 3\log_2 2$
- $\bullet^2$ $\log_2\left(x+1\right) = \log_2 2^3 + \log_2 3^2$
- $\bullet^3$ $\log_2\left(x+1\right) = \log_2\left(2^3 \times 3^2\right)$
- $\bullet^4$ $x = 71$

4 *marks*

10 In the diagram,
angle DEC = angle CEB = x° and
angle CDE = angle BEA = 90°. CD = 1 unit; DE = 3 units.
By writing angle DEA in terms of x°, find the exact value of $\cos\left(\hat{\text{DEA}}\right)$.



7

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
10		7	B	2.3.2, 2.3.3	CN	04/33

The Primary Method m/s is based on the following generic m/s.
THIS GENERIC M/S MAY BE USED AS AN EQUIVALENCE GUIDE BUT ONLY WHERE A CANDIDATE DOES NOT USE THE PRIMARY METHOD OR ANY ALTERNATIVE METHOD SHOWN IN DETAIL IN THE MARKING SCHEME.

- $\bullet^1$ ic : interpret diagram
- $\bullet^2$ pd : expand trig expression
- $\bullet^3$ pd : simplify
- $\bullet^4$ss : use appropriate formula
- $\bullet^5$ pd : process
- $\bullet^6$ ic : interpret
- $\bullet^7$ pd : simplify

Primary Method : Give 1 mark for each •

- $\bullet^1$ $D\hat{E}A = (2x^\circ + 90^\circ)$
- $\bullet^2$ $\cos(2x^\circ)\cos(90^\circ) - \sin(2x^\circ)\sin(90^\circ)$
- $\bullet^3$ $-\sin(2x^\circ)$
- $\bullet^4$ $-2\sin(x^\circ)\cos(x^\circ)$
- $\bullet^5$ $CE = \sqrt{1^2 + 3^2} = \sqrt{10}$ *stated / implied by* •6
- $\bullet^6$ $\sin(x^\circ) = \left(\frac{1}{\sqrt{10}}\right)$ *and* $\cos(x^\circ) = \frac{3}{\sqrt{10}}$
- $\bullet^7$ $\cos D\hat{E}A = -2\left(\frac{1}{\sqrt{10}}\right)\left(\frac{3}{\sqrt{10}}\right) = -\frac{6}{10}$

7 *marks*

Note

1 Although unusual, it would be perfectly acceptable for a candidate to go from $\bullet^1$ to $\bullet^3$ without expanding (via knowledge of transformations). In this case $\bullet^2$ would awarded by default.

2 another common wrong solution

- $\bullet^1\surd$ $D\hat{E}A = (2x^\circ + 90^\circ)$
  $\cos(2x^\circ + 90^\circ)$
- $\bullet^2\times$ $\cos(2x^\circ) + \cos(90^\circ)$
- $\bullet^3\times$ $\cos(2x^\circ)$ [*working eased*]
- $\bullet^4\surd$ *eg* $2\cos^2 x - 1$
- $\bullet^5\surd$ $CE = \sqrt{1^2 + 3^2} = \sqrt{10}$ *stated / implied by* •6
- $\bullet^6\surd$ $\cos(x^\circ) = \frac{3}{\sqrt{10}}$
- $\bullet^7\surd$ $\cos D\hat{E}A = 2\left(\frac{3}{\sqrt{10}}\right)\left(\frac{3}{\sqrt{10}}\right) - 1 = \frac{8}{10}$

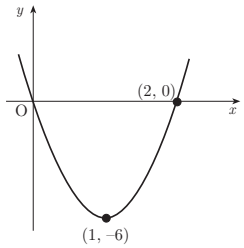
5 marks awarded

1 common wrong solution

- $\bullet^1\surd$ $D\hat{E}A = (2x^\circ + 90^\circ)$
- $\bullet^2\surd$ $\cos(2x^\circ)\cos(90^\circ) - \sin(2x^\circ)\sin(90^\circ)$
  $\cos(2x^\circ)\times 1 - \sin(2x^\circ)\times 0$
- $\bullet^3\times$ $\cos(2x^\circ)$
- $\bullet^4\surd$ *eg* $2\cos^2 x - 1$
- $\bullet^5\surd$ $CE = \sqrt{1^2 + 3^2} = \sqrt{10}$ *stated / implied by* •6
- $\bullet^6\surd$ $\cos(x^\circ) = \frac{3}{\sqrt{10}}$
- $\bullet^7\surd$ $\cos D\hat{E}A = 2\left(\frac{3}{\sqrt{10}}\right)\left(\frac{3}{\sqrt{10}}\right) - 1 = \frac{8}{10}$

6 marks awarded

11 **T**he diagram shows a parabola passing through the points (0, 0), (1, –6) and (2, 0).



(*a*) The equation of the parabola is of the form $y = ax(x-b)$.
Find the values of a and b. **3**

(*b*) This parabola is the graph of $y = f'(x)$.
Given that $f(1) = 4$, find the formula for $f(x)$. **5**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
11	a	3	B	2.1.10	CN	04/57
	b	5	A	2.2.8		

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- $\bullet^1$ ss : use parabolic form
- $\bullet^2$ pd : substitute
- $\bullet^3$ pd : process
- $\bullet^4$ ss : know to integrate
- $\bullet^5$ pd : express in integrable form
- $\bullet^6$ pd : integrate
- $\bullet^7$ ss : introduce constant and substitute
- $\bullet^8$ pd : process

Primary Method : Give 1 mark for each •

- $\bullet^1$ $b = 2$ or $y = ax(x-2)$
- $\bullet^2$ substitute $(1,-6)$
- $\bullet^3$ $a = 6$

3 *marks*

- $\bullet^4$ $f(x) = \int\big(6x(x-2)\big)dx$
- $\bullet^5$ $\int\big(6x^2 - 12x\big)dx$
- $\bullet^6$ $2x^3 - 6x^2$
- $\bullet^7$ $4 = 2\times1^3 - 6\times1^2 + c$
- $\bullet^8$ $c = 8$

5 *marks*

Notes

1 In the primary method, •3 must be justified.
A "guess and check" would be acceptable ie guess $a = 6$ then check that (1, –6) fits the equation.

2 In the primary method, •5 is only available if an intention to integrate has been indicated.

3 For candidates who fail to complete (a) but produce values for a and b ex nihilo, 5 marks are available in (b). A deduction of 1 mark may be made if their choice eases the working.

4 For candidates who retain "*a*" and "*b*" in part (b), marks $\bullet^4$ to $\bullet^7$ are available.

5 **CAVE**

$\int_0^2 6x(x-2)dx = \Big[2x^3 - 6x^2\Big]_0^2 = -8$ may be awarded $\bullet^4$, $\bullet^5$ and $\bullet^6$.

1 Alternative Method for •1 to •3

- $\bullet^1$ two simultaneous equations
  $2a(2-b) = 0$ *and* $a(1-b) = -6$
- $\bullet^2$ $b = 2$
- $\bullet^3$ $a = 6$

3 *marks*

2 Alternative Method for •1 to •3

- $\bullet^1$ $y = k(x-1)^2 - 6$
- $\bullet^2$ $0 = k(2-1)^2 - 6 \Rightarrow k = 6$
- $\bullet^3$ $y = 6(x-1)^2 - 6 \Rightarrow y = 6x(x-2)$

3 *marks*

S1 The IQs of a group of students were measured and the scores recorded in the stem-and-leaf diagram as shown. Identify any outliers.

replacing qu.5 (in position 1)

IQs of a group of students

	10	2 3 5 5 6 8 8
		9
	11	0 0 2 3 5 6 7
		9
	12	1 3
	13	2 6
n=20	10	2 means 102

4

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
S1		4	C	4.1.2, 4.1.3	CN	04/61

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- $\bullet^1$ pd : calculate quartiles
- $\bullet^2$ ss : know how to calculate fences
- $\bullet^3$ pd : calculate fence/interpret outlier
- $\bullet^4$ pd : calculate fence/interpret outlier

Primary Method : Give 1 mark for each •

- $\bullet^1$ $Q_1 = 107, Q_3 = 118$
- $\bullet^2$ *eg lower fence* $= Q_1 - 1 \cdot 5(Q_3 - Q_1)$
- $\bullet^3$ $fence = 90.5$
- $\bullet^4$ $fence = 134.5$ & 136 *is outlier*

4 *marks*

S2 Calculate the mean and variance of the discrete random variable X whose probability distribution is as follows:

x	0	1	2	3
$\mathrm{P}(X = x)$	0.4	0.3	0.2	0.1

6

replacing qu.6

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
S2		6	C	4.2.12	NC	04/66

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- $\bullet^1$ ss : know and state rule for mean
- $\bullet^2$ pd : calculate mean
- $\bullet^3$ ss : know/state rule for variance
- $\bullet^4$ ss : know how to find $E(X^2)$
- $\bullet^5$ pd : calculate $E(X^2)$
- $\bullet^6$ pd : calculate variance

Primary Method : Give 1 mark for each •

- $\bullet^1$ $E(X) = \Sigma xp(x)$
- $\bullet^2$ $\Sigma xp(x) = 1$
- $\bullet^3$ $V(X) = E(X^2) - \Big(E(X)\Big)^2$
- $\bullet^4$ $E(X^2) = \Sigma x^2 p(x)$
- $\bullet^5$ $\Sigma x^2 p(x) = 2$
- $\bullet^6$ $V(X) = 1$

6 *marks*

S3 The committee of New Tron Golf Club consists of 15 men and 10 women which reflects the proportions of men and women who are members of the club.
It is agreed to send a delegation of 10 committee members to a local planning meeting. The members of the delegation are to be chosen at random and will consist of 6 men and 4 women.
What is the probability that both committee members Mr Hook and Miss Green will be selected? **4**

replacing qu.7

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
S3		4	C	4.2.3, 4.2.7	NC	04/67

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- $\bullet^1$ ic : interpret probability
- $\bullet^2$ ic : interpret probability
- $\bullet^3$ ss : know to multiply for independent events
- $\bullet^4$ pd : process

Primary Method : Give 1 mark for each •

- $\bullet^1$ $P(man) = \frac{6}{15}$
- $\bullet^2$ $P(lady) = \frac{4}{10}$
- $\bullet^3$ *multiply*
- $\bullet^4$ $\frac{6}{15} \times \frac{4}{10} = \frac{4}{25}$

4 *marks*

1 Alternative Method

- $\bullet^1$ $eg\ {}^{15}C_6$
- $\bullet^2$ ${}^{15}C_6 \times {}^{10}C_4$
- $\bullet^3$ ${}^{14}C_5 \times {}^{9}C_3$
- $\bullet^4$ $\frac{\frac{14!}{5!9!} \cdot \frac{9!}{3!6!}}{\frac{15!}{6!9!} \cdot \frac{10!}{4!6!}} = \frac{4}{25}$

4 *marks*

S4 The cumulative distribution function for a random variable X is given by

$$F(x) = \begin{cases} \frac{1}{32}x^2\left(6-x\right) & 0 \le x \le 4 \\ \\ 0 & \text{otherwise} \end{cases}$$

Show that the median is 2. **3**

replacing qu.9

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
S4		3	AB	4.3.3, 4.3.5, 2.1.3	NC	04/70

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- $\bullet^1$ ss : know where median is
- $\bullet^2$ pd : substitute
- $\bullet^3$ ic : interpret result

Primary Method : Give 1 mark for each •

- $\bullet^1$ $F(median) = \frac{1}{2}$
- $\bullet^2$ $F(2) = \frac{1}{32} \times 2^2 \times \left(6-2\right)$
- $\bullet^3$ $F(2) = \frac{1}{2}$, *hence median* $= 2$

3 *marks*

