2006 Mathematics

Higher − Paper 1

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 (✗ or X✓). 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 normally be indicated in the marking instructions.

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

9. No piece of work should be scored through without careful checking - 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 Transcription errors: In general, as a consequence of a transcription error, candidates lose the opportunity of gaining either the first ic mark or the first pr mark.

14 Casual errors: In general, as a consequence of a casual error, candidates lose the opportunity of gaining the appropriate ic mark or pr mark.

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

16 Working that has been crossed out by the candidate cannot receive any credit. If you feel that a candidate has been disadvantaged by this action, make a P.A. Referral.

17 Throughout this paper, unless specifically mentioned, a correct answer with no working receives no credit.

Summary

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

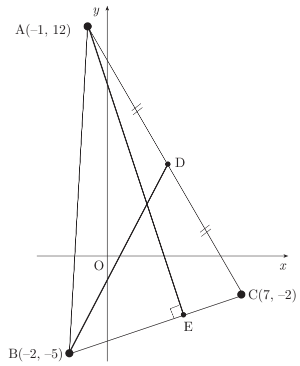
1 **Tick** correct working.
2 Put a mark in the **outer right-hand margin to match the marks allocations on the question paper.**
3 Do **no**t write marks as fractions.
4 Put each mark **at the end** of the candidate's response to the question.
5 **Follow through** errors to see if candidates can score marks subsequent to the error.
6 Do **not** write any comments on the scripts.

1 Triangle ABC has vertices A(–1,12), B(–2, –5) and C(7, –2).

(*a*) Find the equation of the median BD. **3**

(*b*) Find the equation of the altitude AE. **3**

(*c*) Find the coordinates of the point of intersection of BD and AE. **3**



Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
1	a,b,c	3,3,3	C	G7, G8	CN	06/01

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

- •1 ic interpret "median"
- •2 ss find gradient
- •3 ic state equation
- •4 ss find gradient
- •5 ss find perpendicular gradient
- •6 ic state equation
- •7 ss start to solve simultaneous equations
- •8 pr solve for one variable
- •9 pr process

Primary Method : Give 1 mark for each •

- •1 $D=(3,5)$
- •2 $m_{BD}=2$
- •3 $y-5=2(x-3)$ *or* $y+5=2\big(x-(-2)\big)$ *etc* **3 marks**
- •4 $m_{BC}=\frac{1}{3}$ **stated explicitly**
- •5 $m_{alt}=-3$
- •6 $y-12=-3(x-(-1))$ **3 marks**
- •7 $y-5=2(x-3)$ ***and*** $y-12=-3(x-(-1))$ **or equivalent**
- •8 $x=2$
- •9 $y=3$ **3 marks**

Notes

1 For candidates who find two medians •1,•2,•3 and •7,•8,•9 are available.

2 For candidates who find two altitudes •4,•5,•6 and •7,•8,•9 are available.

3 For candidates who find (a) altitude and (b) median see common error box number 3.

4 In (a) note that (4, 7) happens to lie on the median but does not qualify as a point to be used in •3.

Notes cont

5 In (b) •6 is only available as a consequence of attempting to find a perpendicular gradient.

6 In (b) candidates who guess the coordinates for E and use these to find the equation AE, can earn no marks in this part.

7 In (c) note that "equating zeros" is only a valid strategy when either the coefficients of x or the coefficients of y are equal.

8 •7 is a strategy mark for juxtaposing the two required equations.

9 See general note at the foot of page 7.

Common Error 1
Finding two medians

- •1 $D=(3,5)$
- •2 $m_{BD}=2$
- •3 $y-5=2(x-3)$
- •4 X
- •5 X
- •6 X
- •7 $y=2x-1$ & $31x+7y=53$
- •8 $x=\dfrac{4}{3}$
- •9 $y=\dfrac{5}{3}$

maximum of 6 marks

Common Error 2
Finding two altitudes

- •1 X
- •2 X
- •3 X
- •4 $m_{BC}=\frac{1}{3}$
- •5 $m_{alt}=-3$
- •6 $y-12=-3(x-(-1))$
- •7 $4x-7y=27$ & $y=-3x+9$
- •8 $x=\dfrac{18}{5}$
- •9 $y=-\dfrac{9}{5}$

maximum of 6 marks

Common Error 3
Finding (a) altitude and (b) median

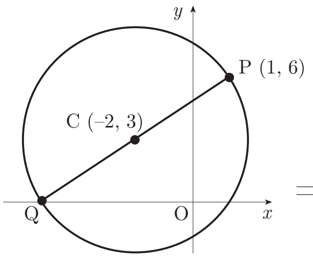
- •1 $m_{AC}=-\frac{7}{4}$
- X √ •2 $m_{BD}=\frac{4}{7}$
- •3 $y--5=\frac{4}{7}(x--2)$
- X √ •4 *midpt of* $BC=\left(\frac{5}{2},-\frac{7}{2}\right)$
- •5 $m_{AC}=-\frac{31}{7}$
- •6 $y-12=-\frac{31}{7}(x-(-1))$
- X √ •7 $4x-7y=27$ & $31x+7y=53$
- X √ •8 $x=\frac{16}{7}$
- X √ •9 $y=-\frac{125}{49}$

maximum of 5 marks

2 A circle has centre C(–2, 3) and passes through P(1, 6).

(*a*) Find the equation of the circle. **2**

(*b*) PQ is a diameter of the circle. Find the equation of the tangent to this circle at Q. **4**



Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
2	a	2	C	G10	CN	06/54
	b	4	C	G11	CN	

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- •1 ic enter coord. of centre in general equation
- •2 ss find (radius)^2
- •3 ss e.g. use $\overrightarrow{PC} = \overrightarrow{CQ}$ to find Q
- •4 pr find gradient of diameter
- •5 ss know and use tangent perp. to diameter
- •6 ic state equation

Primary Method : Give 1 mark for each •

$(x-a)^2 + (y-b)^2 = r^2$

•1 $(x-(-2))^2 + (y-3)^2$

•2 $r^2 = 18$ **2 marks**

•3 $Q = (-5, 0)$

•4 $m_{\text{diameter}} = 1$ stated or implied by •5

•5 $m_{\text{tangent}} = -1$

•6 $y - 0 = -\big(x - (-5)\big)$ **4 marks**

Alternative Method for (a)

For answers of the form $x^2 + y^2 + 2gx + 2fy + c = 0$

•1 $x^2 + y^2 + 4x - 6y + c = 0$

•2 $c = -5$

Notes

1 In (a) $(\sqrt{18})^2$ is not acceptable for •2.

2 In (b) if the coordinates of Q are estimated (i.e. guessed) then •6 can only be awarded if the coordinates are of the form (a, 0) where a < –2.

3 In (b) •6 is only available if an attempt has been made to find a perpendicular gradient.

General Notes applicable throughout the marking scheme

There are many instances when follow throughs come into play and these will not always be highlighted for you. The following example is a reminder of what you have to look out for when you are marking.

example

At the •3 stage a candidate start with the wrong coordinates for Q. Then

X	•3	$Q = (-4, 0)$
$X\surd$	•4	$m_{\text{diameter}} = \frac{6}{5}$
$X\surd$	•5	$m_{\text{tangent}} = -\frac{5}{6}$
$X\surd$	•6	$y - 0 = -\frac{5}{6}\big(x - (-4)\big)$

so the candidate loses •3 but gains •4, •5 and •6 as a consequence of following through.
Any error can be followed through and the subsequent marks awarded provided the working has not been eased.
Any deviation from this will be noted in the marking scheme.

3 Two functions f and g are defined on the set of real numbers by
$f(x) = 2x + 3$ and $g(x) = 2x - 3$.

(a) Find an expressions for (i) $f\big(g(x)\big)$ (ii) $g\big(f(x)\big)$. **3**

(b) Determine the least possible value of $f\big(g(x)\big) \times g\big(f(x)\big)$. **2**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
3	a	3	C	A4	CN	06/07
	b	2	C	A6	CN	

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- $\bullet^1$ ic int. composition
- $\bullet^2$ ic int. composition
- $\bullet^3$ ic int. composition
- $\bullet^4$ pr simplify all functions
- $\bullet^5$ ic int. result

Primary Method : Give 1 mark for each •

- $\bullet^1$ $f\big(g(x)\big) = f(2x-3)$ **stated or implied by •2**
- $\bullet^2$ $2(2x-3)+3$
- $\bullet^3$ $g\big(f(x)\big) = 2(2x+3)-3$ **3 marks**
- $\bullet^4$ $16x^2 - 9$ **stated explicitly**
- $\bullet^5$ $\text{min.value} = -9$ **2 marks**

Notes

1 In (a) 2 marks are available for finding one of $f\big(g(x)\big)$ *or* $g\big(f(x)\big)$ and the third mark is for the other one.

2 In (a) the finding of $f\big(f(x)\big)$ and $g\big(g(x)\big)$ earns no marks.

3 •[5] is only available if •[4] has been awarded.

4 In (b) for •[5], no justification is necessary. Ignore any comments, rational or irrational.

Alternative Marking 1 [Marks 1-3]

- $\bullet^1$ $g\big(f(x)\big) = g(2x+3)$
- $\bullet^2$ $2(2x+3)-3$
- $\bullet^3$ $f\big(g(x)\big) = 2\big(2x-3\big)+3$

Common Error No.1 for (a) "g and f" transposed.

X	$\bullet^1$	$f\big(g(x)\big) = f(2x+3)$
$\surd X$	$\bullet^2$	$2(2x+3)-3$
$\surd X$	$\bullet^3$	$g\big(f(x)\big) = 2(2x-3)+3$

Award 2 out of 3

Common Error No.2 for (a)

X	$\bullet^1$	$f\big(g(x)\big) = f(2x+3)$
$\surd X$	$\bullet^2$	$2(2x+3)-3$
$\surd$	$\bullet^3$	$g\big(f(x)\big) = 2(2x+3)-3$

Award 2 out of 3

Common Error No.3 for (a) Repeated error

$\surd$	$\bullet^1$	$f\big(g(x)\big) = f(2x-3)$
X	$\bullet^2$	$2(2x+3)-3$
$\surd X$	$\bullet^3$	$g\big(f(x)\big) = 2(2x-3)+3$

Award 2 out of 3

4 A sequence is defined by the recurrence relation $u_{n+1} = 0.8u_n + 12$, $u_0 = 4$.

(*a*) State why the recurrence relation has a limit. **1**

(*b*) Find this limit. **2**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
4	a	1	C	A12	NC	06/28
	b	2	C	A13	NC	

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- $\bullet^1$ ic state limit condition
- $\bullet^2$ ss know how to find L
- $\bullet^3$ pr process limt

Primary Method : Give 1 mark for each •

- $\bullet^1$ sequence has limit since $-1 < 0.8 < 1$ **1 mark**
- $\bullet^2$ $L = 0.8L + 12$
- $\bullet^3$ limit $= 60$ **2 marks**

Notes

For (a)

1 **Accept**

$|0.8| < 1$

$0 < 0.8 < 1$

0.8 lies between -1 and 1

0.8 is a proper fraction

2 **Do NOT accept**

$-1 \leq 0.8 \leq 1$

$-1 < a < 1$ unless a is clearly identifed/replaced by 0.8 anywhere in the answer.

$0.8 < 1$

In (b)

3 $L = \dfrac{b}{1-a}$ and nothing else gains **no** marks.

4 $L = \dfrac{12}{0.2}$ *or* $\dfrac{120}{2}$ *or* $\dfrac{60}{1}$ etc does **NOT** gain $\bullet^3$.

5 An answer of 60 without any working gains **NO** marks.

6 Any calculations based on “wrong” formulae gain **NO** marks.

Alternative Method for (b)

- $\bullet^2$ $L = \dfrac{12}{1-0.8}$
- $\bullet^3$ $limit = 60$

Bad Form

- $\bullet^2$ $L = \dfrac{12}{0.2}$
- $\bullet^3$ $limit = 60$

award 2 marks

Common Error 1

- X $\bullet^2$ $L = \dfrac{4}{1-0.8}$
- X √ $\bullet^3$ $limit = 20$

5 A function f is defined by $f(x) = \left(2x-1\right)^5$. Find the coordinates of the stationary point on the graph with equation $y = f(x)$ and determine its nature. **7**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
5		6	C	C8, C9	NC	06/76
		1	B			

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- •1 ss know to start to differentiate
- •2 pr differentiate
- •3 ss set derivative = 0
- •4 pr solve
- •5 pr evaluate
- •6 ic justification
- •7 ic state conclusion

Primary Method : Give 1 mark for each •

- •1 $f'(x) = \ldots\ldots$
- •2 $5(2x-1)^4 \times 2$
- •3 $f'(x) = 0$
- •4 $x = \frac{1}{2}$
- •5 $f(\frac{1}{2}) = 0$
- •6 nature table
- •7 pt of inflexion at $(\frac{1}{2}, 0)$ **7 marks**

Notes

1 The "= 0" shown at •3 must appear at least once somewhere in the working between •1 and •4 (but not necessarily at •3).

2 •4 is only available as a consequence of solving $f'(x) = 0$.

3 A wrong derivative which eases the working will preclude at least •4 from being awarded.

4 For marks •6 and •7, a nature table is mandatory. The minimum amount of detail that is required is shown here:

	$< \frac{1}{2}$	$\frac{1}{2}$	$> \frac{1}{2}$
$f'(x)$	+	0	+
	⋰	⋯	⋰

Candidates who use only $f''(x) = 0$ and try to draw conclusions from this cannot gain •6 or •7.
[$f''(x) = 0$ is a necessary but not sufficient condition for identifying points of inflexion].

5 •7 is **ONLY** available subsequent to a correct nature table for the candidate's own derivative.

6 •4 is lost in each of the following cases for the candidate's solution to the equation at •3.

(i) $x = \frac{1}{2}$ *and* $x =$ *something else*
(ii) *two wrong values for* x
(iii) *guess a value for* x

Only one value for x needs to be followed through for •5, •6 and •7.

Common Error No.1

√	•1	$f'(x) = \ldots\ldots$
X	•2	$5(2x-1)^4$
√	•3	$f'(x) = 0$
X √	•4	$x = \frac{1}{2}$

•5, •6 *and* •7 *are still available*

Common Error No.2

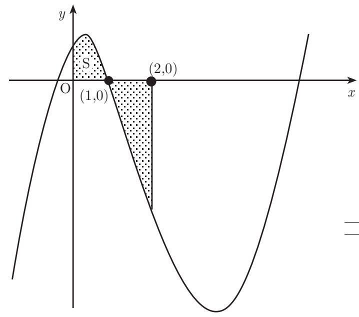
√	•1	$f'(x) = \ldots\ldots$
X	•2	$\frac{1}{12}(2x-1)^6$
√	•3	$f'(x) = 0$
X √	•4	$x = \frac{1}{2}$

•5, •6 *and* •7 *are still available*

6 The graph shown has equation $y = x^3 - 6x^2 + 4x + 1$.
The shaded area is bounded by the curve, the x-axis, the y-axis and the line $x = 2$.

(a) Calculate the shaded area labelled S. **4**

(b) Hence find the total shaded area. **3**



Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
6	a	4	C	C16	NC	06/40
	b	3	B	C16	NC	

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- $\bullet^1$ ss know to integrate
- $\bullet^2$ pr integrate
- $\bullet^3$ ic substitute limits
- $\bullet^4$ pr evaluate
- $\bullet^5$ ic use result from $\bullet^2$ with new limits
- $\bullet^6$ pr evaluate
- $\bullet^7$ ss deal with the "–ve" sign and evaluate total area

Primary Method : Give 1 mark for each ·

- $\bullet^1$ $\int_0^1 \left(x^3 - 6x^2 + 4x + 1\right)dx$ stated or implied by $\bullet^2$
- $\bullet^2$ $\frac{1}{4}x^4 - \frac{6}{3}x^3 + \frac{4}{2}x^2 + x$
- $\bullet^3$ $\left(\frac{1}{4}.1^4 - 2.1^3 + 2.1^2 + 1\right) - 0$
- $\bullet^4$ $\frac{5}{4}$ **or equivalent** **4**
- $\bullet^5$ $\int_1^2 ...dx$
- $\bullet^6$ $\left(\frac{1}{4}.2^4 - 2.2^3 + 2.2^2 + 2\right) - \left(\frac{1}{4}.1^4 - 2.1^3 + 2.1^2 + 1\right) = -\frac{13}{4}$
- $\bullet^7$ $\frac{9}{2}$ **or equivalent** **3**

Notes
for (a)

1. Only a limited number of marks are available to candidates who differentiate –see Common Error No.1.
2. In (a) candidates who transpose the limits can still earn $\bullet^4$ if the deal with the "–ve" sign appropriately.
3. In (b) $\bullet^7$ is lost for such statements as $-3\frac{1}{4} = 3\frac{1}{4}$.
4. In (b) using $\int_0^2 ...dx$ earns no marks.

Alternative Method 1 for (b)

- $\bullet^5$ $\int_2^1 ...dx$
- $\bullet^6$ $\left(\frac{1}{4}.1^4 - 2.1^3 + 2.1^2 + 1\right) - \left(\frac{1}{4}.2^4 - 2.2^3 + 2.2^2 + 2\right)$
- $\bullet^7$ $\frac{9}{2}$

Alternative Method 2 for (b)

- $\bullet^5$ $-\int_1^2 ...dx$
- $\bullet^6$ $-\left(\frac{1}{4}.2^4 - 2.2^3 + 2.2^2 + 2\right) + \left(\frac{1}{4}.1^4 - 2.1^3 + 2.1^2 + 1\right)$
- $\bullet^7$ $\frac{9}{2}$

Alternative Method 3 for (b)

- $\bullet^5$ $\left|\int_1^2 ...dx\right|$
- $\bullet^6$ $\left|\left(\frac{1}{4}.2^4 - 2.2^3 + 2.2^2 + 2\right) - \left(\frac{1}{4}.1^4 - 2.1^3 + 2.1^2 + 1\right)\right|$
- $\bullet^7$ $\frac{9}{2}$

Common Error No.1

√	$\bullet^1$	$\int_0^1 \left(x^3 - 6x^2 + 4x + 1\right)dx$
X	$\bullet^2$	$3x^2 - 12x + 4$
X	$\bullet^3$	$\left(3.1^2 - 12.1 + 4\right) - 4$
X	$\bullet^4$	-9
√	$\bullet^5$	$\int_1^2 ...dx$ *or equivalent*
X √	$\bullet^6$	$\left(3.2^2 - 12.2 + 4\right) - \left(3.1^2 - 12.1 + 4\right) = -3$
X √	$\bullet^7$	12

7 Solve the equation $\sin x° - \sin 2x° = 0$ in the interval $0 \le x \le 360$. **4**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
7		4	C	T10	NC	06/46

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- $\bullet^1$ ss know to use double angle formula
- $\bullet^2$ pr factorise
- $\bullet^3$ pr solve
- $\bullet^4$ ic know exact values

Primary Method : Give 1 mark for each •

- $\bullet^1$ $\sin(x°) - 2\sin(x°)\cos(x°) = 0$
- $\bullet^2$ $\sin(x°)\big(1 - 2\cos(x°)\big) = 0$
- $\bullet^3$ $\sin(x°) = 0 \ or\ \cos(x°) = 0.5$
- $\bullet^4$ $x = 0, 180, 360, \quad 60, 300$

4

Alternative Marking Method (Cross marking for •3 and •4)

- $\bullet^1$ $\sin(x°) - 2\sin(x°)\cos(x°) = 0$
- $\bullet^2$ $\sin(x°)\big(1 - 2\cos(x°)\big) = 0$
- $\bullet^3$ $\sin(x°) = 0 \ and\ x = 0, 180, 360$
- $\bullet^4$ $\cos(x°) = 0.5 \ and\ x = 60, 300$

Alternative Method Division by sin(x)

- $\bullet^1$ $\sin(x°) - 2\sin(x°)\cos(x°) = 0$
- $\bullet^2$ $either\ \sin(x°) = 0 \ or\ \sin(x°) \ne 0$
- $\bullet^3$ $\sin(x°) = 0 \Rightarrow x = 0, 180, 360$
- $\bullet^4$ $\cos(x°) = 0.5 \Rightarrow x = 60, 300$

Notes

1 An "= 0" must appear somewhere between the start and •[2] evidence.

2 The inclusion of extra answers which would have been correct with a larger interval should be treated as bad form and NOT penalised.

3 The omission of a correct answer (e.g. 0) means the candidates loses a mark (•[4] in the Primary Method).

4 Candidates may embark on a journey with the wrong formula for sin(2x°). With an equivalent level of difficulty it may still be worth a maximum of 3 marks. See Common Error No.1.

5 Candidates who draw a sketch of $y = \sin(x°)$ and $y = \sin(2x°)$ giving 0,180,360 may be awarded •[1] and •[3].

Common Error No.1

X $\bullet^1$ $\sin(x°) - \big(1 - 2\sin^2(x°)\big) = 0$

$2\sin^2(x°) + \sin(x°) - 1 = 0$

$X\surd$ $\bullet^2$ $\big(2\sin(x°) - 1\big)\big(\sin(x°) + 1\big) = 0$

$X\surd$ $\bullet^3$ $\sin(x°) = \frac{1}{2} \ or\ \sin(x°) = -1$

$X\surd$ $\bullet^4$ $x = 30, 150, \quad x = 270$

award 3 marks

Common Error No.2

$\sin(x°) - \sin^2(x°) = 0$

X $\bullet^1$

$X\surd$ $\bullet^2$ $\sin(x°)\big(1 - \sin(x°)\big) = 0$

X $\bullet^3$ $\sin(x°) = 0 \ or\ \sin(x°) = 1$

$X\surd$ $\bullet^4$ $x = 0, 180, 360, \quad 90$

award 2 marks

Common Error No.3

$\sin(x) - \sin(2x) = 0$

$\sin(x) = 0, \ \sin(2x) = 0$

etc

gains NO marks

8	(a)	Express $2x^2+4x-3$ in the form $a(x+b)^2+c$.	3
	(b)	Write down the coordinates of the turning point on the parabola with equation $y=2x^2+4x-3$.	1

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
8	a	3	B	A5	NC	06/32
	b	1	C	A6	NC	

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 know how to complete (deal with the "a")
- $\bullet^2$ pr process the value of "b"
- $\bullet^3$ pr process the value of "c"
- $\bullet^4$ ic interpret equation of parabola

Primary Method : Give 1 mark for each •

- $\bullet^1$ $a=2$
- $\bullet^2$ $b=1$
- $\bullet^3$ $c=-5$ **3**

- $\bullet^4$ $(-1,-5)$ **1**

Note

1 Alternative Method 1 should be used for assessing part marks/follow throughs.

2 For $\bullet^4$, no justification is required.
Candidates may choose to differentiate etc. but may still earn only one mark for the correct answer.

3 For $\bullet^4$, accept (–b, c).

Alternative Method 1 for (a)

- $\bullet^1$ $2(x^2+2x)$
- $\bullet^2$ $2(x+1)^2$
- $\bullet^3$ $2(x+1)^2-5$

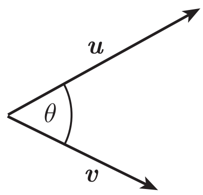
- $\bullet^4$ $(-1,-5)$

Alternative Method 2 for (a) : Comparing coefficients

- $\bullet^1$ $2x^2+4x-3=ax^2+2abx+ab^2+c \quad \Rightarrow a=2$
- $\bullet^2$ $2ab=4 \quad \Rightarrow b=1$
- $\bullet^3$ $ab^2+c=-3 \quad \Rightarrow c=-5$

- $\bullet^4$ $(-1,-5)$

9 $\boldsymbol{u}$ and $\boldsymbol{v}$ are vectors given by $\boldsymbol{u} = \begin{pmatrix} k^3 \\ 1 \\ k+2 \end{pmatrix}$ and $\boldsymbol{v} = \begin{pmatrix} 1 \\ 3k^2 \\ -1 \end{pmatrix}$, where $k > 0$.



(a) If $\boldsymbol{u}.\boldsymbol{v} = 1$ show that $k^3 + 3k^2 - k - 3 = 0$. **2 marks**

(b) Show that $(k+3)$ is a factor of $k^3 + 3k^2 - k - 3$ and hence factorise $k^3 + 3k^2 - k - 3$ fully. **5 marks**

(c) Deduce the only possible value of k. **1 mark**

(d) The angle between $\boldsymbol{u}$ and $\boldsymbol{v}$ is θ. Find the exact value of $\cos\theta$. **3 marks**

Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
8	a	2	C	G26	CN	05/10
	b	5	C	A21	NC	
	c	1	C	A6	CN	
	d	3	C	G28	NC	

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- •1 pr find scalar product
- •2 ic complete proof
- •3 ss know to use $k = -3$
- •4 pr complete evaluation and conclusion
- •5 ic start to find quadratic factor
- •6 ic complete quadratic factor
- •7 pr factorise completely
- •8 ic interpret k
- •9 ic interpret vectors
- •10 pr find magnitudes
- •11 ss use formula

Notes

1 No explanation is required for k but the chosen value must follow from the working for •6 or •7. **Do not accept √1.**

2 In primary method (•4) and alternative (•5) candidates must show some acknowledgement of the resulting "zero". Although a statement w.r.t. the zero is preferable, accept something as simple as "underlining" the zero.

3 Only numerical values are acceptable for •9, •10 and •11; answers are acceptable in unsimplified form eg $\cos\theta = \frac{1}{\sqrt{11}\times\sqrt{11}}$

Primary Method : Give 1 mark for each •

- •1 $\boldsymbol{u}.\boldsymbol{v} = k^3.1 + 1.\left(3k^2\right) + \left(k+2\right).(-1)$ stated or implied by •2 before completion
- •2 $k^3 + 3k^2 - k - 2 = 1$ *and complete* **2 marks**

- •3 know to use $k = -3$
- •4 $-27 + 27 - (-3) - 3 = 0 \Rightarrow x + 3$ *is a factor*
- •5 $(k+3)(k^2 \;....)$
- •6 $(k+3)\left(k^2 - 1\right)$
- •7 $(k+3)(k+1)(k-1)$ **stated explicitly** **5 marks**

- •8 $k = 1$ **1 mark**

- •9 $\boldsymbol{u} = \begin{pmatrix} 1 \\ 1 \\ 3 \end{pmatrix}, \boldsymbol{v} = \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix}$ **stated or implied by •10**
- •10 $|\,\boldsymbol{u}\,| = \sqrt{11}$ *and* $|\,\boldsymbol{v}\,| = \sqrt{11}$
- •11 $\cos\theta = \frac{1}{11}$ **3 marks**

N.B.
•9 and •10 may be cross-marked.

Alternative method 1 (marks 3–7) Long Division

•3
$$\begin{array}{r|llll} & k^2 & & & -1 \\ \hline k+3 & k^3 & +3k^2 & -k & -3 \\ & k^3 & +3k^2 & & \\ & ..... & .... & .... -k & -3 \end{array}$$

•4
$$\begin{array}{rr} -k & -3 \\ \hline \end{array}$$

- •5 *remainder is zero so* $(k+3)$ *is a factor*
- •6 $k^2 - 1$
- •7 $(k+3)(k+1)(k-1)$ **stated explicitly**

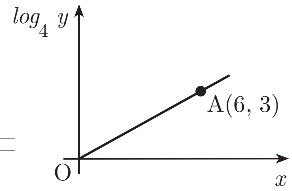
Alternative method 2 (marks 3–7) Synthetic Division

•3
$$\begin{array}{r|l} -3 & \\ \hline & \end{array}$$

•4
$$\begin{array}{r|rrrr} -3 & 1 & 3 & -1 & -3 \\ & & -3 & 0 & 3 \\ \hline & 1 & 0 & -1 & 0 \end{array}$$

- •5 $"f(-3)" = 0$ *so* $(k+3)$ *is a factor*
- •6 $\left(k^2 - 1\right)$
- •7 $(k+3)(k+1)(k-1)$ **stated explicitly**

10 Two variables, x and y, are connected by the law $y = a^x$. A graph of $\log_4(y)$ against x is a straight line passing through the origin and the point A(6,3). Find the value of a. **4**



Qu.	part	marks	Grade	Syllabus Code	Calculator class	Source
10		4	A	A33	NC	06/91

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- •1 ss know to take logarithms
- •2 ic substitute known point
- •3 pr solve
- •4 pr solve

Primary Method : Give 1 mark for each •

- •1 $\log_4(y) = \log_4(a^x)$
- •2 $3 = \log_4(a^6)$
- •3 $a^6 = 4^3$
- •4 $a = 2$

4 marks

Note

1 $m = \frac{1}{2}$ and nothing else gains no marks.

2 For •4, a correct answer without any legitimate evidence gains **NO** marks.

3 For •4, ignore the inclusion of a negative answer.

Alternative Method 1

- •1 $\log_4(y) = \log_4(a^x)$
- •2 $3 = 6\log_4(a)$
- •3 $\log_4(a) = \frac{1}{2}$
- •4 $a = 2$

Alternative Method 2

- •1 $\log_4(y) = mx + c$
- •2 $m = \frac{1}{2},\ c = 0$
- •3 $y = 4^{\frac{1}{2}x}$
- •4 $y = \left(4^{\frac{1}{2}}\right)^x = 2^x \Rightarrow a = 2$

Common Error 1

√	•1	$\log_4(y) = \log_4(a^x)$
X	•2	$\log_4(3) = \log_4(a^6)$
X	•3	$3 = a^6$
X	•4	$a = 3^{\frac{1}{6}}$

Alternative Method 3

- •1 At A $\log_4(y) = 3$
- •2 $y = 4^3$
- •3 $a^6 = 4^3$
- •4 $a = 2$

Common Error 2

X	•1	$\log_4(y) = x$
X	•2	$--$
X √	•3	$y = 4^x$
X	•4	$a = 4$

Alternative Method 4

- •1 $\log_4(y) = \log_4(a^x)$
- •2 $\log_4(y) = x\log_4(a)$
- •3 $\log_4(a) = \frac{1}{2}$
- •4 $a = 4^{\frac{1}{2}} = 2$