H

National
Qualifications
2016

2016 Mathematics

Higher Paper 1

Finalised Marking Instructions

Specific Marking Instructions for each question

Question			Generic Scheme	Illustrative Scheme	Max Mark
1.			●¹ find the gradient ●² state equation	●¹ -4 ●² $y+4x=-5$	**2**

Notes:

1. Accept any rearrangement of $y=-4x-5$ for ●².
2. On this occasion accept $y-3=-4\left(x-(-2)\right)$; however, in future candidates should expect that the final equation will only be accepted when it involves a single constant term.
3. For any acceptable answer without working, award 2/2.
4. ●² is not available as a consequence of using a perpendicular gradient.
5. For candidates who **explicitly state** $m=4$ leading to $y-3=4\left(x-(-2)\right)$, award 1/2.

   For candidates who state $y-3=4\left(x-(-2)\right)$ with no other working, award 0/2.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
2.			●¹ write in differentiable form ●² differentiate first term ●³ differentiate second term	●¹ $\cdots+8x^{\frac{1}{2}}$ stated or implied by ●³ ●² $36x^2$ ●³ $4x^{-\frac{1}{2}}$	**3**

Notes:

1. ●³ is only available for differentiating a term with a fractional index.
2. Where candidates attempt to integrate throughout, only ●¹ is available.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
3.	(a)		•¹ interpret recurrence relation and calculate u_4	•¹ $u_4 = 12$	**1**

Notes:

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		•² communicate condition for limit to exist	•² A limit exists as the recurrence relation is linear and $-1<\frac{1}{3}<1$	**1**

Notes:

1. On this occasion for •² accept:

   any of $-1<\frac{1}{3}<1$ or $\left|\frac{1}{3}\right|<1$ or $0<\frac{1}{3}<1$ with no further comment;

   or statements such as:

   "$\frac{1}{3}$ lies between -1 and 1" or "$\frac{1}{3}$ is a proper fraction"

2. •² is not available for: $-1\le\frac{1}{3}\le1$ or $\frac{1}{3}<1$

   or statements such as:

   "It is between -1 and 1" or "$\frac{1}{3}$ is a fraction"

3. Candidates who state $-1<a<1$ can only gain •² if it is **explicitly stated** that $a=\frac{1}{3}$.

Commonly Observed Responses:

Candidate A	Candidate B
$a=\frac{1}{3}$ $-1<a<1$ so a limit exists. •² ✓	$u_{n+1}=au_n+b$ $u_{n+1}=\frac{1}{3}u_n+10$ $-1<a<1$ so a limit exists. •² ^

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(c)		•³ Know how to calculate limit	•³ $\frac{10}{1-\frac{1}{3}}$ or $L=\frac{1}{3}L+10$	**2**
			•⁴ calculate limit	•⁴ 15	

Notes:

4. Do not accept $L=\frac{b}{1-a}$ with no further working for •³.
5. •³ and •⁴ are not available to candidates who conjecture that $L=15$ following the calculation of further terms in the sequence.
6. For $L=15$ with no working, award 0/2.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
4.			●[1] find the centre ●[2] calculate the radius ●[3] state equation of circle	●[1] $(-3,4)$ stated or implied by ●[3] ●[2] $\sqrt{17}$ ●[3] $(x+3)^2+(y-4)^2=17$ or equivalent	3

Notes:

1. Accept $\frac{\sqrt{68}}{2}$ for ●[2].
2. ●[3] is not available to candidates who do not simplify $\left(\sqrt{17}\right)^2$ or $\left(\frac{\sqrt{68}}{2}\right)^2$.
3. ●[3] is not available to candidates who do not attempt to half the diameter.
4. ●[3] is not available to candidates who use either A or B for the centre.
5. ●[3] is not available to candidates who substitute a negative value for the radius.
6. ●[2]&●[3] are not available to candidates if the diameter or radius appears ex nihilo.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
5.			●[1] start to integrate ●[2] complete integration	●[1] $\ldots\times\sin(4x+1)$ ●[2] $2\sin(4x+1)+c$	2

Notes:

1. An answer which has not been fully simplified, eg $\frac{8\sin(4x+1)}{4}+c$ or $\frac{4\sin(4x+1)}{2}+c$, does not gain ●[2].
2. Where candidates have differentiated throughout, or in part (indicated by the appearance of a negative sign or $\times 4$), see candidates A to F.
3. No marks are available for a line of working containing $\sin(4x+1)^2$ or for any working thereafter.

Commonly Observed Responses:

Candidate A	Candidate C	Candidate E
Differentiated throughout:	Differentiated in part:	Differentiated in part:
$-32\sin(4x+1)+c$ award 0/2	$32\sin(4x+1)+c$ award 1/2	$-2\sin(4x+1)+c$ award 1/2
Candidate B	**Candidate D**	**Candidate F**
Differentiated throughout:	Differentiated in part:	Differentiated in part:
$-32\sin(4x+1)$ award 0/2	$32\sin(4x+1)$ award 0/2	$-2\sin(4x+1)$ award 0/2

Question			Generic Scheme	Illustrative Scheme	Max Mark
6.	(a)			**Method 1:**	**3**
			•¹ equate composite function to x	•¹ $f\left(f^{-1}(x)\right)=x$	
			•² write $f\left(f^{-1}(x)\right)$ in terms of $f^{-1}(x)$	•² $3f^{-1}(x)+5=x$	
			•³ state inverse function	•³ $f^{-1}(x)=\frac{x-5}{3}$	
				Method 2:	**3**
			•¹ write as $y=3x+5$ and start to rearrange	•¹ $y-5=3x$	
			•² complete rearrangement	•² $x=\frac{y-5}{3}$	
			•³ state inverse function	•³ $f^{-1}(x)=\frac{x-5}{3}$	
				Method 3	**3**
			•¹ interchange variables	•¹ $x=3y+5$	
			•² complete rearrangement	•² $\frac{x-5}{3}=y$	
			•³ state inverse function	•³ $f^{-1}(x)=\frac{x-5}{3}$	

Notes:

1. $y=\frac{x-5}{3}$ does not gain •³.

2. At •³ stage, accept f^{-1} expressed in terms of any dummy variable eg $f^{-1}(y)=\frac{y-5}{3}$.

3. $f^{-1}(x)=\frac{x-5}{3}$ with no working gains 3/3.

Commonly Observed Responses:

Candidate A

$\times 3 \quad +5$

$x \rightarrow 3x \rightarrow 3x+5=f(x)$

$\div 3 \quad -5$

•¹ ✓

$\frac{x-5}{3}$ •² ✓

$f^{-1}(x)=\frac{x-5}{3}$ •³ ✓

•¹ awarded for knowing to perform inverse operations in reverse order.

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		•[1] correct value	•[1] 2	**1**

Notes:

Commonly Observed Responses:

Candidate B

$g(x) = 3x + 1$

$g(2) = 3 \times 2 + 1 = 7$

$g^{-1}(x) = \dfrac{x-1}{3}$

$g^{-1}(7) = \dfrac{7-1}{3} = 2$ •[4] ✘

If the candidate had followed this by stating that this would be true for all functions g for which $g(2) = 7$ and g^{-1} exists then •[4] would be awarded.

Question			Generic Scheme	Illustrative Scheme	Max Mark
7.	(a)		$\bullet^1$ identify pathway $\bullet^2$ state $\overrightarrow{FH}$	$\bullet^1$ $\overrightarrow{FG}+\overrightarrow{GH}$ $\bullet^2$ $\mathbf{i}+3\mathbf{j}-4\mathbf{k}$	**2**

Notes:

1. Award $\bullet^1$ for $(-2\mathbf{i}-6\mathbf{j}+3\mathbf{k})+(3\mathbf{i}+9\mathbf{j}-7\mathbf{k})$.
2. For $\mathbf{i}+3\mathbf{j}-4\mathbf{k}$ without working, award both $\bullet^1$ and $\bullet^2$.
3. Accept, throughout the question, solutions written as column vectors.
4. $\bullet^2$ is not available for adding or subtracting vectors within an invalid strategy.
5. Where candidates choose specific points consistent with the given vectors only $\bullet^1$ and $\bullet^4$ are available. However, should the statement 'without loss of generality' precede the selected points then all 4 marks are available.

Commonly Observed Responses:

Candidate A

$\overrightarrow{FH}=\overrightarrow{FG}+\overrightarrow{EH}$ $\quad\bullet^1$ ✗

$\begin{pmatrix}-2\\-6\\3\end{pmatrix}+\begin{pmatrix}2\\3\\1\end{pmatrix}$

$\begin{pmatrix}0\\-3\\4\end{pmatrix}$ $\quad\bullet^2$ ✓2

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		$\bullet^1$ identify pathway $\bullet^2$ $\overrightarrow{FE}$	$\bullet^1$ $\overrightarrow{FH}+\overrightarrow{HE}$ or equivalent $\bullet^2$ $-\mathbf{i}-5\mathbf{k}$	**2**

Notes:

6. Award $\bullet^3$ for $(\mathbf{i}+3\mathbf{j}-4\mathbf{k})-(2\mathbf{i}+3\mathbf{j}+\mathbf{k})$
 or $(\mathbf{i}+3\mathbf{j}-4\mathbf{k})+(-2\mathbf{i}-3\mathbf{j}-\mathbf{k})$
 or $(-2\mathbf{i}-6\mathbf{j}+3\mathbf{k})+(3\mathbf{i}+9\mathbf{j}-7\mathbf{k})-(2\mathbf{i}+3\mathbf{j}+\mathbf{k})$
 or $(-2\mathbf{i}-6\mathbf{j}+3\mathbf{k})+(3\mathbf{i}+9\mathbf{j}-7\mathbf{k})+(-2\mathbf{i}-3\mathbf{j}-\mathbf{k})$.
7. For $-\mathbf{i}-5\mathbf{k}$ without working, award 0/2.
8. $\bullet^4$ is not available for simply adding or subtracting vectors. There must be evidence of a valid strategy at $\bullet^3$.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
8.			•¹ substitute for y	•¹ $x^2+(3x-5)^2+2x-4(3x-5)-5...$	5
			Method 1 & 2	**Method 1**	
			•² express in standard quadratic form •³ factorise or use discriminant	•² $10x^2-40x+40$ •³ $10(x-2)^2$ $\}=0$	
			•⁴ interpret result to demonstrate tangency	•⁴ only one solution implies tangency (or repeated factor implies tangency)	
			•⁵ find coordinates	•⁵ $x=2,\ y=1$	
				Method 2	
				•² $10x^2-40x+40=0$ **stated explicitly**	
				•³ $(-40)^2-4\times10\times40$ or $(-4)^2-4\times1\times4$	
				•⁴ $b^2-4ac=0$ so line is a tangent	
				•⁵ $x=2,\ y=1$	
			Method 3	**Method 3**	
			•¹ make inference and state m_{rad}	•¹ If $y=3x-5$ is a tangent, $m_{rad}=\frac{-1}{3}$	
			•² find the centre and the equation of the radius •³ solve simultaneous equations	•² $(-1,2)$ and $3y=-x+5$ •³ $3y=-x+5$, $y=3x-5$ $\rightarrow(2,1)$	
			•⁴ verify location of point of intersection	•⁴ check $(2,1)$ lies on the circle.	
			•⁵ communicates result	•⁵ $\therefore$ the line is a tangent to the circle	

Notes:

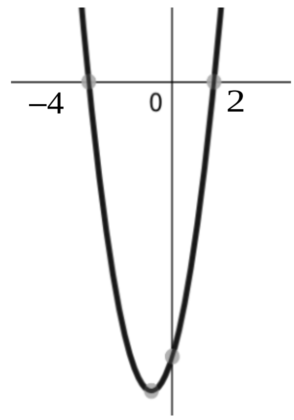
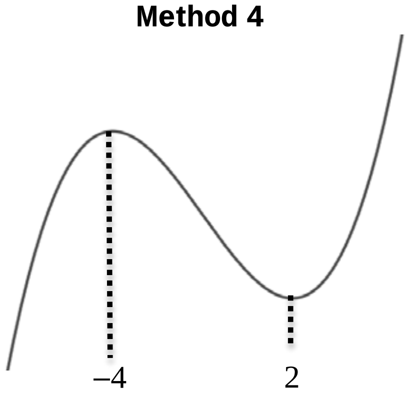
1. In Method 1 "$=0$" must appear at •² or •³ stage for •² to be awarded.
2. Award •³ and •⁴ for correct use of quadratic formula to get equal (repeated) roots $\Rightarrow$ line is a tangent.

Question			Generic Scheme	Illustrative Scheme	Max Mark
Commonly Observed Responses:					
Candidate A $x^2+(3x-5)^2+2x-4(3x-5)-5=0$ •1 ✓ $10x^2-40x+40=0$ •2 ✓ $b^2-4ac=(-40)^2-4\times10\times40=0\Rightarrow$ tgt •3 ✓				**Candidate B** $x^2+(3x-5)^2+2x-4(3x-5)-5=0$ •1 ✓ $10x^2-40x+40$ •2 ^ $b^2-4ac=(-40)^2-4\times10\times40=0\Rightarrow$ tgt •3 ✓1	
Candidate C $x^2+(3x-5)^2+2x-4(3x-5)-5=0$ •1 ✓ $x^2+\underline{9x^2+25}+2x-12x+20-5=0$ $10x^2-10x+40=0$ •2 ✗ $b^2-4ac=(-10)^2-4\times10\times40=-1500\Rightarrow$ no real roots so line is not a tangent •3 ✓1 •4 and •5 are unavailable.				**Candidate D** $x^2+(3x-5)^2+2x-4(3x-5)-5=0$ •1 ✓ $10x^2-40x+40=0$ •2 ✓ $10(x-2)^2$ •3 ✓ Repeated root $\Rightarrow$ Only one point of contact. •4 ✓	
9	(a)		•1 know to and differentiate one term •2 complete differentiation and equate to zero •3 factorise derivative •4 process for x	•1 eg $f'(x)=3x^2...$ •2 $3x^2+6x-24=0$ •3 $3(x+4)(x-2)$ •4 -4 and 2	4

Notes:

1. •2 is only available if "$=0$" appears at •2 or •3 stage.
2. •3 is available for substituting correctly in the quadratic formula.
3. At •3 do not penalise candidates who fail to extract the common factor or who have divided the quadratic equation by 3.
4. •3 and •4 are not available to candidates who arrive at a linear expression at •2.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		●5 know how to identify where curve is increasing ●6 state range	●5 **Method 1**  **Method 2** $3x^2 + 6x - 24 > 0$ **Method 3** Table of signs for a derivative – see the additional page for acceptable responses. **Method 4**  ●6 $x < -4$ and $x > 2$	2

Notes:

5. For $x < -4$ and $x > 2$ without working award 0/2.
6. $2 < x < -4$ does not gain ●6.

Commonly Observed Responses:

Table of signs for a derivative - acceptable responses.

x	-4^-	-4	-4^+
$\frac{dy}{dx}$ or $f'(x)$	$+$	0	$-$
Shape or Slope	/	—	\

x	2^-	2	2^+
$\frac{dy}{dx}$ or $f'(x)$	$-$	0	$+$
Shape or Slope	\	—	/

x	$\rightarrow$	-4	$\rightarrow$
$\frac{dy}{dx}$ or $f'(x)$	$+$	0	$-$
Shape or Slope	/	—	\

x	$\rightarrow$	2	$\rightarrow$
$\frac{dy}{dx}$ or $f'(x)$	$-$	0	$+$
Shape or Slope	\	—	/

Arrows are taken to mean "in the neighbourhood of"

x	a	-4	b	2	c
$\frac{dy}{dx}$ or $f'(x)$	$+$	0	$-$	0	$+$
Shape or Slope	/	—	\	—	/

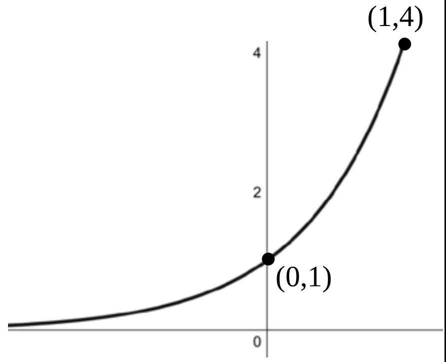
Where: $a < -4$, $-4 < b < 2$, $c > 2$
Since the function is continuous '$-4 < b < 2$' is acceptable.

x	$\rightarrow$	-4	$\rightarrow$	2	$\rightarrow$
$\frac{dy}{dx}$ or $f'(x)$	$+$	0	$-$	0	$+$
Shape or Slope	/	—	\	—	/

Since the function is continuous '$-4 \rightarrow 2$' is acceptable.

General Comments

- Since this question refers to both y and $f(x)$, $\frac{dy}{dx}$ and $f'(x)$ are accepted.
- The row labelled 'shape' or 'slope' is not required in this question since the sign of the derivative is sufficient to indicate where the function is increasing.
- For this question, do not penalise the omission of 'x' on the top row of the table.

Question			Generic Scheme	Illustrative Scheme	Max Mark
10.			•[1] graph reflected in $y=x$ •[2] correct annotation	•[1]  •[2] $(0,1)$ and $(1,4)$	2

Notes:

1. For •[1] accept any graph of the correct shape and orientation which crosses the $y-\text{axis}$. The graph must not cross the $x-\text{axis}$.
2. Both $(0,1)$ and $(1,4)$ must be marked and labelled on the graph for •[2] to be awarded.
3. •[2] is only available where the candidate has attempted to reflect the given curve in the line $y=x$.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
11.	(a)		•[1] interpret ratio •[2] determine coordinates	•[1] $\frac{1}{3}$ •[2] $(2,1,0)$	**2**

Notes:

1. •[1] may be implied by •[2] or be evidenced by their working.
2. For $(3,-1,2)$ award 1/2.
3. For $(2,1,0)$ without working award 2/2.
4. $\begin{pmatrix}2\\1\\0\end{pmatrix}$ gains 1/2.
5. $\begin{pmatrix}3\\-1\\2\end{pmatrix}$ gains 0/2.

Commonly Observed Responses:

Candidate A	Candidate B
$\overrightarrow{BC}=\frac{1}{3}\overrightarrow{AC}$ •[1] ✗ $(3,-1,2)$ •[2] ✓1	$\frac{\overrightarrow{AB}}{\overrightarrow{BC}}=\frac{1}{2}$ $2\overrightarrow{AB}=\overrightarrow{BC}$ $2(\mathbf{b}-\mathbf{a})=\mathbf{c}-\mathbf{b}$ $3\mathbf{b}=\mathbf{c}+2\mathbf{a}$ •[1] ✓ $3\mathbf{b}=\begin{pmatrix}6\\3\\0\end{pmatrix}$ $\mathbf{b}=\begin{pmatrix}2\\1\\0\end{pmatrix}$ $B(2,1,0)$ •[2] ✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		•¹ find $\overrightarrow{AC}$	•¹ $\overrightarrow{AC}=\begin{pmatrix}3\\-6\\6\end{pmatrix}$	**3**
			•² find $\lvert\overrightarrow{AC}\rvert$	•² 9	
			•³ determine k	•³ $\frac{1}{9}$	

Notes:

6. Evidence for •³ may appear in part (a).
7. •³ may be implied at •⁴ stage by :
   - $\sqrt{3^2+(-6)^2+6^2}$
   - $\sqrt{3^2-6^2+6^2}=9$
   - $\sqrt{3^2+-6^2+6^2}=9$.
8. $\sqrt{81}$ must be simplified at the •⁴ or •⁵ stage for •⁴ to be awarded.
9. •⁵ can only be awarded as a consequence of a valid strategy at •⁴. k must be >0.

Commonly Observed Responses:

Candidate A		Candidate B		Candidate C	
$\lvert\overrightarrow{AC}\rvert=\sqrt{81}$	•⁴ ✓	$\lvert\overrightarrow{AC}\rvert=\sqrt{81}$	•⁴ ✓2	$\lvert\overrightarrow{AC}\rvert=\sqrt{81}$	•⁴ ✓2
$\frac{1}{9}$	•⁵ ✓	$\frac{1}{\sqrt{81}}$	•⁵ ✓1		•⁵ ^

ALTERNATIVE STRATEGY

Where candidates use the distance formulae to determine the distance from A to C, award •³ for $AC=\sqrt{3^2+6^2+6^2}$.

Question			Generic Scheme	Illustrative Scheme	Max Mark
12.	(a)		•¹ interpret notation •² demonstrate result	•¹ $2(3-x)^2-4(3-x)+5$ •² $18-12x+2x^2-12+4x+5$ leading to $2x^2-8x+11$	**2**

Notes:

1. At •² there must be a relevant intermediate step between •¹ and the final answer for •² to be awarded.
2. $f(3-x)$ alone is not sufficient to gain •¹.
3. Beware of candidates who fudge their working between •¹ and •².

Commonly Observed Responses:

	(b)		 •¹ identify common factor •² start to complete the square •³ write in required form	**Method 1** •¹ $2[x^2-4x...$ stated or implied by •² •² $2(x-2)^2...$ •³ $2(x-2)^2+3$	**3**
			  •¹ expand completed square form •² equate coefficients •³ process for q and r and write in required form	**Method 2** •¹ $px^2+2pqx+pq^2+r$ •² $p=2,\ 2pq=-8,\ pq^2+r=11$ •³ $2(x-2)^2+3$	

Notes:

4. At •⁵ $2(x+(-2))^2+3$ must be simplified to $2(x-2)^2+3$.
5. $2(x-2)^2+3$ with no working gains •⁵ only; however, see Candidate G.
6. Where a candidate has used the function they arrived at in part (a) as $h(x)$, •³ is not available. However, •⁴ and •⁵ can still be gained for dealing with an expression of equivalent difficulty.
7. •⁵ is only available for a calculation involving both the multiplication and addition of integers.

Question	Generic Scheme	Illustrative Scheme	Max Mark

Commonly Observed Responses:

Candidate A $2\left(x^2-4x+\frac{11}{2}\right)$ •3 ✓ $2\left(x^2-4x+4-4+\frac{11}{2}\right)$ •4 not awarded at this line. $2(x-2)^2+\frac{3}{2}$ •4 ✓ •5 ✗	**Candidate B** $2x^2-8x+11=2(x-4)^2-16+11$ •3 ✗ •4 ✗ $=2(x-4)^2-5$ •5 ✓2
Candidate C $px^2+2pqx+pq^2+r$ •3 ✓ $p=2,\ 2pq=-8,\ q^2+r=11$ •4 ✗ $p=2,\ q=-2,\ r=7$ $2(x-2)^2+7$ •5 ✓1	**Candidate D** $2\left[\left(x^2-8x\right)+11\right]$ •3 ✗ $2\left[(x-4)^2-16\right]+11$ •4 ✓1 $2(x-4)^2-21$ •5 ✓1
Candidate E $p(x+q)^2+r=px^2+2pqx+pq^2+r$ •3 ✓ $p=2,\ 2pq=-8,\ pq^2+r=11$ •4 ✓ $q=-2,\ r=3$ •5 ✓ •5 is awarded as all working relates to completed square form	**Candidate F** $px^2+2pqx+pq^2+r$ •3 ✓ $p=2,\ 2pq=-8,\ pq^2+r=11$ •4 ✓ $q=-2,\ r=3$ •5 ✗ •5 is lost as no reference is made to completed square form
Candidate G $2(x-2)^2+3$ Check: $2\left(x^2-4x+4\right)+3$ $=2x^2-8x+8+3$ $2x^2-8x+11$ Award 3/3	**Candidate H** $2x^2-8x+11$ $=2(x-2)^2-4+11$ •3 ✓ •4 ✓ $=2(x-2)^2+7$ •5 ✗

Question			Generic Scheme	Illustrative Scheme	Max Mark
13.			•1 calculate lengths AC and AD	•1 $AC=\sqrt{17}$ and $AD=5$ stated or implied by •3	5
			•2 select appropriate formula and express in terms of p and q	•2 $\cos q\cos p+\sin q\sin p$ stated or implied by •4	
			•3 calculate two of $\cos p,\ \cos q,\ \sin p,\ \sin q$	•3 $\cos p=\frac{4}{\sqrt{17}}$, $\cos q=\frac{4}{5}$ $\sin p=\frac{1}{\sqrt{17}}$, $\sin q=\frac{3}{5}$	
			•4 calculate other two and substitute into formula	•4 $\frac{4}{5}\times\frac{4}{\sqrt{17}}+\frac{3}{5}\times\frac{1}{\sqrt{17}}$	
			•5 arrange into required form	•5 $\frac{19}{5\sqrt{17}}\times\frac{\sqrt{17}}{\sqrt{17}}=\frac{19\sqrt{17}}{85}$ or $\frac{19}{5\sqrt{17}}=\frac{19\sqrt{17}}{5\times17}=\frac{19\sqrt{17}}{85}$	

Notes:

1. For any attempt to use $\cos(q-p)=\cos q-\cos p$, only •1 and •3 are available.
2. At the •3 and •4 stages, do not penalise the use of fractions greater than 1 resulting from an error at •1. •5 will be lost.
3. Candidates who write $\cos\left(\frac{4}{5}\right)\times\cos\left(\frac{4}{\sqrt{17}}\right)+\sin\left(\frac{3}{5}\right)\times\sin\left(\frac{1}{\sqrt{17}}\right)$ gain •1, •2 and •3.

   •4 and •5 are unavailable.
4. Clear evidence of multiplying by $\frac{\sqrt{17}}{\sqrt{17}}$ must be seen between •4 and •5 for •5 to be awarded.
5. •4 implies •1, •2 and •3.

Commonly Observed Responses:

Candidate A		Candidate B	
$\frac{4}{5}\times\frac{4}{\sqrt{17}}+\frac{3}{5}\times\frac{1}{\sqrt{17}}$	•4 ✓	$AC=\sqrt{17}$ and $AD=\sqrt{21}$	•1 ✗
$\frac{19}{5\sqrt{17}}\times\sqrt{17}$		$\cos q\cos p+\sin q\sin p$	•2 ✓
$\frac{19\sqrt{17}}{85}$	•5 ✗	$\cos p=\frac{4}{\sqrt{17}}$ $\sin p=\frac{1}{\sqrt{17}}$	•3 ✓
		$\frac{\sqrt{17}}{\sqrt{21}}\times\frac{4}{\sqrt{17}}+\frac{2}{\sqrt{21}}\times\frac{1}{\sqrt{17}}$	•4 ✗
		=...•5 not available	

Question			Generic Scheme	Illustrative Scheme	Max Mark
14.	(a)		●[1] state value	●[1] 2	**1**

Notes:

1. Evidence for ●[1] may not appear until part (b).

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		●[2] use result of part (a)	●[2] $\log_4 x + \log_4(x-6) = 2$	**5**
			●[3] use laws of logarithms	●[3] $\log_4 x(x-6) = 2$	
			●[4] use laws of logarithms	●[4] $x(x-6) = 4^2$	
			●[5] write in standard quadratic form	●[5] $x^2 - 6x - 16 = 0$	
			●[6] solve for x and identify appropriate solution	●[6] 8	

Notes:

2. ●[3] & ●[4] can only be awarded for use of laws of logarithms applied to algebraic expressions of equivalent difficulty.
3. ●[4] is not available for $x(x-6) = 2^4$; however candidates may still gain ●[5] & ●[6].
4. ●[6] is only available for solving a polynomial of degree 2 or higher.
5. ●[6] is not available for responses which retain invalid solutions.

Commonly Observed Responses:

Candidate A		Candidate B		Candidate C	
$\log_5 25 = 5$	●[1] ✗	$\log_5 25 = 2$	●[1] ✓	$\log_5 25 = 2$	●[1] ✓
$\log_4 x(x-6) = 5$	●[2] ✓1	$\log_4 x(x-6) = 2$	●[2] ✓	$\log_4 x(x-6) = 2$	●[2] ✓
	●[3] ✓1		●[3] ✓		●[3] ✓
$x(x-6) = 4^5$	●[4] ✓1	$x(x-6) = 8$	●[4] ✗	$x(x-6) = 8$	●[4] ✗
$x^2 - 6x - 1024 = 0$	●[5] ✓1	$x^2 - 6x - 8 = 0$	●[5] ✓1	$x^2 - 6x + 8 = 0$	●[5] ✗
35.14...	●[6] ✓1	7.12...	●[6] ✓1	$x = 2, 4$	●[6] ✗
				or	
				$x =$ ~~2~~, ~~4~~	●[6] ✗

Question			Generic Scheme	Illustrative Scheme	Max Mark
15.	(a)		●[1] value of a	●[1] $a=4$	**3**
			●[2] value of b	●[2] $b=-5$	
			●[3] calculate k	●[3] $k=-\frac{1}{12}$	

Notes:

1. Evidence for the values of a and b may first appear in an expression for $f(x)$. Where marks have been awarded for a and b in an expression for $f(x)$ ignore any values attributed to a and b in subsequent working.

Commonly Observed Responses:

Candidate A	Candidate B	Candidate C
Both roots interchanged		Using $(1,9)$
$a=-5$ ●[1] ✗	$a=4$ ●[1] ✓	$a=-4$ ●[1] ✗
$b=4$ ●[2] ✓1	$b=5$ ●[2] ✗	$b=5$ ●[2] ✓1
$k=\frac{1}{6}$ ●[3] ✓1	$k=-\frac{3}{16}$ ●[3] ✓1	$k=\frac{9}{80}$ ●[3] ✓1

Candidate D - BEWARE	Summary for expressions of $f(x)$ for ●[1] and ●[2] :
Using $(0,9)$	**signs correct, brackets correct**
$a=-5$ ●[1] ✗	$f(x)=(x-4)(x+5)^2$ ●[1] ✓ ●[2] ✓
$b=4$ ●[2] ✓1	**signs incorrect, brackets correct**
$k=\frac{9}{80}$ ●[3] ✗	$f(x)=(x+4)(x-5)^2$ ●[1] ✗ ●[2] ✓1
	signs correct, brackets incorrect
	$f(x)=(x+5)(x-4)^2$ ●[1] ✗ ●[2] ✓1

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		●[1] state range of values	●[1] $d>9$	**1**

Notes:

Commonly Observed Responses:

[END OF MARKING INSTRUCTIONS]