Detailed Marking Instructions for each question

Question	Generic Scheme	Illustrative Scheme	Max Mark
1.			
	$\bullet^1$ equate scalar product to zero $\bullet^2$ state value of t	$\bullet^1$ $-24+2t+6=0$ $\bullet^2$ $t=9$	**2**
Notes:			
Commonly Observed Responses:			
Candidate A $-24+2t+6=-1$ $t=\frac{17}{2}$ or $8\frac{1}{2}$	$\bullet^1$ × $\bullet^2$ ✓1		
2.			
	$\bullet^1$ know to and differentiate $\bullet^2$ evaluate $\frac{dy}{dx}$ $\bullet^3$ evaluate y-coordinate $\bullet^4$ state equation of tangent	$\bullet^1$ $6x^2$ $\bullet^2$ 24 $\bullet^3$ -13 $\bullet^4$ $y=24x+35$	**4**
Notes:			
1. $\bullet^4$ is only available if an attempt has been made to find the gradient from differentiation. 2. At mark $\bullet^4$ accept $y+13=24(x+2)$, $y-24x=35$ or any other rearrangement of the equation.			
Commonly Observed Responses:			

Question	Generic Scheme	Illustrative Scheme	Max Mark
3.			
	•¹ know to use $x=-3$ •² interpret result and state conclusion	**Method 1** •¹ $(-3)^3-3(-3)^2-10(-3)+24$ •² $=0\therefore(x+3)$ is a factor. **Method 2** •¹ $-3 \mid 1 \quad -3 \quad -10 \quad 24$ $\quad\quad\quad -3$ $\quad\quad 1$ •² $-3 \mid 1 \quad -3 \quad -10 \quad 24$ $\quad\quad\quad -3 \quad 18 \quad -24$ $\quad\quad 1 \quad -6 \quad 8 \quad 0$ remainder $=0\therefore(x+3)$ is a factor. **Method 3** •¹ $x+3\overline{)x^3-3x^2-10x+24}$ with x^2 above and x^3+3x^2 below •² $=0\therefore(x+3)$ is a factor.	**4**
	•³ state quadratic factor •⁴ factorise completely	•³ x^2-6x+8 stated or implied by •⁴ •⁴ $(x+3)(x-4)(x-2)$	

Notes:

1. Communication at •² must be consistent with working at that stage ie a candidate's working must arrive legitimately at 0 before •² is awarded.
2. Accept any of the following for •²:
'$f(-3)=0$ so $(x+3)$ is a factor'
'since remainder is 0, it is a factor'
the 0 from the table linked to the word 'factor' by eg 'so', 'hence', '$\therefore$', '$\rightarrow$', '$\Rightarrow$'
3. Do not accept any of the following for •²:
double underlining the zero or boxing the zero without comment
'$x=3$ is a factor', '$(x-3)$ is a factor', '$x=-3$ is a root', '$(x-3)$ is a root', "$(x+3)$ is a root"
the word 'factor' **only,** with no link
4. At •⁴ the expression may be written in any order.
5. An incorrect quadratic correctly factorised may gain •⁴
6. Where the quadratic factor obtained is irreducible, candidates must clearly demonstrate that $b^2-4ac<0$ to gain •⁴
7. $=0$ must appear at •¹ or •² for •² to be awarded.
8. For candidates who do not arrive at 0 at the •² stage •²•³•⁴ not available.
9. Do not penalise candidates who attempt to solve a cubic equation. However, within this working there may be evidence of the correct factorisation of the cubic.

Commonly Observed Responses:

Candidate A

$2\ \big|\ 1\ \ -3\ \ -10\ \ 24$

$\qquad\quad\ \ 2\ \ -2\ \ -24$

$\qquad 1\ \ -1\ \ -12\ \ \ 0\ \Rightarrow x-2$ is a factor $\bullet^2$ ✓1

$(x-2)(x^2-x-12)$ $\bullet^3$ ✓

$(x-2)(x-4)(x+3)\Rightarrow x+3$ is a factor $\bullet^4$ ✓

$\bullet^1$ ✓

Candidate B

$2\ \big|\ 1\ \ -3\ \ -10\ \ 24$

$\qquad\quad\ \ 2\ \ -2\ \ -24$

$\qquad 1\ \ -1\ \ -12\ \ \ 0\ \Rightarrow x-2$ is a factor $\bullet^1$ ✓2 $\bullet^2$ ✓1

4.			
	$\bullet^1$ state the value of p $\bullet^2$ state the value of q $\bullet^3$ state the value of r	$\bullet^1$ $p=3$ $\bullet^2$ $q=4$ $\bullet^3$ $r=1$	**3**

Notes:

1. These are the only acceptable responses for p, q and r **.**

Commonly Observed Responses:

5(a).			
	$\bullet^1$ let $y=6-2x$ and rearrange. $\bullet^2$ state expression. **Method 2** $\bullet^3$ equates composite function to x $\bullet^1$ start to rearrange. $\bullet^2$ state expression.	$\bullet^1$ $x=\frac{6-y}{2}$ or $y=\frac{6-x}{2}$ $\bullet^2$ $g^{-1}(x)=\frac{6-x}{2}$ or $3-\frac{x}{2}$ or $\frac{x-6}{-2}$ **Method 2** $g(g^{-1}(x))=x$ this gains $\bullet^3$ $6-2g^{-1}(x)=x$ $g^{-1}(x)=\frac{6-x}{2}$ or $3-\frac{x}{2}$ or $\frac{x-6}{-2}$	**2**

Notes:

1. At $\bullet^1$ accept any equivalent expression with any 2 distinct variables.

Commonly Observed Responses:

5(b).			
	$\bullet^3$ state expression	$\bullet^3$ x	**1**

Notes:

2. Candidates using method 2 may be awarded $\bullet^3$ at line one.
3. For candidates who attempt to find the composite function $g\left(g^{-1}(x)\right)$, accept $6-2\left(\frac{6-x}{2}\right)$ for $\bullet^3$.
4. In this case $\bullet^3$ may be awarded as follow through where an incorrect $g^{-1}(x)$ is found at $\bullet^2$, provided it includes the variable x.

Commonly Observed Responses:

Question	Generic Scheme	Illustrative Scheme	Max Mark
6.			
	$\bullet^1$ use laws of logs $\bullet^2$ use laws of logs ^{3} evaluate log	$\bullet^1$ $\log_6 27^{\frac{1}{3}}$ $\bullet^2$ $\log_6\left(12\times 27^{\frac{1}{3}}\right)$ $\bullet^3$ 2	**3**

Notes:

Commonly Observed Responses:

Candidate A

$\log_6 12+\log_6 9$ $\bullet^1$ ×

$\log_6(12\times 9)$ $\bullet^2$ ✓1

$\log_6 108$ $\bullet^3$ ✓2

Candidate B

$\frac{1}{3}\log_6(12\times 27)$

$\frac{1}{3}\log_6 324$

$\log_6 324^{\frac{1}{3}}$

Award 1 out of 3 ^,^ ✓1

Question	Generic Scheme	Illustrative Scheme	Max Mark
7.			
	$\bullet^1$ write in differentiable form $\bullet^2$ differentiate first term $\bullet^3$ differentiate second term $\bullet^4$ evaluate derivative at $x=4$	$\bullet^1$ $3x^{\frac{3}{2}}-2x^{-1}$ $\bullet^2$ $\frac{9}{2}x^{\frac{1}{2}}+\ldots$ $\bullet^3$ $\ldots+2x^{-2}$ $\bullet^4$ $9\frac{1}{8}$	**4**

Notes:

1. $\bullet^2$ must involve a fractional index.
2. $\bullet^3$ must involve a negative index.
3. $\bullet^4$ is only available as a consequence of substituting into a 'derivative' containing a fractional or negative index.
4. If no attempt has been made to expand the bracket at $\bullet^1$ then $\bullet^2$ & $\bullet^3$ are not available. $\bullet^4$ is still available as follow through.

Commonly Observed Responses:

Candidate A

$f(x)=3x^{\frac{1}{2}}-2x^{-\frac{1}{4}}$

$f'(x)=\frac{3}{2}x^{-\frac{1}{2}}+\frac{1}{2}x^{-\frac{5}{4}}$ $\bullet^1$ ×

$=\frac{3}{2\sqrt{x}}+\frac{1}{2\sqrt[4]{x^5}}$ $\bullet^2$ ✓1, $\bullet^3$ ✓1, $\bullet^4$ ✓1

$f'(4)=\frac{3}{2\sqrt{4}}+\frac{1}{2\sqrt[4]{4^5}}$

$=\frac{3}{4}+\frac{1}{8\sqrt{2}}$

Question	Generic Scheme	Illustrative Scheme	Max Mark
8.			
	• [1] interpret information • [2] express in standard quadratic form • [3] factorise • [4] state range	• [1] $x(x-2)<15$ • [2] $x^2-2x-15<0$ • [3] $(x-5)(x+3)<0$ • [4] $2<x<5$	**4**

Notes:

Commonly Observed Responses:

Candidate A

$x(x-2)=15$

$x^2-2x-15=0$

$x=-3,\ 5$

• [1] ×
• [2] ✓2
• [3] ✓1
• [4] ^

Candidate B - Mistaking perimeter for area

$4x-4<15$

$x<\frac{19}{4}$

Award 1/4

Candidate C

$x^2-2x<15$

$x>2$

Award 1/4

Candidate D

$x^2-2x<15$

$x>2$

$x<5$

Award 2/4

Inequalities not linked by 'and'

Candidate E

$x^2-2x<15$

$x>2$

and

$x<5$

Award 4/4

Inequalities linked by 'and'

Question	Generic Scheme	Illustrative Scheme	Max Mark
9.			
	$\bullet^1$ find gradient of AB	$\bullet^1$ $m_{AB} = -\sqrt{3}$	**3**
	$\bullet^2$ calculate gradient of BC	$\bullet^2$ $m_{BC} = -\frac{1}{\sqrt{3}}$	
	$\bullet^3$ interpret results and state conclusion	$\bullet^3$ $m_{AB} \neq m_{BC} \Rightarrow$ points are not collinear.	
		Method 2	
		$\bullet^1$ $m_{AB} = -\sqrt{3}$	
		$\bullet^2$ AB makes 120° with positive direction of the $x-$axis .	
		$\bullet^3$ $120 \neq 150$ so points are not collinear.	
Notes:			
1. The statement made at $\bullet^3$ must be consistent with the gradients or angles found for $\bullet^1$ and $\bullet^2$.			
Commonly Observed Responses:			
10(a).			
	$\bullet^1$ state value of $\cos 2x$	$\bullet^1$ $\frac{4}{5}$	**1**
Notes:			
Commonly Observed Responses:			
Candidate A		**Candidate B**	
$\cos 2x = \frac{3}{5}$	$\bullet^1$ ×	$\cos 2x = 4$	$\bullet^1$ ×
$2\cos^2 x - 1 = \ldots$	$\bullet^2$ ✓1	$2\cos^2 x - 1 = 4$	$\bullet^2$ ✓1
$\cos x = \frac{2}{\sqrt{5}}$	$\bullet^3$ ✓1	$\cos^2 x = \frac{5}{2}$	
		$\cos x = \sqrt{\frac{5}{2}}$	$\bullet^3$ × invalid answer
10(b).			
	$\bullet^2$ use double angle formula	$\bullet^2$ $2\cos^2 x - 1 = \ldots$	**2**
	$\bullet^3$ evaluate $\cos x$	$\bullet^3$ $\frac{3}{\sqrt{10}}$	
Notes:			
1. Ignore the inclusion of $-\frac{3}{\sqrt{10}}$.			
2. At $\bullet^2$ the double angle formula must be equated to the candidates answer to part (a).			
Commonly Observed Responses:			

Question		Generic Scheme	Illustrative Scheme	Max Mark
11(a).				
		$\bullet^1$ state coordinates of centre	$\bullet^1$ $(-8,-2)$	**4**
		$\bullet^2$ find gradient of radius	$\bullet^2$ $-\frac{1}{2}$	
		$\bullet^3$ state perpendicular gradient	$\bullet^3$ 2	
		$\bullet^4$ determine equation of tangent	$\bullet^4$ $y=2x-1$	

Notes:

1. $\bullet^4$ is only available as a consequence of trying to find and use a perpendicular gradient.

2. At mark $\bullet^4$ accept $y+5=2(x+2)$, $y-2x=-1$, $y-2x+1=0$ or any other rearrangement of the equation.

Commonly Observed Responses:

Question	Generic Scheme	Illustrative Scheme	Max Mark
11(b).			
	Method 1 •5 arrange equation of tangent in appropriate form and equate y_{tangent} to y_{parabola} •6 rearrange and equate to 0 •7 know to use discriminant and identify $a, b, \text{and } c$ •8 simplify and equate to 0 •9 start to solve •10 state value of p	**Method 1** •5 $2x-1=-2x^2+px+1-p$ •6 $2x^2+(2-p)x+p-2=0$ •7 $(2-p)^2-4\times2\times(p-2)$ •8 $p^2-12p+20=0$ •9 $(p-10)(p-2)=0$ •10 $p=10$	**6**
	Method 2 •5 arrange equation of tangent in appropriate form and equate y_{tangent} to y_{parabola} •6 find $\frac{dy}{dx}$ for parabola •7 equate to gradient of line and rearrange for p •8 substitute and arrange in standard form •9 factorise and solve for x •10 state value of p	**Method 2** •5 $2x-1=-2x^2+px+1-p$ •6 $\frac{dy}{dx}=-4x+p$ •7 $2=-4x+p$ $p=2+4x$ •8 $0=2x^2-4x$ •9 $0=2x(x-2)$ $x=0,\ x=4$ •10 $p=10$	

Notes:

1. At •6 accept $2x^2+2x-px+p-2=0$.
2. At •7 accept $a=2,\ b=(2-p),\ \text{and } c=(p-2)$.

Commonly Observed Responses:

Just using the parabola

$a=-2 \quad b=p \quad c=1-p$

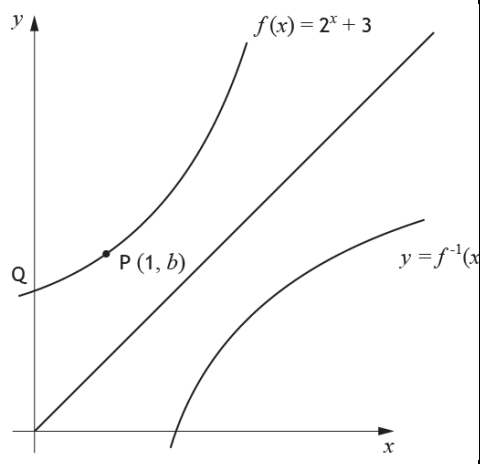
$b^2-4ac=p^2-4\times(-2)(1-p)$

$=p^2-8p+8=0$

$p=4\pm\sqrt{8}$

$p=4+\sqrt{8}$ as $p>3$

•5 ^
•6 ^
•7 ✓1
•8 ✓2
•9 ✓1
•10 ✓1

Question	Generic Scheme	Illustrative Scheme	Max Mark
12.			
	• [1] interpret integral below $x-$axis • [2] evaluate	• [1] -1 (accept area below $x-\text{axis} = 1$) • [2] $-\frac{1}{2}$	**2**
Notes:			
1. For candidates who calculate the area as $\frac{3}{2}$ award 1 out of 2.			
Commonly Observed Responses:			
13(a)			
	• [1] calculate b	• [1] 5	**1**
Notes:			
Commonly Observed Responses:			
13 (b)(i)			
	• [2] reflecting in the line $y = x$	• [2] 	**1**
Notes:			
1. If the reflected graph cuts the $y-$axis, • [2] is not awarded.			
Commonly Observed Responses:			

Question	Generic Scheme	Illustrative Scheme	Max Mark
13(b)(ii)			
	•³ calculate y intercept •⁴ state coordinates of image of Q •⁵ state coordinates of image of P	•³ 4 •⁴ $(4,\ 0)$ see note 2 •⁵ $(5,\ 1)$	**3**
Notes:			
2. •⁴ can only be awarded if $(4,0)$ is clearly identified either by their labelling or by their diagram. 3. •³ is awarded for the appearance of 4, or $(4,0)$ or $(0,4)$. 4. •⁵ is awarded for the appearance of $(5,1)$. Ignore any labelling attached to this point.			
Commonly Observed Responses:			
Candidate A $y=f(x)$ reflected in $x-$axis 4 •³ ✓ (0,-4) •⁴ ✓ 2 (1,-5) •⁵ ✓1		**Candidate B** $y=f(x)$ reflected in $y-$axis 4 •³ ✓ (0,4) •⁴ ✓ 2 (-1,5) •⁵ ✓ 2	
13(c)			
	•⁶ state x coordinate of R •⁷ state y coordinate of R	•⁶ $x=2$ •⁷ $y=-7$	**2**
Notes:			
Commonly Observed Responses:			
14.			
	•¹ identify length of radius •² determine value of k	$y-$axis tangent to circle: •¹ $r=6$; •² $k=25$ Circle passes through origin: $r=\sqrt{61}$; $k=0$	**2**

Question	Generic Scheme	Illustrative Scheme	Max Mark
15.			
	$\bullet^1$ know to integrate	$\bullet^1$ $\int$	**6**
	$\bullet^2$ integrate a term	$\bullet^2$ $\frac{1}{50}t^2 \ldots$ or $\ldots - kt$	
	$\bullet^3$ complete integration	$\bullet^3$ $\ldots - kt$ or $\frac{1}{50}t^2 \ldots$	
	$\bullet^4$ find constant of integration	$\bullet^4$ $c = 100$	
	$\bullet^5$ find value of k	$\bullet^5$ $k = 2$	
	$\bullet^6$ state expression for T	^{6} $T = \frac{1}{50}t^2 - 2t + 100$	
Notes:			
1. Accept unsimplified expressions at $\bullet^2$ and $\bullet^3$ stage. 2. $\bullet^4$, $\bullet^5$ and $\bullet^6$ are not available for candidates who have not considered the constant of integration. 3. $\bullet^1$ may be implied by $\bullet^2$.			
Commonly Observed Responses:			

[END OF MARKING INSTRUCTIONS]