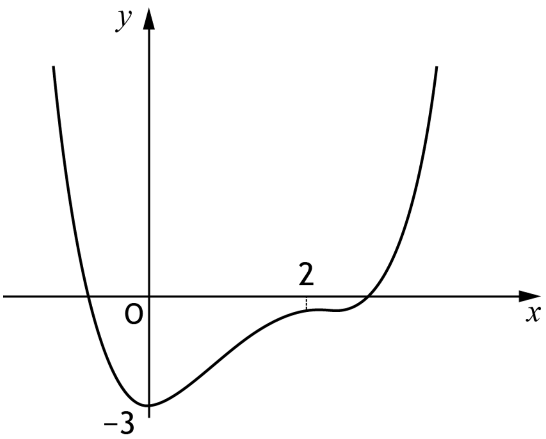
Detailed Marking Instructions for each question

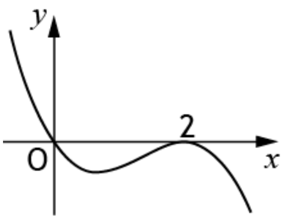
Question		Expected response (Give one mark for each •)	Max mark	Additional guidance (Illustration of evidence for awarding a mark at each •)
1		$y-12=6(x-5)$	3	
		•[1] know to differentiate •[2] calculate gradient •[3] state equation of tangent		•[1] $2x-4$ •[2] 6 •[3] $y-12=6(x-5)$
2		$a=1$, $b=-2$ and $k=-1$	3	
		•[1] interpret a and b •[2] know to substitute (1, 2) •[3] state the value of k		•[1] $a=1,\ b=-2$ or $a=-2,\ b=1$ •[2] $2=k\times1\times(1+1)\times(1-2)$ •[3] -1
3		$\frac{1}{12}$	3	
		•[1] complete integration •[2] substitute limits •[3] evaluate		•[1] $-\frac{1}{6}x^{-1}$ •[2] $\left(-\frac{1}{6\times2}\right)-\left(-\frac{1}{6\times1}\right)$ •[3] $\frac{1}{12}$
4		Statements B and D are true.	3	
		•[1] statements B and D correct •[2] calculate maximum value •[3] calculate value of x		•[1] B **and** D •[2] max is $2-3\times-1$ **or** $f\left(\frac{11\pi}{6}\right)=2-3\sin\left(\frac{11\pi}{6}-\frac{\pi}{3}\right)=2-3\sin\left(\frac{3\pi}{2}\right)=5$ •[3] $x-\frac{\pi}{3}=\frac{3\pi}{2}\Rightarrow x=\frac{3\pi}{2}+\frac{\pi}{3}\Rightarrow x=\frac{11\pi}{6}$

5	**(a)**	$a=-7$ and $b=10$	4	
		●[1] know to use $x=1$ and obtain an equation ●[2] know to use $x=2$ and obtain an equation ●[3] process equations to find one value ●[4] find the other value		●[1] $(1)^3-4(1)^2+a(1)+b=0$ ●[2] $(2)^3-4(2)^2+a(2)+b=-12$ ●[3] $a=-7$ and $b=10$ ●[4] $b=10$ and $a=-7$
Notes		1 An incorrect value at ●[3] should be followed through for the possible award of ●[4]. However, if the equations are such that no solution exists, then ●[3] and ●[4] are not available. 2 Synthetic Division is an acceptable alternative method.		
5	**(b)**	$x=1$, $x=5$, $x=-2$	4	
		●[5] substitute for a and b and know to divide by $x-1$ ●[6] obtain quadratic factor ●[7] complete factorisation ●[8] state solution		●[5] $\left(x^3-4x^2-7x+10\right)\div\left(x-1\right)$ stated or implied by ●[6] ●[6] $\left(x-1\right)\left(x^2-3x-10\right)$ ●[7] $(x-1)(x-5)(x+2)$ ●[8] $x=1$, $x=5$, $x=-2$
Notes		3 For candidates who substitute $a=-7$ into the correct quotient from part (a), ●[5], ●[6] and ●[7] are available. 4 Candidates who use incorrect values obtained in part (a) may gain ●[5], ●[6] and ●[7]. 5 Where the quadratic factor obtained is irreducible, candidates must clearly demonstrate that $b^2-4ac<0$ to gain mark ●[7]. 6 Do not penalise the inclusion of "$=0$" or for solving for x. 7 Candidates who use values, ex nihilo, for a and b can gain ●[5], if division is correct.		

6	**(a)**	$y-3=\frac{1}{3}(x-1)$	4	
		●[1] find midpoint of PQ ●[2] find gradient of PQ ●[3] interpret perpendicular gradient ●[4] state equation of perpendicular bisector		●[1] (1, 3) ●[2] -3 ●[3] $\frac{1}{3}$ ●[4] $y-3=\frac{1}{3}(x-1)$
Notes		1 ●[4] is only available if a midpoint **and** a perpendicular gradient are used. 2 Candidates who use $y=mx+c$ must obtain a numerical value for c before ●[4] is available.		
6	**(b)**	$y-(-2)=-3(x-1)$	2	
		●[5] use parallel gradients ●[6] state equation of line		●[5] -3 ●[6] $y-(-2)=-3(x-1)$
Notes		3 ●[6] is only available to candidates who use R and their gradient of PQ from (a).		
6	**(c)**	$x=-\frac{1}{2},\ y=\frac{5}{2}$	3	
		●[7] use valid approach ●[8] solve for one variable ●[9] solve for other variable		●[7] $x-3y=-8$ and $9x+3y=3$ **or** $-3x+1=\frac{1}{3}x+\frac{8}{3}$ **or** $3(3y-8)+y=1$ ●[8] $x=-\frac{1}{2}$ ●[9] $y=\frac{5}{2}$
Notes		4 **Neither** $x-3y=-8$ and $3x+y=1$ **nor** $y=-3x+1$ and $3y=x+8$ are sufficient to gain ●[7]. 5 ●[7], ●[8] and ●[9] are not available to candidates who: — equate zeros — give answers only, without working — use R for equations in both (a) and (b) — use the same gradient for the lines in (a) and (b)		

6	(d)	$\sqrt{\frac{5}{2}}$	2	
		●[10] identify appropriate points ●[11] calculate distance		●[10] (1, 3) and $\left(-\frac{1}{2},\frac{5}{2}\right)$ ●[11] $\sqrt{\frac{5}{2}}$ accept $\frac{\sqrt{10}}{2}$ or $\sqrt{2\cdot 5}$
Notes		6 ●[10] and ●[11] are only available for considering the distance between the midpoint of PQ and the candidate's answer from (c) **or** for considering the perpendicular distance from P or Q to l_2. 7 At least one coordinate at ●[10] stage must be a fraction for ●[11] to be available. 8 There should only be one calculation of a distance to gain ●[11].		
7	(a)	0, 60, 300	5	
		●[1] know to use double angle formula ●[2] express as a quadratic in $\cos x°$ ●[3] start to solve ●[4] reduce to equations in $\cos x°$ only ●[5] process solutions in given domain		**Method 1:** Using factorisation ●[1] $2\cos^2 x° - 1...$ **stated or implied by ●[2]** ●[2] $2\cos^2 x° - 3\cos x° + 1 = 0$ ●[3] $(2\cos x° - 1)(\cos x° - 1)$ } $= 0$ must appear at either of these lines to gain ●[2] **Method 2:** Using quadratic formula ●[1] $2\cos^2 x° - 1...$ **stated or implied by ●[2]** ●[2] $2\cos^2 x° - 3\cos x° + 1 = 0$ **stated explicitly** ●[3] $\frac{-(-3)\pm\sqrt{(-3)^2-4\times 2\times 1}}{2\times 2}$ **In both methods:** ●[4] $\cos x° = \frac{1}{2}$ and $\cos x° = 1$ ●[5] 0, 60, 300 Candidates who include 360 lose ●[5]. **or** ●[4] $\cos x = 1$ and $x = 0$ ●[5] $\cos x° = \frac{1}{2}$ and $x = 60$ or 300 Candidates who include 360 lose ●[5].
Notes		1 ●[1] is not available for simply stating that $\cos 2A = 2\cos^2 A - 1$ with no further working. 2 In the event of $\cos^2 x - \sin^2 x$ or $1 - 2\sin^2 x$ being substituted for $\cos 2x$, ●[1] cannot		

		be awarded until the equation reduces to a quadratic in $\cos x$. 3 Substituting $\cos 2\text{A} = 2\cos^2 \text{A} - 1$ or $\cos 2a = 2\cos^2 a - 1$ etc should be treated as bad form throughout. 4 Candidates may express the quadratic equation obtained at the $\bullet^2$ stage in the form $2c^2 - 3c + 1$ or $2x^2 - 3x + 1$ etc. For candidates who do not solve a trigonometric quadratic equation at $\bullet^5$, $\cos x$ must appear explicitly to gain $\bullet^4$. 5 $\bullet^4$ and $\bullet^5$ are only available as a consequence of solving a quadratic equation. 6 Any attempt to solve $ax^2 + bx = c$ loses $\bullet^3$, $\bullet^4$ and $\bullet^5$. 7 $\bullet^5$ is not available to candidates who work in radian measure and do not convert their answers into degree measure.		
7	**(b)**	0, 30, 150, 180, 210 and 330	2	
		$\bullet^6$ interpret relationship with (a) $\bullet^7$ state valid values		$\bullet^6$ $2x = 0$ and 60 and 300 $\bullet^7$ 0, 30, 150, 180, 210 and 330
Notes		8 Do not penalise the inclusion of 360 in (b). 9 Ignore extra answers, correct or incorrect, outside the given interval, but penalise incorrect answers within the interval. 10 Do not penalise candidates who use radians in (b) if they have already been penalised in (a). 11 Candidates who go back to "first principles" for (b) can only gain $\bullet^6$ and $\bullet^7$ for a correct method leading to valid solutions.		
8	**(a)**		3	
		$\bullet^1$ reflection in x-axis $\bullet^2$ translation $\begin{bmatrix} 0 \\ 2 \end{bmatrix}$ $\bullet^3$ annotation of "transformed" graph		$\bullet^1$ reflection of graph in x-axis $\bullet^2$ graph moves parallel to y-axis by 2 units upwards $\bullet^3$ two "transformed" points appropriately annotated

Notes	1 All graphs must include both the x and y axes (labelled or unlabelled), however the origin need not be labelled. 2 No marks are available unless a graph is attempted. 3 No marks are available to a candidate who makes several attempts at a graph on the same diagram, unless it is clear which is the final graph. 4 A linear graph gains no marks in both (a) and (b). 5 For ●^{3} "transformed" means a reflection followed by a translation. 6 ●^{1} and ●^{2} apply to the entire curve. 7 A reflection in any line parallel to the y-axis does not gain ●^{1} or ●^{3}. 8 A translation other than $\begin{bmatrix}0\\2\end{bmatrix}$ does not gain ●^{2} or ●^{3}.			
8	**(b)**		3	
		●^{4} identify roots ●^{5} interpret point of inflection ●^{6} complete cubic curve		●^{4} 0 **and** 2 only ●^{5} turning point at (2, 0) ●^{6} cubic passing through origin with negative gradient
9	**(a)**	$k=2$ and $a=\frac{\pi}{3}$	4	
		●^{1} use appropriate compound angle formula ●^{2} compare coefficients ●^{3} process k ●^{4} process a		●^{1} $k\cos A\cos B - k\sin A\sin B$ **stated explicitly** ●^{2} $k\cos a = 1$ and $k\sin a=\sqrt{3}$ **stated explicitly** ●^{3} 2 (do not accept $\sqrt{4}$) ●^{4} $\frac{\pi}{3}$ **but** must be consistent with ●^{2}
Notes	1 Treat $k\cos A\cos B - \sin A\sin B$ as bad form only if the equations at the ●^{2} stage both contain k. 2 $2\cos A\cos B - 2\sin A\sin B$ or $2(\cos A\cos B - \sin A\sin B)$ is acceptable for ●^{1} and ●^{3}. 3 Accept $k\cos a = 1$ and $-k\sin a = -\sqrt{3}$ for ●^{2}. 4 ●^{2} is not available for $k\cos 4x = 1$ and $k\sin 4x=\sqrt{3}$, however, ●^{4} is still available. 5 ●^{4} is only available for a single value of a. 6 Candidates who work in degrees and do not convert to radian measure in (a) do not gain ●^{4}.			

		7 Candidates may use any form of the wave equation for ●1, ●2 and ●3, however, ●4 is only available if the value of a is interpreted for the form $k\cos(4x+a)$.		
9	(b)	$\left(\frac{\pi}{24},0\right)$ $\left(\frac{7\pi}{24},0\right)$	3	
		●5 strategy for finding roots		●5 $2\cos\left(4x+\frac{\pi}{3}\right)=0$ or $\sqrt{3}\sin 4x=\cos 4x$
		●6 start to solve for multiple angles		●6 $4x=\left(\frac{\pi}{2}-\frac{\pi}{3}\right),\left(\frac{3\pi}{2}-\frac{\pi}{3}\right)...$
		●7 state both roots in given domain		●7 $\frac{\pi}{24},\frac{7\pi}{24}$
Notes		8 Candidates should only be penalised once for leaving their answer in degrees in (a) and (b). 9 If the expression used in (b) is not consistent with (a) then only ●6 and ●7 are available. 10 Correct roots without working cannot gain ●6 but will gain ●7. 11 Candidates should only be penalised once for not simplifying $\sqrt{4}$ in (a) and (b).		
10		$y=\frac{3}{2}\sin 2x+\frac{\sqrt{3}}{4}$	4	
		●1 know to integrate		●1 $\frac{3}{2}\sin 2x+...$
		●2 substitute $\left(\frac{7\pi}{6},\sqrt{3}\right)$		●2 $\sqrt{3}=\frac{3}{2}\sin\left(2\times\frac{7\pi}{6}\right)+c$
		●3 use exact values		●3 $\sqrt{3}=\frac{3}{2}\times\left(\frac{\sqrt{3}}{2}\right)+c$
		●4 express y in terms of x		●4 $y=\frac{3}{2}\sin 2x+\frac{\sqrt{3}}{4}$
11	(a)	$3\left(x^3-1\right)+1$	2	
		●1 interpret notation		●1 $g\left(x^3-1\right)$
		●2 complete process		●2 $3\left(x^3-1\right)+1$

11	**(b)**	$h(x)=\sqrt[3]{\frac{x+2}{3}}$	3	
		●[3] start to rearrange for $x=$		●[3] $3x^3=y+2$
		●[4] rearrange		●[4] $x=\sqrt[3]{\frac{y+2}{3}}$
		●[5] write in functional form: $h(x)=$ or $y=$		●[5] $h(x)=\sqrt[3]{\frac{x+2}{3}}$

[END OF EXEMPLAR MARKING INSTRUCTIONS]