Question Number	Scheme	Marks
5 (a)	$\mathrm{f}(x)=3x^3+ax^2-10x+b$	
	$\mathrm{f}\left(\frac{4}{3}\right)=0\Rightarrow 3\times\left(\frac{4}{3}\right)^3+a\left(\frac{4}{3}\right)^2-10\left(\frac{4}{3}\right)+b=0$	M1
	$\frac{64}{9}+\frac{16}{9}a-\frac{40}{3}+b=0\Rightarrow 64+16a-120+9b=0\quad\Rightarrow 16a+9b=56$ *	A1*
		(2)
(b)	$\mathrm{f}(2)=b\Rightarrow 3\times(2)^3+a(2)^2-10(2)+b=b$ leading to an equation in just a	M1
	$4a=-4\Rightarrow a=-1$	A1
	Substitutes $a=$ '-1' in $-16+9b=56\Rightarrow b=\ldots$	M1
	$\Rightarrow b=8$	A1
		(4)
(c)	$\mathrm{f}(x)=3x^3-x^2-10x+8=(3x-4)(x^2+x-2)$	M1, A1
	$=(3x-4)(x+2)(x-1)$	A1
		(3)
		(9 marks)

Question Number	Scheme	Notes	Marks
4(a)(i)	(−7, 9) or e.g. $x = -7$, $y = 9$	$x = -7$ **or** $y = 9$	B1
		$x = -7$ **and** $y = 9$	B1
	Award the marks in (a) once correct answers are seen. **Special case:** If all you see is (9, −7) award B1B0		
(a)(ii)	<u>Examples:</u> $r = \sqrt{\left(-3-(\text{"}-7\text{"})\right)^2 + \left(12-\text{"}9\text{"}\right)^2}$ **or** $r = \sqrt{\left(-11-(\text{"}-7\text{"})\right)^2 + \left(6-\text{"}9\text{"}\right)^2}$ **or** $r = \frac{1}{2}\sqrt{(-3+11)^2 + (12-6)^2}$	Correct strategy for the radius. Must be a correct method for their centre (if used) **but allow 1 sign slip within one of the brackets**. A correct answer scores both marks. Must see the ½ if finding the length of the diameter.	M1
	$r = 5$	Correct radius	A1
			(4)
(b)	$(x+7)^2 + (y-9)^2 = 5^2$ or e.g. $x^2 + y^2 + 2\times 7x - 2\times 9y + 7^2 + 9^2 - 5^2 = 0$ M1: Correct attempt at circle equation using their values. Allow for $\left(x \pm (\text{their} -7)\right)^2 + \left(y \pm (\text{their } 9)\right)^2 = (\text{their numerical } r)^2$ or e.g. $x^2 + y^2 \pm 2\times(\text{their} -7)x \pm 2\times(\text{their } 9)y + (\text{their} -7)^2 + (\text{their } 9)^2 - (\text{their numerical } r)^2 = 0$ A1: Correct equation in any form		M1A1
			(2)
(c)	$m_{radius} = \frac{12-9}{-3+7}\left(=\frac{3}{4}\right)$ **or** $m_{tangent} = -1 \div \left(\frac{12-9}{-3+7}\right)\left(= -\frac{4}{3}\right)$ **or** $m_{tangent} = -\left(\frac{-3+7}{12-9}\right)\left(= -\frac{4}{3}\right)$	This mark is for an attempt to find the radius gradient **or** the tangent gradient. If the method is not clear allow one sign error in the numerator or denominator.	M1
	Alternative for the first M: $(x+7)^2 + (y-9)^2 = 5^2 \Rightarrow 2(x+7) + 2(y-9)\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{x+7}{9-y} = \frac{-3+7}{9-12}\left(= -\frac{4}{3}\right)$ Allow for $(x+7)^2 + (y-9)^2 = 5^2 \Rightarrow \alpha(x+7) + \beta(y-9)\frac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = \ldots$		
	$y - 12 = -\frac{4}{3}(x+3)$ Uses a correct straight line method for the **tangent** using the point Q. Must be fully correct work here so must be a clear attempt at the tangent not the radius. So if the radius gradient is found previously, must apply negative reciprocal rule to their radius gradient. If using $y = mx + c$ must reach as far as $c = \ldots$		M1
	$4x + 3y - 24 = 0$	Allow any integer multiple	A1
			(3)
			Total 9

Question Number	Scheme	Marks
6(a)	$(x\pm3)^2+(y\pm7)^2\pm\ldots=\ldots$	M1
	Centre = $(3,7)$	A1
		(2)
(b)	Attempts $(\pm3)^2+(\pm7)^2\pm32$	M1
	Radius = $3\sqrt{10}$	A1
		(2)
(c)	Uses radius < 3 $\Rightarrow 9+49-k<9$ or uses radius > 0 $\Rightarrow 9+49-k>0$	M1
	$k>49$ or $k<58$	A1
	Uses radius < 3 $\Rightarrow 9+49-k<9$ and uses radius > 0 $\Rightarrow 9+49-k>0$	dM1
	$49<k<58$ oe (see notes)	A1
		(4)
		(8 marks)

Question Number	Scheme	Marks
9(a)	$y=x^3-5x^2+3x+14\Rightarrow\frac{dy}{dx}=3x^2-10x+3=0$	M1
	Roots are $3,\ \frac{1}{3}$ $\Rightarrow$ when $x=3,\ y="3"^3-5\times"3"^2+3\times"3"+14=\ldots.$	dM1
	Centre is $(3, 5)$	A1
		(3)
(b)	At A $y=8$	B1
	$r^2=(2-"3")^2+("8"-"5")^2\quad(=10)$	M1
	$(x-3)^2+(y-5)^2=10$	A1
		(3)
(c)	$\frac{"8"-"5"}{2-"3"}=\ldots(-3)$	M1
	$y-"8"="\frac{1}{3}"(x-2)$	M1
	$y=\frac{1}{3}x+\frac{22}{3}$ *	A1*
		(3)
(d)	$\int_0^2 x^3-5x^2+3x+14\,dx=\ldots\left(\frac{1}{4}x^4-\frac{5}{3}x^3+\frac{3}{2}x^2+14x\right)$	M1
	Area = $\left[\frac{1}{4}x^4-\frac{5}{3}x^3+\frac{3}{2}x^2+14x\right]_0^2-\left(\frac{1}{2}\times\left(\frac{22}{3}+"8"\right)\times2\right)=\ldots$ $\frac{1}{4}\times16-\frac{5}{3}\times8+\frac{3}{2}\times4+14\times2-\frac{46}{3}$	dM1
	$\frac{74}{3}-\frac{46}{3}=\frac{28}{3}$	A1
		(3)
		(12 marks)

Question Number	Scheme	Marks
3. (a)	Attempts $f\left(-\frac{3}{2}\right)=6\left(-\frac{3}{2}\right)^3+17\left(-\frac{3}{2}\right)^2+4\left(-\frac{3}{2}\right)-12$	M1
	$=0 \Rightarrow (2x+3)$ is a factor *	A1*
		(2)
(b)	$6x^3+17x^2+4x-12=(2x+3)\left(3x^2+4x-4\right)$	M1 A1
	$=(2x+3)(3x-2)(x+2)$	dM1 A1
		(4)
(c)	Solves $\tan\theta=-\frac{3}{2}$ or "-2" or "$\frac{2}{3}$"	M1
	$\theta=$ awrt 2.03, 2.16	A1
		(2)
		(8 marks)

Question Number	Scheme	Marks
4 (a)	$f(x)=4x^3+13x^2-10x+8$ $$\begin{array}{r} 4x^2+21x+32 \\ x-2\overline{)4x^3+13x^2-10x+8} \\ \underline{4x^3-8x^2} \\ 21x^2-10x \\ \underline{21x^2-42x} \\ 32x+8 \\ \underline{32x-64} \\ 72 \end{array}$$ Synthetic Division $$\begin{array}{r\|rrr\|r} 2 & 4 & 13 & -10 & 8 \\ & & 8 & 42 & 64 \\ \hline & 4 & 21 & 32 & 72 \end{array}$$	
(i)	$Q(x)=4x^2+21x+32$	M1, A1
(ii)	$R=72$	M1, A1
		(4)
(b)(i)	Attempts $f(-4)=4\times-64+13\times16-10\times-4+8$	M1
	$=-256+208+40+8=0$ Hence $(x+4)$ is a factor *	A1*
(ii)	$f(x)=4x^3+13x^2-10x+8=(x+4)\left(4x^2-3x+2\right)$	M1
	For their $4x^2-3x+2$ attempts "b^2-4ac" $=9-32$,	M1
	$b^2-4ac' < 0$ so $4x^2-3x+2$ has no real roots and $f(x)=0$ has one at $x=-4$	A1*
		(5)
(c)	$(f'(x))=12x^2+26x-10=2(3x-1)(2x+5)$	M1
	$-\frac{5}{2}<x<\frac{1}{3}$	dM1, A1
		(3)
		(12 marks)

Question Number	Scheme	Marks
10	Sets $m=3p+1$ or $m=3p+2$ ($p>0$) o.e. and attempts m^2+3m+2	M1
	E.g. $m^2+3m+2=(3p+1)^2+3(3p+1)+2=9p^2+15p+6=3\left(3p^2+5p+2\right)$	A1
	Sets $m=3p+1$ and $m=3p+2$ ($p>0$) and attempts m^2+3m+2	dM1
	E.g. $m^2+3m+2=(3p+2)^2+3(3p+2)+2=9p^2+21p+12=3\left(3p^2+7p+4\right)$	
	And gives a minimal conclusion *	A1* **(4 marks)**