Question Number	Scheme	Marks
6(a)	Sets $f\left(-\frac{3}{2}\right)=0 \Rightarrow \left(9p+4q=102\right)$	M1
	Sets $f(-2)=-5 \Rightarrow \left(4p+q=43\right)$	M1
	Solves to get values for p and q	dM1
	(i) $p=10$ * (ii) $q=3$ following two correct equations	A1*, A1
		(5)
(b)	$f'(x)=12x^2+20x+8$	B1
	Solves $f'(x)=0 \Rightarrow 4\left(3x+2\right)(x+1)=0 \Rightarrow x=-\frac{2}{3},-1$	M1, A1
	$-1<x<-\frac{2}{3}$	A1
		(4)
		Total 9

(a)

M1: Attempts to set $f\left(-\frac{3}{2}\right)=0$ **to form an equation in *p* and *q***. Setting $f\left(\frac{3}{2}\right)=0$ is M0

Award for an attempt such as $4\left(\frac{-3}{2}\right)^3+p\left(\frac{-3}{2}\right)^2+8\left(\frac{-3}{2}\right)+q=0$ condoning slips (e.g. lack of bracketing)

Note that the partially simplified correct equation is $-\frac{27}{2}+\frac{9p}{4}-12+q=0$

You may see an attempt via division. Look for division by $\left(2x+3\right)$ leading to a remainder in *p* and *q* which should be set equal to 0

M1: Attempts to set $f(-2)=-5$ **to form an equation in *p* and *q***. Setting $f(2)=-5$ or $f(-2)=5$ is M0

Award for $4\left(-2\right)^3+p\left(-2\right)^2+8\left(-2\right)+q=-5$ condoning slips (e.g. lack of bracketing).

Note that the partially simplified correct equation is $-32+4p-16+q=-5$

You may see an attempt via division. Look for division by $\left(x+2\right)$ leading to a remainder in *p* and *q* which should be set equal to -5

dM1: Solves a pair of equations in both *p* and *q* resulting from setting $f\left(\pm\frac{3}{2}\right)=0$ and $f(\pm2)=\pm5$

Just look for some work (either substitution or elimination) which may or may not be correct leading to values for *p* and *q*. They know that *p* should be 10 so there will be a certain amount of fudging. Be generous here and give BOD if they show **some** correct work leading to both values Allow the solution to be done via a calculator but the solution must fit at least one of the equations if done this way.

So if both equations are correct, or only one equation is correct, writing down *p* = 10, *q* =3 would score this mark as it is a solution to both.

Examples of sufficient work

Ex 1 (Correct equations/elimination): $\frac{9}{4}p+q=\frac{51}{2}$ (1),

$4p+q=43$ (2), then (2) − (1) $\frac{7}{4}p=... \Rightarrow p=..., q=...$

Ex 2: (Incorrect first equation f (3/2) =0, substitution)

$\frac{9}{4}p+q=-\frac{51}{2},\ 4p+q=43 \Rightarrow \frac{9}{4}p+43-4p=\frac{51}{2} \Rightarrow p=..., q=...$

Ex 3: (Incorrect second equation f (2) = −5: Calculator solution)

Either $9p+4q=102,\ 4p+q=-53 \Rightarrow p=10, q=-93$ (solution to 2nd equation)

Or $9p+4q=102,\ 4p+q=-53 \Rightarrow p=10, q=3$ (solution to 1st equation)

A1*: Achieves $p=10$ from solving a correct pair of simultaneous equations.

There must have been some attempt to justify this as it is a given answer.

So, a correct intermediate line **must be seen**. E.g. $\frac{9p}{4}+q=\frac{51}{2},\ 4p+q=43 \Rightarrow \frac{7}{4}p=\frac{35}{2} \Rightarrow p=10$

Allow this to be scored from a correct intermediate line of the form $ap+b=c$

A1: $q=3$. **This can only be awarded if the two simultaneous that were 'solved' were both correct.**

There is no requirement to see an intermediate line here.

(b)

B1: Differentiates to achieve $12x^2+20x+8$

M1: Attempts to find the critical values of the equation $"f'(x)"=0$.

Allow any valid method including via a calculator. Their $f'(x)$ must be of the form ax^2+bx+c

A1: Achieves the correct exact critical values. Do not accept – 0.67 but allow recurring decimals $-0.\dot{6}$

A1: $-1<x<-\frac{2}{3}$ OR $-1\leqslant x\leqslant -\frac{2}{3}$ but the inequality must be used consistently.

Allow versions such as $\left(-1,-\frac{2}{3}\right)$ and $\left[-1,-\frac{2}{3}\right]$

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Note that candidates cannot just use their calculators to solve part (b).

So $f(x)=4x^3+10x^2+8x+3$ followed by $-1<x<-\frac{2}{3}$ is 0 marks.

The minimum working required would be sight of $f'(x)$ followed by the solution.

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Question Number	Scheme	Marks
7 (i)	States or uses $\tan x = \dfrac{\sin x}{\cos x}$	M1
	$3\sin x \tan x = 11 + \cos x \Rightarrow 3\sin^2 x = 11\cos x + \cos^2 x$	
	$\Rightarrow 3\left(1-\cos^2 x\right) = 11\cos x + \cos^2 x \Rightarrow 4\cos^2 x + 11\cos x - 3 = 0$	dM1, A1
	$\Rightarrow \left(4\cos x - 1\right)\left(\cos x + 3\right) = 0 \Rightarrow \cos x = \dfrac{1}{4} \Rightarrow x = 1.318,\ 4.965$	dM1 A1
		(5)
(ii)	$\cos\theta = \dfrac{1}{3} \Rightarrow \sin^2\theta = 1 - \dfrac{1}{3^2} \Rightarrow \tan\theta = \dfrac{\sin\theta}{\cos\theta} = \dfrac{\sqrt{1-\frac{1}{3^2}}}{\frac{1}{3}}$	M1
	$\Rightarrow \tan\theta = 2\sqrt{2}$	A1
		(2)
		Total 7

(i)

M1: States or uses $\tan x = \dfrac{\sin x}{\cos x}$ o.e.

dM1: Uses $\tan x = \dfrac{\sin x}{\cos x}$, attempts to multiply by $\cos x$ and then uses $\sin^2 x = \pm 1 \pm \cos^2 x$ to set up a 3 TQ equation in $\cos x$

A1: Correct simplified quadratic equation in $\cos x$. Terms can be on either side of the equation. The '= 0' can be implied by a subsequent attempt to solve.

dM1: Solves a quadratic equation in $\cos x$ by any allowable method (including a calculator) to find $\cos x$ and proceeds to a value for x (in degrees or radians) via arccos. Dependent upon the first M only

Minimum working required would be $4\cos^2 x + 11\cos x - 3 = 0 \Rightarrow \cos x = 0.25 \Rightarrow x = 1.3$

Note that

- $\cos x = \dfrac{1}{4} \Rightarrow x = 0.2527$ is dM0 as it is $\arcsin\left(\dfrac{1}{4}\right)$ not $\arccos\left(\dfrac{1}{4}\right)$
- $\cos x = \dfrac{1}{4} \Rightarrow x = 0.9689$ is dM0 as it is $\cos\left(\dfrac{1}{4}\right)$ not $\arccos\left(\dfrac{1}{4}\right)$

A1: $x =$ awrt $1.318,\ 4.965$ following the award of all previous marks.

Ignore any extra solutions outside the range, but withhold this mark for any extra solutions within it.

Notes: Condone notation such as $\tan = \dfrac{\sin}{\cos}$ and $\cos x^2$ for $\cos^2 x$. This is not a proof.