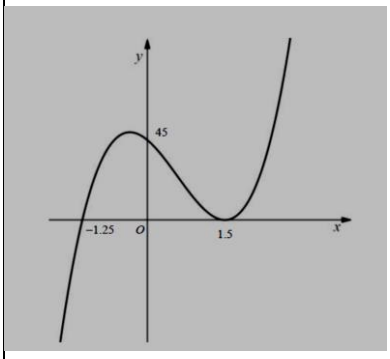
Question Number	Scheme	Marks
8 (a)	$f'(x) = 2(x-3)(3x+2) = 6x^2 - 14x - 12$	B1
	$f(x) = 2x^3 - 7x^2 - 12x + k$	M1, A1
	Uses $P(4, 13) \Rightarrow 13 = 2\times64 - 7\times16 - 12\times4 + k \Rightarrow k = ...$	M1
	$(f(x)) = 2x^3 - 7x^2 - 12x + 45$	A1
		(5)
(b)	$2x^3 - 7x^2 - 12x + 45 \equiv (x^2 - 6x + 9)(px + q) \Rightarrow p = "2"$ or $q = \frac{"45"}{9}$	B1 ft
	States either $2x^3 - 7x^2 - 12x + 45 \equiv (x-3)^2(2x+5)$ or $p = 2$ & $q = 5$ following a fully correct (a) or correct but incomplete part (a) (See notes)	B1
		(2)
(c)		
	+ ve cubic curve	B1
	"Correct" y intercept for their part (b) equation. So $9q$ or "45"	B1ft
	Turning point at (1.5, 0)	B1
	x intercept at $(-1.25, 0)$	B1
		(4)
		(11 marks)

Mark parts (a) and (b) together but f(x) must be obtained via integration AND the use of (4, 13)

(a)

B1: $2(x-3)(3x+2) = 6x^2 - 14x - 12$ which may be left unsimplified BUT the brackets must be expanded

M1: Attempts to multiply out $2(x-3)(3x+2)$ and integrate each term.

Look for an expanded form which would simplify to $ax^2 + bx + c$ and **then each term** being integrated with each of the powers being correctly dealt with. So $ax^2 \to ...x^3$, $bx \to ...x^2$ and $+c \to cx$

There is no requirement to have a constant of integration for this mark

A1: $f(x) = 2x^3 - 7x^2 - 12x + k$ including the $+k$. (Any constant is acceptable)

The expression must now be in simplest form

M1: Uses $P(4, 13)$ and finds a value for k. It is dependent upon some 'correct' integration.

So, look for substituting $x = 4, y = 13$ into their $y = f(x)$ and finding a value for k.

A1: $f(x) = 2x^3 - 7x^2 - 12x + 45$. There is no requirement to see the f (x)

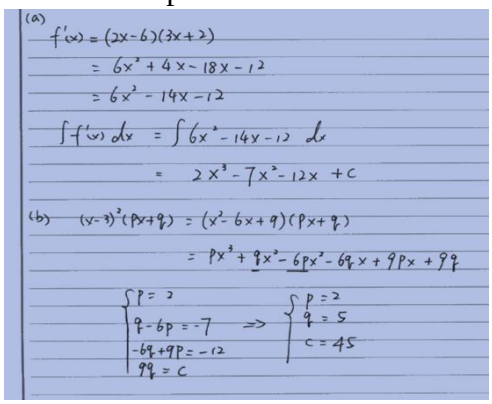
(b)

B1ft: Achieves either value following through on their $2x^3-7x^2-12x+45$.
So score for either of

- $p = 2$ or the coefficient of their x^3 term
- $q = 5$ or their constant term divided by 9

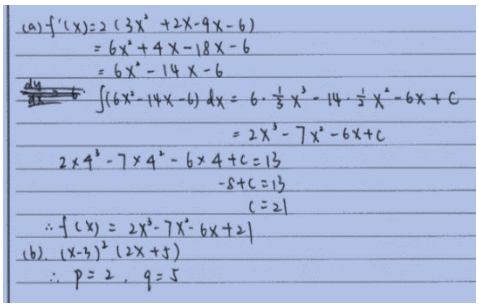
B1: $(x-3)^2(2x+5)$ OR $p = 2$ or $q = 5$.

Must follow a fully correct part (a) = (1,1,1,1,1) or a correct but incomplete part (a) = (1,1,1,0,0)
Cannot be scored from multiple answers or implied from an attempt at division
Note that finding the two correct values is considered sufficient as long as $f(x) = 2x^3-7x^2-12x+45$
Useful examples



E.g I
(a) 1, 1, 1, 0, 0
No use of (4, 13) at all in the question so the final two marks cannot be awarded. (Note that they do find $c = 45$ in part (b) from expanding $(x-3)^2(2x+5)$ but this does not score those marks.)
(b) 1, 1
Correct values in (b) following a correct but incomplete part (a).
Note that $2x^3-7x^2-12x+c=(x-3)^2(2x+5)$ when $c = 45$.

Note that they could go on to score all marks in part (c)



E.g II
(a) 0, 1, 0, 1, 0
Incorrect expansion in (a) but uses (4, 13) to find c
(b)1, 0
Not a fully correct (a)
$2x^3-7x^2-6x-21 \neq (x-3)^2(2x+5)$
Note that they could go on to score all marks in part (c) using the answer to part (b)

(c)

B1: For a positive cubic shaped curve with, from left to right, a maximum and then a minimum.
Do not be concerned by the position of the curve or the turning points. Be generous on graphs that appear linear in places but penalise three straight lines. Use review if unclear.

B1ft: For a correct y intercept for their $y = f(2x)$. Don't be concerned if this is their maximum turning point.
FT on their answer to (a) for their '$2x^3-7x^2-12x+\underline{\underline{45}}$' provided that the constant term is not zero or their answer to (b) for their $9q$ provided $q \neq 0$

B1: Turning point tangential to the x-axis at 1.5. Allow for maximum or minimum point
Do not allow if marked (0, 1.5)

B1: x intercept at -1.25. The graph must pass through (not stop at) the axis here. Allow if there are other intercepts. Do not allow if marked (0, - 1.25).

Question Number	Scheme	Marks
9. (a)	(i) 3 (ii) 101 (iii) 2	B1 B1 B1 **(3)**
(b)	$a = \frac{2\pi}{3}$ o.e.	B1 **(1)**
(c)	Attempts x coordinate of Q: $x = "\frac{2\pi}{3}" + \pi = \frac{5\pi}{3}$	M1
	Attempts both y coordinates $P\left(\frac{2\pi}{3}, \frac{\pi}{3}\right)$ $Q\left(\frac{5\pi}{3}, -\frac{2\pi}{3}\right)$	dM1
	Attempts mid-point $PQ = \left(\frac{1}{2}\left(\frac{2\pi}{3} + \frac{5\pi}{3}\right), \frac{1}{2}\left(\frac{\pi}{3} - \frac{2\pi}{3}\right)\right)$	ddM1
	$= \left(\frac{7\pi}{6}, -\frac{\pi}{6}\right)$	A1 **(4)** **(8 marks)**

The answers to parts (a) and (b) may very well appear in the question. Be aware of this when marking.

(a)(i) B1: 3

(a)(ii) B1: 101

(a)(iii) B1: 2

(b)

B1: $a = \frac{2\pi}{3}$ o.e. so accept $a = \frac{4\pi}{6}$. Condone $x \leftrightarrow a$

Do not accept/condone $120°$

(c)

M1: For

- either the correct x coordinate of Q which can be scored for $\left(\frac{3\pi}{2} + \frac{\pi}{6}\right)$
- or an attempt at the x coordinate of Q by adding on π to the x coordinate of P

The following marks are dependent upon this, so if (c) starts M0, it is automatically dM0, ddM0, A0.

dM1: Attempts coordinates for **BOTH** P and Q using the equation $y = \pi - x$

It is dependent upon the previous method mark.

ddM1: Correct attempt at mid-point.

There must be an attempt to add the pairs of coordinates before halving the sum.

It is dependent upon BOTH the previous method marks **and the value of *a* lying in the region** $\frac{\pi}{2} < a < \pi$. Look for $\left(\frac{a + (a + \pi)}{2}, \frac{(\pi - a) + (\pi - (a + \pi))}{2}\right)$

A1: $\left(\frac{7\pi}{6}, -\frac{\pi}{6}\right)$ but may be written as $x = \ldots, y = \ldots$