Question	Scheme	Marks	AOs
12 (a)	e.g. Substitutes $x = 6$ into both $(y =) \frac{15x}{(2x+3)(x-3)}$ and $(y =) 2x-10$ and finds the y values for both	M1	1.1b
	e.g. Achieves 2 for both and makes a valid conclusion *	A1*	2.4
		(2)	
(b)	Sets $\frac{15x}{(2x+3)(x-3)} = 2x-10$ and attempts to cross multiply	M1	1.1b
	$4x^3 - 26x^2 - 3x + 90 = 0 \qquad *$	A1*	2.1
		(2)	
(c)	Deduces that $(x-6)$ is a factor and attempts to divide	M1	2.1
	$4x^3 - 26x^2 - 3x + 90 = (x - 6)(4x^2 - 2x - 15)$	A1	1.1b
	Solves their $4x^2 - 2x - 15$ using suitable method	M1	1.1b
	Deduces $x = \frac{1 - \sqrt{61}}{4}$ (see note)	A1	2.2a
		(4)	
(8 marks)			
Notes:			
(a) Must be seen in (a) to score M1: Examples to verify include: • substitutes $x = 6$ into both $(y =) \frac{15x}{(2x+3)(x-3)}$ and $(y =) 2x-10$ and finds the y			
values for both			
• substitutes $x = 6$ into one of the two equations to find $y = 2$ and then substitutes this into			
the other equation and solves to find x			
• sets $\frac{15x}{(2x+3)(x-3)} = 2x-10 \implies$ cubic equation (=0 implied) and either substitutes $x = 6$			
	into the expression, attempts $f(6)$ or else attempts to divide the cubic = 0 by $(x-6)$.		
Condone without calculations for this mark only. i.e. $f(6) = 0$			
Condone slips for this mark in any of the outlined approaches. There may be variations of these as well.			
e.g.	e.g. $\frac{15 \times 6}{(2 \times 6 + 3)(6 - 3)} = 2$ and $12 - 10 = 2$ so they intersect (allow eg meet/cross/intercept)		
e.g.	e.g. $\frac{15 \times 6}{(2 \times 6 + 3)(6 - 3)} = 2 \Rightarrow 2 = 2x - 10 \Rightarrow x = 6$ so they intersect Acceptable alternatives are: $f(x) = 4x^3 - 26x^2 - 3x + 90$, $f(6) = 4 \times 6^3 - 26 \times 6^2 - 3 \times 6 + 90 = 0 \Rightarrow$ so they intersect		
	$f(x) = 4x^3 - 26x^2 - 3x + 90 \Rightarrow (x - 6)(4x^2 - 2x - 15)$ so $x = 6$ is a root so they intersect		
	OR $(x-6)$ is a factor hence they intersect		
1	Only accept verified, QED etc if there is a preamble mentioning intersection about how it will be shown.		

M1A0 with or without a conclusion. Requires all 3 roots. Work seen in (a) must be used in (b) to score

Sets $\frac{15x}{(2x+3)(x-3)} = 2x-10$ and attempts to cross multiply to form a cubic equation. M1:

Condone slips provided the intention is clear.

 $\Rightarrow 4x^3 - 26x^2 - 3x + 90 = 0$ * which is A1*

to a simplified expression of $15x = 4x^3 - 26x^2 + 12x + 90$

(b)

A1*:

(c)

M1:

A1:

M1:

A1:

decimal form.

answer. e.g.

Score for 15x = (2x-10)(2x+3)(x-3) or may be implied by an attempt to multiply two

Special case: $(f(x) = 4x^3 - 26x^2 - 3x + 90 = 0 \text{ o.e.}) \Rightarrow \text{awrt} -1.7, 6, \text{ awrt} 2.2 \text{ Scores}$

of the three brackets out e.g. $15x = (2x-10)(2x^2-3x-9)$ or

 $15x = (x-3)\left(4x^2 - 14x - 30\right) \text{ or } 15x = \left(2x+3\right)(2x^2 - 16x + 30) \text{ (may be unsimplified)}$

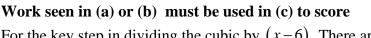
Condone invisible brackets to be implied by further work which is not the given answer.

Do not allow this mark to be scored for proceeding straight from $\frac{15x}{(2x+3)(x-3)} = 2x-10$

Achieves the given answer with sufficient intermediate steps seen and **no errors**

including invisible brackets in the main body of their solution (ignore "side workings") Expect to see on the right hand side the product of a linear and a quadratic expression and an expression with all of the brackets multiplied out before simplifying to the given

 $\frac{15x}{(2x+3)(x-3)} = 2x - 10 \Rightarrow 15x = \left(4x^2 - 14x - 30\right)(x-3) \Rightarrow 15x = 4x^3 - 26x^2 + 12x + 90$



For the key step in dividing the cubic by (x-6). There are various methods or ways to

- present their solution so typically methods by inspection look for first and last terms e.g. $(x-6)(4x^2 \pm ... x \pm 15)$
- by division look for a three term quadratic quotient of $4x^2 2x \pm ...$ $4x^3 - 26x^2 - 3x + 90 = (x - 6)(4x^2 - 2x - 15)$ This may be implied by sight of

dividing by (x-6) however poor to achieve a three term quadratic factor

Whilst not dependent on the previous method mark, it does require an attempt at

Solves their $4x^2 - 2x - 15 = 0$ using either the quadratic formula or completing the square.

Usual rules apply for solving a quadratic. It cannot be scored for stating the roots

The root $(x =) \frac{1 + \sqrt{61}}{4}$ must be rejected if found. Isw if they put their exact value in

directly via use of a calculator which is M0A0

 $(x=)\frac{1-\sqrt{61}}{4}$ or exact equivalent e.g. $\frac{1}{4}-\sqrt{\frac{61}{16}}$

 $(4x^2-2x-15)$ in their working.