Via firstly integrating

Question	Scheme	Marks	AOs

8	$f'(x)=6x^2+ax-23 \Rightarrow f(x)=2x^3+\frac{1}{2}ax^2-23x+c$	M1 A1	1.1b 1.1b
	$"c"=-12$	B1	2.2a
	$f(-4)=0 \Rightarrow 2\times(-4)^3+\frac{1}{2}a(-4)^2-23(-4)-12=0$	dM1	3.1a
	$a=\ldots\ (6)$	dM1	1.1b
	$(f(x)=)2x^3+3x^2-23x-12$ Or Equivalent e.g. $(f(x)=)(x+4)(2x^2-5x-3)$ $(f(x)=)(x+4)(2x+1)(x-3)$	A1cso	2.1
		(6)	
			(6 marks)

Notes:

M1: Integrates $f'(x)$ with two correct indices. There is no requirement for the $+c$

A1: Fully correct integration (may be unsimplified). The $+c$ must be seen (or implied by the -12)

B1: Deduces that the constant term is -12

dM1: Dependent upon having done some integration. It is for setting up a linear equation in a by using $f(-4)=0$

May also see long division attempted for this mark. Need to see a complete method leading to a remainder in terms of a which is then set = 0.

For reference, the quotient is $2x^2+\left(\frac{a}{2}-8\right)x+9-2a$ and the remainder is $8a-48$

May also use $(x+4)(px^2+qx+r)=2x^3+\frac{1}{2}ax^2-23x-12$ and compare coefficients to find p, q and r and hence a. Allow this mark if they solve for p, q and r

Note that some candidates use 2f(x) which is acceptable and gives the same result if executed correctly.

dM1: Solves the linear equation in a or uses p, q and r to find a.

It is dependent upon having attempted some integration and used $f(\pm 4)=0$ or long division/comparing coefficients with $(x+4)$ as a factor.

A1cso: For $(f(x)=)2x^3+3x^2-23x-12$ oe. Note that "f(x) =" does not need to be seen and ignore any "= 0"

Via firstly using factor

Question	Scheme	Marks	AOs
8 Alt	$f(x)=(x+4)(Ax^2+Bx+C)$	M1 A1	1.1b 1.1b
	$f(x)=Ax^3+(4A+B)x^2+(4B+C)x+4C \Rightarrow C=-3$	B1	2.2a
	$f'(x)=3Ax^2+2(4A+B)x+(4B+C)$ and $f'(x)=6x^2+ax-23$ $\Rightarrow A=\ldots$	dM1	3.1a
	Full method to get A, B and C	dM1	1.1b
	$f(x)=(x+4)(2x^2-5x-3)$	A1cso	2.1
		(6)	
			(6 marks)

Notes:

M1: Uses the fact that f(x) is a cubic expression with a factor of $(x+4)$

A1: For $f(x)=(x+4)(Ax^2+Bx+C)$

B1: Deduces that $C=-3$

dM1: Attempts to differentiate either by product rule or via multiplication and compares to $f'(x) = 6x^2 + ax - 23$ to find A.

dM1: Full method to get A, B and C

A1cso: $f(x) = (x + 4)(2x^2 - 5x - 3)$ or $f(x) = (x + 4)(2x + 1)(x - 3)$