Question	Scheme	Marks	AOs
10(a)	e.g. $\dfrac{3kx-18}{(x+4)(x-2)} \equiv \dfrac{A}{x+4}+\dfrac{B}{x-2} \Rightarrow 3kx-18 \equiv A(x-2)+B(x+4)$ **or** $\dfrac{3kx-18}{(x+4)(x-2)} \equiv \dfrac{A}{x-2}+\dfrac{B}{x+4} \Rightarrow 3kx-18 \equiv A(x+4)+B(x-2)$	**B1**	1.1b
	$6k-18=6B \Rightarrow B=...$ or $-12k-18=-6A \Rightarrow A=...$ **or** $3kx-18 \equiv (A+B)x+4B-2A \Rightarrow A+B=3k,\ -18=4B-2A$ $\Rightarrow A=...$ or $B=...$	**M1**	1.1b
	$\dfrac{2k+3}{x+4}+\dfrac{k-3}{x-2}$	**A1**	1.1b
		(3)	
(b)	$\int \left(\dfrac{"2k+3"}{x+4}+\dfrac{"k-3"}{x-2}\right)\mathrm{d}x = ...\ln(x+4)+...\ln(x-2)$	**M1**	1.2
	$("2k+3")\ln(x+4)+("k-3")\ln(x-2)$	**A1ft**	1.1b
	$("2k+3")\ln(5)-("k-3")\ln(5) \Rightarrow ("k+6")\ln 5 = 21 \Rightarrow k=...$	**dM1**	3.1a
	$(k=)\dfrac{21}{\ln 5}-6$	**A1**	2.2a
		(4)	
		(7 marks)	

Notes

(a)

B1: Correct form for the partial fractions and sets up the correct corresponding identity which may be implied by two equations in *A* and *B* if they are comparing coefficients.

M1: Either

- substitutes $x=2$ or $x=-4$ in an attempt to find *A* or *B* in terms of *k*
- expands the rhs, collects terms and compares coefficients in an attempt to find *A* or *B* in terms of *k*

Or may be implied by one correct fraction (numerator **and** denominator)

You may see candidates substituting two other values of *x* and then solving simultaneous equations.

A1: Achieves $\dfrac{2k+3}{x+4}+\dfrac{k-3}{x-2}$ with no errors. Must be the correct partial fractions not just for correct numerators. May be seen in (b). Correct answer implies B1M1A1. One correct fraction only B0M1A0

(b)

M1: Attempts to find $\int \left(\frac{"2k+3"}{x+4}+\frac{"k-3"}{x-2}\right) \mathrm{d}x$. Score for either $\frac{\cdots}{x+4} \to \ldots\ln(x+4)$ or $\frac{\cdots}{x-2} \to \ldots\ln(x-2)$

Allow the … to be in terms of k or just constants but there must be no x terms.

Condone invisible brackets for this mark.

A1ft: $("2k+3")\ln|x+4|+("k-3")\ln|x-2|$

but condone round brackets e.g. $("2k+3")\ln(x+4)+("k-3")\ln(x-2)$ or equivalent e.g.

$("2k+3")\ln(x+4)+("k-3")\ln(2-x)$

Follow through their partial fractions with numerators which must both be in terms of k.

Condone missing brackets as long as they are recovered later e.g. when applying limits.

dM1: A full attempt to find the value of k. To score this mark they must have attempted to integrate their partial fractions, substituted in the correct limits, subtracted either way round, set = 21 and attempted to solve to find k. Condone omission of the terms containing ln(1) or ln(-1).

Note that e.g. ln(-5) or ln(5) must be seen but may be disregarded **after** substitution and subtraction.

Do not be concerned with the processing as long as they proceed to $k = \ldots$

Condone if they use x instead of k after limits have been used as long as the intention is clear.

A1: Deduces $(k=)\frac{21}{\ln 5}-6$ or exact equivalent e.g. $\frac{21-6\ln 5}{\ln 5}$, $\frac{21-3\ln 25}{\ln 5}$.

Allow recovery from expressions that contain e.g. ln(–5) as long as it is dealt with subsequently.

Also allow recovery from invisible brackets. Condone $x=\frac{21}{\ln 5}-6$

Some candidates may use substitution in part (b) e.g.

$$\int \left(\frac{"2k+3"}{x+4}+\frac{"k-3"}{x-2}\right) \mathrm{d}x = \int \left(\frac{"2k+3"}{x+4}\right) \mathrm{d}x + \int \left(\frac{"k-3"}{x-2}\right) \mathrm{d}x$$

$$u=x+4 \Rightarrow \int \left(\frac{"2k+3"}{x+4}\right) \mathrm{d}x = \int \left(\frac{"2k+3"}{u}\right) \mathrm{d}u = \ldots\ln u$$

$$u=x-2 \Rightarrow \int \left(\frac{"k-3"}{x-2}\right) \mathrm{d}x = \int \left(\frac{"k-3"}{u}\right) \mathrm{d}u = \ldots\ln u$$

Score **M1** for integrating at least once to an appropriate form as in the main scheme e.g. …ln$u$

A1ft: For $("2k+3")\ln|u|+("k-3")\ln|u|$

but condone $("2k+3")\ln u+("k-3")\ln u$ which may be seen separately

Follow through their "A" and "B" in terms of k.

Condone missing brackets as long as they are recovered later e.g. when applying limits.

dM1: A full attempt to find the value of k. To score this mark they must have attempted to integrate their partial fractions using substitution, substituted in the correct changed limits and subtracts either way round, set = 21 and attempted to solve to find k. Do not be concerned with processing as long as they proceed to $k = \ldots$ Condone omission of terms which contain e.g. ln(1) or ln(-1).

Note that e.g. ln(-5) or ln(5) must be seen but may be disregarded **after** substitution and subtraction.

$$\left[(2k+3)\ln u\right]_1^5 + \left[(k-3)\ln u\right]_{-5}^{-1} = 21 \Rightarrow (2k+3)\ln 5 - (2k+3)\ln 1 + (k-3)\ln 1 - (k-3)\ln 5 = 21$$

$$\Rightarrow (2k+3)\ln 5 - (k-3)\ln 5 = 21 \Rightarrow \left(k+6\right)\ln 5 = 21 \Rightarrow k = \ldots$$

A1: $k = \frac{21}{\ln 5} - 6$ or exact equivalent e.g. $\frac{21 - 6\ln 5}{\ln 5}$, $\frac{21 - 3\ln 25}{\ln 5}$, $21\log_5 \mathrm{e} - 6$.

Allow recovery from expressions that contain e.g. ln(–5) as long as it is dealt with subsequently.

Also allow recovery from invisible brackets.