Question Number	Scheme	Marks
3	$y\cos^2(2x)\dfrac{\mathrm{d}y}{\mathrm{d}x}=3\sin 2x \rightarrow \int y\ \mathrm{d}y=\int 3\dfrac{\sin 2x}{\cos^2 2x}\ \mathrm{d}x$	M1
	$\int y\ \mathrm{d}y=\int 3\sec(2x)\tan(2x)\,\mathrm{d}x$	A1
	$\dfrac{y^2}{2}=\dfrac{3}{2}\sec 2x\ (+c)$	M1A1
	$\dfrac{16}{2}=\dfrac{3}{2}\sec\left(2\dfrac{\pi}{6}\right)+c \Rightarrow c=\ldots\ (=5)$	dM1
	$y^2=3\sec 2x+10$	A1
		(6)

Main method

M1**:** For an attempt to separate the variables **OR** use of $\dfrac{\sin 2x}{\cos^2 2x}\equiv \sec 2x\tan 2x$

For the attempt at separation of variables it is not necessary to have the integral signs but the dx and dy must be present and in the correct positions (on at least one line)

E.g. $y\cos^2(2x)\dfrac{\mathrm{d}y}{\mathrm{d}x}=3\sin 2x \rightarrow \int y\ \mathrm{d}y=\int 3\dfrac{\sin 2x}{\cos^2 2x}\ \mathrm{d}x$ or $\int y\dfrac{\mathrm{d}y}{\mathrm{d}x}\mathrm{d}x=\int 3\dfrac{\sin 2x}{\cos^2 2x}\ \mathrm{d}x$

Condone a slip on the position (or omission) of the 3

A1: Correct separation of variables **AND** use of $\dfrac{\sin 2x}{\cos^2 2x}=\sec 2x\tan 2x$

E.g. $\int y\ \mathrm{d}y=\int 3\sec(2x)\tan(2x)\,\mathrm{d}x$ o.e. with or without the integral signs

Note that $\int \dfrac{1}{3}y\ \mathrm{d}y=\int \sec(2x)\tan(2x)\,\mathrm{d}x$ is also correct

M1: Correct attempted integration of the $\sec 2x\tan 2x$ to reach $\mathrm{f}(y)=\alpha\sec 2x\ (+c)$ with or without the c

A1: Correct integration.

For example, $\dfrac{y^2}{2}=\dfrac{3}{2}\sec 2x\ (+c)$ Accept with or without the c

Note that that $y^2=3\sec 2x\ (+c)$ and $\dfrac{y^2}{3}=\sec 2x\ (+c)$ are also examples of correct work.

dM1: Substitutes in $y=4$ and $x=\dfrac{\pi}{6}$ into an integrated equation of the form $\mathrm{f}(y)=\alpha\sec 2x+c$ and proceeds to find c. It is dependent on the previous method mark. You may need to check calculations if the substitution isn't shown. You may see this attempted via $\left[\dfrac{y^2}{2}\right]_4^y=\left[\dfrac{3}{2}\sec 2x\right]_{\frac{\pi}{6}}^x$

A1: $y^2=3\sec 2x+10$ or equivalent such as $y^2=\dfrac{3}{\cos 2x}+10$ but ISW after a correct answer.

The answer is required to be in the form $y^2=$

A score of 1,0,1,1,1,1 is possible for candidates who never have a dx and/or a dy when separating the variables, but do everything else correctly.

Question Number	Scheme	Marks
3 ALT	$y\cos^2(2x)\dfrac{\mathrm{d}y}{\mathrm{d}x} = 3\sin 2x \rightarrow \int y\ \mathrm{d}y = \int 3\dfrac{\sin 2x}{\cos^2 2x}\ \mathrm{d}x \rightarrow \int y\ \mathrm{d}y = 3(\cos 2x)^n$ where $n = -1$ or -3	M1, A1
	$\dfrac{y^2}{2} = \dfrac{3}{2}(\cos 2x)^{-1}\ (+c)$	M1A1
	$\dfrac{16}{2} = \dfrac{3}{2\cos\left(\dfrac{\pi}{3}\right)} + c \Rightarrow c = \ldots (= 5)$	dM1
	$y^2 = \dfrac{3}{\cos 2x} + 10$	A1

Alt versions will integrate $\dfrac{\sin 2x}{\cos^2 2x}$ using substitution or reverse chain rule

The key here is realising that the integral of this is $(\cos 2x)^n$ or u^n where $u = \cos 2x$

M1**:** For an attempt to separate the variables **OR** use of $\int \dfrac{\sin 2x}{\cos^2 2x}\mathrm{d}x \equiv (\cos 2x)^n$

For separation of variables look for example for $y\cos^2(2x)\dfrac{\mathrm{d}y}{\mathrm{d}x} = 3\sin 2x \rightarrow \int y\ \mathrm{d}y = \int 3\dfrac{\sin 2x}{\cos^2 2x}\ \mathrm{d}x$.

condoning a slip on the position (or omission) of the 3 and omission of the integral signs

A1: Correct separation of variables **AND** use of $\int \dfrac{\sin 2x}{\cos^2 2x}\mathrm{d}x \equiv (\cos 2x)^n$ where $n = -1$ or -3

If the candidate sets $u = \cos 2x$ it is for integrating $\int \dfrac{\sin 2x}{\cos^2 2x}\mathrm{d}x$ to u^n where $n = -1$ or -3

M1: Correct attempted integration of the $\int \dfrac{\sin 2x}{\cos^2 2x}\mathrm{d}x$ to reach $\mathrm{f}(y) = \dfrac{\alpha}{\cos 2x}\ (+c)$ o.e with or without the c

A1: Correct integration. For example, $\dfrac{y^2}{2} = \dfrac{3}{2\cos 2x}\ (+c)$ o.e. Accept with or without the c

Note that that $y^2 = \dfrac{3}{\cos 2x}\ (+c)$ and $\dfrac{y^2}{3} = (\cos 2x)^{-1}\ (+c)$ are also examples of correct work.

dM1: Substitutes in $y = 4$ and $x = \dfrac{\pi}{6}$ into an integrated equation of the form $\mathrm{f}(y) = \dfrac{\alpha}{\cos 2x} + c$ o.e. and proceeds to find c. It is dependent on the previous method mark.

A1: $y^2 = \dfrac{3}{\cos 2x} + 10$ or equivalent such as $y^2 = \dfrac{3}{\cos 2x} + 10$ but ISW after a correct answer.

The answer is required to be in the form $y^2 =$

……..

Also note that you may attempt using integration by parts. FYI $\int 3\sin 2x\sec^2 2x\ \mathrm{d}x = \dfrac{3}{2}\sin 2x\tan 2x + \dfrac{3}{2}\cos 2x$

1st A1: Correct separation of variables and $\int 3\sin 2x\sec^2 2x\ \mathrm{d}x = \pm\lambda\sin 2x\tan 2x \pm \kappa\cos 2x \qquad \lambda, \kappa > 0$

2nd M1: $\int 3\sin 2x\sec^2 2x\ \mathrm{d}x = \lambda\sin 2x\tan 2x \pm \kappa\cos 2x \qquad \lambda, \kappa > 0$

2nd A1: $\int 3\sin 2x\sec^2 2x\ \mathrm{d}x = \dfrac{3}{2}\sin 2x\tan 2x + \dfrac{3}{2}\cos 2x$