Question	Scheme	Marks	AOs
12(a)	$\int x\sin kx\,\mathrm{d}x = -\frac{1}{k}x\cos kx + \frac{1}{k}\int \cos kx\,\mathrm{d}x$	M1 A1	2.1 1.1b
	$\frac{1}{k^2}\sin kx - \frac{1}{k}x\cos kx + c$	A1*	1.1b
		(3)	
(b)	$\frac{\mathrm{d}H}{\mathrm{d}t} = \frac{t\sin\left(\frac{\pi t}{5}\right)}{10H} \Rightarrow \int 10H\,\mathrm{d}H = \int t\sin\left(\frac{\pi t}{5}\right)\mathrm{d}t$	M1	3.1a
	$5H^2 = \frac{25}{\pi^2}\sin\left(\frac{\pi t}{5}\right) - \frac{5}{\pi}t\cos\left(\frac{\pi t}{5}\right) + c$	M1 A1	1.1b 1.1b
	$t = 0, H = 5 \Rightarrow c = 125$	M1	3.4
	$H = \sqrt{\frac{5}{\pi^2}\sin\left(\frac{52\pi}{5}\right) - \frac{1}{\pi}\times 52\cos\left(\frac{52\pi}{5}\right) + 25}$	M1	1.1b
	$H = 4.51\,\mathrm{m}$	A1	3.2a
		(6)	
			(9 marks)

Notes

(a)

M1: Attempts integration by parts and obtains $\pm Ax\cos kx \pm B\int \cos kx\,\mathrm{d}x$

A1: For $\int x\sin kx\,\mathrm{d}x = -\frac{1}{k}x\cos kx + \frac{1}{k}\int \cos kx\,\mathrm{d}x$

A1*: Correct proof

(b)

M1: Attempts to separate the variables to obtain $\int 10H\,\mathrm{d}H = \int t\sin\left(\frac{\pi t}{5}\right)\mathrm{d}t$ or equivalent e.g.

$\int H\,\mathrm{d}H = \int \frac{1}{10}t\sin\left(\frac{\pi t}{5}\right)\mathrm{d}t$

M1: For using part (a) (or starting again) and integrating both sides to obtain

$AH^2 = B\sin\left(\frac{\pi t}{5}\right) - Ct\cos\left(\frac{\pi t}{5}\right)(+c)$ with or without the "$+c$"

A1: $5H^2 = \frac{25}{\pi^2}\sin\left(\frac{\pi t}{5}\right) - \frac{5}{\pi}t\cos\left(\frac{\pi t}{5}\right)(+c)$ or equivalent with or without the "$+c$"

M1: Substitutes $t = 0$ and $H = 5$ in order to find the constant of integration.

M1: Uses $t = 52$ to find H

A1: Correct height of awrt 4.51 m including units.