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18/ENG03/006
Civil Engineering

① $y = 3e^{2x}$, $y = 3e^{-x}$ at ordinates $x = 1$ and $x = 2$
Area bounded by the curve.

$$\int_1^2 3^{2x}\,dx - \int_1^2 3e^{-x}\,dx^2$$

$$A = \left[\frac{3}{2}(e^{2x} + c)\right] - \left[-3e^{-x} + c\right]_6^2$$

$$A = [70.81] - [0.698]$$

②

$y = 2\sin\left(\frac{\pi t}{10}\right)$, $x =$

$x = 2 + 2t - 2\cos\left(\frac{\pi t}{10}\right)$

at ordinates
$t_2 = 10$ and $t_1 = 0$

$$\frac{dx}{dt} = 2 - 2\left[-\sin\frac{\pi t}{10}\right]\times\frac{\pi}{10}$$

$$\frac{2x}{dt} = 2 + \frac{\pi}{5}\sin\frac{\pi t}{10}$$

$$2x = 2 + \frac{\pi}{5}\sin\left(\frac{\pi t}{10}\right)dt$$

Area bounded by the parametric Equations

$$A = \int_{x_1}^{x_2} y\,dx$$

$$A = \int_{x_1}^{x_2} 2\sin\left(\frac{\pi t}{10}\right)2x$$

$$A = \int_{t_1}^{t_2} 2\sin\frac{\pi t}{10}\left(2 + \frac{\pi}{5}\sin\left(\frac{\pi t}{10}\right)\right)dt$$

$$A = \int_0^{10} 4\sin\frac{\pi t}{10} + \frac{2\pi}{5}\sin^2\left(\frac{\pi t}{10}\right)dt$$

$$A = \int_0^{10} 4\sin\left(\frac{\pi t}{10}\right)2t + \int_0^{10}\frac{2\pi}{5}\sin^2\left(\frac{\pi t}{10}\right)2t$$

But $\cos^2 x - \sin^2 x = \cos 2x$
$1 - \sin x - \sin^2 x = \cos 2x$
$1 - 2\sin^2 x = \cos 2x$

$$\sin^2 x = \frac{1 - \cos 2x}{2}$$

$$\int \sin^2 x\,dx =$$

$$\int \frac{1 - \cos 2x}{2}2x = \frac{1}{2}\int 1 - \cos 2x\,2x$$

$$= \frac{1}{2}\left[x - \frac{1}{2}\sin 2x + C\right]$$

$$A = \left[4 \times \frac{10}{\pi} x - \cos\left(\frac{\pi t}{10}\right) + c \right]_0^1$$

$$+ \left[\frac{2\pi}{5} \times \frac{10}{\pi} \times \frac{1}{2} \left(\frac{\pi t}{10} - \frac{1}{2} \sin\left(\frac{2 \times \pi t}{10}\right) + c \right) \right]_0^{10}$$

$$A = \left[\frac{-40}{\pi} \cos\left(\frac{\pi t}{10}\right) + c \right]_0^{10} + \left[2 \left(\frac{\pi t}{10} - \frac{1}{2} \sin\left(\frac{2 \times \pi t}{10}\right) + c \right) \right]_0^{10}$$

$$= \left[\frac{-40}{\pi} \cos\left(\frac{\pi(10)}{10}\right) + c \quad + \frac{40}{\pi} \left[\cos\left(\frac{\pi 10}{10}\right) - c \right] \right]$$

$$+$$

$$\left[2\left(\frac{\pi \times 10}{10}\right) - \frac{1}{2} \sin\left(\frac{2\pi \times 10}{10}\right) + c - 2\left(\frac{\pi \times 0}{10}\right) + \frac{\sin\left(\frac{2\pi \times 10}{10}\right)}{2} - c \right]$$

$$A = \left[\frac{-40}{\pi} \cos\pi + \frac{40}{\pi} \cos 0 \right] + \left[2\pi - \frac{1}{2} \sin(2x) + \frac{1}{2} \sin(0) \right]$$

$$A = \left[\frac{-40 \times -1}{\pi} \right] + \frac{40}{\pi} + \left[2\pi - 0 + 0 \right]$$

$$A = \frac{80}{\pi} + 2\pi$$

$$= 31.75 \text{ Square unit}$$