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Civic Engineering

1 $y_a = 3e^{2x}$

$y_a = 3e^{-x}$, $x = 1, x = 2$

$\text{Area} = \int_a^b y_a dx - \int_a^b y_b dx$

$y_a = 3e^{2x}$

$\int_1^2 3e^{2x} = \left[\frac{3e^{2x}}{2}\right]_1^2 = \frac{3e^4}{2} - \frac{3e^2}{2}$

$= 70.81$ Square units

$y_b = 3e^{-x}$

$\int_1^2 3e^{x} = \left[\frac{3e^{-x}}{-1}\right]_1^2 = -3e^{-2} - (-3e^{-1})$

$= 0.698$ square units

$\therefore$ Area bounded by the curves

$= 70.81 - 0.698 = 70.116$ square units

2 $y = 2\sin \frac{\pi}{10}t$

$x = 2t + 2t - 2\cos \frac{\pi}{10}t$

$\text{Area} = \int_a^b y\,dx \quad b = 10, \ a = 0$

$dx = 2t \frac{\pi}{5}\sin \frac{\pi}{10}t\,dt$

$\therefore A = \int_0^{10} 2\sin \frac{\pi}{10}t + \left[2t + \frac{\pi}{5}\sin \frac{\pi}{10}t\right]$

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

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

$= 10\left[-\frac{40\cos\left(\frac{\pi b}{10}\right)}{\pi} + \left(\frac{2\pi}{5} \times \pi t - 5\sin\left(\frac{\pi t}{5}\right)\right)\right]$

$= 10\left[\frac{-40\cos\left(\frac{\pi b}{10}\right)}{\pi} + \frac{\pi t - 5\sin\left(\frac{\pi b}{5}\right)}{5}\right]$

$$= \left[\frac{-40\cos\left(\frac{\pi(10)}{10}\right)}{\pi} + \frac{\pi(10) - 5\sin\left(\frac{\pi(10)}{5}\right)}{5}\right]$$

$$- \left[\frac{-40\cos\left(\frac{\pi(10)}{10}\right)}{\pi} + \right.$$

$$\left.\frac{\pi(0) - 5\sin\left(\frac{\pi(0)}{5}\right)}{5}\right] = \left[\frac{40 + 2\pi}{\pi}\right] - \left[\frac{40 + 0}{\pi}\right]$$

$$= \frac{40}{\pi} + 2\pi + \frac{40}{\pi} = \frac{80}{\pi} + 2\pi$$

$= 31.74$ square units