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Mechanical Engineering.

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

ordinate at $x = 1$ and $x = 2$

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

$y_a = 3e^{2x}$

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

$= 70.81$ Square Units

$y_b = 3e^{-x}$

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

$= 0.698$ Square Units

$\therefore$ Area bounded by the curves

$= 70.81 - 0.698 = 70.116$ Square Units.

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

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

$t = 0$ and $t = 10$.

$$\text{Area} = \int_b^a y \, dx$$

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

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

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

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

$$= {}_0^{10}\left[\frac{-40\cos\left(\frac{\pi t}{10}\right)}{\pi} + \left(\frac{2\pi}{5}\times\pi t - 5\sin\left(\frac{\pi t}{5}\right)\right)\right]$$

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

$$= \left[\frac{-40\cos\frac{\pi(10)}{10}}{\pi} + \frac{\pi(10) - 5\sin\frac{\pi(10)}{5}}{5}\right] - \left[\frac{-40\cos\left(\frac{\pi\cos}{10}\right)}{\pi} + \frac{\pi(0) - 5\sin\frac{\pi(0)}{5}}{5}\right]$$

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

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

$$= 31.74 \text{ Square Units}$$