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1) $y = 3e^{2x}$ and $y = 3e^{-x}$ at the points $x=1$ and $x=2$. Find the area bounded by the curves.

<u>Soln</u>

Area between 2 curves

$A = \int_a^b f(x) - g(x)\,dx$ where $f(x) = 3e^{2x}$ and $g(x) = 3e^{-x}$

$a = 1$, $b = 2$

$$A = \int_1^2 3e^{2x} - (3e^{-x})\,dx$$

$$A = \int_1^2 3e^{2x} - 3e^{-x} = 3\int_1^2 e^{2x} - e^{-x}$$

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

$$A = 3\left[\left(\frac{e^{2(2)}}{2} + e^{-2}\right) - \left(\frac{e^{2(1)}}{2} + e^{-1}\right)\right]$$

$$A = 3\left[(27.2 + 0.135) - 4.06\right]$$

$$A = 3(23.275)$$

$= 69.823$ units^2 $\simeq 70$ units^2

2) $y = 2\sin \frac{\pi}{10}t \qquad x = 2 + 2t - 2\cos \frac{\pi}{10}t$

$A = \int_a^b y\,dx$

let $\frac{\pi}{10} = u$

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

$\frac{dx}{dt} = 2 + 2u\sin ut$

$dx = 2 + 2u\sin ut\,dt$

$A = \int_0^{10} 2\sin ut\,(2 + 2u\sin ut)\,dt$

$= 4\int_0^{10} \sin ut + u\sin^2 ut\,dt$

$\sin^2\theta = \frac{1}{2}(1 - \cos 2\theta)$

$= 4\int_0^{10} \sin ut + \frac{u}{2}(1 - \cos 2ut)\Big]\,dt$

$= 4\left[-\frac{\cos ut}{u} + \frac{ut}{2} - \frac{u}{4u}\sin 2ut\right]_0^{10}$

$c = \frac{\pi}{10}$

$= 4\left[\frac{\pi t}{20} - \frac{10}{\pi}\cos\frac{\pi}{10}t - \frac{1}{4}\sin\frac{\pi}{5}t\right]_0^{10}$

$= \left[\frac{\pi t}{6} - \frac{40}{\pi}\frac{\cos\pi t}{10} - \frac{\sin\pi t}{5}\right]_0^{10}$

$= \left(\frac{\pi(10)}{5} - \frac{\sin\pi(10)}{5} - \frac{40}{\pi}\cos\frac{\pi(10)}{10}\right) - \left(\frac{\pi(0)}{6} - \frac{\sin\pi(0)}{5} - \frac{40}{\pi}\frac{\cos\pi(0)}{10}\right)$

$= 2\pi + 40/\pi + 40/\pi = 31.75$ square units