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25/10/19

Matric No. 18/eng06/027

Mechanical Engineering

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

$$A = \int_1^2 y dx = \int_1^2 (3e^{2x}) dx = \left[ \frac{3e^{2x}}{2} \right]_1^2$$

$$= \left[ \frac{3e^{2(2)}}{2} - \frac{3e^{2(1)}}{2} \right] = 70.81 \text{ units}^2$$

$$\left[ \frac{-40 \cos(\pi/10 \times 10)}{\pi} \right] - \left[ \frac{-40 \cos(\pi/10 \times 10)}{\pi} \right]$$

$$= 25.46 \text{ units}^2$$

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

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

$$= \left[ -3e^{-2} + 3e^{-1} \right] = 0.698 \text{ units}^2$$

$$\frac{2\pi}{5} \left( \frac{10 - 2\pi \sin \pi \times 10}{2 \cdot 10 \cdot 5} \right) \left( \frac{0 - 2\pi \sin \pi \times 10}{2 \cdot 10 \cdot 5} \right)$$

$$\left( \frac{2\pi \times 10}{2} \right) \left( \frac{2\pi \times 10}{2} \right)$$

$$70.81 - 0.698 = 70.116 \text{ units}^2$$

$$= 19.18 \text{ units}^2$$

②  $y = 2 \sin \pi/10 t$ ,  $x = 2 + 2t = 2 \cos \pi/10 t$

$t = 0$  and  $t = 10$

$$A = \int_0^{10} y dx = \int_0^{10} (2 \sin(\pi/10 t)) dx$$

$$dx/dt = 0 + 2t \cdot 2\pi/10 \sin \pi/10 t$$

$$dx = 2t \cdot \pi/5 \sin \pi/10 t dt$$

$$\int_0^{10} (2 \sin(\pi/10 t)) \cdot (2t \cdot \pi/5 \sin(\pi/10 t)) dt$$

$$\int_0^{10} (4 \sin(\pi/10 t)) + (2\pi/5 \sin^2(\pi/10 t)) dt$$

$$\int_0^{10} (4 \sin(\pi/10 t) + 2\pi/5 \sin^2(\pi/10 t)) dt$$

Let  $\sin^2(\pi/10 t) = \sin^2 a$

recall,  $\cos 2a = \cos^2 a - \sin^2 a$

$$\cos 2a = (1 - \sin^2 a) - \sin^2 a$$

$$\cos 2a = 1 - 2\sin^2 a$$

$$2\sin^2 a = 1 - \cos 2a$$

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

$$\Rightarrow \sin^2(\pi/10 t) = \frac{1}{2} - \frac{\cos 2(\pi/10 t)}{2}$$

$$\left[ \frac{-40 \cos \pi/10 t}{\pi/10} \right]_0^{10} + \frac{2\pi}{5} \int_0^{10} \left[ \frac{1}{2} - \frac{\cos 2(\pi/10 t)}{2} \right]$$

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