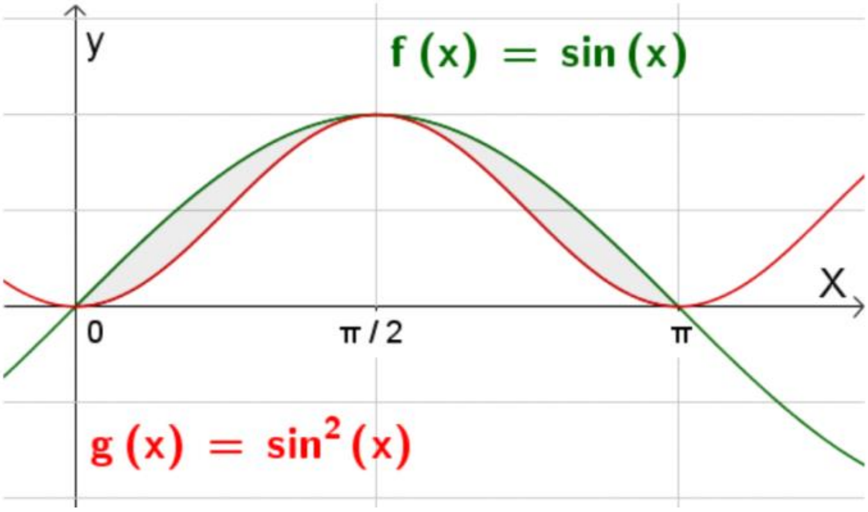
# Area between Graphs

Show that the area bounded by the graphs of y = f(x) and y = g(x) in the interval $0 \leq x \leq \pi$ is given by 2 - $\frac{\pi}{2}$

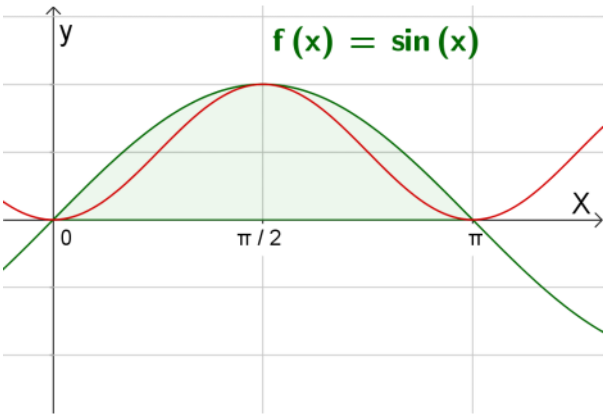
f(x) = sinx

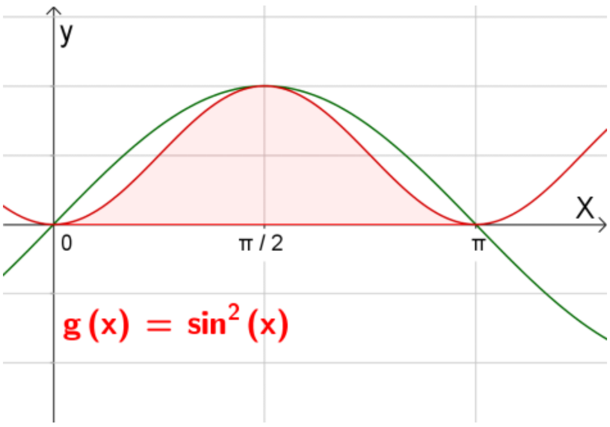
g(x) = sin²x




Area under a curve

$$A = \int_a^b y \, dx \text{ or } A = \int_a^b x \, dy$$



$\int \sin x \, dx = -\cos x + C$

$\int \cos x \, dx = \sin x + C$

Double angle identities

$\sin 2\theta = 2\sin\theta\cos\theta$

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

$\tan 2\theta = \dfrac{2\tan\theta}{1-\tan^2\theta}$

$$= \int_0^{\pi} \sin x \, dx - \int_0^{\pi} \sin^2 x \, dx$$

$\cos 2x \equiv 1 - 2\sin^2 x$

$2\sin^2 x \equiv 1 - \cos 2x$

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

$$= \left[-\cos x\right]_0^{\pi} - \int_0^{\pi} \left(\frac{1}{2} - \frac{1}{2}\cos 2x\right) dx$$

$$= \left[-\cos \pi - (-\cos 0)\right] - \left[\frac{1}{2}x - \frac{1}{4}\sin 2x\right]_0^{\pi}$$

$$= \left[1 + 1\right] - \left[\left(\frac{\pi}{2} - \frac{1}{4}\sin 2\pi\right) - \left(0 - \frac{1}{4}\sin 0\right)\right]$$

$$= 2 - \left[\left(\frac{\pi}{2} - 0\right) - (0 - 0)\right]$$

$$= 2 - \frac{\pi}{2}$$