$$\langle x \rangle = \frac{L}{\pi^2}\left[\underbrace{\int_0^{\pi}\theta\, d\theta}_{=\frac{\pi^2}{2}} - \underbrace{\int_0^{\pi}\theta \cos 2n\theta\, d\theta}\right]$$

$\Downarrow$ 2^{nd} term integrate by parts $\Downarrow$

$$\left.\begin{aligned} u &= \theta \\ dv &= \cos 2n\theta\, d\theta \end{aligned}\right\} \quad \int u\, dv = uv - \int v\, du$$

$$\Rightarrow 2^{nd} \text{ term} = \frac{\theta}{2n}\cancel{\sin 2n\theta}^{\,0}\Big|_0^{\pi} - \frac{1}{n}\underbrace{\int_0^{\pi}\sin 2n\theta\, d\theta}_{\frac{1}{2n^2}\cos 2n\theta\big|_0^{\pi} = 0}$$

$$\Rightarrow 2^{nd} \text{ term} = 0$$

$$\Rightarrow \langle x \rangle = \frac{L}{\pi^2}\times\frac{\pi^2}{2} = \frac{L}{2} \Rightarrow \boxed{\langle x \rangle = \frac{L}{2}}$$

$$\langle x^2 \rangle = \frac{L^2}{\pi^3}\left(\underbrace{\int_0^{\pi}\theta^2 d\theta}_{=\frac{\pi^3}{3}} - \underbrace{\int_0^{\pi}\theta^2\cos 2n\theta\, d\theta}\right)$$

$\Downarrow$ $\Leftarrow$ integrate by parts

$$\int_0^{\pi}\theta^2\cos 2n\theta\, d\theta = \frac{\theta^2}{2n}\cancel{\sin 2n\theta}^{\,0}\Big|_0^{\pi} - \frac{1}{n}\underbrace{\int_0^{\pi}\theta \sin 2n\theta\, d\theta}$$

integrate by parts

$$-\frac{1}{n}\left[\frac{\theta}{2n}\cos 2n\theta\Big|_0^{\pi} + \frac{1}{2n}\int_0^{\pi}\cancel{\cos 2n\theta}^{\,0}\, d\theta\right]$$

$$= -\frac{1}{n}\times\left(-\frac{\pi}{2n}\right) = \frac{\pi}{2n^2}$$

$$\Rightarrow \langle x^2 \rangle = \frac{L^2}{\pi^3}\left[\frac{\pi^3}{3} - \frac{\pi}{2n^2}\right] = \boxed{\frac{L^2}{3} - \frac{L^2}{2n^2\pi^2}}$$