Consider the functions \( \sin \theta \) and \( \cos \theta \)

What are their “lengths” as vectors in the IP space of functions?

\[
\| \sin \| ^2 = \int_0^{2\pi} \sin^2 \theta \, d\theta
\]

\[
\| \cos \| ^2 = \int_0^{2\pi} \cos^2 \theta \, d\theta
\]

Carry out these integrals in two ways:
(a) By drawing careful sketches of the graphs of the two functions and thinking about what the integral means.

(b) By expressing \( \sin \) and \( \cos \) in terms of complex exponentials and evaluating

\[
\int_0^{2\pi} e^{ni\theta} \, d\theta
\]

for an arbitrary value of \( n \).
(Do you have to do something special for \( n = 0 \)?)