

Homework #2

due Tuesday February 12

1. Hirose and Lonngren Chapter 3 #3. (Show that

$$\cos x = \frac{e^{ix} + e^{-ix}}{2}, \quad \sin x = \frac{e^{ix} - e^{-ix}}{2i}. \quad (1)$$

Also display these relationships geometrically as vector diagrams in the $x - y$ plane.

2. To take successive derivatives of $e^{i\theta}$ with respect to θ , one merely multiplies by i :

$$\frac{d}{d\theta} (Ae^{i\theta}) = iAe^{i\theta} \quad (2)$$

Show that this prescription works if the sinusoidal representation $e^{i\theta} = \cos \theta + i \sin \theta$ is used.

3. Show that the total energy of a simple pendulum undergoing small oscillations of an amplitude θ_0 is approximately $E \approx \frac{1}{2}mg\ell\theta_0^2$. *Hint: use the approximation $\cos \theta \approx 1 - \frac{1}{2}\theta^2$ for small θ . This approximation follows from Equation 3.4 in Hirose & Lonngren.*
4. Hirose and Lonngren Chapter 1 # 10.
5. Tipler & Mosca Chapter 29 #37.
6. Verify that $x = Ae^{-\alpha t} \cos \omega t$ is a possible solution to the equation

$$\frac{d^2x}{dt^2} + \gamma \frac{dx}{dt} + \omega_0^2 x = 0 \quad (3)$$

and find α and ω in terms of γ and ω_0 .