FIRST MIDTERM

Given a mass on a frictionless surface oscillating according to the function (distances are in meters, angular frequency in rad/s.):

\[ x = 3.25 \cos(0.435 t + 62.5^\circ) \]

(a) Calculate the velocity at \( t = 0 \).

\[-1.254 \text{ m/s}\]

(b) Calculate the position at \( t = 0 \).

\[1.501 \text{ m}\]

(c) If the mass is 0.177 kg, calculate the energy in the oscillations.

\[1.769 \text{ J}\]

(d) Express the solution above as \( A \cos \omega t + B \sin \omega t \). Calculate \( A \) and \( B \).

\[ A = 1.501 \text{ m} \]

\[ B = -2.88 \text{ m} \]

(e) How far does the mass travel in 3.00 s?

\[3.89 \text{ m}\]
(a) For $V_t$, need $\frac{dx}{dt}$

$$x(t) = 3.25 \cos (0.435t + 62.5^\circ)$$

$$\frac{dx}{dt} = -3.25(0.435) \sin (0.435t + 62.5^\circ) = -1.254 \text{ m/s}$$

(b) $x(0) = 3.25 \cos (0 + 62.5^\circ) = 1.501 \text{ m}$

(c) Energy is all kinetic @ $x = 0$

$$E_T = \frac{1}{2} m V_{max}^2 \quad V_{max} = (3.25)(0.435)(1)$$

$$E_T = 0.8769 \text{ J}$$

(d) $\cos(A+B) = \cos A \cos B - \sin A \sin B$

$$3.25 \cos(62.5^\circ) \cos wt - 3.25 \sin(62.5^\circ) \sin wt$$

$$= 1.501 \cos wt + (-2.88) \sin wt$$

$$A = 1.501 \quad B = -2.88$$

**next pg. for e)**
since phase angle ≠ 0, must see what were looking e.

\[ \tau = \frac{2\pi}{\omega} = 14.445 \quad \frac{14.44}{4} = 3.615 \text{ min} \]

Even if oscillation began @ \( x = 0 \) (i.e. phase angle = 90°), then in 3 seconds the object would only move in one direction. This allows me to use \[ |X(3) - X(0)| = \text{dist. traveled} \]

\[ \Delta x = \frac{3.25}{2} \left\{ \cos \left( \frac{425}{3} + \frac{62.5\pi}{180} \right) - \cos \left( 0 + \frac{62.5\pi}{180} \right) \right\} \]

\[ x(0) = \frac{1.50 \text{ m}}{X(3)'' = \frac{2.387 \text{ m}}{X(3) = 3.89 \text{ m}}} \]