Warm Up Exercises: Circular Motion

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October 21, 2022

1 Memory Bank

- Force of drag, in air or other gas: $F_D = \frac{1}{2} C \rho A v^2$.
- In the above formula, C is an empirical constant, ρ is the density of the air or gas, A is the area of the object, and v is the object's velocity.
- Circular motion position with angular velocity $\omega = \Delta\theta / \Delta t$:

$$\vec{r}(t) = r\cos(\omega t)\hat{i} + r\sin(\omega t)\hat{j} \tag{1}$$

- $a_C = r\omega^2$ ... Centripetal force.
- $v = r\omega$ ... Radial velocity.
- $\vec{s} = -k\Delta\vec{x}$ ... Spring force.

2 Circular Motion

1. Suppose a system is rotating about the origin with a radius $r = 1.0$ m, and angular speed $\omega = \pi$ radians per second. (a) How long does the object take to complete one rotation? (b) What is the angular velocity in rotations per minute? (c) Where is the system at $t = 0.5,\ 1.5,\ 2.5, ...$ seconds?

2. In the prior problem, if the mass of the system is 30 kg, what is $F_C = m\ a_C$?

3 Spring Forces

1. Suppose a 0.25 kg mass is hung from a spring, and the spring stretches 0.1 m. What is the spring constant, k?

2. Assume the spring constant from the prior problem, but now assume the mass is stretching the spring along a 45 degree incline plane (no friction). What is the new Δx?