Warm Up Exercises: Drag, Circular Motion

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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.

2 Drag Forces, Circular Motion

1. Suppose the mass of a skydiver is $m = 65.0$ kg, and $C = 1.0$. Also, $\rho = 1.2$ kg/m^3, and $A = 0.5$ m^2. Equate the weight force and the drag force, and solve for the velocity. This is the terminal velocity.

2. Suppose a system is rotating about the origin with a radius $r = 1.0$ m, and angular speed $\omega = 2\pi/10$ radians per second. (a) Where is the system at $t = 0$ seconds? (b) Where is the system at $t = 5$ seconds? (c) What are the radial velocity and centripetal acceleration?

3. Find the time t that makes the position $\vec{r} = -1.0\hat{j}$ m.