AP Kinematics Review

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1 Summary

1.1 Constant Acceleration

$$v_f = v_0 + at \tag{1}$$

$$S_f = S_0 + v_0 t + \frac{1}{2}at^2 \tag{2}$$

$$v_f^2 - v_0^2 = 2a\Delta S \tag{3}$$

For 2D scenarios, treat the situation as two separate 1D problems.

1.2 Non-constant Acceleration

$$\vec{v} = \frac{d\vec{S}}{dt} \tag{4}$$

$$\vec{a} = \frac{d\vec{v}}{dt} \tag{5}$$

2 Problems

1. A monkey has stolen your physics textbook in the jungle! You decide that you must catch it in a net. You get up on a tree that is level with the vines the monkey is swinging on. Assume that the monkey has a constant horizontal velocity of v_m with respect to the wind, the maximum velocity that the net can be launched at is v_n with respect to the ground, and the wind is blowing against the monkey at a velocity v_w. When the monkey is right in front of you, you will fire your net. At what angle with respect to the line formed between you and the monkey when it is in front of you will you fire the launcher in order to retrieve your textbook? Assume gravity is not acting on the net and the distance between your tree and the monkey's is D.

2. You are launching a projectile from the surface of a planet whose gravitational acceleration is determined by $a = \alpha t$, where t is the time from when the projectile is launched. What will be the range and maximum height of your projectile and how long will it be in the air, assuming that you launch it at an angle θ with the horizontal and with an initial velocity v?

3. You are sitting on a spring seat at the top of a spinning ball on the ground. The ball is rotating with initial angular velocity ω, angular acceleration α, and radius R. After 5 seconds, the seat pushes you upward with a velocity v_s. How long will your flight be and how far would you have travelled from the ball?