Summary

General Principles

Kinematics describes motion in terms of position, velocity, and acceleration.

General kinematic relationships are given **mathematically** by:

Instantaneous velocity $v_s = ds/dt =$ slope of position graph

Instantaneous acceleration $a_s = dv_s/dt =$ slope of velocity graph

Final position $$s_{\mathrm{f}} = s_{\mathrm{i}} + \int_{t_{\mathrm{i}}}^{t_{\mathrm{f}}} v_s\,dt = s_{\mathrm{i}} + \begin{cases}\text{area under the velocity} \\ \text{curve from } t_{\mathrm{i}} \text{ to } t_{\mathrm{f}}\end{cases}$$

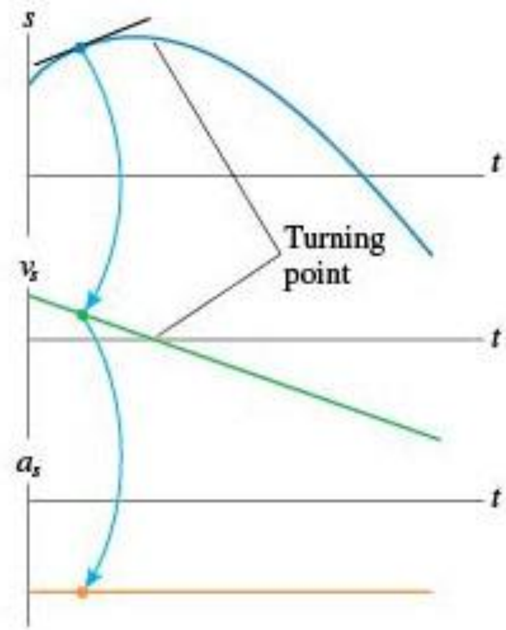
Final velocity $$v_{\mathrm{f}s} = v_{\mathrm{i}s} + \int_{t_{\mathrm{i}}}^{t_{\mathrm{f}}} a_s\,dt = v_{\mathrm{i}s} + \begin{cases}\text{area under the acceleration} \\ \text{curve from } t_{\mathrm{i}} \text{ to } t_{\mathrm{f}}\end{cases}$$

Summary

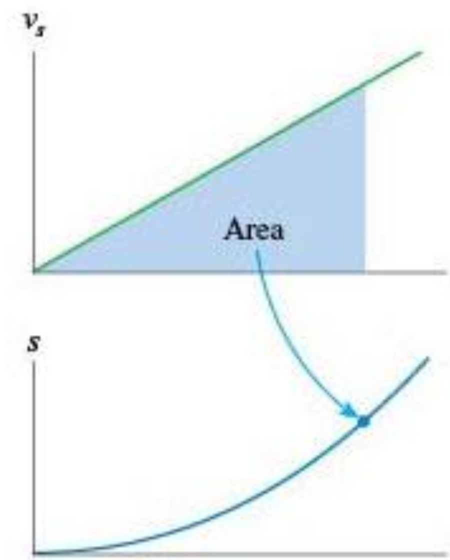
Important Concepts

Position, velocity, and acceleration are related graphically.

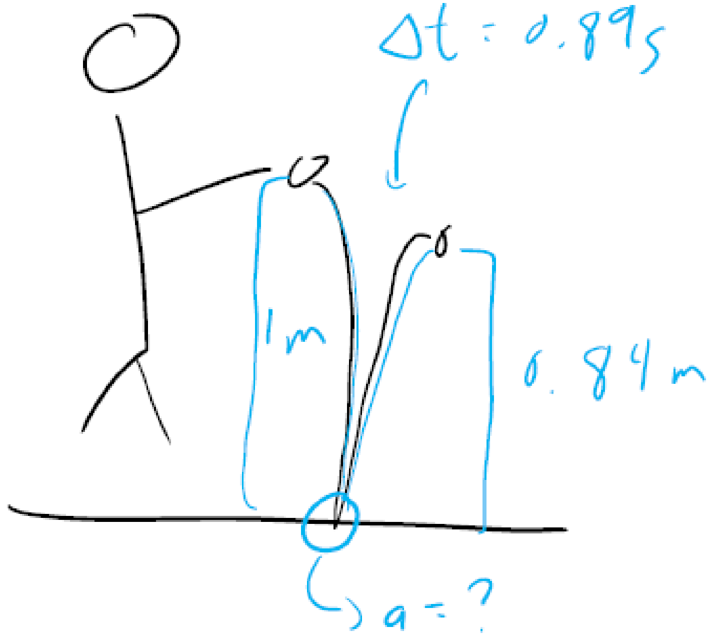
- The slope of the position-versus-time graph is the value on the velocity graph.
- The slope of the velocity graph is the value on the acceleration graph.
- s is a maximum or minimum at a turning point, and $v_s = 0$.

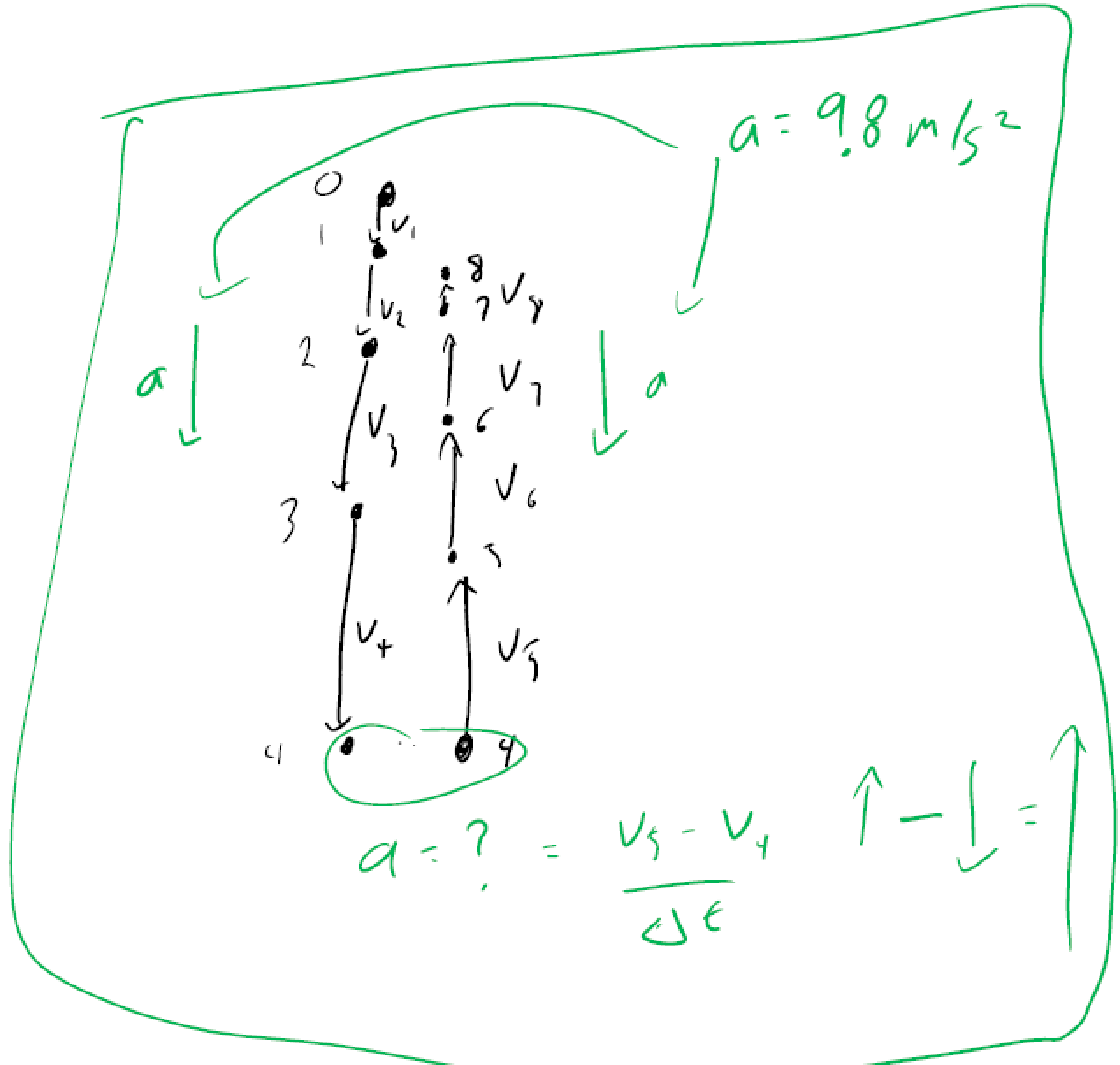


- Displacement is the area under the velocity curve.



You drop a ball from a height of 1.00 m. It bounces up to a height of 0.84 m after 0.89 s. What was the average acceleration of the ball when it was touching the ground?





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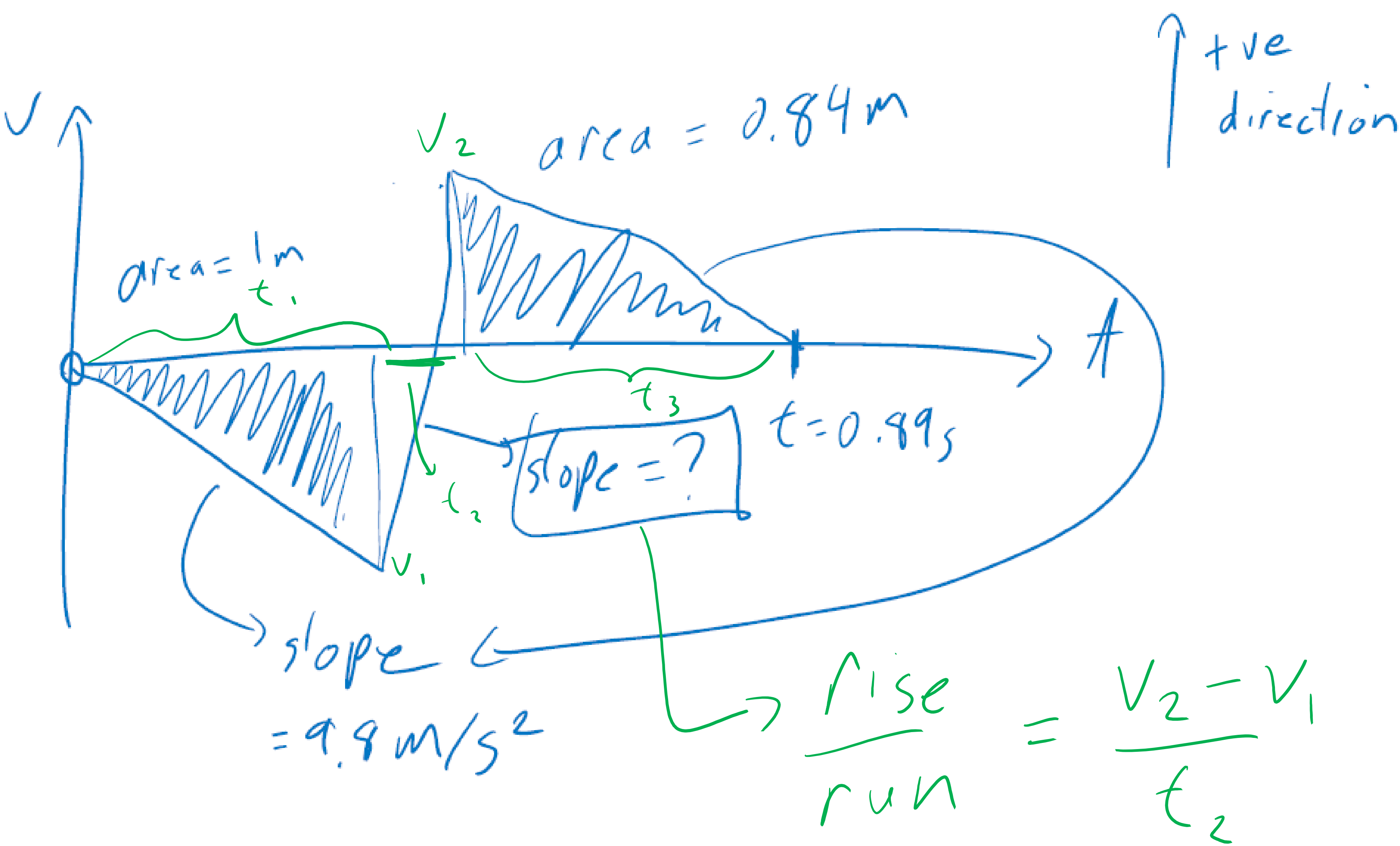

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$h_1 = 1m = \frac{1}{2} v_1 t_1 \rightarrow t_1 = \frac{2h_1}{v_1}$

$a = \frac{v_2 - v_1}{t_2}$

$h_2 = 0.84m = \frac{1}{2} v_2 t_3$

$g = 9.8\frac{m}{s^2} = \frac{v_1}{t_1} = \frac{0 - v_2}{t_3}$

$\boxed{350\ m/s^2}$

$t_1 + t_2 + t_3 = 0.89s \rightarrow t_2 = 0.89s - t_1 - t_3$

$v_1^2 = 2gh_1 \rightarrow t_1 = \frac{2h_1}{\sqrt{2gh_1}}$

$v_2^2 = 2gh_2$

$a = \frac{\left|\sqrt{2gh_2}\right| + \left|\sqrt{2gh_1}\right|}{0.89s - \sqrt{\frac{2h_1}{g}} - \sqrt{\frac{2h_2}{g}}}$

Team Up Questions

$$s = \left(1\,\frac{m}{s^4}\right)t^4$$