

# 6. Mind Map: Equations of Motion Under Gravity

## Equations of Motion (under gravity g)

Core Concept —  $g = 9.8 \text{ m/s}^2$  downward

*"g" is a constant vector. Always pointing downward*

Sign Convention:  
Choose upward as positive

Upward:  $v = +$ ,  $a = -g$   
Downward:  $v = -$ ,  $a = -g$   
Peak:  $v = 0$ ,  $a = -g$

Key Equations  
(upward is positive)

Velocity after time  $t$  —  $v = v_0 - gt$

Displacement after time  $t$ : —  $y = y_0 + v_0t - \frac{1}{2}gt^2$   
or  
 $y - y_0 = v_0t - \frac{1}{2}gt^2$

Velocity-position relation —  $v^2 = v_0^2 - 2g(y - y_0)$

Special Cases

Time to reach max height —  $t = v_0/g$

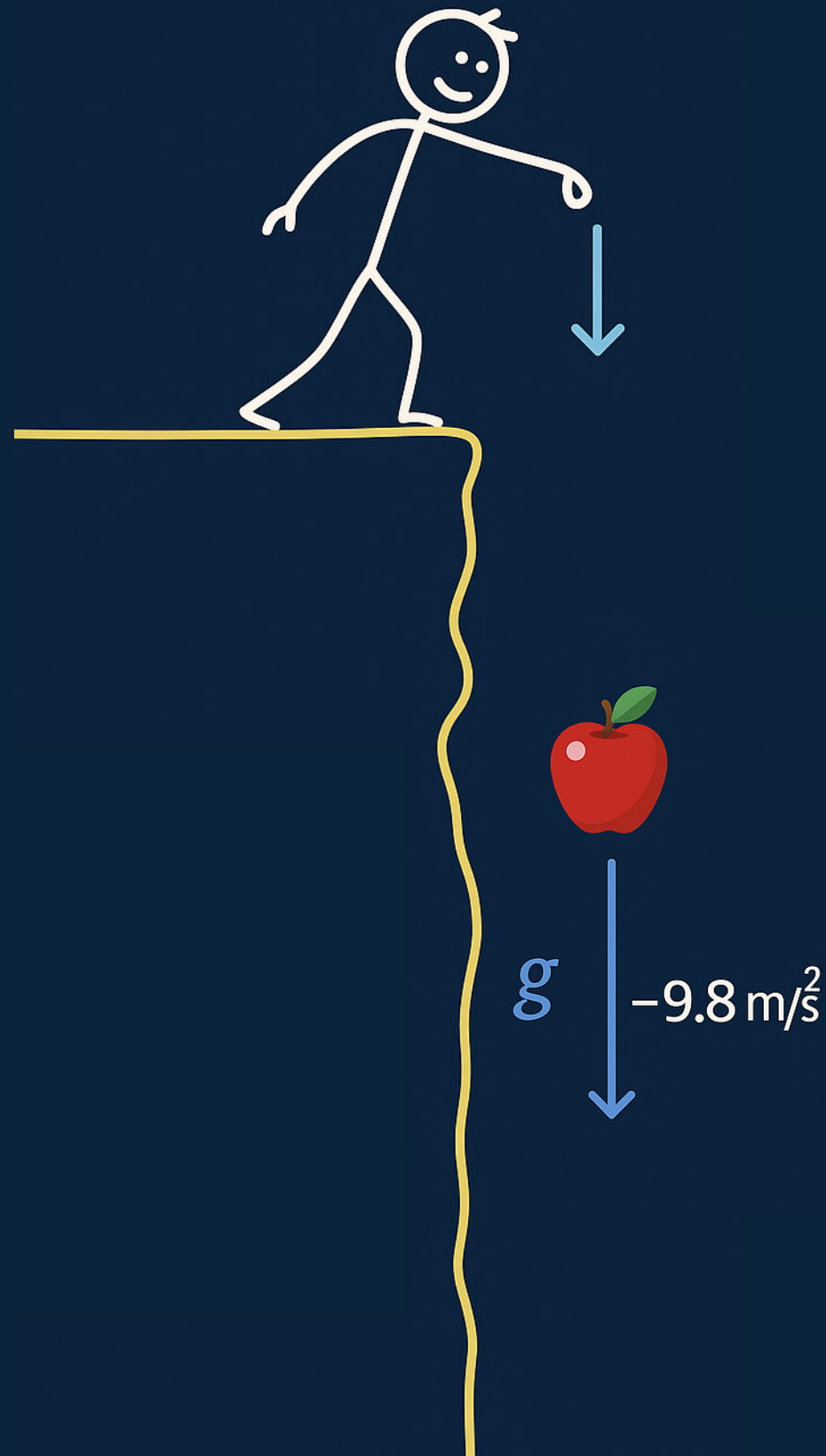
Time to reach max height  $h$ , if  $h$  is known —  $t = \sqrt{(2h/g)}$

Displacement when object is dropped ( $v_0 = 0$ ) —  $s = - (\frac{1}{2} gt^2)$

Height ( $h$ ) above the ground after  $t$  seconds,  
when dropped from a height  $H$  —  $h = H - \frac{1}{2}gt^2$

Motion in Discrete Time:  $n$ th Second Analysis - Distance  
covered in the  $n$ th second (Assumes initial velocity = 0) —  $h_n - h_{n-1} = \frac{1}{2} g(2n - 1)$

# Looking at Gravity in a Different Way



$$g = 9.8 \text{ m/s}^2$$

Read as

$$g = (9.8 \text{ m/s}) / \text{s}$$

*Which means velocity will increase  
@ 9.8 m/s EVERY SECOND*