

4.27.20

## Motion Equations: Freefall

### Today's Objectives:

- Learn Earth's acceleration due to gravity
- Understand terminal velocity
- Solve freefall problems



JFF Q: Is a penny dropped from a skyscraper deadly???

## Motion Equations: Freefall



Horiz



All objects fall at the same rate, despite their mass.

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

Due to Earth's  
gravity

## Why do a book and a piece of paper fall differently?

Air Resistance

No Air (Vacuum)

- All objects fall together (Big or small)

In Air

Air Resistance depends on Area

**Terminal Velocity:** An object's max speed through air.



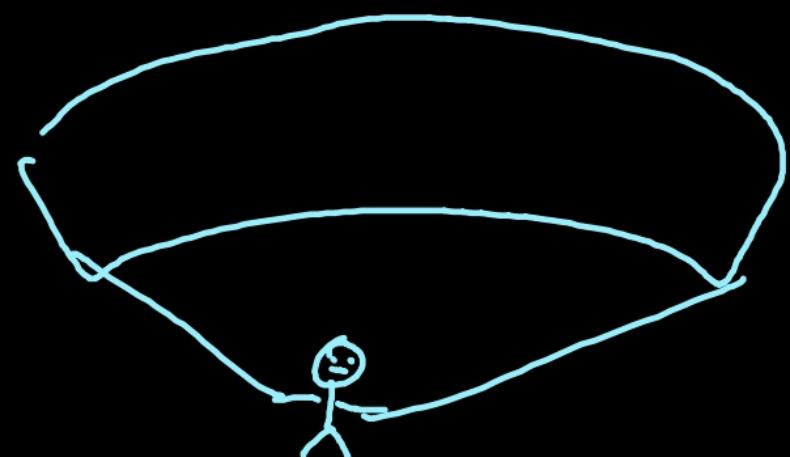
120 mph

Pencil



200 mph

Open Parachute



410 mph

2 types of vertical motion problems:

①

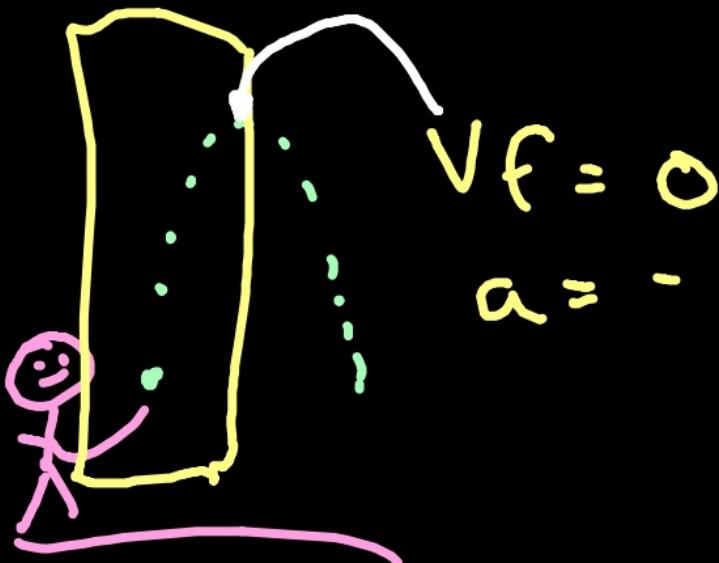
Dropped object

$$V_0 = 0$$

$$a = -9.8$$

②

Fired Up



$$V_f = 0$$

$$a = -9.8$$

A stone is dropped, and it hits the ground 3 s later.

A) how fast was it going when it hit the ground?

$$t = 3$$

$$\times V_0 = 0$$

$$\times a = -9.8$$

$$V_f = ?$$

$$V_f = V_0 + a t$$
$$0 + (-9.8) \cdot 3$$
$$V_f = -29.4 \text{ m/s}$$

B) What was its displacement?

$$d = \frac{1}{2} (V_0 + V_f) t$$
$$= \frac{1}{2} (0 + -29.4) 3$$
$$d = -44.1 \text{ m}$$

1)   $v = d/t$

2)  $V_f = V_0 + at$

3)  $a = (V_f - V_0)/t$

4)  $d = V_0 t + 1/2 a t^2$

5)  $d = 1/2(V_0 + V_f)t$

6)  $V_f^2 = V_0^2 + 2ad$