

Topic 2B: Acceleration Due To Gravity (Projectiles in One Dimension)

Skill 14: Free Fall - Gravity is only a force on the vertical axis

A projectile is any object that experiences the net force of gravity. (In this class we ignore air resistance in calculations)

★ Since gravity is the only force it is the Net Force ★ for a projectile

Remember - whatever happens to net force happens to acceleration

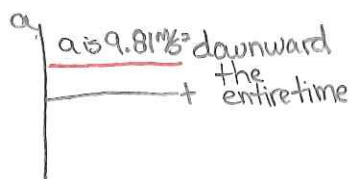
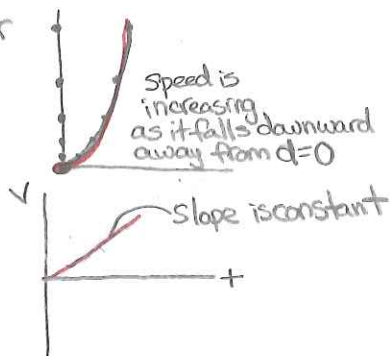
The acceleration due to (force of) gravity is symbolized by lower case g or gravitational field strength

on Earth $g = 9.81 \text{ m/s}^2$ or 9.81 N/kg for all objects, regardless of mass when air resistance is ignored

(for smaller mass planets, gravitational field strength is smaller)

For objects dropped from rest ($v_i = 0$) and moving away (without changing direction) down can be defined as positive (+)

Dot diagram for falling away
 $t=0$ $d=0$



If you consider down as negative the ground the graphs would be



Falling toward ground $d=0$

- For object falling from rest equations can be simplified to
- $d = v_i t + \frac{1}{2} a t^2$ becomes $d = \frac{1}{2} a t^2$
Since $a = g = 9.81 \text{ m/s}^2$ $d = (4.9 \text{ m/s}^2) t^2$ or $d = (5 \text{ m/s}^2) t^2$
accurate approximate
- $v_f = v_i + a t$ becomes $v_f = a t$
Since $a = g = 9.81 \text{ m/s}^2$ $v_f = (9.81 \text{ m/s}^2) t$ or $v_f = (10 \text{ m/s}^2) t$
accurate approximate

Benchmarks for $v_i = 0$, when $a = g = 10 \text{ m/s}^2$

v_f	d	a	t
10 m/s	5m	10 m/s^2	1s
20 m/s	20m		2s
30 m/s	45m		3s
40 m/s	80m		4s
50 m/s	125m		5s
60 m/s	180m		6s
70 m/s	245m		7s
80 m/s	320m		8s
90 m/s	405m		9s
100 m/s	500m		10s

Benchmarks can be used for 0.1s to 1.0 seconds but you must turn meters into centimeters
ie $0.3 \text{ s} = 45 \text{ cm}$
Since $3 \text{ s} = 45 \text{ m}$

Note: doubling $t =$ quadrupled d
by reverse logic doubling $d = \sqrt{2} \times t$ or $1.4 t$
5m fall takes 1s, a 10m fall takes 1.4s...