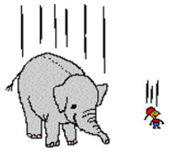


Ch 2 – Freefall Acceleration

Mr. Sudbury

Pondering the Apple

- Isaac Newton
- Observed an apple fall from a tree.
- Wondered about gravitation and its effect on the universe.

Gravity

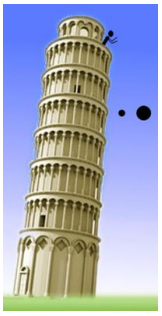
- The force of attraction between any two objects…
- Gravity is dependant on the mass of the objects.
  - More mass = stronger attraction.
- On earth, all things are attracted, or accelerate, to the center of the earth (because it is the biggest mass!).

Free Fall

- Because of gravity, when objects fall, they accelerate. (Free-Fall Acceleration!!!)
- What FORCES act on any falling object?
  - Gravity
  - Air resistance
- Air resistance effects almost all free fall situations on earth, but we will ignore air resistance when we talk about falling objects.
- Objects in true free-fall are **only** affected by gravity.

Free Fall

- In a true freefall, since we ignore air resistance, all objects fall with the same acceleration.



When something falls…

How Fast?

$$v = at$$

If a rock in freefall had a speedometer…

Table 2.2
Free Fall Speeds of Objects Dropped from Rest

Elapsed Time (seconds)	Instantaneous Speed (meters/second)
0	0
1	10
2	20
3	30
4	40
5	50
.	.
.	.
.	.
t	$10t$

When something falls…

How Far?

$$d = \frac{1}{2}at^2$$

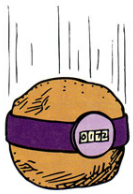


Table 2.3
Free Fall Distances of an Object Dropped from Rest

Elapsed Time (seconds)	Distances Fallen (meters)
0	0
1	5
2	20
3	45
4	80
5	125
.	.
.	.
.	.
t	$\frac{1}{2}gt^2$

When something falls…

…it accelerates.

$$a = \frac{V_f - V_i}{t}$$

How fast does it accelerate?

9.8 m/s^2 or $m/s/s$

When something falls…

How Fast?

$$v = at$$

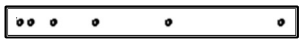
How Far?

$$d = \frac{1}{2}at^2$$

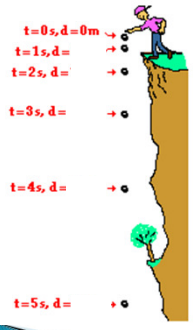
Free Fall from V_i=0

- The student dropped the rock from V_i = 0.

Ticker Tape…



Free Fall from V_i=0

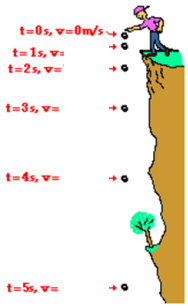


- What are the distances of the rock at t=1 through t=5?

$$\Delta d = \frac{1}{2}a(\Delta t)^2$$

- What is the distance the rock fell after 15 seconds?
- 1102.5 m

Free Fall from V_i=0



- What are the velocities of the rock at t=1 through t=5?
- v = at or v = gt
- What is the velocity of the falling rock after 15 seconds?
- 147 m/s

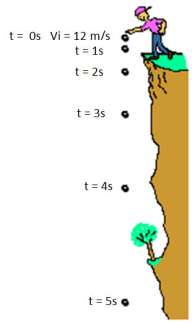
Free Fall from $V_i \neq 0$

- Instead of:

$$\Delta d = \frac{1}{2}\, a(\Delta t)^2$$

- Use:

$$\Delta d = v_i(\Delta t) + \frac{1}{2}\, a(\Delta t)^2$$



Freefall Practice Problems

1. Looking down over the edge of the empire state building, your sunglasses fall off. Ignoring air resistance, what is their velocity after 9.4 seconds (right before they hit the ground)?

Freefall Practice Problems

2. If you sunglasses fall for 9.4 seconds before they hit the sidewalk below. What distance did they fall?

Freefall Practice Problems

3. What is the acceleration of gravity on the moon if a freely falling object has a velocity of 21.5 m/s and falls for 13.4 seconds?

Freefall Practice Problems

You make a wish and toss a quarter into a very deep wishing well. Ignoring air resistance, it took 6.4 seconds to hit the bottom.

4. What distance did the coin fall?

5. What was the coin's velocity?

Free Fall

- The End