Table 1 The Five Key Equations of Accelerated Motion

	Equation	Variables found in equation	Variables not in equation
Equation 1	$\Delta\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right)\Delta t$	$\Delta\vec{d}$, Δt, $\vec{v}_f$, $\vec{v}_i$	$\vec{a}_{av}$
Equation 2	$\vec{v}_f = \vec{v}_i + \vec{a}_{av}\Delta t$	$\vec{a}_{av}$, Δt, $\vec{v}_f$, $\vec{v}_i$	$\Delta\vec{d}$
Equation 3	$\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}_{av}\Delta t^2$	$\Delta\vec{d}$, $\vec{a}_{av}$, Δt, $\vec{v}_i$	$\vec{v}_f$
Equation 4	$v_f^2 = v_i^2 + 2a_{av}\Delta d$	Δd, a_{av}, v_f, v_i	Δt
Equation 5	$\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}_{av}\Delta t^2$	$\Delta\vec{d}$, $\vec{a}_{av}$, Δt, $\vec{v}_f$	$\vec{v}_i$

Learning Goal: By the end of today, I will be able to solve problems algebraically that involve the gravitational acceleration constant.

Section 1.6 - Acceleration Due to Gravity - Near the Earth's Surface

All objects with Mass experience an attractive force that is referred to as Gravity.

The Sun's gravitational pull is what keeps the planets in their orbits.

The Earth's gravitational pull is what causes objects to fall to the ground when they are not supported.

The gravitational pull (force) on Earth causes objects to fall with an ACCELERATION of 9.8 m/s^2 or 32.2 ft/s^2.

As we will learn in our next unit, the force of gravity is dependent on how close the two objects are together. Thus gravitational force, and consequently the acceleration due to gravity varies somewhat around the globe.

The symbol for the acceleration due to gravity is "g".

The direction of the acceleration is always towards the Earth and is usually represented with a "negative" sign to communicate "down". ie. $-9.8 m/s^2$

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Practice

A ball is dropped from the roof of a building. If it takes the ball 2.6 s to reach the ground, how tall is the building?

A hot air balloon is hovering at height of 52 m above the ground. A penny is dropped from the balloon. Assume no air resistance.
(a) How long does it take the penny to hit the ground?
(b) What is the final velocity of the penny just before it hits the ground?

Determining the Height Reached by a Ball Thrown Straight Up in the Air

A tennis ball is thrown straight up in the air, leaving the person's hand with an initial velocity of 3.0 m/s, as shown in Figure 2.

How high, from where it was thrown, does the ball go?

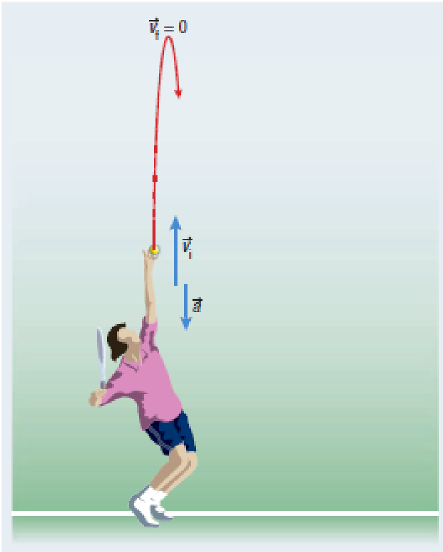


Figure 2 The motion of a ball thrown straight upward

Practice

A golf ball is thrown straight up in the air at a velocity of 8.3 m/s.
(a) Determine the maximum height of the golf ball [redacted]
(b) How long will it take the ball to reach its maximum height? [redacted]
(c) How long will it take the ball to fall from its maximum height to the height from which it was initially launched? [redacted]

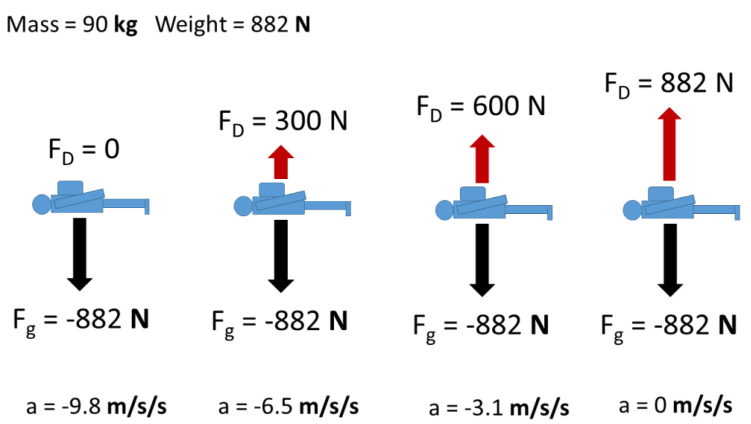
A rock is thrown downward from a bridge that is 12 m above a small creek. The rock has an initial velocity of 3.0 m/s downward. What is the velocity of the rock just before it hits the water? [redacted]

Terminal Velocity/Speed

A falling object with a reasonable mass can achieve a constant velocity when falling large distances.

The force upward generated by air resistance (proportional to surface area and speed) balances the gravitational force, to create a Net Force of Zero, ceasing acceleration.

velocity increases ~ drag force increases -->



<u>Typical Terminal Velocities</u>

human - 50 m/s

human with parachute - 5-10 m/s

dandelion seed - 0.5 m/s

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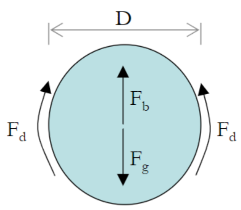
Without terminal velocity, precipitation of any kind would act like bullets from the sky.

Forces acting on rain drop

- Three forces acting on rain drop
  - Gravity force due to weight
  - Buoyancy force due to displacement of air
  - Drag force due to friction with surrounding air



$$Volume = \frac{\pi}{6} D^3$$

$$Area = \frac{\pi}{4} D^2$$

$$F_g = \rho_w g \frac{\pi}{6} D^3 \qquad F_b = \rho_a g \frac{\pi}{6} D^3$$

$$F_d = C_d \rho_a A \frac{V^2}{2} = C_d \rho_a D^2 \frac{\pi}{4} \frac{V^2}{2}$$

p_w density of water

p_a density of air

g acceleration due to gravity

D diameter

F_b buoyance force

F_d drag force

C_d drag coefficient (0.5 - 2)

shape dependent

Different mediums, will have different terminal velocities, ie. air vs water vs jello

Link

Homework

Read 32 - 40

page 37 #9, 11, 12, 15

page 39 #19, 20