Freeee Faaaalling

The sign is important.
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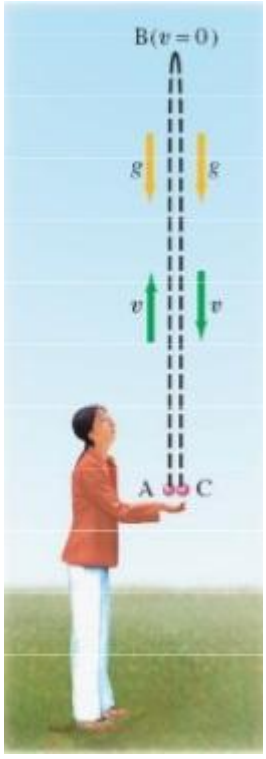
The SIGN is IMPORTANT.

If you don't remember that the sign is important you will be wrong. This is because the sign is important.

Example: I throw a ball straight up into the air at a velocity of 29.4m/s. How long until the ball reaches its highest point?

$v_0 = 29.4$ m/s $a = -9.81$ m/s^{-2} $\frac{m}{s^2}$ $\frac{\frac{m}{s}}{s}$



In 1s what is the velocity of the ball and how far did it travel?

$v = at$

$v_f + v_i = a - 9.81(1)$ (29.4)

$v_f = 29.4 - 9.81$

$v_f = 19.6$ m/s

$d = vt \rightarrow d = \frac{v_f + v_i}{2} t$

$d = \frac{19.6 + 29.4}{2}(1)$

$d = 24.5$ m

After 2s what is the velocity of the ball and how far did it travel in that second?

$v = 19.6 - 9.81$

$v = 9.79$ m/s

$d = \frac{v_f + v_0}{2} t = \left(\frac{9.79 + 19.6}{2}\right)$

$= 14.7$ m

After 3s what is the velocity of the ball and how far did it travel in that second?

$v = 0$ $d = 4.9$ m

Velocity of the ball when you catch it $= -29.4$ m/s

Let's compare dropping a Jesse off of a cliff vs throwing it down the cliff. Assume that the thrown Jesse leaves the person's hand at 5m/s.

A. What is the distance that the objects travel in 5s?
B. What is the velocity of the Jesse after 5 seconds in each scenario?

	Distance(m)	Velocity(m/s)
A	~123	49
B	150	54

$d = 0(5) + \frac{-9.81(5)^2}{2}$

$= -123\text{m}$

$v = at$

$v = -9.81(5)$

$= -49\ m/s$

We've talked about basketball too much. I learned we have a lot of volleyball players in the class too. ~~Holly~~ Willow, how high does a volleyball travel when a person sets it up for the smash? (3)

Using the height that ~~Holly~~ Willow tells us, what is the initial velocity of the volleyball?

hint: look at what we have (v_f,a,d) and what we want, v_0. One formula has all of this for us.

$$v_f^2 = v_0^2 + 2ad$$

$0 = V_0^2 - 2(9.81)(3)$

$-V_0^2 = -58.9$

$\sqrt{V_0^2} = \pm\sqrt{58.9}$

$V_0 = 7.67\ m/s$

Who knows their vertical leap? (vertical displacement via jumping). reference: Michael Jordan's vertical was 1.29m.

What is the takeoff speed? What is the hangtime? (total time in air)

$$v_f^2 = v_0^2 + 2ad$$

Hint: $v_0 = 5.0\ m/s$

Total Time = hangtime

$$v_f - v_0 = at$$

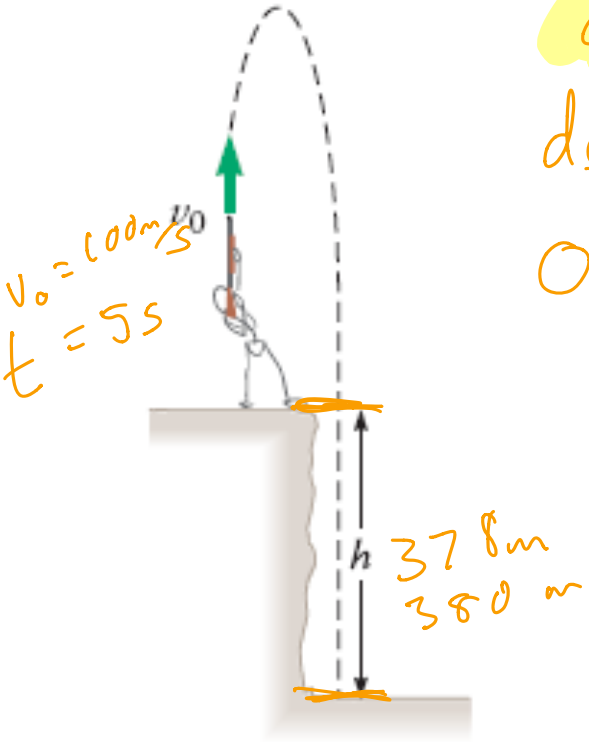
$$-5 - 5 = -9.81t$$

$$\frac{-10}{-9.81} = t$$

$$1.02\,s = t$$

But wait, there's more! What if the starting and finishing ground are at different locations?

height of the cliff = ?



$$d = v_0 t + \frac{at^2}{2}$$

$$d_f - d_0 = v_0 t + \frac{at^2}{2}$$

$$0 - h = 100(5) - 4.9(5)^2$$

$$-h = 500 - 123$$

$$-h = 377$$

I found the reason for the negative height here. $V_0 = 100 m/s$. ∴ in 5s it's still on the way up.
I should have used 25s instead of 5s.

Practice

1. How long will it take for a falling object to reach 108 m/s if its initial velocity is 10.0 m/s?

2. You throw a ball downward from a window at a speed of 2.0 m/s. The ball accelerates at 9.8 m/s^2. How fast is it moving when it hits the sidewalk 2.5 m below?

3. At the beginning of a basketball game, a referee tosses the ball straight up with a speed of 4.6 m/s. A player cannot touch the ball until after it reaches its max height and begins to fall down. What is the minimum time that a player must wait before touching the ball.

4. How high will an arrow be 7.0 seconds after being shot straight up at 50.0 m/s?

5. A ball is thrown up into the air at 15 m/s and returns to the throwers hand 3.06 seconds later. What is the velocity of the ball when it is caught? What do you notice about the answer? What conclusions can you draw from this answer?

6. A cat is capable of jumping to a height of 2.20 m. Determine the takeoff speed of the cat.

7. With what speed in miles/hr (1 m/s = 2.23 mi/hr) must an object be thrown to reach a height of 91.5 m (equivalent to one football field)? Assume negligible air resistance.

8. A ball is thrown upward with an initial velocity of 20.0 m/s. How long is the ball in the air?

9. A baseball is popped straight up into the air and has a hang-time of 6.25 s. Determine the height to which the ball rises before it reaches its peak. (Hint: the time to rise to the peak is one-half the total hang-time.)

10. If you fire a cannonball straight upwards with a starting speed of 40.0 m/s. How high does it go, and how long will it be in the air?

11. A ball is thrown straight upward and rises to a maximum height of 24 m above its launch point. At what height above its launch point has the speed of the ball decreased to one-half of its initial value?

12. A ball is dropped from a roof to the ground 8.0 m below. A rock is thrown down from the roof 0.600 s later. If they both hit the ground at the same time, what was the initial speed of the rock?

13. A ball thrown vertically upward is caught by the thrower after 5.00 s. (a) Find the initial velocity of the ball. (b) Find the maximum height it reaches.

1. Answer: 10.0 seconds
2. Answer: 7.3 m/s downward
3. Answer: $t = 0.47$ seconds
4. Answer: 110 m
5. Answer: 15 m/s downward
6. Answer: $v_i = 6.56$ m/s
7. Answer: $v_i = 42.3$ m/s, $v_i = 94.4$ mi/hr
8. Answer: 4.08 s
9. Answer: $d = 47.9$ m
10. Answer: $d = 81.6$m, 8.16 s
11. Answer: $d = 18$ m
12. Answer: 8.5 m/s downward
13. Answer: 24.5 m/s, 30.6 m