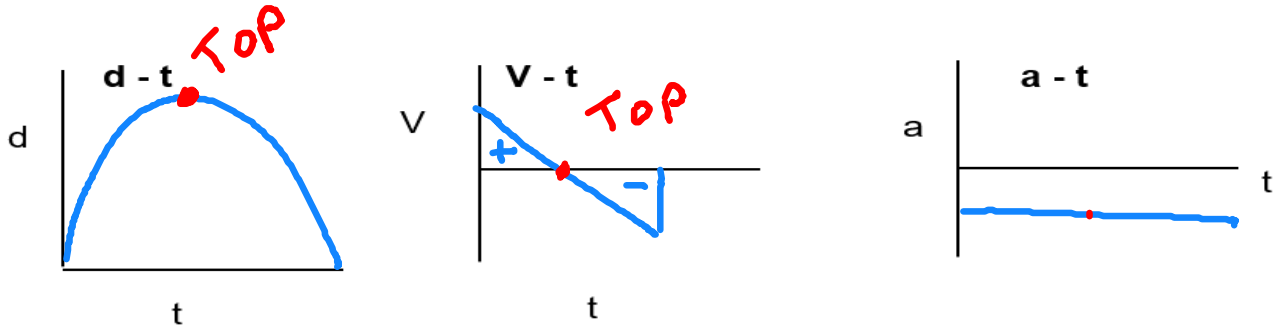


Intro to Free Fall Problems

1. Objects in free-fall accelerate at what rate? -9.8m/s^2

2. Use the graphs generated by the demonstration to answer the following questions.



a) Show on the D-t graph and the V-t graph where the cart is at the top of its path.

b) Based on the V-t graph, how do you know that the ball is at the top of the path?

Changed directions

c) That is the velocity at the top of the path? 0

d) How does the time to the top of the path compare to the total time "in the air"?

Time to the top is half the total time

e) Describe the acceleration from the beginning to the end.

constant & negative

3) What set of rules can apply to all problems in freefall?

- The time up and the time down equals half of the total time in the air.

- On the way up the velocity is + and the acceleration is - therefore the object is? slowing down

- At the top the velocity is 0.

- On the way down the velocity is - and the acceleration is - therefore the object is? speeding up

- The freefall acceleration is always? $g = 9.8\text{m/s}^2$
 a_g

Examples:

A ball is tossed straight up into the air where up is taken as the positive direction. The table below indicates the sign of the velocity and acceleration at points A-E

Point	V	a
A	+	+
B	+	-
C	-	+
D	-	-
E	0	+
F	0	-

- a. At what point is the ball moving up?
V is "+" a is "-" B
- b. At what point is the ball moving down?
Both are "-" D
- c. At what point is the ball changing direction?
v = 0 a is "-" F

E1. A pitcher tosses a ball into the air straight up and it takes 6.0 seconds for the ball to come back down to the pitcher, how long until the ball reached the top of its path?

Time UP = 6.0 / 2 = 3.0

Draw a motion diagram below:

V_i = ? (29.4)
V_f = 0
*d = **
a = -9.8
t = 3

a) At what velocity did the ball leave the pitcher's hand?

V_f = V_i + at *v = 29.4 m/s*

0 = V_i - 9.8(3)

0 = V_i - 29.4

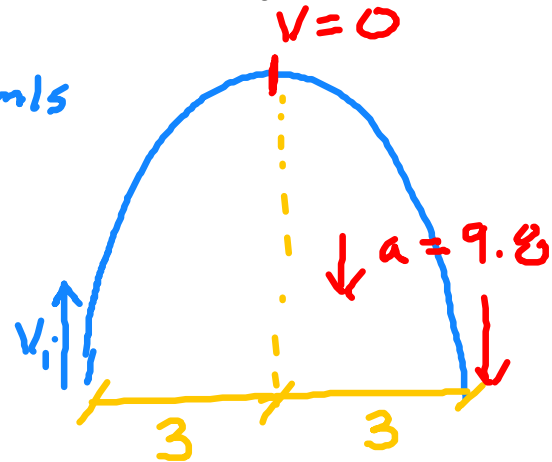
b) How high did the ball go?

d = (V_i + V_f) · t / 2

d = ((29.4 + 0) / 2) (3) = 44.1 m

c) What was velocity when the pitcher caught the ball?
 (Do you need to calculate this?)

V = -29.4 m/s



E2. A climber knocks a rock loose while ascending a vertical wall, the rock starts to fall when it is 35m above the ground, how long do the people below have to take cover?

d = v_it + 1/2 at²
-35 = 1/2 (-9.8) t²
-35 = -4.9 t²
-4.9 -4.9
t² = 7.14

t = √7.14
t = 2.67 Sec

V_i = 0
*V_f = **
d = -35
a = -9.8
t = ?

Free Fall Practice Problems

1 a) A cannon fires a cannonball straight up at 90 m/s. How long is the cannonball in the air? (time up and down)

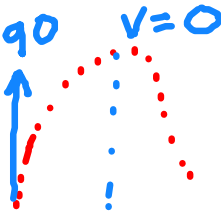
$V_i =$

$V_f =$

$d =$

$a =$

$t =$



b) How high does the cannonball go?

E1

2 a) An archer shoots an arrow straight up into the air. She times the arrow and it is in the air for 5 seconds. How high does the arrow go in 2.5 seconds (the top of the path)? (hint What is the velocity at the top of the path?)

$V_i =$

$V_f =$

$d =$

$a =$

$t =$

b) How fast did she shoot the arrow? (what is the initial velocity?)

c) What is the velocity when the arrow hits the ground?

E2

3 a) A mountain climber wants to figure out how high a cliff is, so he drops a rock off the ledge. The rock takes 2.6 seconds to hit the ground. How high is the cliff?

$V_i =$

$V_f =$

$d =$

$a =$

$t =$

b) How fast does the rock hit the ground?

c) What acceleration does the rock experience?

- 1) 18.4 m/s, 413 m 2) 30.6m, 24.5 m/s, -24.5 m/s 3) 33 m