

Kinematics

Thursday, October 13, 2011 9:02 AM

These are the equations which describe motion. There are 4 variables in each kinematic equation, three you will be given in a problem, you need to find the fourth.

- d <= stands for displacement/distance units of meters
 - t <= stands for time units of seconds
 - a <= acceleration units of meters/second²
 - v_f <= final velocity/speed units of meters/second
 - v_o (v_i) <= initial velocity / speed units meters/second
- $v_o \uparrow$
 $v_i \uparrow$
- 46 m
- blah blah 0.27 s
blah 9.8 m/s²
16 m/s

- 1) go thru problem
 - 2) write down the variables you have
 - 3) match what you have with formulas
 - 4) Solve
- The Magic Words:
 Falls: $v_o = 0$, $a = 9.8 \text{ m/s}^2$ [down]
 Dropped: same as falls
 Stops: $v_f = 0$
 Rest: one of your velocities is zero
- $a = 9.8 \frac{\text{m}}{\text{s}^2}$ down because of gravity
 $v_o = 0$
- TO REST: $v_f = 0$
 AT REST: $v_o = 0$

SOLVING KINEMATICS is about matching information with a formula

A cat
 You run at 3.0 m/s toward a spear and stop after being skewered in 1.0 m
 find the acceleration

Redmas $0 = 9 + 2a$

$v_o = 3 \frac{\text{m}}{\text{s}}$

$v_f = 0$

$d = 1.0 \text{ m}$

$a = ?$ if object is decelerating -9

deceleration

$v_f^2 = v_o^2 + 2ad$
 $0^2 = 3^2 + 2(a)(1)$

$0 = 9 + 2a$
 $-9 = 2a$
 $a = -4.5 \frac{\text{m}}{\text{s}^2}$

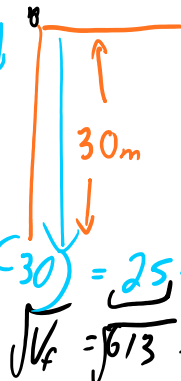
$a = -4.5 \frac{\text{m}}{\text{s}^2}$

Watch out for directions. Suppose your problem gives you a direction like UP then anything going the other way is negative.

A cat is thrown down with an initial velocity of 5.0 m/s off a 30 m high bridge. With what speed will it impact the ground? [Draw a picture]

$v_o = +5$ direction
 $a = +9.8 \frac{\text{m}}{\text{s}^2}$
 $d = +30 \text{ m}$
 $v_f = ?$

$v_f^2 = v_o^2 + 2ad$
 $= (-5)^2 + 2(-9.8)(-30) = 25 + 588$



$v_f = \sqrt{613} = 24.7 \frac{\text{m}}{\text{s}}$

But if the same cat is thrown UP from the same height at 5.0 m/s

- Then
- $v_i = 5 \text{ m/s}$
- $d = -30 \text{ m}$ <= negative because it finishes down 30 m
- $a = -9.8 \text{ m/s}^2$
- $v_f = ?$

Same formula $v_f^2 = v_i^2 + 2ad$ and you get the same answer because a and d are both negative so the negatives factor out!

$V_f = ?$

Same formula $V_f^2 = V_i^2 + 2ad$ and you get the same answer because a and d are both negative so the negatives factor out!

A motorcycle travels at 25 m/s east when it applies the brakes. If it stops after 1.2 s determine the acceleration of the bike.

.83

$$V_0 = 25 \frac{m}{s}$$

$$V_f = 0$$

$$t = 1.2 \text{ s}$$

$$a = ?$$

$$V_f = V_0 + at$$

$$0 = 25 + a(1.2)$$

$$\frac{-25}{1.2} = a = -20.8 \frac{m}{s^2}$$

~~Answer: acceleration is -20.8 m/s^2~~

How far does a cat travel if its initial velocity is 10 m/s and it accelerates at 5.0 m/s² for 3.0 seconds?

Δt
 $\uparrow \uparrow$
 $t_0 = 0$
 $t = 3$

$$d$$

$$v_0 = 10$$

$$a = 5$$

$$t = 3$$

$$d = v_0 t + \frac{1}{2} a t^2$$

$$d = (10)(3) + \frac{1}{2} (5) 3^2$$

$$= 30 + 22.5$$

$$= 52.5 \text{ m}$$

Practice:

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Answers are on page 660