Motion 1

FORMULAS

$\bar{v} = \frac{d}{t}$ $\bar{v} = \frac{v_f + v_i}{2}$ $x\ ^{km}/_{h} \times \frac{1000\ m}{3600\ s} = y\ ^{m}/_{s}$ $g = 10.0\ ^{m}/_{s^2}$ (9.8 $^{m}/_{s^2}$)

Don't have distance? $a = \frac{v_f - v_i}{t}$ $v_f = v_i + at$; when $v_i = 0$, $v_f = at$

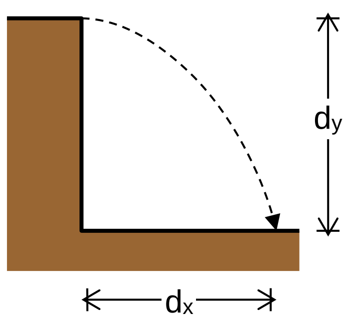
Don't have final velocity? $d = v_i \cdot t + \frac{1}{2} a \cdot t^2$ when $v_i = 0$, $d = \frac{1}{2}at^2$

Don't have time? $v_f^2 = v_i^2 + 2a \cdot d$ when $v_i = 0$, $v_f^2 = 2ad$

COMMON PHRASES

"comes to a stop" → $v_f = 0$
"starting from rest" → $v_i = 0$
"moving at constant velocity" → $a = 0$

HORIZONTALLY-FIRED PROJECTILES



d_x = the horizontal distance the object travels
d_y = the vertical distance the object falls
v_x = velocity at which the object was fired

Then: $d_x = v_x t$ ← no acceleration!
$d_y = \frac{1}{2}at^2 = \frac{1}{2}(10\ ^{m}/_{s^2})t^2$ ← acceleration due to gravity

The time required for the object to reach the ground is the same as if it were dropped from rest. Gravity causes an increase in the vertical velocity, but it doesn't affect the horizontal velocity, which is constant. In general, an acceleration can't affect any motion perpendicular to the direction in which it acts.

EXERCISES

A. A uniformly-moving body travels a distance of 3.0 m in 2.0 seconds.
1) What is its speed? 2) How long will it take to travel 8.0 m?

B. You walk to the store for 800 m at a speed of 1.6 $^{m}/_{s}$ and then jog for 800 m at 15

Authored by Gordon Wong

$^{km}/_{h}$. Determine your average speed in:

1) meters per second   2) kilometers per hour

C. A freight train accelerates uniformly from rest and travels 150 m in 50 s. Determine:

1) its acceleration   2) its final speed

D. A ball is dropped from a bridge. It takes 3.5 s for the ball to strike the surface of the water below. Determine:

1) the height of the bridge (m)   2) the ball's speed when it hits the water

E. A ball is thrown straight down from the top of a building, leaving the thrower's hand at a velocity of 10.0 $^{m}/_{s}$. After 2.50 seconds have passed:

1) what will be the velocity of the ball?   2) how far will it have fallen?

The building is 375 m tall. When the ball reaches the ground:

3) how long will it have been in the air?   4) what will its velocity be?

F. A stone is flung horizontally off a cliff 56 m high with a velocity of 16 $^{m}/_{s}$. When it reaches the ground below:

1) how long will it have been in the air?   2) how far from the cliff base will it be?

SOLUTIONS

A. (1) 1.5 $^{m}/_{s}$ (2) 5.3 s

B. (1) 2.3 $^{m}/_{s}$ (2) 8.3 $^{km}/_{h}$

C. (1) 0.12 $^{m}/_{s^2}$ (2) 6.0 $^{m}/_{s}$

D. (1) 61 m   (2) 35 $^{m}/_{s}$

E. (1) 35.0 $^{m}/_{s}$ (2) 56.3 m   (3) 7.72 s   (4) 87.2 $^{m}/_{s}$

F. (1) 3.3 s   (2) 54 m