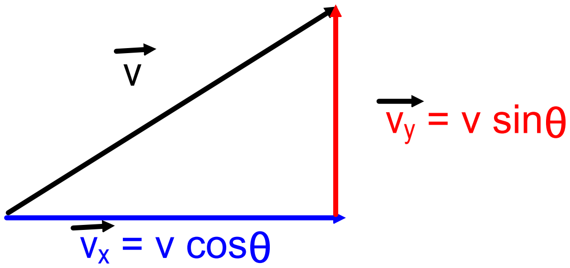
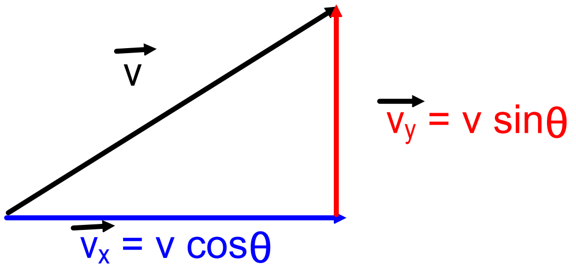
Component Vectors:

Recall that in order to simplify vector calculations we change a complex vector into two simple horizontal (x) and vertical (y) vectors

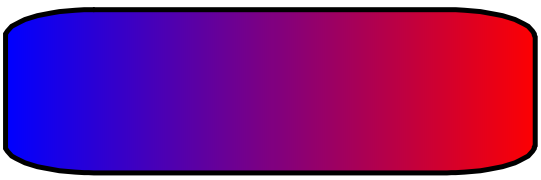


Component Vectors: (review)

Recall that in order to simplify vector calculations we change a complex vector into two simple horizontal (x) and vertical (y) vectors



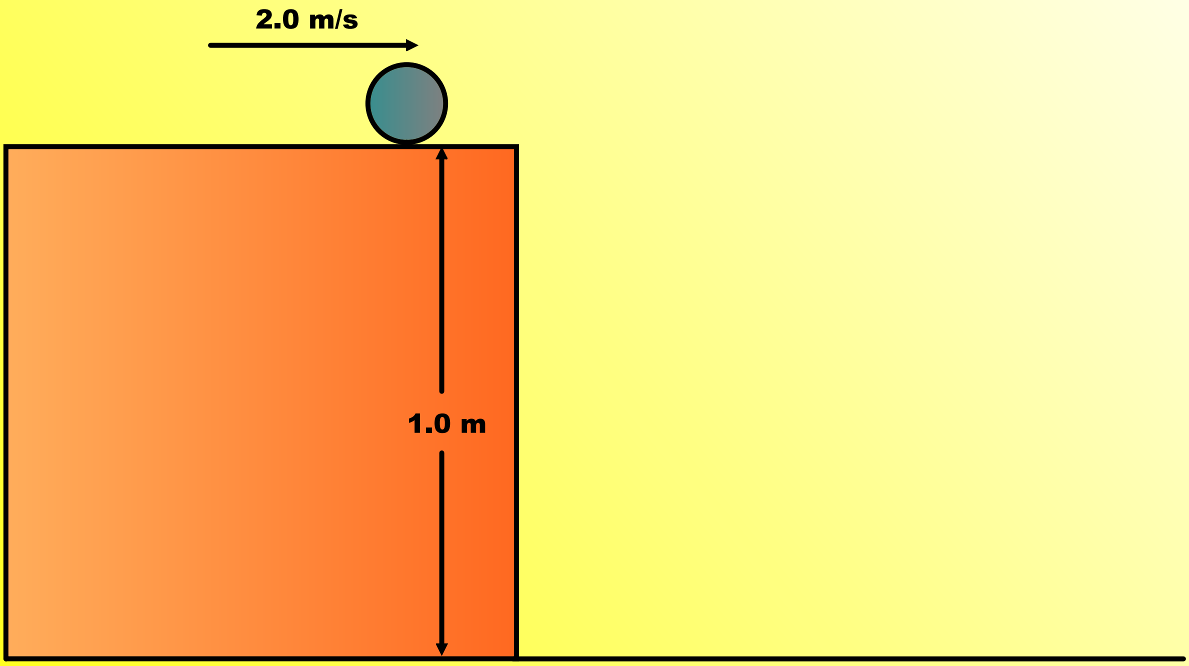
If $\vec{v}$ = 10 m/s [30 degrees up] what are $\vec{v_x}$ and $\vec{v_y}$?

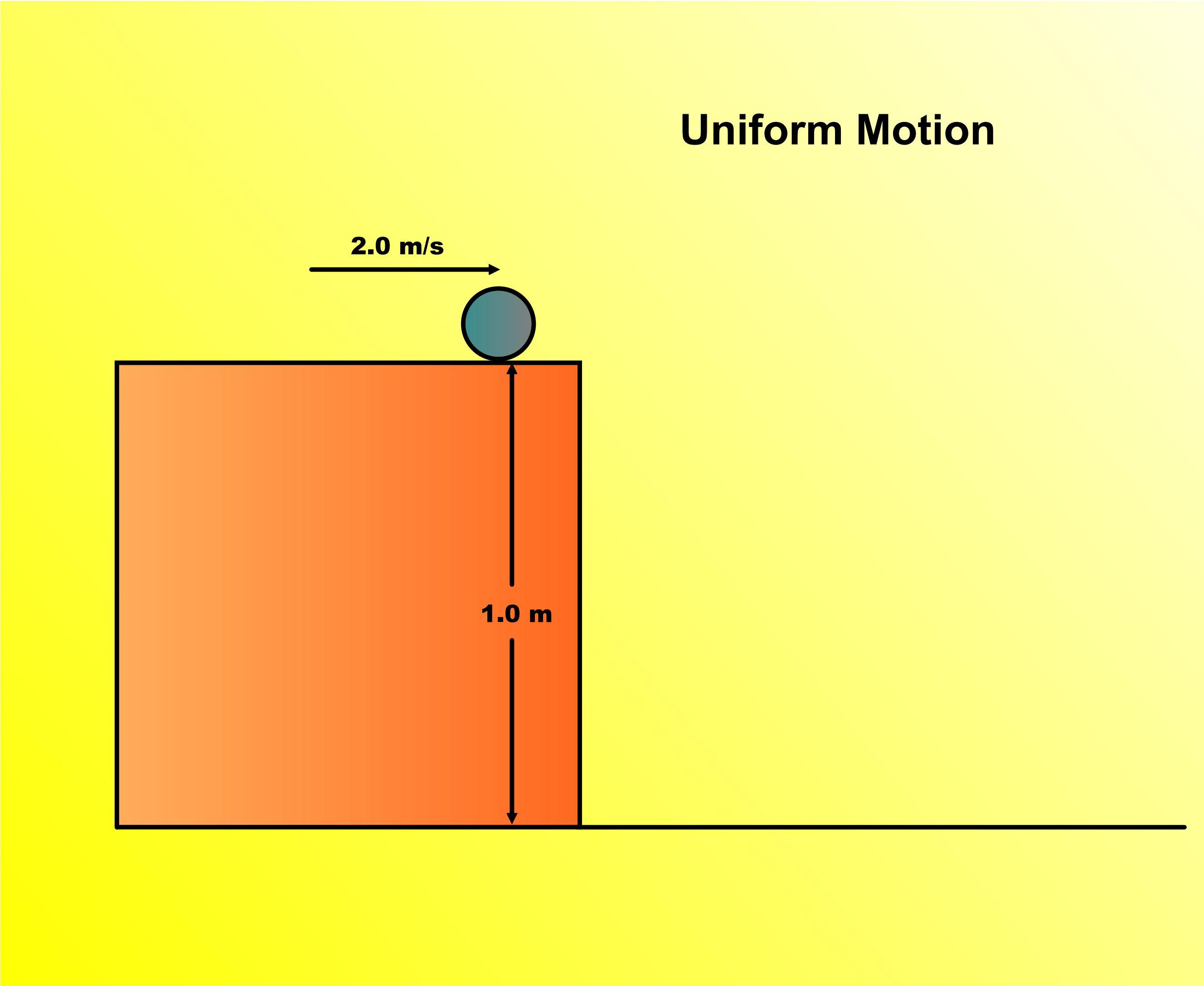


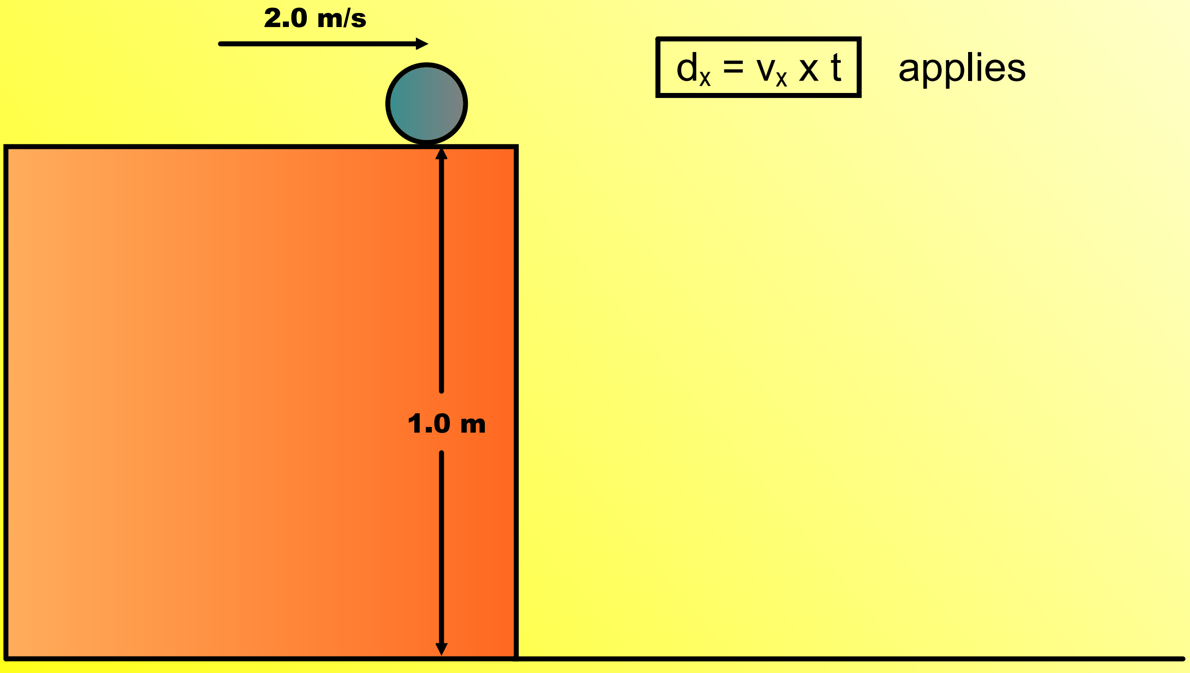
What type of motion does the ball have as it travels across the desktop?

A. Uniform

B. Accelerated




Uniform Motion
2.0 m/s
1.0 m



Uniform Motion

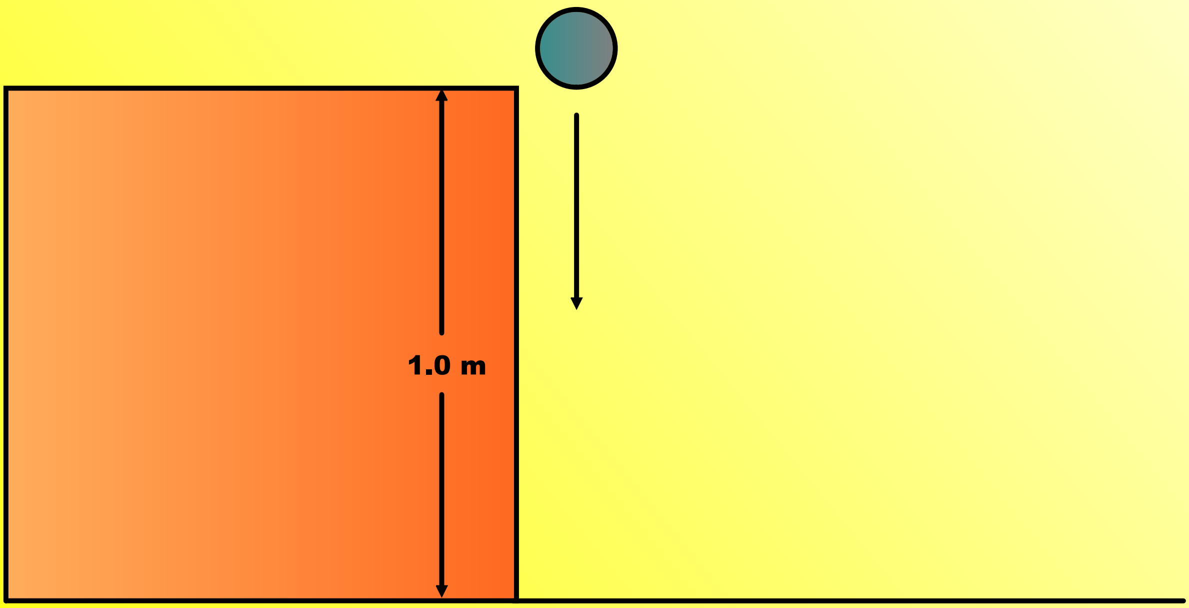
Therefore the formula

$d_x = v_x \times t$ applies

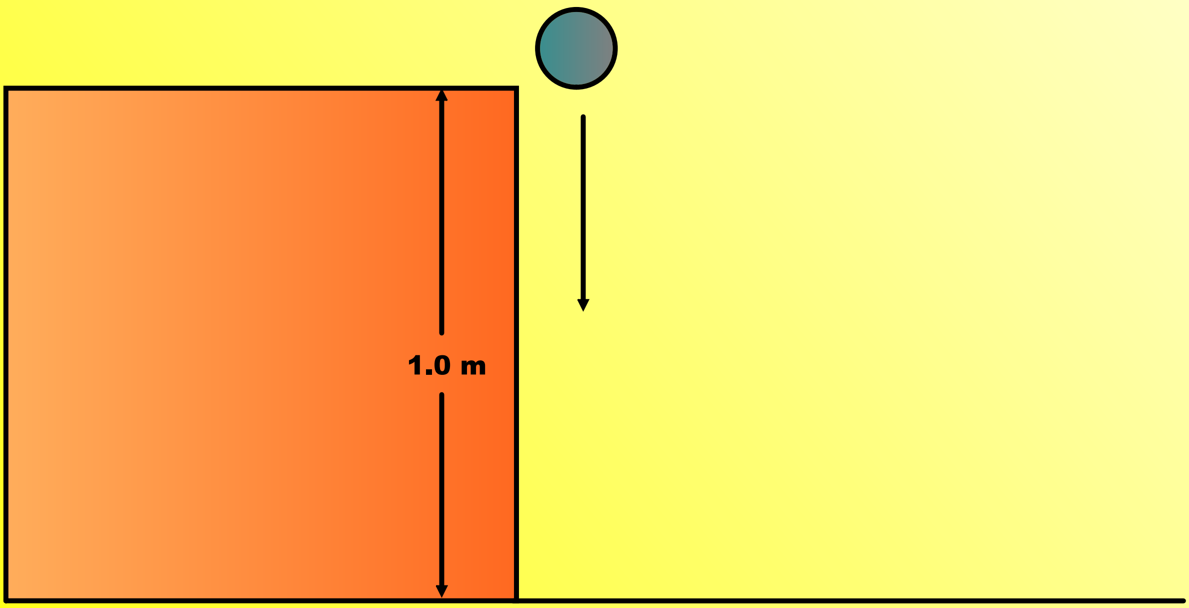
What type of motion would this ball have as it falls?

A. Uniform

B. Accelerated

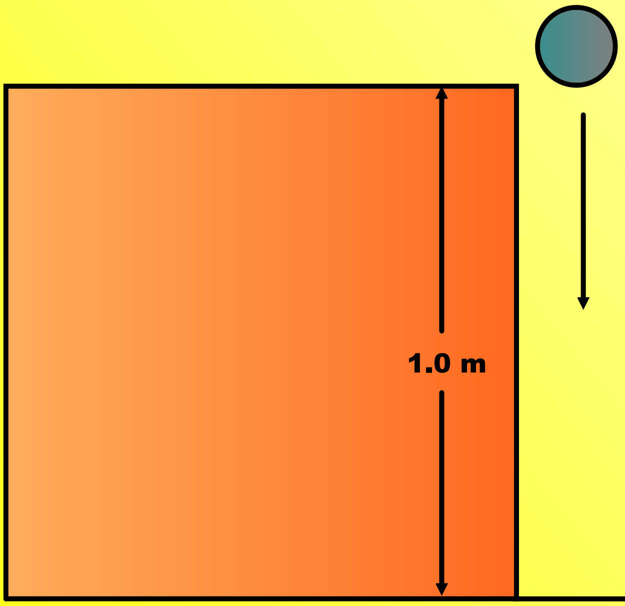


Accelerated Motion



Accelerated Motion

Therefore the following formulas apply:



$d_y = v_{iy}\,t + (a_y\,t^2)/2$ [no vf]

$d_y = v_{fy}\,t - (a_y\,t^2)/2$ [no v_i]

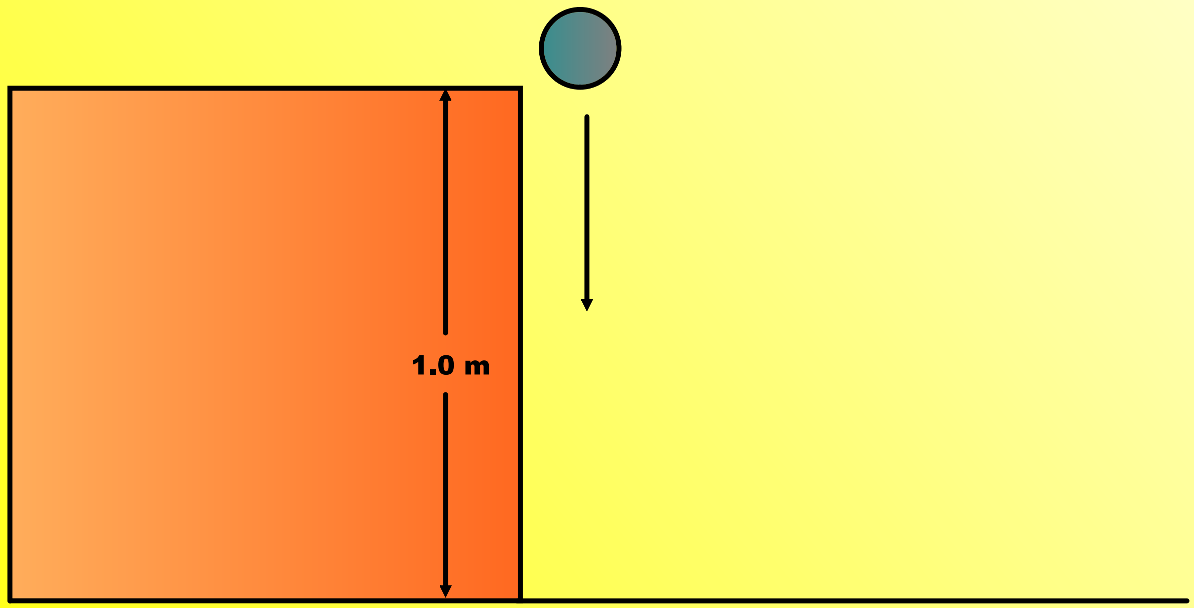
$d_y = (v_{fy}^2 - v_{iy}^2) / 2a_y$ [no t]

$d_y = [(v_{fy} + v_{iy})/2]\,t$ [no a]

$a_y = (v_{fy} - v_{iy}) / t$ [no d]

$a_y = -9.80\ m/s^2$

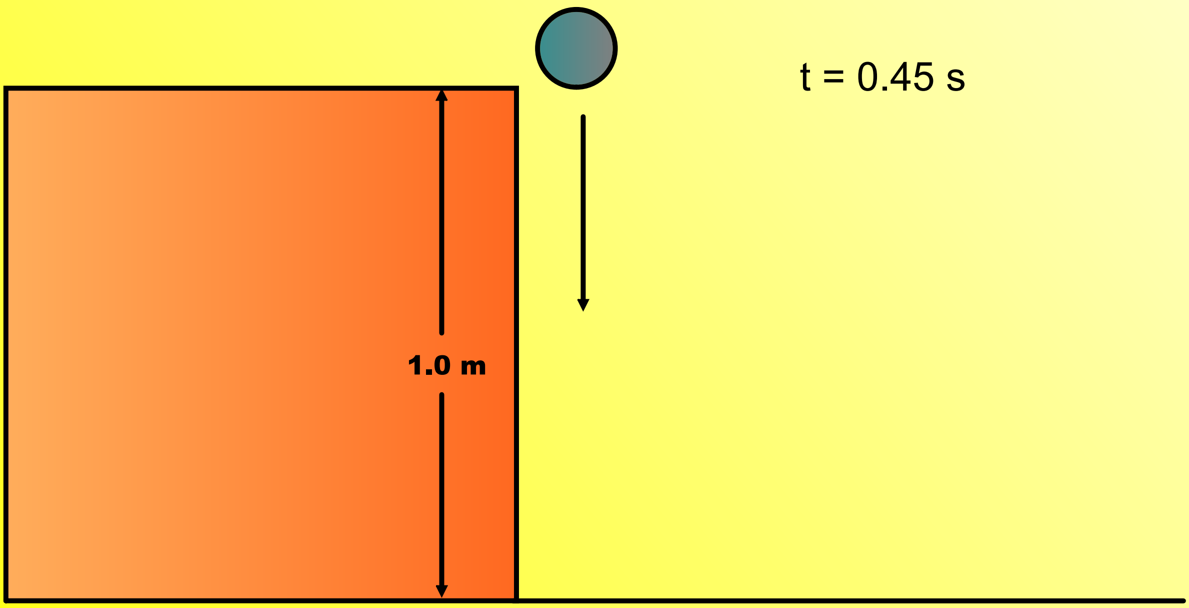
How long does it take for this ball to hit the floor?



How long does it take for this ball to hit the floor?

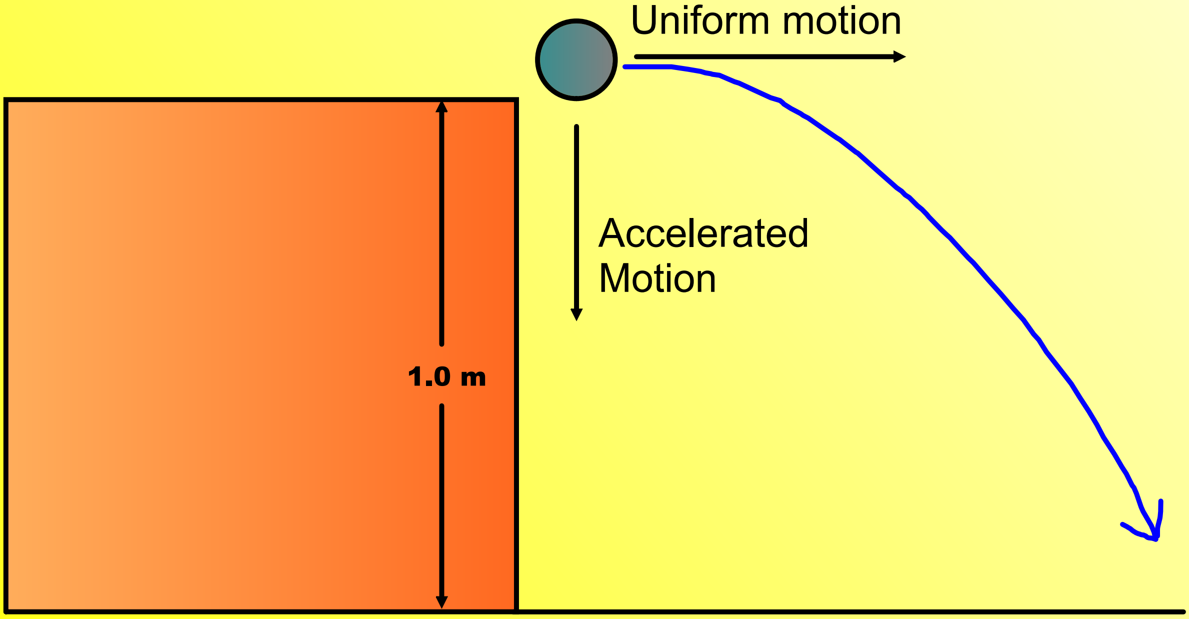
$$d_y = v_{iy}t + (a_y t^2) / 2$$

$$\text{gives } t = \sqrt{2d_y / a_y}$$

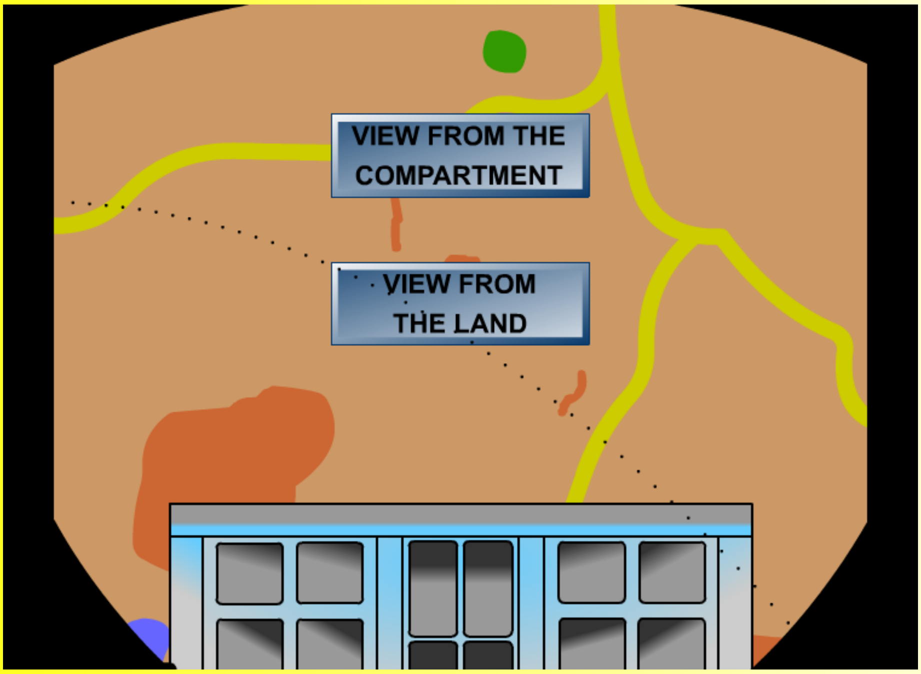


$$t = 0.45 \text{ s}$$

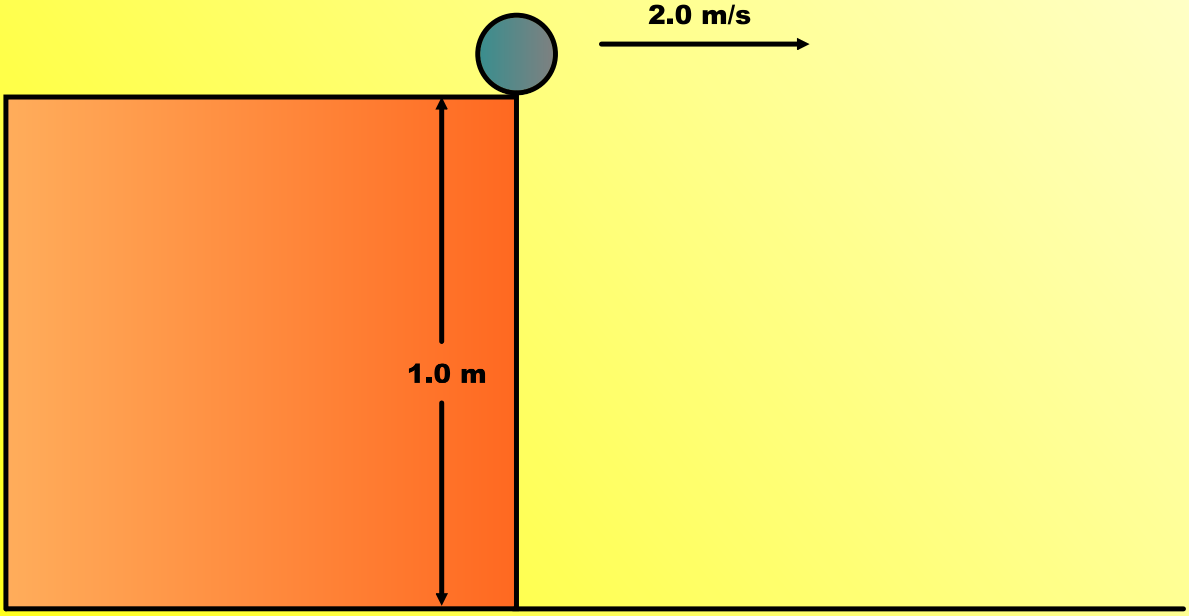
Projectile Motion has both Uniform and Accelerated components to its motion. **Uniform in the horizontal** dimension and **accelerated in the vertical** dimension.



Projectile from a Plane Travelling Horizontally



How far does the ball travel to the right while it is falling?
(ie What is the ball's range?)



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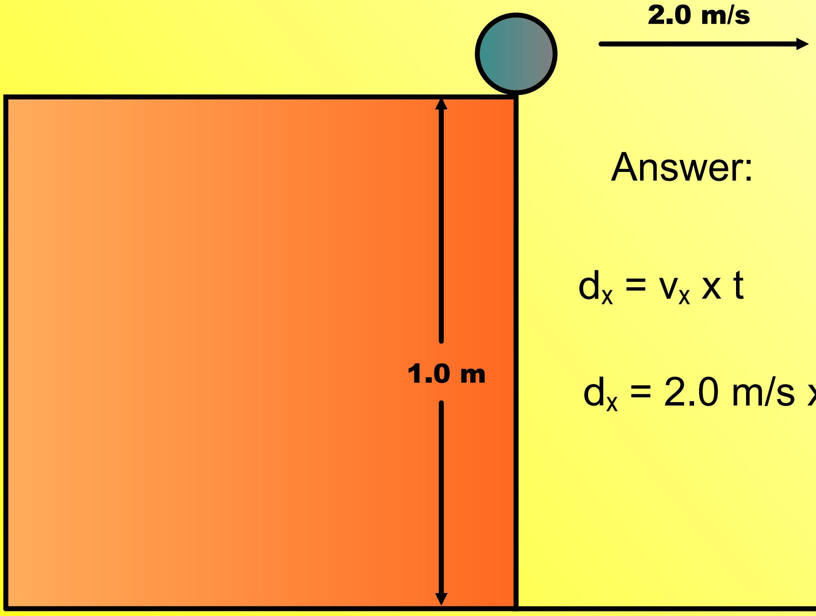


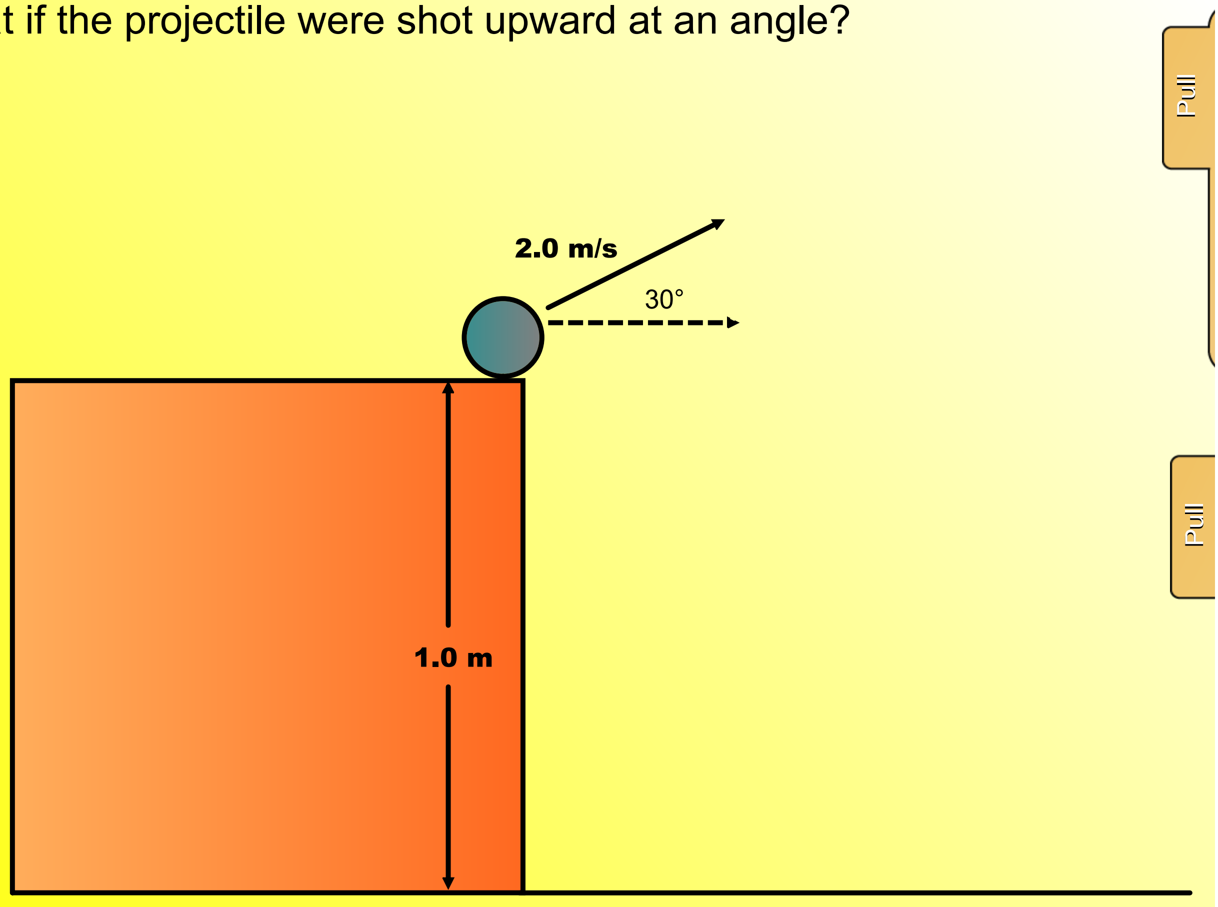
Answer:

$d_x = v_x \times t$

$d_x = 2.0 \text{ m/s} \times 0.45 \text{ s} =$ **<u>0.90 m</u>**

Read: Sec 3.2 pp. 84 - 86
Do : #s 1-3 p.86

What if the projectile were shot upward at an angle?



First off, we'll consider a ball being kicked on a soccer field.

The velocity at which it is kicked can be broken into vertical and horizontal components.

Horizontally: $v_{ix} = 2 \cos 30° =$ **1.7 m/s**

Pull

Vertically: $v_{iy} = 2 \sin 30° =$ **1.0 m/s**

How long will the ball be in the air?

Pull

Another way to approach this problem is to use a second degree polynomial derived from:

$d_y = v_{iy}\, t + (a_y t^2)/2$

or

$d_y = v_{fy}\, t - (a_y t^2)/2$

For this problem $d_y = 0$ (since it lands at the same level from which it is kicked) ; $v_{iy} = 1.0$ m/s and $a_y = -9.8\ m/s^2$

This gives $0 = t - 4.9\, t^2$

$4.9\, t = 1$

so, $t = 1 / 4.9 =$ **<u>0.20 s</u>**

What is the ball's range?

Try This:

A ball is kicked at 5.0 m/s and an angle of 40°. What is its time aloft and its range?

HW: Complete #2a through d on page 94

What is the final velocity of the ball?

$$\overline{d}_y = (\overline{v}_{fy}^2 - \overline{v}_{iy}^2) / 2\overline{a}_y$$

Rearranging gives:

/s[Up]

We can solve for $|\vec{v_f}|$ using the Pythagorean Theorem:

$$|\vec{v_f}| = \sqrt{v_{fx}^2 + v_{fy}^2} = \sqrt{1.7^2 + 1.0^2}$$

$$= \sqrt{3.89} = \underline{2.0\ m/s}$$

Use $\tan\theta$ = (opp / adj) to find the angle θ.

$$\theta = \tan^{-1}(v_y / v_x)$$

$$= \tan^{-1}(1.0 / 1.7) = 30°$$

$\vec{v_x}$ = 2.0 m/s [30° Down]

Now complete 2e on page 94

HW/SW: Study examples pp. 88 - 91
complete #s 20, 22, 27, 29, 31 and 33 pp.115 -116