Lesson 11 – Projectile Motion in the Horizontal

DEMO: Independence of Components

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- All the balls fall at the same rate
- The horizontal and vertical motions are independent of each other
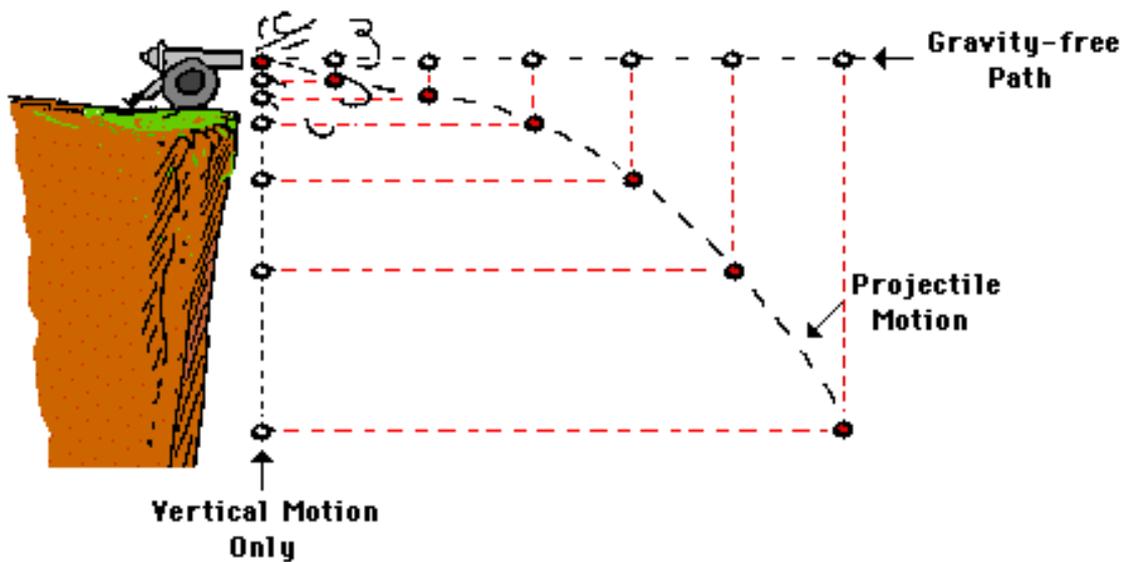
v_1 v_2 v_3
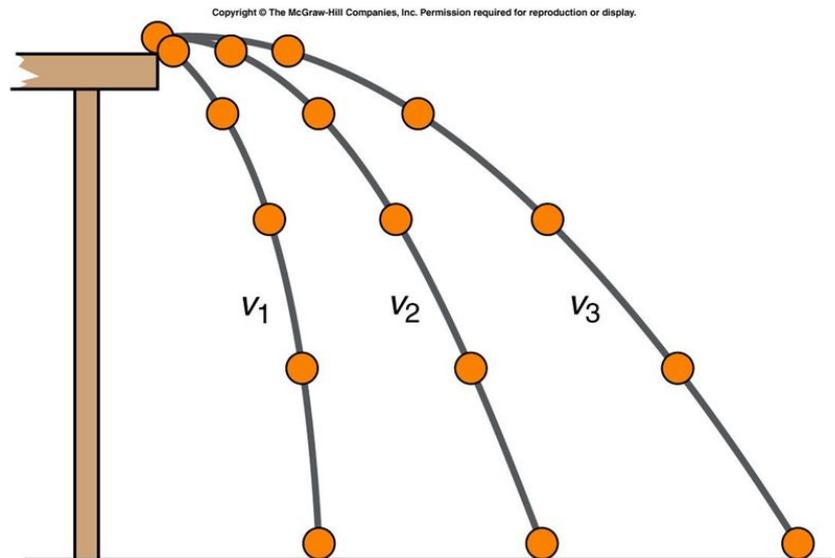
Thought Problem

What hits the ground first a bullet fired at 100 m/s horizontally or a bullet dropped from the same height?
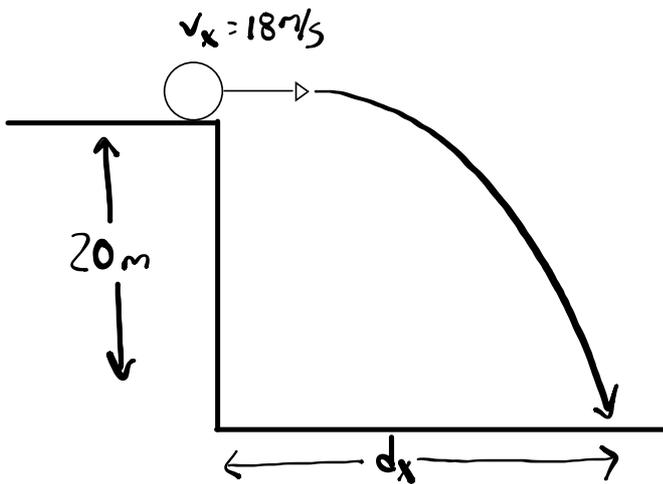
Same time!

Independence of Vx and Vy

Demo

Q1: Head Smashed In Buffalo Jump, near Fort Macleod is a place where Blackfoot Indians chased bison off 20.0 m tall cliffs. Assuming the bison moved at a speed of 18.0 m/s at the top of the cliff, how far from the base do the bison land.

$v_x = 18 \text{ m/s}$

20 m

d_x

x-comp

$v_x = 18 \text{ m/s}$
$d_x = ?$
$t = ?$

y-comp

$v_{iy} = 0 \text{ m/s}$
$a = -9.81 \text{ m/s}^2$
$d_y = -20 \text{ m}$
$t = ?$

$$d = v_i t + \tfrac{1}{2} a t^2$$
$$-20 = (0)t + \tfrac{1}{2}(-9.81)t^2$$
$$-20 = -4.905 t^2$$
$$\div(-4.905) \quad \div(-4.905)$$
$$4.077 = t^2$$
$$\boxed{2.019 \text{ s} = t}$$

x-comp

$$v = \frac{d}{t}$$
$$18 = \frac{d}{2.019}$$
$$\boxed{36.35 \text{ m} = d_x}$$

Q2: Participants in a road race take water from a refreshment station and throw their cups away down the course. If a runner has a forward speed of 6.20 m/s, how far in advance of the garbage pail should he release his water cup if the vertical distance between the lid of the garbage can and the runner's point of release is 0.50 m.

$\underline{x\text{-comp}}$

$v_x = 6.2 \text{m/s}$

$d_x = ?$

$t = ?$

$\underline{y\text{-comp}}$

$v_{iy} = 0 \text{m/s}$

$a_y = -9.81 \text{m/s}^2$

$d_y = -0.5 \text{m}$

$t =$

6.2m/s

0.5m

dx
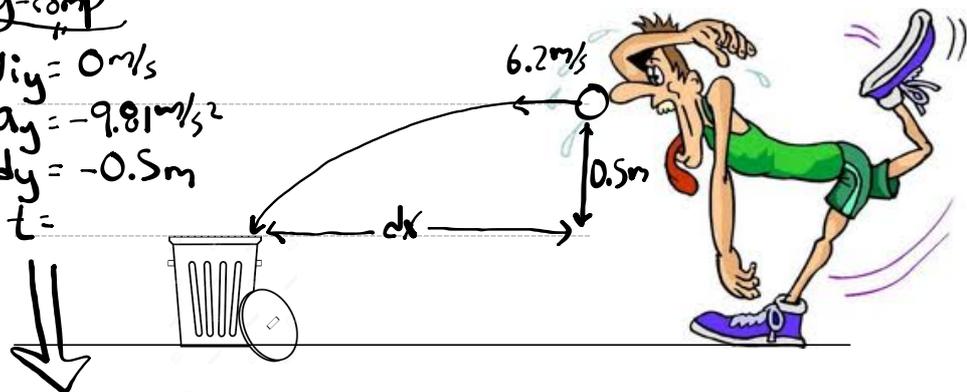
$$d = v_i t + \tfrac{1}{2} a t^2$$

$$-0.5 = (0)t + \tfrac{1}{2}(-9.81)t^2$$

$$-0.5 = -4.905 t^2$$

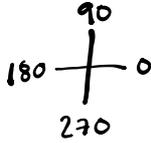$$\div(-4.905) \qquad \div(-4.905)$$

$$0.1019 = t^2$$

$$\boxed{0.3193 = t}$$

$\underline{x\text{-comp}}$

$$v_x = \frac{d_x}{t}$$

$$6.2 = \frac{d_x}{0.3193}$$

$$\boxed{d_x = 1.98 \text{m}}$$

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Q3: A ball moving at 6 m/s [0] rolls horizontally off of a 10 m ledge. What is the speed of the ball just before it hits the ground?

a. 6 m/s
b. 14 m/s
c. 15 m/s
d. 20 m/s

90

180 ─┼─ 0

270

6 m/s

$V_f = ?$

X-comp

$V_x = 6 m/s$
$d_x = ?$
$t = ?$

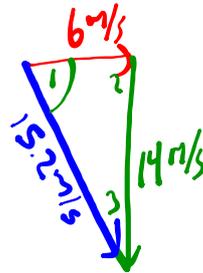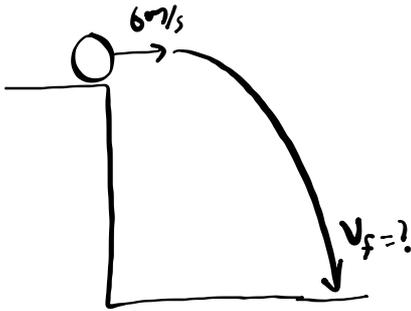**y-comp**

$V_{iy} = 0 m/s$
$a = -9.81 m/s^2$
$d_y = -10 m$
$t = ?$
$V_{fy} = ?$

$V_f^2 = V_i^2 + 2ad$
$= (0)^2 + 2(-9.81)(-10)$
$V_f^2 = 196.2$

$V_{fy} = 14.007 m/s$

6 m/s

15.2 m/s

14 m/s

Q4: The ball strikes the ground at what angle?•

*(Record your **three-digit** answer in the Numerical Response boxes below)*

| 6 | 6 | • | 8 |

$Tan\theta = \left(\dfrac{14.007}{6}\right)$

$\theta = 66.8°$

Practice

Pg 107 #1-3
Pg 109 #1
Pg 114 #13, 16