Projectile Motion
Gazelles off of Cliffs

Review

1-D motion in the x-direction
(without acceleration…)

$\Delta x =$
$v_i =$
$v_f = v_i$
$a = 0$
$t =$

$\Delta x =$
$v_x =$
$t =$

$$v_x = \frac{\Delta x}{t}$$

Review

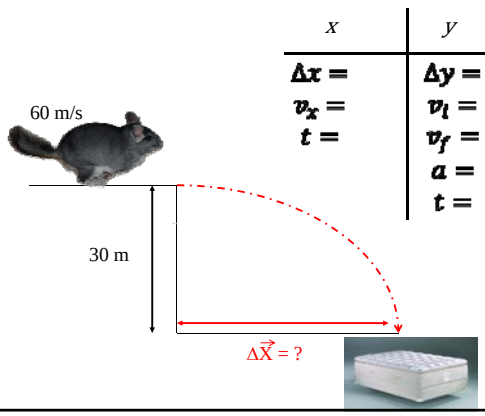
Free fall
(in the y-direction)

$\Delta y =$
$v_i =$
$v_f =$
$a = -9.8\ m/s^2$
$t =$

$$\Delta y = v_i \cdot t + \frac{1}{2} a \cdot t^2$$
$$v_f^2 = v_i^2 + 2a \cdot \Delta y$$
$$v_f = v_i + a \cdot t$$

Sample Problem

- A chinchilla is seen running at 60 m/s at the top of a 30 meter high cliff. If the chinchilla runs straight off of the cliff, how far away from the base of the cliff should the soft mattress be placed so that the chinchilla doesn't injure itself.
- First draw a picture and separate the information into X and Y information.



x	y
$\Delta x =$	$\Delta y =$
$v_x =$	$v_i =$
$t =$	$v_f =$
	$a =$
	$t =$

$\Delta y =$
$v_i =$
$v_f =$
$a =$
$t =$

$$\Delta y = V_i t + \frac{1}{2} a t^2$$
$$-30m = 0m/s(t) + \frac{1}{2}(-9.8m/s^2)t^2$$
$$t = 2.47\,\text{sec}$$

X	Y
$\vec{V}_x$ = 60 m/s	$\vec{V}_i$ = 0 m/s
$\vec{\Delta X}$ = ?	a = -9.8 m/s^2
t =	$\vec{\Delta y}$ = -30 m
	t = 2.47 sec

Note there is ***NO*** acceleration in the X direction; therefore, the **ONLY** formula you may use is **v =Δx/t**

$$V_x = \frac{\Delta X}{t}$$

$$60m/s = \frac{\Delta X}{2.47\,\text{sec}}$$

$$\Delta X = 148.5m$$

Sample Problem 2

- A wombat running with a velocity of 35 m/s does not see the cliff ahead and runs horizontally off the cliff. If he lands in soft mud 40 meters from the base of the cliff, how high is the cliff?

X	Y
$\vec{V}_x$ = 35 m/s	$\vec{V}_i$ = 0 m/s
$\vec{\Delta X}$ = 40 m	a = -9.8 m/s^2
t =	$\vec{\Delta y}$ = ?
	t =

TIME IS THE SAME IN BOTH THE X AND Y DIRECTIONS….

SOLVE FOR TIME WHERE YOU HAVE ENOUGH INFORMATION

Note there is ***NO*** acceleration in the X direction; therefore, the **ONLY** formula you may use is **v =Δx/t**

$$V_x = \frac{\Delta X}{t}$$

$$35m/s = \frac{40m}{t} \qquad t = 1.14\,\text{sec}$$

X	Y
$\vec{V}_x$ = 35 m/s	$\vec{V}_i$ = 0 m/s
$\vec{\Delta X}$ = 40 m	a = -9.8 m/s^2
t = 1.14 s	$\vec{\Delta y}$ = ?
	t = 1. 14 s

Note there ***IS*** acceleration in the Y direction therefore any kinematic may be used

$$\Delta y = V_i t + \frac{1}{2}at^2$$

$$\Delta y = 0m/s(1.14s) + \frac{1}{2}(-9.8m/s^2)(1.14s)^2$$

$$\Delta y = -6.37m$$

The cliff is 6.37 m high