Mastering Physics Assignment #1

The first assignment is available at the Mastering Physics website for PHYS1020UM

It is due on Monday, September 24, at 5 pm

Register for Mastering Physics if you haven't done so already!

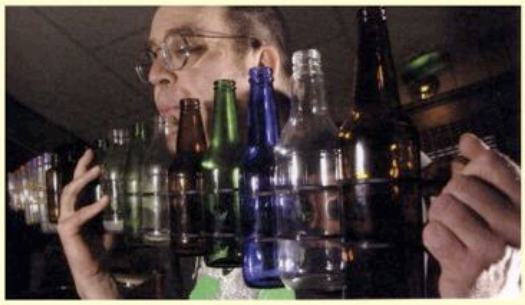
(5% of final grade for Mastering Physics assignments)

Answers to even-numbered problems

Username: PHYS1020

Password: xxxxxxxx

FALL 2007



Welcome to Physics 1020!

Instructors | Required Materials | Schedule | Policies/Evaluation | Suggested Problems | Formula Sheet

Answers to Even-Numbered Problems

Mastering Physics Assignment # 1

Information on "Mastering Physics"

Combining Mastering Physics with Mastering Chemistry

GENERAL PHYSICS I: PHYS 1020

Schedule - Fall 2007
(lecture schedule is approximate)

3	M	17	5			Errors Lecture
	W	19	6	Chapter 3	Kinematics in two dimensions	
	F	21	7			
4	M	24	8			Experiment 1: Measurement of Length and Mass
	W	26	9	Chapter 4	Forces and Newton's laws	
	F	28	10			
5	M	**Oct 1**	11			Tutorial and Test 1 (chapters 1, 2, 3)
	W	3	12	Chapter 5	Uniform circular motion	
	F	5	13			

Next week

Experiment 1, measurement of length and mass

Week of October 1

Tutorial and test 1 on chapters 1, 2, 3

Projectile Motion

- Consider motion in x and y separately
- Ignore air resistance → velocity in x-direction is constant
- Write down positions in x and y as a function of time
- Remember that the projectile travels up and down (y) in the same time that it is travelling sideways (x)

Clickers!

3.C8: A rifle, at a height H above the ground, fires a bullet parallel to the ground.

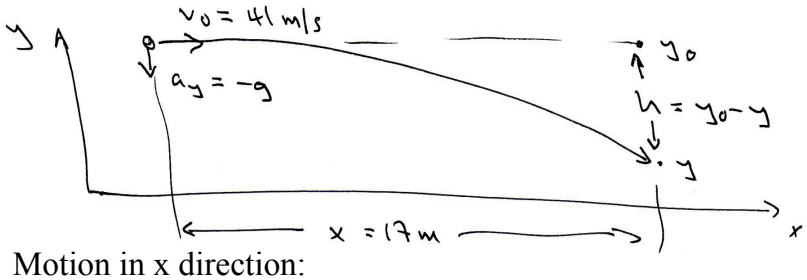
At the same instant and at the same height, a second bullet is dropped from rest.

In the absence of air resistance, which bullet strikes the ground first?

A) The bullet that is dropped strikes the ground first
B) The bullet fired from the rifle strikes the ground first
C) The bullets strike the ground at the same time
D) Impossible to say without knowing the speed of the bullet

Projectile Motion

3.24/26: A ball is thrown horizontally at 41 m/s. How much does it drop while travelling a horizontal distance of 17 m?



Motion in x direction:

$v_x = v_0 = 41$ m/s (constant in absence of air resistance)

Time to travel 17 m in x direction: $t = \dfrac{17 \text{ m}}{41 \text{ m/s}} = 0.4146 \text{ s}$

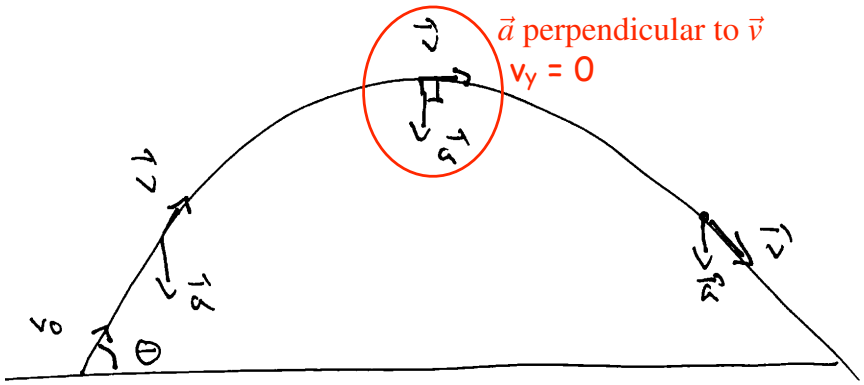
Motion in y: $y = y_0 + v_{0y}t - \dfrac{1}{2}gt^2$

Ball drops by: $h = y_0 - y = 0 + \dfrac{1}{2}g \times 0.4146^2 = 0.84 \text{ m}$

3.C2: An object is thrown up in the air at an angle θ.

a) Is there a point where the acceleration and velocity are perpendicular?

b) Is there any point where velocity and acceleration are parallel?

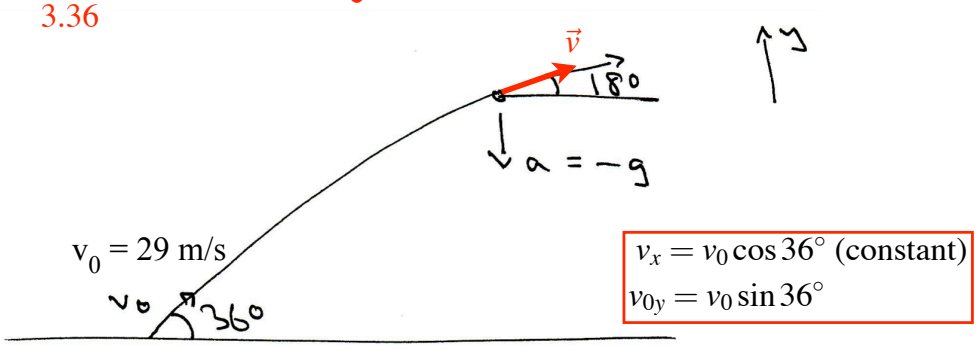


Acceleration is always downward – gravity always pulls downward

Velocity is always tangent to the trajectory

Projectile Motion

3.36



$v_x = v_0 \cos 36^\circ$ (constant)

$v_{0y} = v_0 \sin 36^\circ$

A projectile is launched with initial speed v_0 = 29 m/s at 36° to the horizontal. When does the path make an angle of 18° to the horizontal?

The angle to the horizontal is given by: $\tan\theta = \dfrac{v_y}{v_x}$

So need to find when: $v_y = v_x \tan 18^\circ$

So need to find when: $v_y = v_x \tan 18^\circ$

$v_0 = 29$ m/s

v_x

So, $v_y = v_0 \cos 36^\circ \tan 18^\circ = 0.2629 v_0$

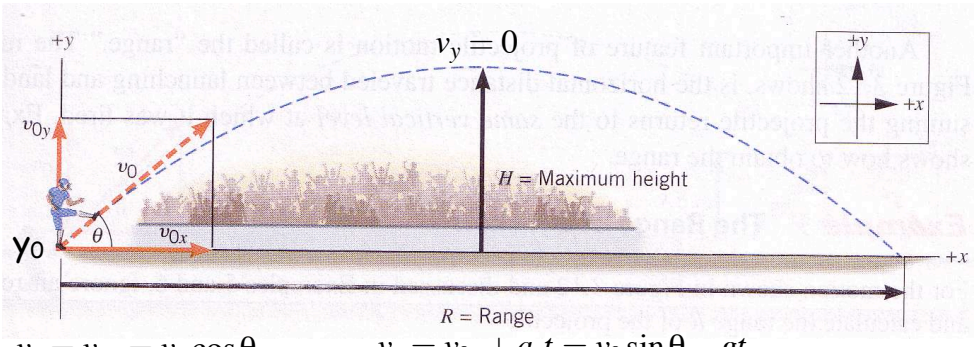
Famous equation for v_y:

$$v_y = v_{0y} - gt$$

Therefore, $t = \dfrac{v_{0y} - v_y}{g} = \dfrac{v_0 \sin 36^\circ - 0.2629 v_0}{g}$

$$t = (29 \text{ m/s}) \times \frac{(\sin 36^\circ - 0.2629)}{9.8} = 0.961 \text{ s}$$

Projectile Motion – Range, Maximum Height



$v_x = v_{0x} = v_0 \cos\theta$ $\qquad$ $v_y = v_{0y} + a_y t = v_0 \sin\theta - gt$

In a time t, the projectile travels a distance R (range) to the right

$R = v_x t \rightarrow t = R/v_x$ and v_x is constant

In the same time, the projectile falls back to the ground, at $y = y_0$

$$y - y_0 = v_{0y} t - \frac{1}{2} g t^2$$

$$0 = v_{0y} t - \frac{1}{2} g t^2 \rightarrow t = 2v_{0y}/g$$

$$t = \frac{R}{v_x} = \frac{2v_{0y}}{g} \rightarrow R = \frac{2v_x v_{0y}}{g}$$

Range of a projectile

$$R = \frac{2v_x v_{0y}}{g} = \frac{2v_0^2 \sin\theta\cos\theta}{g} \qquad [2\sin\theta\cos\theta = \sin 2\theta]$$

$$\boxed{R = \frac{v_0^2 \sin 2\theta}{g}}$$

Maximum range when $\theta = 45°$

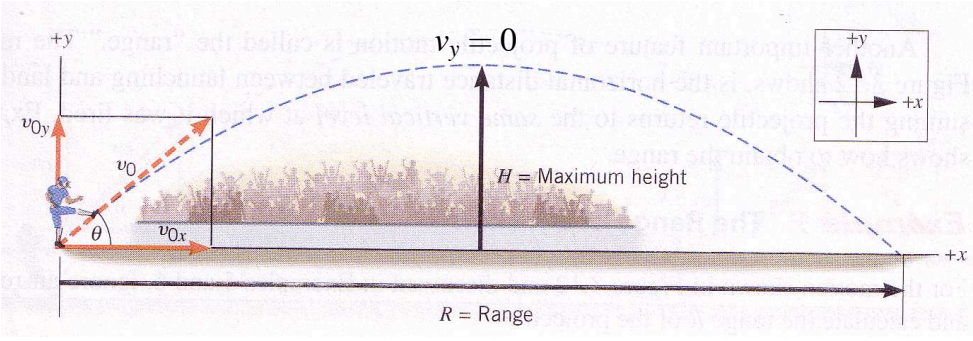
Projectile reaches maximum height, H, when $v_y = 0$

$$v_y^2 = v_{0y}^2 - 2g(y - y_0) \qquad \text{so, } 0 = (v_0 \sin\theta)^2 - 2gH$$

$$\boxed{\text{Therefore } H = \frac{(v_0 \sin\theta)^2}{2g}}$$

eg $v_0 = 100$ m/s, $\theta = 30° \rightarrow R = 884$ m, $H = 128$ m

Projectile Motion – Range, Maximum Height



The projectile travels the horizontal distance R in the same time that is travels up to height H and back down to the initial height.

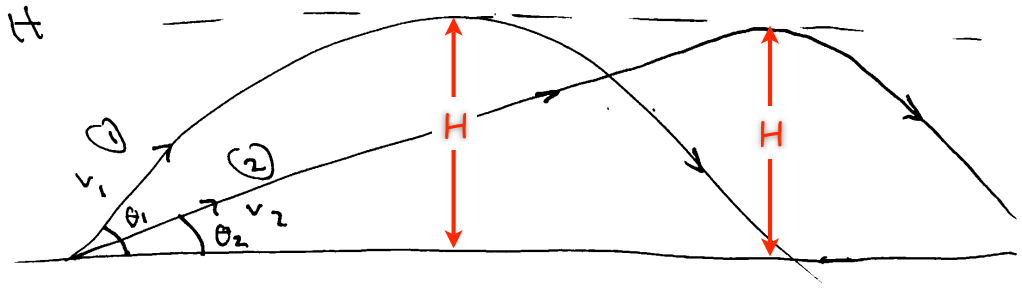
$$\boxed{R = \frac{v_0^2 \sin 2\theta}{g}, \quad \text{greatest range when } \theta = 45°}$$

$$\boxed{H = \frac{(v_0 \sin\theta)^2}{2g}}$$

Clickers!

3.C12: Balls 1 and 2 are launched from the same spot at different angles to the ground. They both reach the same maximum height, H, but ball 2 has the greater range.

Decide which ball, if either, has the greater initial speed.



A) Ball 1 is faster, B) Ball 2 is faster

As they reach the same maximum height, they must have the same initial speed in upward direction, $v_{oy1} = v_{oy2}$, so $v_1 \sin\theta_1 = v_2 \sin\theta_2$