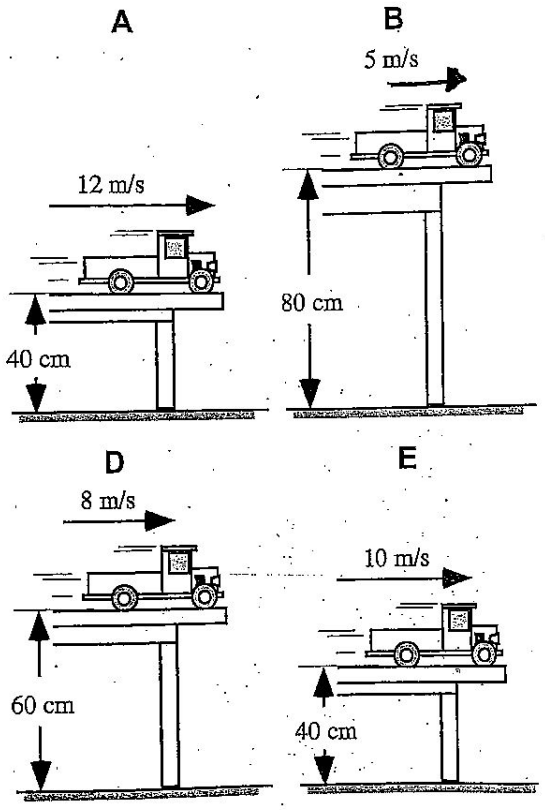
C2

PHY 111 **Toy Trucks off Tables**

Each of the figures shows a toy truck rolling off a table. The height of the table and the speed of the truck are given.

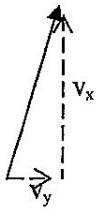
How far forward will each truck go before hitting the floor?



2

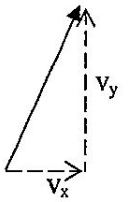
PHY 111 **Getting v_x and v_y from v_o and the angle θ (homework)**

You are given the initial velocity v_o and the angle θ. Find the components of the velocity, v_x and v_y.



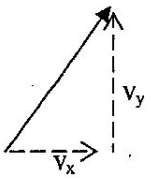
$v_o = 80$ m/s $\quad v_x =$

$\theta = 60°$ $\quad v_y =$



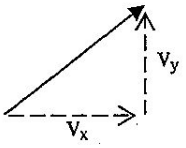
$v_o = 80$ m/s $\quad v_x =$

$\theta = 53°$ $\quad v_y =$



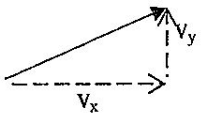
$v_o = 80$ m/s $\quad v_x =$

$\theta = 45°$ $\quad v_y =$



$v_o = 80$ m/s $\quad v_x =$

$\theta = 37°$ $\quad v_y =$

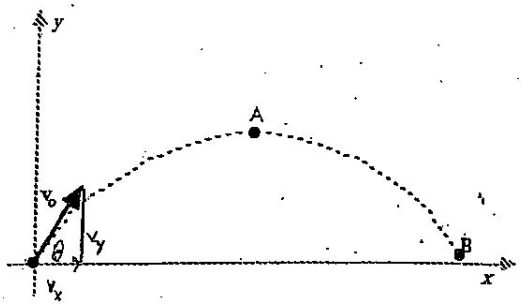


$v_o = 80$ m/s $\quad v_x =$

$\theta = 30°$ $\quad v_y =$

PHY 111 How far does it go? #2

1. You are given the initial velocity v_o and the angle θ of a projectile launched from the ground and returning to the ground.
a) Find the components of the velocity, v_x and v_y.
b) What is the total air time for the projectile (time up + time down)?
c) Determine the forward distance the projectile travels while in flight.
2. You are given the components of the initial velocity, v_{xo} and v_{yo} of a projectile launched from the ground and returning to the ground.
a) Find the initial velocity v_o and the angle θ.
b) What is the total air time for the projectile (time up + time down)?
c) Determine the forward distance the projectile travels while in flight.



1. $v_o = 75$ m/s

$\theta = 37°$

$v_{xo} =$ (round)

$v_{yo} =$ (round)

air time =

forward distance =

velocity at point A =

2. $v_{xo} = 40$ m/s

$v_{yo} = 65$ m/s

$v_o =$

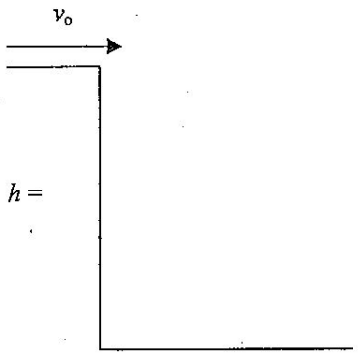
$\theta =$

air time =

forward distance =

velocity at point A =

3.



$v_o = 45$ m/sec

$h = 180$ m

$v_{xo} =$

$v_{yo} =$

air time =

forward distance =

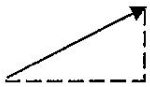
Trace the trajectory.

4

PHY 111 How far does it go? #3

You are given the initial velocity v_o and the angle θ of a projectile launched from the ground and returning to the ground.
a) Find the components of the velocity, v_x and v_y (round to the nearest whole number).
b) What is the total air time for the projectile (time up + time down)?
c) Determine the forward distance the projectile travels while in flight.
d) What is the shape of the projectile's path? Make a rough sketch of the projectile's path.

1.



$v_o = 53.85$ m/s

$\theta = 21.8°$

$v_x =$

$v_y =$

air time =

forward distance =

2.

$v_o = 47.17$ m/s

$\theta = 58°$

$v_x =$

$v_y =$

air time =

forward distance =

PHY 111 **Projectile Motion Problem (Baseball)**

1. A baseball player throws a baseball at a speed of 42 m/s at an angle of 40° above the horizontal. The ball will be caught at the same height it was thrown. We will want to find the horizontal distance the ball travels.

a) Determine the x and y components of the initial velocity. Draw the initial velocity vector and draw the components.

$v_{ox} =$

$v_{oy} =$

b) How long will it take for the ball to reach the top its trajectory? How long will the ball be in flight?

c) What will the ball's velocity be at the highest point of its trajectory?

d) What horizontal distance does the ball travel?

6

PHY 111 **Robbie Knieval**

A few years ago, Robbie Knieval jumped a relatively narrow part of the Grand Canyon on a motorcycle. According to news reports and photographs, his take off speed was about 100 mph (about 45 m/s) and the angle of the take-off ramp was about 21°.

For the purposes of this problem, we assume that his take-off elevation was the same as his landing elevation ($y_o = y_f = 0$). You may let g =10 m/s/s and ignore the effects of air resistance (a luxury that Robbie Knieval did not have).

- Find the x and y components of initial velocity.

  v_{ox} =

  v_{oy} =

- Use the vertical motion to determine how long he was in the air.

- Use the horizontal motion to determine the horizontal distance he will travel while in the air.

- Write the equations of motions and check the distance on the calculator.

  $x(t)$ =

  $y(t)$ =

  horizontal distance on calculator:

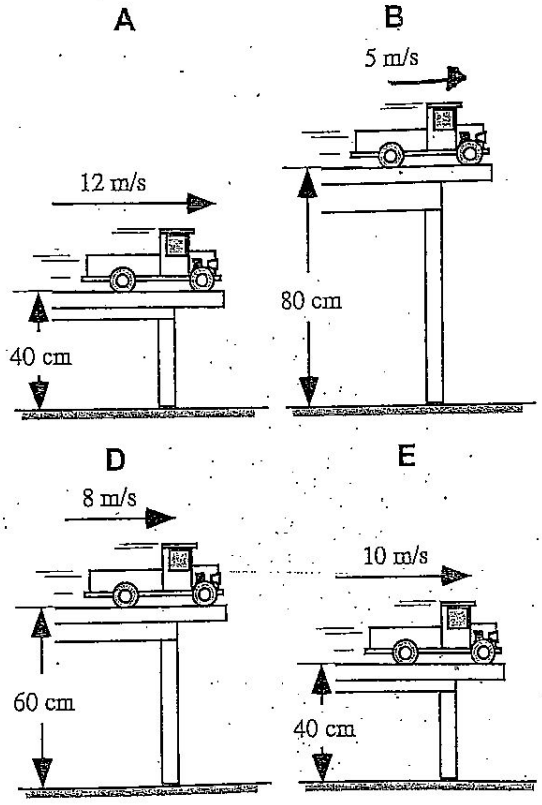
  maximum height above $y = 0$ on calculator:

- Would you expect your answer for the horizontal distance to be more or less than actual distance traveled? Explain. (Note: The actual distance of his jump was 228 feet.)

PHY 111 **Toy Trucks off Tables** #2

Each of the figures shows a toy truck rolling off a table. The height of the table and the speed of the truck are given.

What is the impact speed of each truck as it hits the floor?



8

PHY 111 **Jumping off a dock**

A man runs horizontally off a dock and tries to land in a boat 8 feet away. The dock is 6 feet above the boat. We will want to find what speed the man needs in order to land in the boat. (Let 1 foot = 30 cm.) (Convert distances to meters.)

a) What is the time that the man will be in the air?

b) What is the minimum speed the man will need in order to land in the boat?

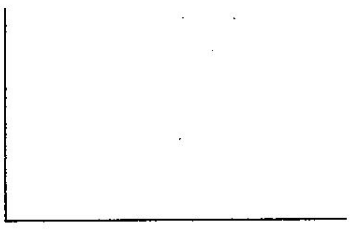
c) What will be the man's impact speed when he hits the boat?

d) Write the parametric equations of motions for the man while he is in the air.

$x(t) =$

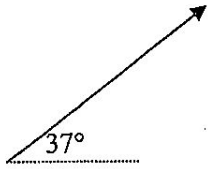
$y(t) =$

e) Sketch the man's path. Label and scale your axes.



PHY 111 **Projectile Motion/Finding the value of *g* on a planet**

A projectile is launched from the surface of another planet with an initial velocity of 100 m/s at an angle of 37° above the ground.



$v_o = 100$ m/s $\qquad v_x =$

$\theta = 37°$ $\qquad v_y =$

1. Find the *x* and *y* components of the initial velocity.

2. The total flight time for the projectile (up and down) is 10 seconds. What is the value of *g* on the planet?

3. What is the total distance the projectile travels?

4. What is the speed of the projectile at the top of its path?

5. How high is the projectile at the top of its path?

6. Write the parametric equations for *x(t)* and *y(t)* for the motion.

x(t) = $\qquad$ *y(t)* =

10

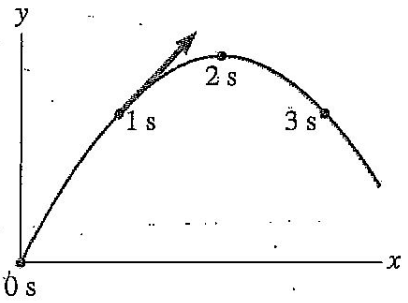
PHY 111 **What is the value of 'g' on a planet?**

1. A ball is thrown straight upward from the ground at a speed of 24 m/sec. It takes 12 seconds for the ball to reach its highest point and return to the ground. What is the value of g on that planet?

2. On another planet, a ball is thrown from the ground at a speed of 25.8 m/sec at an angle of 54.5° above the horizontal. It takes 6 seconds for the ball to return to the ground. What is the value of g on that planet? (3 sec up and 3 sec down)

PHY 111 **Projectile Motion: unknown value of g**

The diagram shows the path of a projectile on an unknown planet. One second after launch, it is moving with a velocity of $v_x = 2$ m/s and $v_y = 2$ m/s. Answer the following questions.



a) Fill in the components of the x and y components of velocity at t = 0, 2, 3 and 4 seconds. Determine the actual speed at each time.

time t	v_x (m/s)	v_y (m/s)	speed (m/s)
0			
1			
2			
3			
4			

b) What is the value of g on this planet?

c) What is the forward distance the projectile travels while in flight?

d) What is the launch angle of the projectile?

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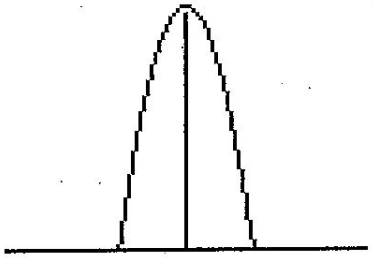
PHY 111 Angle and velocity for a football

A football is kicked from ground level and lands 50 meters from where it was kicked. The ball is in the air for 4 seconds. (a) What is the initial vertical velocity v_{oy} of the ball? (b) What is the initial horizontal velocity v_{ox} of the ball? (c) What is the initial speed of the ball when kicked? (d) At what angle above the horizontal is the ball kicked?

PHY 111 Finding the launch angle and launch velocity

A man stands 10 m in front of a wall which is 45 m tall and throws a ball over the wall so that it the ball just barely passes over the wall at the top of its trajectory.



a) How many seconds does it take for the ball to reach the top of its path? What is the total air time? (Ignore the x direction.)

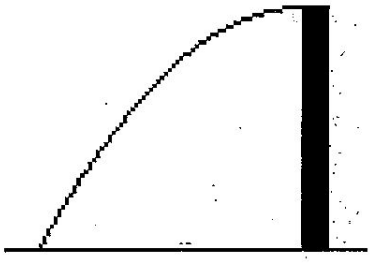
b) What was the total forward distance traveled? Determine the initial horizontal velocity.
(Ignore the y direction.)

c) Determine the speed and the angle at which the ball was launched

14

PHY 111 Hitting a tower at the top of the trajectory

An object is launched from the ground with a velocity of 80 m/s at an angle of 30° above the horizontal. At the very top of its trajectory, the object hits a tower
Find (a) how high above the ground the object hits the tower, (b) the distance from the launch point to the base of the tower and (c) the speed of then object when it hits the tower.



PHY 111 Determining the speed of a bullet.

A bullet is shot from the barrel of a gun that is perfectly horizontal. The target is located 40 m away. By the time the bullet has hit the target, the bullet has dropped 1 foot (30 cm) from its original horizontal path. What was the original horizontal speed of the bullet?

a) Give one fact about the vertical motion that will help to solve the problem.

b) Give one fact about the horizontal motion that will help to solve the problem.

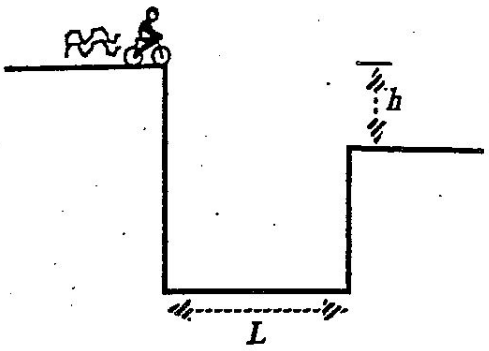
c) Find the original horizontal speed of the bullet.

Projectile Motion Problem 1

(a) Determine an expression for the minimum speed of a cyclist at the edge of a gulley in order to make it to the other side.

(b) Evaluate the expression to see if variation of the magnitude of each quatity in the expression on the right has the expected effect on the speed.

(c) Apply the expression for the case of a cyclist crossing a 10-m wide gulley to the other side which is 2.0 m lower. Ignore air resistance and assume that $g = 10\ m/s^2$.



↑ Homework: Find the minimum speed in order to cross the gulley.