Worksheet 2.4

More Practice-Projectile Motion

1. A canon is fired at an angle of 30° and lands 5 seconds later.
   a. What was the initial velocity of the cannon in the y-direction/
   b. What was the initial velocity along the direction of launch (30°)?
   c. What was the maximum height of the canon ball?

   d. At t = 3 s, what is the magnitude and angle of the velocity along the path of motion?

$t_i=0, t_f=5s$ $\quad V_{yi}=V_0\sin30=V_0(.5)$

$\theta=30°$ $\quad V_{xi}=V_0\cos30=V_0(.866)$

$y_i=0m$

$y_f=0m$

$t_{max\,height}=2.5s$

a) $0=-10(2.5)+V_0\sin30$

$V_0=50m/s$

$V_{yi}=50\sin30=25m/s$

b) $V_0=50m/s$

c) $y_f=\frac{-10}{2}(2.5)^2+25(2.5)+0$

$y_f=31.25m$

d) $V_x=50\cos30=43.3m/s$

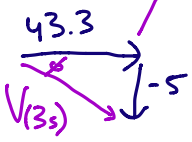
$V_{y(3)}=-10(3)+25=-5m/s$

$43.3^2+(-5)^2=V^2$

$V=43.6m/s$

$\phi=\tan^{-1}\left(\frac{5}{43.3}\right)$

$\phi=6.6°$



2. A sling-shot fires a rock an angle of 30° from a height of 0 m with an initial velocity of 40 m/s.
   a. At 3 seconds into the rock's flight, what is the velocity in the y-direction?
   b. At 3 seconds into the rock's flight, what is the velocity in the x-direction?
   c. What is the combined velocity and angle of the rock at 3 seconds into the trip?

$\theta=30°$ $y_i=0$

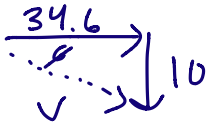
$V_0=40m/s$

$V_{yi}=40\sin(30)=20m/s$

$V_{xi}=40\cos(30)=34.6m/s$

a) $V_{y(3)}=-10(3)+20=-10m/s$

b) $V_{x(3)}=34.6m/s$ constant



c) $(-10)^2+(34.6)^2=V^2$

$V=36m/s$

$\phi=\tan^{-1}\left(\frac{10}{34.6}\right)=16.1°$

3. A skier flies off a jump 10 m high at an angle of 30° with an initial velocity of 20 m/s.
   a. How far does the skier go? x_f?
   b. What is the velocity of the skier as they land their jump? V_f?
   c. What angle does the skier land at? ϕ_f?

$y_i=10m$

$\phi=30°$

$V_0=20m/s$

$V_{yi}=10m/s$

$V_{xi}=17.3m/s$

a) Need t_f. use $y(t)$ eq. $\rightarrow 0=\frac{-10}{2}t^2+10t+10$

$0=5t^2-10t-10$

$0=t^2-2t-2$

$t=2.7s$

$x_f=(17.3m/s)(2.7s)$

$=46.71m$

b) $V_x=17.3m/s$

$V_y=-10(2.7)+10=-17m/s$

$V^2=(-17)^2+17.3^2$

$V=24.3m/s$ $\quad \phi=\tan^{-1}\left(\frac{17.3}{17}\right)=45.5°$

4. An unmanned rocket to the moon is launched from a 10 m tall platform at an angle of 80° and an initial velocity of 100 m/s.

a. How long does it take for the rocket to get to its maximum height?
b. What is the maximum height of the rocket?
c. At what time is the velocity of the rocket in the y-direction = -20 m/s?
d. Where is the rocket in the x-direction at that same time?

$y_i = 10m$
$\theta = 80°$
$V_0 = 100 m/s$
$V_{yi} = 98.5 m/s$
$V_{xi} = 17.4 m/s$

a) $0 = -10t + 98.5$
$t = 9.85s$

b) $y_f = \frac{-10}{2}(9.85)^2 + 98.5(9.85) + 10 = 495m$

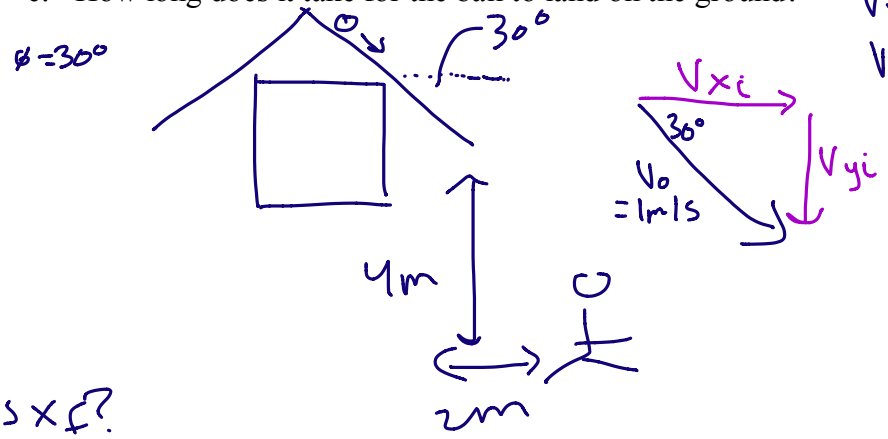
c) $V_y = -20 m/s = -10t + 98.5$
$t = 11.85s$

d) $X = (17.4 m/s)(11.85s) = 206.19m$

5. A ball rolls down a roof angled at 30° to the horizontal and rolls off the edge with a velocity of 1 m/s. A person is standing 4 m below the roof and 2 m away in the horizontal direction.

a. How close to the person does the ball land?
b. What are the velocities in the x and y directions when the ball lands on the ground?
c. How long does it take for the ball to land on the ground?

$V_{xi} = 1 \cos 30 = .866 m/s$
$V_{yi} = 1 \sin 30 = .5 m/s$



a) what's x_f?
$x_i = 0m$
$y_i = 4m$
need t_f
$0 = \frac{-10}{2}t^2 + .5t + 4$
$t = .86s$

Now...
$x_f = .866 m/s (.86s) = .74m$

b) $V_x = .866 m/s$
$V_y = -10(.86) + -5 = -13.6 m/s$

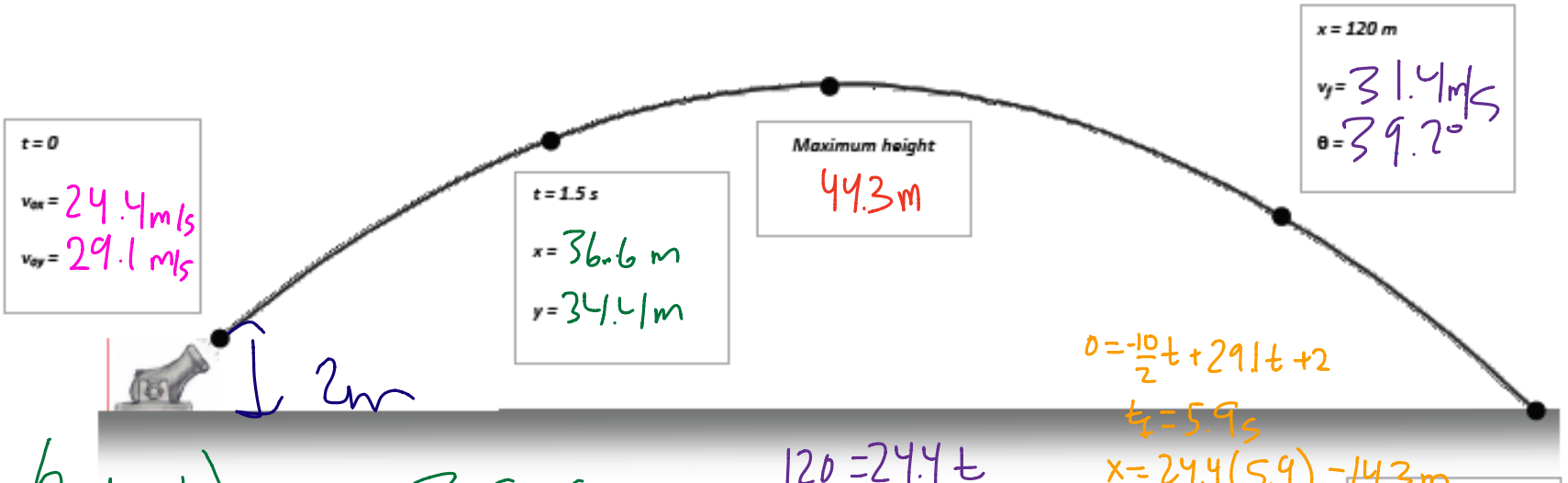
c) .86s

Physics
Projectile Motion Problems II

$V_0 = 38\ m/s \quad \theta = 50^\circ$

Name:
Period:

3. A cannon fires a cannonball with an initial speed of 38 m/s at an angle of 50 degrees from a height of 2 meters. Your task is to fill in the missing information on the trajectory below. **Fill in the missing elements for each box.** You will show your work in the region below the diagram – just put your final answers in the boxes.

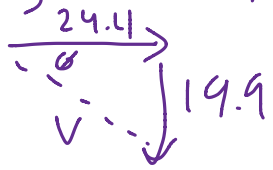


$X = (24.4)1.5 = 36.6$

$y = -\frac{10}{2}(1.5^2) + 29.1(1.5) + 2 = 34.4$

$0 = -10t + 29.1$
$t = 2.91s$
$y = \frac{-10}{2}(2.91)^2 + 29.1(2.91) + 2 = 44.3m$

$120 = 24.4t$
$t = 4.9s$
$v_x = 24.4\ m/s$
$v_y = -10(4.9s) + 29.1 = -19.9\ m/s$



$v^2 = 24.4^2 + 19.9^2$
$V = 31.4\ m/s \quad \phi = \tan^{-1}\left(\frac{19.9}{24.4}\right) = 39.2^\circ$

$0 = \frac{-10}{2}t + 29.1t + 2$
$t = 5.9s$
$x = 24.4(5.9) = 143m$