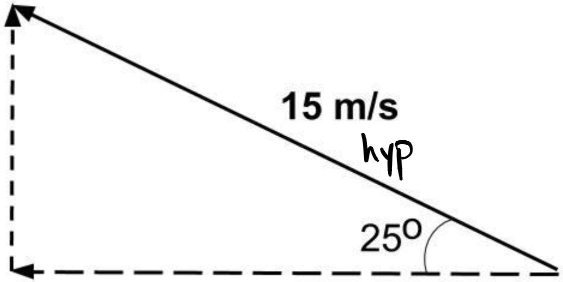
Kinematics in Two Dimensions

Chapter 2 Part 2

DO NOW!!!!

1)

V_y = ??
opp



V_x = ??
adj

$\sin\theta = \frac{opp}{hyp}$

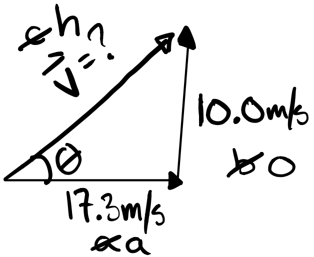
$\sin 25° = \frac{V_y}{15 m/s}$

$V_y = 15 \cdot \sin 25 = 6.3 m/s$ $\quad$ $V_x = 15 \cos 25 = 14 m/s$

2)

v_x = 17.3 m/s $\quad$ v_y = 10.0 m/s

$\vec{v}$ = ??????



$a^2 + b^2 = c^2$

$\vec{v} = \sqrt{v_x^2 + v_y^2}$

$\vec{v} = \sqrt{17.3^2 + 10.0^2}$

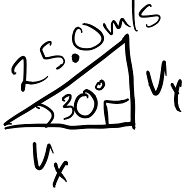
$\vec{v} = 20.0 m/s$

at 30.0° above the horizon

$\theta = \tan^{-1}\left(\frac{10.0}{17.3}\right) = 30.0°$

Example

What is Known?? In SI units????



$v_y = 25.0 \sin 30$

$= 12.5\ m/s$

$v_x = 25.0 \cos 30$

$= 21.7 m/s$

$g = -9.81 m/s^2$

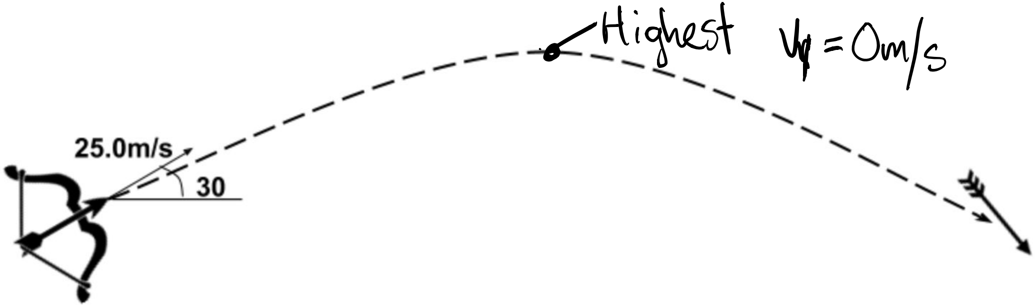
What formulas can be used?

$v_f = v_i + at$

$d = \frac{1}{2}(v_i + v_f)\,t$

$d = v_i t + \frac{1}{2} at^2$

$v_f^2 = v_i^2 + 2ad$



What is the maximum height reached by the arrow?

$$\cancel{v_f}^{\,0} = v_i^2 + 2ad$$

$$d = \frac{v_i^2}{-2a}$$

$v_f = 0$m/s

$v_i = 12.5$m/s

$$d = \frac{12.5^2}{-2 \cdot 9.81} = \boxed{7.96\text{m}}$$

How far does the arrow travel in the horizontal?

$v_{ix} = 21.0$m/s (constant v) $t_x = 2.55$s

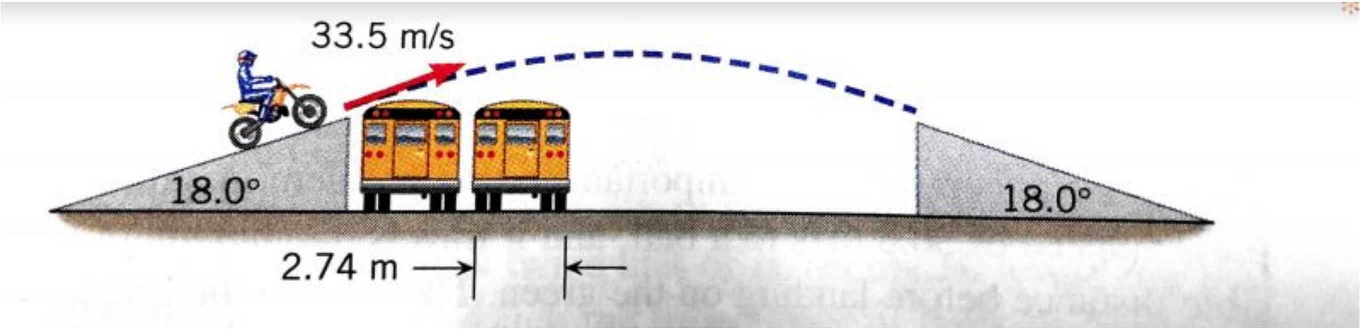
need time (from v_y)

$$a = \frac{\Delta v}{\Delta t} = \frac{\cancel{v_{fy}}^{\,0} - v_{iy}}{\Delta t} \rightarrow \Delta t = \frac{-v_{iy}}{a} = \frac{-12.5\text{m/s}}{-9.81\text{m/s}^2} = 1.27\text{s}$$ (to peak, double for full flight)

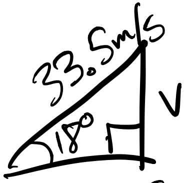
$$d_x = v_x \cdot t = 21.7\text{m/s} \cdot 2.55\text{s} = \boxed{55.3\text{m}}$$

Example

What is the maximum number of buses that he can jump over?



What is Known?? In SI units????



$V_y = 33.5 \cdot \sin 18$
$= 10.4\,m/s$

$V_x = 33.5 \cdot \cos 18$
$= 31.9\,m/s$

$a = -9.81\,m/s^2$

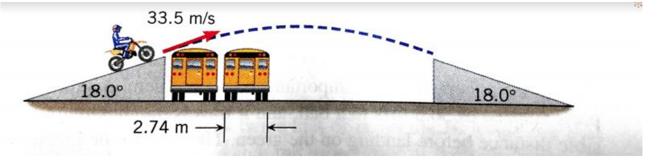
What formulas can be used?

$v_f = v_i + at$

$d = ½ (v_i + v_f)\, t$

$d = v_i\, t + ½\, at^2$

$v_f^2 = v_i^2 + 2ad$



$V_x = 31.9\,m/s$ (contant velocity)
need time

$$t_y = \frac{\Delta v}{a} = \frac{\cancel{v_{fy}}^{\,0} - v_{iy}}{a} = \frac{-10.4\,m/s}{-9.81\,m/s^2}$$
(to peak)

$= 1.06\,s$ (to peak)

$2t = 2.12\,s$ (to landing)

$t_x = 2.12\,s$

$d_x = vt = 31.9\,m/s \cdot 2.12\,s$

$d_x = 67.6\,m$

$$\#\text{ buses} = \frac{67.6\,m}{2.74\,m/\text{bus}} = 24.6\text{ buses}\ldots$$

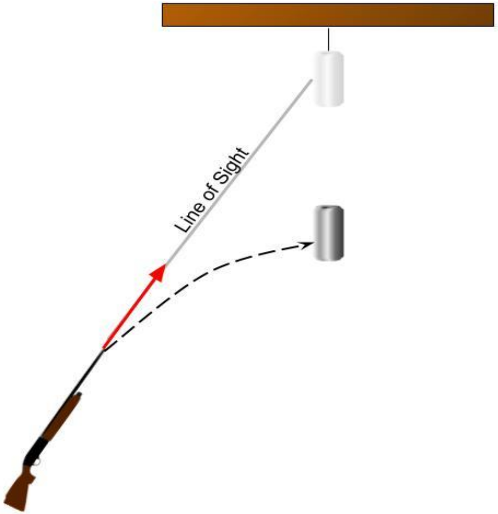
$\boxed{24\text{ buses}}$

Practice

Pg. 82 in your workbook

Questions 1-8, 10, 11

CHALLENGE (VERY HARD)



A small can is hanging from the ceiling. A rifle is aimed directly at the can, as the figure illustrates. At the instant the gun is fired, the can is released. Ignoring air resistance; show that the bullet will always strike the can, regardless of the initial speed of the bullet. Assume that the bullet will strike the can before it hits the ground.