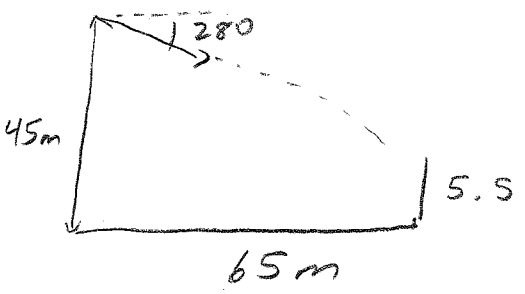
Physics 10154 - Exam #3C

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A rock is launched from atop a 45 meter building with an initial speed of 35 meters/sec directed 28° below the horizontal. There is a wall 65 meters from the base of the building, and the wall is 5.5 meters high. Does the shot hit the wall, pass over the wall, or fall short of the wall? Justify your answer mathematically.



Find Δy at $\Delta x = 65$

X	Y
$\Delta x = 65$	$\Delta y = ?$
$V_{ox} = 35\cos 28$ 30.9	$V_{oy} = -35\sin 28$ -16.4
$V_x = 30.9$	$V_y = ?$
$a_x = 0$	$a_y = -9.8$
$t = ?$	$t = ?$

$$t = \frac{\Delta x}{V_{ox}} = \frac{65}{30.9} = 2.10$$

$$\Delta y = V_{oy}t + \frac{1}{2}a_y t^2$$
$$= (-16.4)(2.1) - 4.9(2.1)^2$$
$$= \boxed{-56.1\ m}, \text{ below ground, which is } \Delta y = -45$$

So shot falls short of wall

2. A bus travelling 55 miles/hour sees a gap ahead in a bridge and so begins accelerating at a rate of 3.5 meters/sec^2 up a 150-meter long ramp angled 6.5° above the horizontal. The top of the ramp is 17 meters above ground level on the far side of the gap. What is the largest possible horizontal gap (measured from ground level directly below where the bus leaves the ramp to ground level on the far side of the gap) the bus can jump?

$$V_0 = 55 \frac{mi}{hr} \cdot \frac{1609\,m}{1\,mi} \cdot \frac{1\,hr}{3600\,s} = 24.6\ m/s$$

Δs along ramp

$\Delta s = 150$

$V_0 = 24.6$

$V = ?$

$a = 3.5\ m/s^2$

$t = ?$

$$v^2 = v_0^2 + 2a\Delta s$$
$$= (24.6)^2 + 2(3.5)(150)$$
$$= 40.7\ m/s$$

$V_x = 40.7 \cos 6.5° = 40.4$

$V_y = 40.7 \sin 6.5° = 4.6$

x	y
$\Delta x = ?$	$\Delta y = -17$
$V_{ox} = 40.4$	$V_{oy} = 4.6$
$V_x = 40.4$	$V_y = 0$
$a_x = 0$	$a_y = -9.8$
$t =$	$t = ?$

$$\Delta y = V_{oy} t + \frac{1}{2} a t^2$$
$$-17 = 4.6t - 4.9t^2$$
$$4.9t^2 - 4.6t - 17 = 0$$
$$t = \frac{4.6 \pm \sqrt{(4.6)^2 - 4(4.9)(-17)}}{9.8}$$
$$= 0.47 \pm 1.92 = 2.4\ s$$

$$\Delta x = V_{ox} t = (40.4)(2.4) = \boxed{97\ m}$$