

Physics 10154 - Exam #2B

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. A boy throws a stone off the roof of a 35-meter tall building with a speed of 18 meters/sec at an angle of 22° below the horizontal.

(a) How long (in seconds) does it take for the stone to hit the ground, and (b) what is the magnitude and direction of the final velocity of the stone the instant before it hits?

$$\Delta x = ?$$

$$\Delta y = -35$$

$$V_{0x} = 18 \cos 22^\circ$$

$$V_{0y} = -18 \sin 22^\circ$$

$$V_x = 18 \cos 22^\circ$$

$$V_y = ?$$

$$a_x = 0$$

$$a_y = -9.8$$

$$t = ?$$

$$t = ?$$

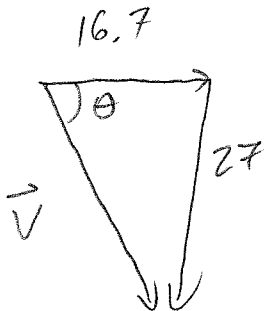
$$V_y^2 = V_{0y}^2 + 2a_y \Delta y$$

$$V_x = 16.7 \text{ m/s}$$

$$= (6.74)^2 + 2(-9.8)(-35) \Rightarrow V_y = -27.0 \text{ m/s}$$

$$V_y = V_{0y} + a_y t$$

$$t = \frac{-27 - (-6.74)}{-9.8} = \boxed{2.15}$$



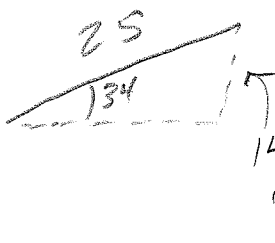
$$|\vec{v}| = \sqrt{16.7^2 + 27^2} = 32 \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{27}{16.7}\right) =$$

$$\boxed{58^\circ \text{ below } +x}$$

2. A motorcycle is at ground level at the bottom of a 25-meter long ramp, angled 34° above the horizontal, moving 27 meters/sec with a constant acceleration of 14 meters/sec^2 . If the point at which the motorcycle leaves the ramp and enters free-fall is called $x = 0$, what is the x -coordinate where the motorcycle lands back at ground?


Ramp:



$\Delta s = 25 \text{ m}$
 $v_0 = 27 \text{ m/s}$
 $v = ?$
 $a = 14 \text{ m/s}^2$
 $t = ?$

$v^2 = v_0^2 + 2a\Delta x$
 $v^2 = (27)^2 + 2(14)(25)$
 $v = 37.8 \text{ m/s}$

Free fall



$\Delta x = ?$
 $\Delta y = -14$
 $v_{0x} = 37.8 \cos 34^\circ$
 $v_{0y} = 37.8 \sin 34^\circ$
 $v_x = 37.8 \cos 34^\circ$
 $v_y = ?$
 $a_x = 0$
 $a_y = -9.8$
 $t = ?$
 $t = ?$

y-motion: $-14 = 21.1t - 4.9t^2$
 $4.9t^2 - 21.1t - 14 = 0$

$$t = \frac{21.1 \pm \sqrt{21.1^2 - 4(4.9)(-14)}}{9.8} = 2.15 \pm 2.74$$

$$= \underline{4.89 \text{ s}}$$

$$\Delta x = (31.3)(4.89) = \boxed{150 \text{ m}}$$