Test 3 Review

On the test you **MUST** show **ALL** work in order to receive **ANY** credit for an answer. For test corrections you must complete the review!!

1. A Chihuahua named Tito was ejected from the passenger seat of a car and vaulted over four lanes of oncoming traffic before landing safely (at the same level) on a grassy shoulder (based on a true story). If Tito was thrown at 7 m/s at an angle of 32 degrees above horizontal, how long did he spend in the air?

$v_{yi} = 7\sin(32)$, $v_x = 7\cos(32)$

X	Y
$v_x = 5.94$ m/s	$v_{iy} = 3.71$ m/s
$\Delta x = ?$	$a = -9.8$ m/s²
$t = ?$	$v_{fy} = -3.71$ m/s
	$t = ?$ (Δy)

$v_f = v_i + at$

$-3.71\text{ m/s} = 3.71\text{ m/s} - (9.8\text{ m/s}^2)t$

$-3.71 \quad -3.71$

$\frac{-7.42\text{ m/s}}{-9.8\text{ m/s}^2} = \frac{(9.8\text{ m/s}^2)t}{-9.8\text{ m/s}^2}$

0.76 s

2. While attacking a castle, a flaming projectile is launched from a trebuchet (catapult) at 35 m/s at an angle of 48 degrees above horizontal. If the projectile lands at the foot of the castle walls, how far away from the castle are the attacking forces?

X	Y
$\Delta x = ?$	$v_{iy} = 35\sin(48) = 26.01$ m/s
$v_x = 35\cos(48) = 23.42$ m/s	$v_f = -26.01$ m/s
$t = ? = 5.31$ s	$a = -9.8$ m/s²
	$t = ? = 5.31$ s (Δy?)

$v_f = v_i + at$

$-26.01 = 26.01 + (-9.8)t$

$-26.01 \quad -26.01$

$\frac{-52.02}{-9.8} = \frac{-9.8t}{-9.8}$

$\Delta x = ?$ $t = 5.31$ s

$v_x = \frac{\Delta x}{t}$

$\Delta x = (v_x)t$

$\Delta x = (23.42)(5.31)$

124.32 m

3. A howitzer can fire a shell at 305 m/s at an angle of 40 degrees above horizontal. What is the maximum height that the shell will reach on its path toward the target?

$\Delta y = ?$, $v_f = 0$

X	Y
$v_x = 305\cos(40)$	$v_{yi} = 305\sin(40) = 196.05$ m/s
$v_x = 233.64$ m/s	$v_{yf} = 0$ m/s (@ max ht.)
$\Delta x = ?$	$a = -9.8$ m/s²
$t = ?$	$\Delta y = ?$ (t?)

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (196.05)^2 + 2(-9.8)\Delta y$

$-(196.05)^2 = (-19.6)\Delta y$

$\frac{-38435.69}{-19.6} = \frac{(-19.6)\Delta y}{-19.6}$

1961.00 m

4. In Pittsburgh, PA a 30 year old woman drove her car off of a parking garage. If the car was traveling 7 m/s and the parking garage was 17 meters high, how far from the base of the garage did the car land? (She was only slightly injured)

X	Y
$v_x = 7$ m/s	$v_{iy} = 0$ m/s (left horizontally)
$\Delta x = ?$	$\Delta y = -17$ m (went down)
$t = ? = 1.86$ s	$a = -9.8$ m/s²
	$t = ? = 1.86$ s (v_f?)

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

$-17 = \frac{1}{2}(-9.8)t^2$

$-17 = -4.9t^2$

$t^2 = \sqrt{3.47\text{ s}^2}$

$t = 1.86$ s

$v_x = \frac{\Delta x}{t}$

$7 = \frac{\Delta x}{1.86}$

$\Delta x = 13.04$ m

13.04 m

5. A gazelle that is being chased by a rabid capybara (the world's largest rodent), accidentally runs off a cliff. How fast is the gazelle running at the top of the 20 meter high cliff if it lands 45 meters away from the base?

X	Y
$\Delta x = 45$ m	$\Delta y = -20$ m (went ↓)
$v_x = ?$	$a = -9.8$ m/s²
$t = ? = 2.02$ s	$t = ? = 2.02$ s
	$v_i = 0$ m/s (went off horiz.)
	(v_f?)

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

$-20 = \frac{1}{2}(-9.8)t^2$

$\frac{+20}{+4.9} = \frac{-4.9t^2}{-4.9}$

$t^2 = 4.08$

$t = 2.02$ s

$v_x = \frac{\Delta x}{t}$

$v_x = \frac{45\text{ m}}{2.02\text{ s}}$ = **22.27 m/s**

6. A Ferrari speeding along at 35 m/s can't negotiate a curve and horizontally drives off a high cliff. If the beautiful red sports car lands safely in a net 55 meters from the base of the cliff, how high was the cliff?

X	Y
$v_x = 35$ m/s	$v_{iy} = 0$ m/s
$\Delta x = 55$ m	$t = 1.57$ s
$t = ? = 1.57$ s	$\Delta y = ?$
$v_x = \frac{\Delta x}{t}$	(v_f?)
$35 = \frac{55}{t}$ $t = \frac{55}{35} = 1.57$ s	$a = -9.8$ m/s²

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

$\Delta y = \frac{1}{2}(-9.8)(1.57)^2$

$\Delta y = (-4.9)(2.47)$

$\Delta y = -12.1$ m = distance fallen

12.1 m

height = +

7. A gazelle is fired out of a cannon at 70 m/s at an angle of 25 degrees above horizontal. If the cannon is on a cliff that is 55 meters tall, how long is the gazelle in the air?

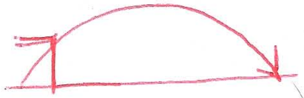
X	Y
$V_x = 70\cos(25)$	$V_{yi} = 70\sin(25) = 29.58$ m/s
$V_x = 63.44$ m/s	$a = -9.8$ m/s^2
$\Delta x = ?$	$\Delta y = -55$ m
$t = ?$	$t = ?$

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

$-55 = 29.58t - 4.9t^2$

$+4.9t^2 - 29.58t \quad -29.58t \quad +4.9t^2$

$4.9t^2 - 29.58t - 55 = 0$ (A, B, C) → QUADFORM → 7.53 & −1.49



7.53 s

8. A stunt platypus is launched from a cannon with a velocity of 85 m/s at an angle of 50 degrees above the horizontal from a point on a cliff 45 meters above a level plain below. How far from the base of the cliff will the platypus land?

X	Y
$V_x = 85\cos(50)$	$V_{yi} = 85\sin(50)$
$V_x = 54.64$ m/s	$V_{yi} = 65.11$ m/s
$\Delta x = ?$	$\Delta y = -45$ m
$t = ? = 13.95$ s	$a = -9.8$ m/s^2
	$t = ? = 13.95$ s

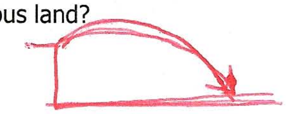
$\Delta y = v_i t + \frac{1}{2}at^2$

$-45 = (65.11)t - 4.9t^2$

$4.9t^2 - 65.11t - 45 = 0$

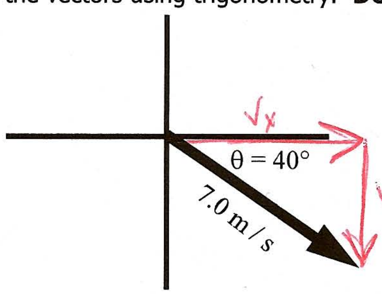
QUADFORM → $t = 13.95$ s

$V_x = \frac{\Delta x}{t}$; $\Delta x = V_x \cdot t = (54.64)(13.95\text{ s})$



761.98 m

9. Resolve the vectors using trigonometry. **DO NOT FORGET THE SIGN!!!!!!**



$V_x = (7.0\text{ m/s})\cos(40°) = 5.36$ m/s

$V_y = (7.0\text{ m/s})\sin(40°) = 4.50$ m/s

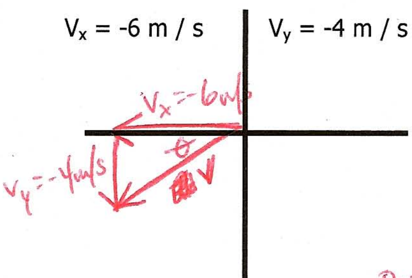
V_x = 5.36 m/s

V_y = − 4.50 m/s

pointing downwards

10. Find the resultant velocity and direction (angle) Draw the vector.

V_x = -6 m / s | V_y = -4 m / s



$V^2 = V_x^2 + V_y^2$

$V^2 = (-6)^2 + (-4)^2$

$V = \sqrt{36+16}$

$V = 7.21$ m/s

$\theta = \tan^{-1}\left(\frac{+4}{+6}\right) = 33.69°$

V = 7.21 m/s

θ = 33.69°

11. An airplane taxis to the end of a runway before taking off. The magnitude of the plane's total displacement is 599 m. The northern component of this displacement is 89 m.

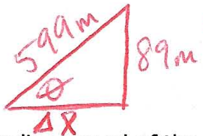
A. What is the displacement's eastern component?

$599^2 = 89^2 + (\Delta x)^2$

$\Delta x = \sqrt{599^2 - 89^2} = 592.35$ m

592.35 m

B. What is the direction of the total displacement?

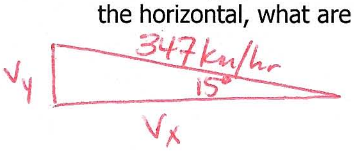


$\sin\theta = \frac{89}{599}$

$\theta = \sin^{-1}\left(\frac{89}{599}\right)$ use 2nd SIN in calc →

8.54°

12. The landing speed of the space shuttle *Columbia* is 347 km/h. If the shuttle is landing at an angle of 15.0° with respect to the horizontal, what are the horizontal and the vertical components of its velocity in km/hr?



$V_x = 347\cos(15) = 335.18$ m/s

$V_y = 347\sin(15) = 89.81$ m/s

V_x = 335.18 m/s

V_y = − 89.81 m/s

landing: velocity is directed downward!