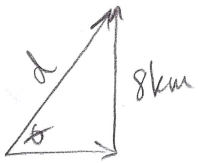
Review For Fall Final 1st Installment

1. An airplane travels 1200 km in 90 minutes. What is the average speed in m/s for this trip?

$d = 1200\text{ km} = 1{,}200{,}000\text{ m}$
$t = 90\text{ min} = 5400\text{ s}$
$s = ?$

$s = \frac{d}{t} = \frac{1.20E6\text{ m}}{5400\text{ s}} = \boxed{222.2\text{ m/s}}$

2. A gazelle moves 6 km to the east and then travels 8 km north. What is the displacement of the gazelle (include the angle)?



$a^2 + b^2 = c^2$
$d = \sqrt{8^2 + 6^2}$
$d = \boxed{10\text{ km } @53°}$

$\tan\theta = \frac{opp}{adj}$
$\theta = \tan^{-1}\left(\frac{opp}{adj}\right)$
$\theta = \tan^{-1}\left(\frac{8}{6}\right) = 53°$

3. A car with a velocity of 25 m/s comes to rest in a distance of 115 m. What was the acceleration of the car?

$v_i = 25\text{ m/s}$
$v_f = 0\text{ m/s}$
$\Delta x = 115\text{ m}$
$a = ?$

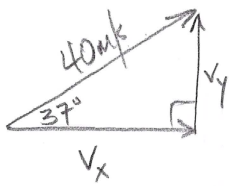
$v_f^2 = v_i^2 + 2a\Delta x$
$a = \frac{v_f^2 - v_i^2}{2\Delta x}$
$a = \frac{0^2 - 25^2}{2(115)} = \boxed{-2.72\text{ m/s}^2}$

4. A jet liner must reach a speed of 80 m/s from rest for takeoff. If the runway is 1300 meters long, what constant acceleration is needed?

$v_i = 0\text{ m/s}$
$v_f = 80\text{ m/s}$
$\Delta x = 1300\text{ m}$
$a = ?$

$v_f^2 = v_i^2 + 2a\Delta x$
$a = \frac{v_f^2 - v_i^2}{2\Delta x}$
$a = \frac{80^2 - 0^2}{2(1300)} = \boxed{2.46\text{ m/s}^2}$

5. A gazelle is launched with a velocity of 40 m/s at an angle of 37 degrees above horizontal. What are the horizontal and vertical components of the gazelle's velocity?



$v_y = v\sin\theta$
$v_y = 40\sin(37°)$
$= \boxed{24.07\text{ m/s}}$

$v_x = v\cos\theta$
$v_x = 40\cos(37°)$
$= \boxed{31.95\text{ m/s}}$

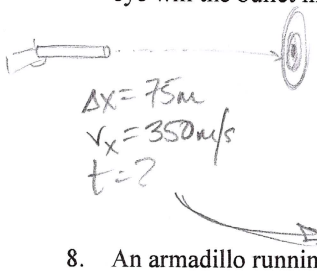
6. A stone is thrown straight upward and it rises to a height of 35 m. How long will it take for the ball to land? (Include up trip in answer.)

$\Delta y = -35\text{ m}$
$v_i = 0\text{ m/s}$
$v_f = ?$
$a = -9.8\text{ m/s}^2$
$t = ?$

$\Delta y = v_i t + \frac{1}{2}at^2$
$t = \sqrt{\frac{2\Delta y}{a}}$
$t = \sqrt{\frac{2(-35)}{-9.8}}$
$t = 2.67\text{ s}$ ← this is the way down

total time $= 2(2.67)$
$= \boxed{5.35\text{ s}}$

7. A rifle is aimed directly at the bull's eye of a target 75 meters away. If the bullet has a speed of 350 m/s, how far below the bull's eye will the bullet hit?



$\Delta x = 75m$, $v_x = 350 m/s$, $t = ?$

$\Delta y = ?$, $v_i = 0 m/s$, $v_f = ?$, $a = -9.8 m/s^2$, $t = ?$

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

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

$t = \frac{75}{350}$

$t = 0.214 s$

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

$\Delta y = \frac{1}{2}(-9.8)(0.214)^2$

$\Delta y = \boxed{-0.225 m}$

8. An armadillo running at 20 m / s at the top of a 30 meter high cliff runs horizontally off of the cliff. How far from the base does it land?

$v_x = 20 m/s$, $\Delta x = ?$, $t = ?$

$\Delta y = -30 m$, $v_i = 0 m/s$, $v_f = ?$, $a = -9.8 m/s^2$, $t = ?$

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

$t = \sqrt{\frac{2\Delta y}{a}}$

$t = \sqrt{\frac{2(-30)}{-9.8}}$

$t = 2.47 s$

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

$\Delta x = v_x \cdot t$

$\Delta x = (20)(2.47)$

$= \boxed{49.49 m}$

9. A gazelle travels 17 meters horizontally from the base of a 30 meter high cliff. How fast was the gazelle running when it ran off of the top of the cliff?

$\Delta x = 17m$, $v_x = ?$, $t = ?$

$\Delta y = -30m$, $v_i = 0 m/s$, $v_f = ?$, $a = -9.8 m/s^2$, $t = ?$

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

$t = \sqrt{\frac{2\Delta y}{a}}$

$t = \sqrt{\frac{2(-30)}{-9.8}}$

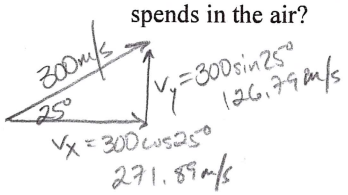
$t = 2.47 s$

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

$v_x = \frac{17m}{2.47 s}$

$v_x = \boxed{6.87 m/s}$

10. A gazelle is fired at 300 m / s out of a cannon inclined at 25 degrees above horizontal. What is the total time that the gazelle spends in the air?



$v_i = 126.79 m/s$, $v_f = -126.79 m/s$, $\Delta y = 0$, $a = -9.8 m/s^2$, $t = ?$

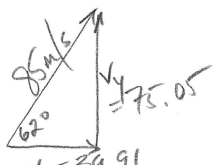
$v_f = v_i + at$

$t = \frac{v_f - v_i}{a}$

$t = \frac{-126.79 - 126.79}{-9.8}$

$t = \boxed{25.87 s}$

11. A catapult can launch a projectile at 85 m / s at an angle of 62 degrees above horizontal. How far will the projectile travel?



$v_i = 75.05 m/s$, $v_f = -75.05 m/s$, $\Delta y = 0$, $a = -9.8 m/s^2$, $t = ?$

$v_f = v_i + at$

$t = \frac{v_f - v_i}{a}$

$t = \frac{-75.05 - 75.05}{-9.8}$

$t = 15.32 s$

$v_x = 39.91 m/s$

$t = 15.32 s$

$\Delta x = ?$

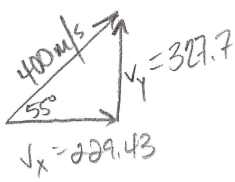
$v_x = \frac{\Delta x}{t}$

$\Delta x = v_x \cdot t$

$\Delta x = (39.91)(15.32)$

$= \boxed{611.2 m}$

12. A gazelle is launched from a cannon 400.0 m/s at a 55 degree angle from a 35 meter high cliff. How far from the base of the cliff will the gazelle land?



$\Delta x = ?$, $v_x = 229.43 m/s$, $t = ?$

$\Delta y = -35m$, $v_i = 327.7 m/s$, $v_f = ? = -328.71 m/s$, $a = -9.8 m/s^2$, $t = ? = 66.98 s$

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

$v_f = \sqrt{(327.7)^2 + 2(-9.8)(-35)}$

$v_f = -328.71 m/s$

$v_f = v_i + at$

$t = \frac{v_f - v_i}{a}$

$t = \frac{-328.71 - 327.7}{-9.8} = 66.98 s$

$\Delta x = v_x \cdot t$

$\Delta x = (229.43)(66.98)$

$= \boxed{15,366 m}$