1/28/2010

Physics 30 Review: Adding Vectors

Name: Key!

Date: Sept 2nd 2011

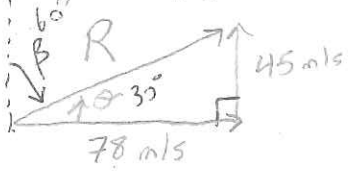
"Hows' abouts' you add these here vectors and we'll all get along real nice like"

Add the following vectors. Notate the resultant in the same method of notation as used in the question. Obey all rules of showing work and significant digits!

1) 52.08 N [W] and 24.00 N [E]. **(28. 08 N [W])**

$-52.08\ N + 24.00\ N = 28.08\ N$ West. colinear

2) 45 m/s [N] and 78 m/s [E] **(90 m/s 30° N of E)**



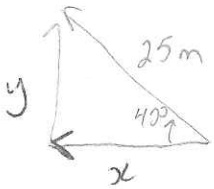
$R^2 = (45\ m/s)^2 + (78\ m/s)^2$

$R = 90\ m/s$

$\theta = \tan^{-1}\left(\frac{45\ m/s}{78\ m/s}\right)$

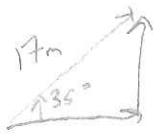
$= 30°$ N of E. or $60°$ E of N

3) 25 m 40° N of W and 17 m 35° N of E. (*Draw a diagram of the vectors.*) **(26 m 79° N of ~~E~~ W)**



$y = \sin(40°)(25m) = 16.0697\ m$

$x = \cos(40°)(25m) = 19.1511\ m$

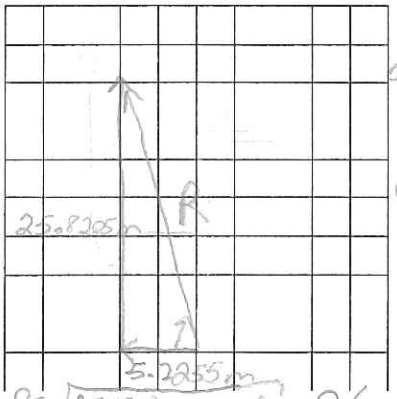


$y = \sin(35°)(17m) = 9.7508\ m$

$x = \cos(35°)(17m) = 13.9256\ m$

$x_{TOT} = 19.1511\ m + 13.9256\ m - 5.2255\ m$

$y_{TOT} = 16.0697\ m + 9.7508\ m = 25.8205\ m$

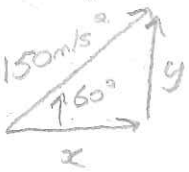


$\theta = \tan^{-1}\left[\frac{25.8\ m}{5.2\ m}\right]$

$\theta = 79°$ N of W

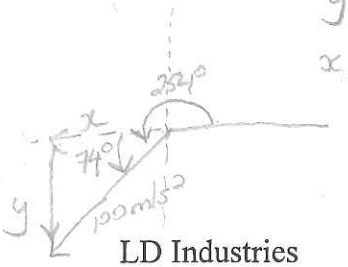
$R = \sqrt{(25.8\ m)^2 + (5.2\ m)^2} = 26\ m$

4) 150 m/s^2 [60°] and 100 m/s^2 [254°] **(58.2 m/s^2 35.1° N of E)**



$y = \sin(60°)(150\ m/s^2) = 129.9038\ m/s^2$

$x = \cos(60°)(150\ m/s^2) = 75\ m/s^2$

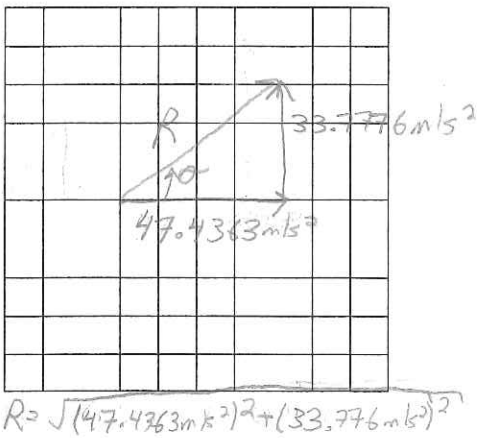


$y = \sin(74°)(100\ m/s^2) = -96.1262\ m/s^2$

$x = \cos(74°)(100\ m/s^2) = -27.5637\ m/s^2$

$y_{TOT} = 129.9038\ m/s^2 + -96.1262\ m/s^2 = 33.7776\ m/s^2$

$x_{TOT} = 75\ m/s^2 + -27.5637\ m/s^2 = 47.4363\ m/s^2$



$R = \sqrt{(47.4363\ m/s^2)^2 + (33.7776\ m/s^2)^2}$

$R = 58.2\ m/s^2$

$\theta = \tan^{-1}\left[\frac{33.7776\ m/s^2}{47.4363\ m/s^2}\right] = 35.5°$ N of E

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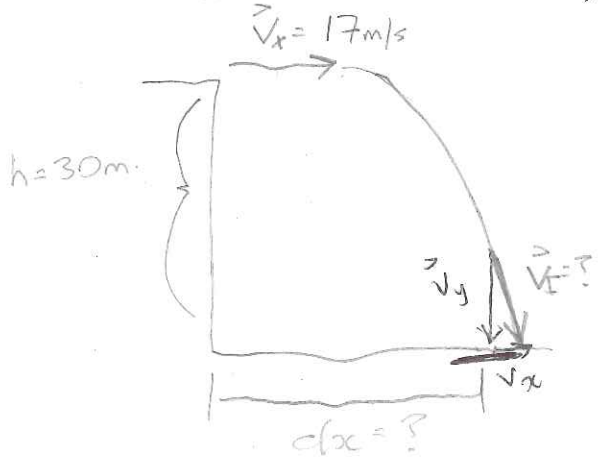
Complete the following projectile motion problem.

5) A projectile is fired horizontally with an initial velocity of 17 m/s from a height of 30 m. Calculate the range of the projectile and the final velocity. **(range = 42 m, final velocity = 30 m/s at 55° from the horizontal)**



$\vec{d}_y = \vec{v}_{iy} t + \frac{1}{2}\vec{a}t^2$ (or $t = \sqrt{\frac{-2d_y}{g}}$ the Half time eqn.)

$(-30m) = (0 m/s)t + \frac{1}{2}(-9.81 m/s^2)t^2$

$t = 2.473 s$

$\vec{d}_x = \vec{v}_x t$

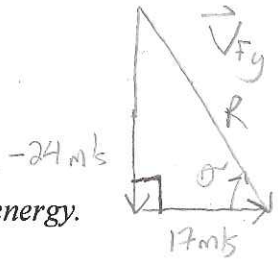
$= (17 m/s)(2.473 s)$

$= 42 m$

$\vec{v}_{fy}^2 = \vec{v}_{iy}^2 + 2\vec{a}\vec{d}_y$

$\vec{v}_{fy} = \sqrt{2(-9.81 m/s^2)(-30m)}$

$\vec{v}_{fy} = 24.261 m/s$

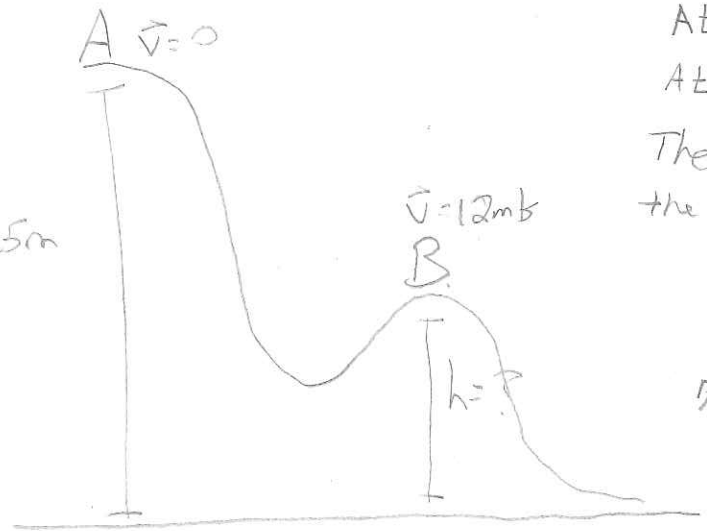


$R = 30 m/s$

$\theta = \tan^{-1}\left[\frac{24 m/s}{17 m/s}\right] = 55°$ from horz.

Solve the following problem using the conservation of energy.

6) Rollercoaster begins its movement from an initial height of 25 m in the air and initial velocity of 0 m/s. Later in the movement, the rollercoaster is moving at 12 m/s. Calculate the height of the rollercoaster at this point, assuming the rollercoaster and track are an isolated system. **(18 m)**



At point A, all the energy is PE.

At point B, some is PE, some is KE.

The sum of the ΔE stays the same throughout the ride.

$PE_A = PE_B + KE_B$

$mgh = mgh + \frac{1}{2}m\vec{v}^2$

$h = \frac{gh - \frac{1}{2}\vec{v}^2}{g} = h - \frac{\vec{v}^2}{2g} = 25m - \frac{(12 m/s)^2}{2(9.81 m/s^2)}$

$h = 18 m$

Bonus Questions: Answer only **ONE!!!**

Fair Bonus Question: Do you remember your grade from P20? What was it?

Unfair Bonus Question: What do you think LD's P20 grade was?