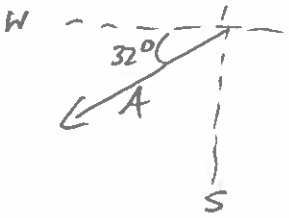
Physics 10154 - Exam #1A

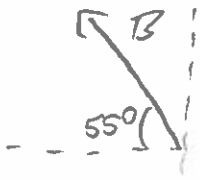
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct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

1. (30 pts) Starting at the origin, a person walks 347 meters in a direction 32.0° South of West, then 565 meters in a direction 55.0° North of West. If the person now wishes to walk in a straight line back to the origin, what must be the magnitude and direction of the displacement?



$A_x = -347\cos 32^\circ = -294.27$

$A_y = -347\sin 32^\circ = -183.88$

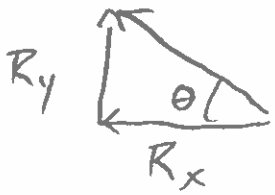


$B_x = -565\cos 55^\circ = -324.07$

$B_y = +565\sin 55^\circ = +462.82$

$R_x = -294.27 - 324.07 = -618.34$

$R_y = -183.88 + 462.82 = +278.94$



$|\vec{R}| = \sqrt{R_x^2 + R_y^2} = 678\ m$

$\theta = \tan^{-1}\left(\frac{278.94}{618.34}\right) = 24.3^\circ N\ of\ W$

To return, just travel a distance $|\vec{R}|$ in the opposite direction

678 m, 24.3° S of E

2. (35 pts) A 5.0-kg ball is dropped from rest. The ball reaches the halfway point between the starting point and the ground in 2.2 seconds. How long (in seconds) does the second half of the motion take?

1st half

$\Delta y = ?$

$v_0 = 0$

$v = ?$

$a = 9.8\ m/s^2$

$t = 2.2\ s$

$\Delta y_1 = v_0 t + \frac{1}{2} a t^2$

$= 0 + \frac{1}{2}(9.8)(2.2)^2 = 23.7\ m$

So $\Delta y_{tot} = 2 * \Delta y_1 = 47.4\ m$

whole motion

$\Delta y = 47.4\ m$

$v_0 = 0$

$v = ?$

$a = 9.8\ m/s^2$

$t = ?$

$47.4 = 0 + \frac{1}{2}(9.8) t^2$

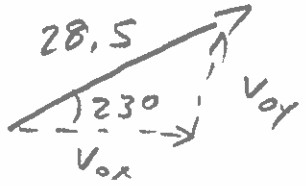
$t = \sqrt{\frac{47.4}{4.9}} = 3.11\ s$

$t_1 + t_2 = t_{tot}$

$2.2 + t_2 = 3.11$

$\boxed{t_2 = 0.91\ s}$

3. (35 pts) A stone is launched with an initial velocity of 28.5 m/s at an angle 23.0° above the horizontal. Some time after reaching the top of its arc of motion, the ball lands on a platform that is raised 3.10 meters above the launch point. What is the magnitude and direction of the final velocity of the ball just before it lands?

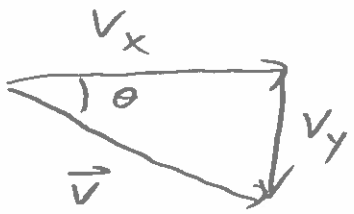


X	Y
$\Delta x = ?$	$\Delta y = 3.10\,m$
$v_{ox} = 26.23\ m/s$	$v_{oy} = 11.14\ m/s$
$v_x = 26.23\ m/s$	$v_y = ?$
$a_x = 0$	$a_y = -9.8\ m/s^2$
$t = ?$	$t = ?$

$$v_y^2 = v_{oy}^2 + 2a_y \Delta y$$

$$v_y^2 = (11.14)^2 + 2(-9.8)(3.10)$$

$v_y = \pm 7.95$, use -7.95 since it reaches max height before landing



$$|v| = \sqrt{v_x^2 + v_y^2} = \boxed{27.4\ m/s}$$

$$\theta = \tan^{-1}\left(\frac{7.95}{26.23}\right) = \boxed{16.9°\text{ below } +x}$$