PH 111

Free-fall objects

2-36: A ball is thrown vertically upward with a speed of 25 m/s

a. How high does it rise?

Assume height relative to release level

$\vec{v}_{oy} = +25\ m/s \quad \vec{a}_y = -9.8\ m/s^2 \quad \vec{v}_y = 0\ m/s$

Looking for $\vec{y}_{max}$

$0 = 25^2 + 2(-9.8)\vec{y} \quad \vec{y}_{max} = 32\ m$

b. How long does it take to reach its highest point?

$0 = 25 - 9.8t \quad t = 2.6\ s$

c. How long does it take the ball to hit the ground from its highest point?

Assume launched from ground

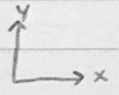
$t = 2(2.6) = 5.2\ s$

d. What is its velocity when it returns to the same level from which it started?

$\vec{v}_y = -25\ m/s$

Ways to indicate direction for vector quantities

1. Use +/- with number



2. Use a labeled arrow

$v = 2.3\ m/s$

3. Use words

Vectors in 3 dimensions

position: $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$

displacement $= \Delta\vec{r} = \vec{r} - \vec{r}_o = (x - x_o)\hat{i} + (y - y_o)\hat{j} + (z - z_o)\hat{k}$

$\vec{v}_{avg} = \Delta\vec{r}/\Delta t \quad \vec{v}_{inst} = \lim_{\Delta t \to 0} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} + \frac{dz}{dt}\hat{k}$

$\vec{a}_{avg} = \Delta\vec{v}/\Delta t \quad \vec{a}_{inst} = \frac{d\vec{v}}{dt}$

Horizontal	Vertical	
$a_x = 0$	$a_y = -g$	$v^2 = v_o^2 + 2ax$
$x = v_o t$ (range)	Same as →	$v = v_o + at$
		$x = v_o t + \frac{1}{2}at^2$