## LECTURE #6 – SUMMARY

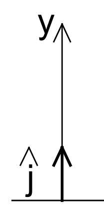
### Section II.2 The Acceleration of Gravity

When an object is dropped, it falls at a constantly increasing rate, assuming that it is in free fall, i.e., under the influence of gravity alone.
We will refer to the "acceleration due to gravity", and use the symbol $\vec{g}$.
magnitude, $g \cong 9.8\ \text{m/s}^2$ direction = downwards
$\vec{g}$ is independent of mass, and has been determined empirically.

First, we must choose a co-ordinate system. When dealing with problems in the vertical direction, it is common to use the y axis and the unit vector $\hat{j}$.

$$\vec{g} = -9.8\frac{\text{m}}{\text{s}^2}\hat{j} = -g\hat{j} \qquad \text{where } g = 9.8\frac{\text{m}}{\text{s}^2} = |\vec{g}|$$

$x \rightarrow y$
$\hat{i} \rightarrow \hat{j}$
$a \rightarrow -g$ (where $\hat{j}$ points upwards)




define positive y as upwards

So the previous equations become

$$\boxed{\begin{aligned} \vec{a}(t) &= -g\hat{j} \\ \vec{v}(t) &= v(t)\hat{j} = [v_o - g(t - t_o)]\hat{j} \\ \vec{y}(t) &= y(t)\hat{j} = \left[y_o + v_o(t - t_o) - \tfrac{1}{2}g(t - t_o)^2\right]\hat{j} \end{aligned}}$$

$$\boxed{\begin{aligned} \vec{y}(t) &= \left\{y_o + \tfrac{1}{2}[v_o + v(t)](t - t_o)\right\}\hat{j} \\ v(t)^2 &= v_o^{\ 2} - 2g[y(t) - y_o] \end{aligned}}$$

*Note: It is also valid to define positive y as downwards – just be consistent within a given problem. In this case, the signs will be different in the above equations!*

### Section II.3 Motion in More than One Dimension

Let's consider an acceleration vector: $\boxed{\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}}$
and in general: $a_x = a_x(t)$ $a_y = a_y(t)$ $a_z = a_z(t)$

The component of acceleration in one direction has NO effect on motion in a perpendicular direction.
Therefore:
(1) We can treat the x, y, z components of motion independently.
(2) The equations of motion that we have derived for the 1-D case can be applied independently to each component.

e.g., If two objects leave the edge of the table at the same time, they will hit the ground at the same time!