Name ____________________

Motion With Constant Acceleration (p. 65 – 71)

Examples: - Free-falling objects
- Projectiles

I. Velocity With Average Acceleration

1. Use the following equation to find the derivatives.

p. 65

$$\bar{a} \equiv \frac{\Delta v}{\Delta t} = \frac{(v_f - v_i)}{(t_f - t_i)}$$

1. $\Delta v = \bar{a}\,\Delta t$ $\qquad v_f - v_i = \bar{a}\,\Delta t$

2. $v_f = v_i + \bar{a}\,\Delta t$

2. Write out the equation for determining Final Velocity With Average Acceleration.

$v = v_0 + at$

$v_f = v_i + \bar{a}\,\Delta t$

$\bar{a}$ can be substituted with "a" for constant acceleration

$v_i = v_f - a\Delta t$

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

3. Besides final velocity, what else can this equation be used to determine?

1. Time (with constant acceleration at a given velocity)
2. Initial Velocity (with final velocity and time given)

II. Position With Constant Acceleration

1. Use the following equation to find the derivatives.

$\bar{v} = \Delta d / \Delta t$ $\qquad$ 1. $\Delta d = v\,\Delta t$

2. What do each of the following variables represent on a v-t graph?

p. 66

v = Height of the plotted line above the t-axis (y-axis)

Δt = Width of the shaded rectangle (x-axis)

3. The area under the v-t graph is equal to the object's displacement.

Circle One : True False

4. Derive d_f from the following equations, which determine area under a v-t graph.

p. 68

Area
Rectangle = lw
Triangle = ½ bh

$\Delta d_{rectangle} = v_i\,\Delta t$

$\Delta d_{triangle} = \frac{1}{2}\,\Delta v\,\Delta t$

$\Delta d_{triangle}$ (substituting = $\Delta v = \bar{a}t$) = $\frac{1}{2}(a\Delta t)\Delta t$ or $\frac{1}{2}\bar{a}(\Delta t)^2$

$\Delta d = \Delta d_{rectangle} + \Delta d_{triangle} = v_i\Delta t + \frac{1}{2}\bar{a}(\Delta t)^2$

$\Delta d = d_f - d_i$

$d_f = d_i + v_i t_f + \frac{1}{2}\bar{a} t_f^2$

Name ______________________

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

5. **Write the formula for determining Position With Average Acceleration.**

$d_f = d_i + v_i t_f + \frac{1}{2}\bar{a} t_f^2$

III. An Alternate Expression

$p.68$

1. **Use the following equation to find the derivatives.**

$v_f = v_i + \bar{a}t_f$ 1. $t_f = \frac{v_f - v_i}{\bar{a}}$

2. **Using the equation $d_f = d_i + v_i t_f + \frac{1}{2}\bar{a}t_f^2$, substitute t_f with the previous derivative.**

$d_f = d_i + v_i\left(\frac{v_f - v_i}{\bar{a}}\right) + \frac{1}{2}\bar{a}\left(\frac{v_f - v_i}{\bar{a}}\right)^2$

$v^2 = v_0^2 + 2ax$

3. **Write out the formula for determining Velocity With Constant Acceleration.**

$v_f^2 = v_i^2 + 2\bar{a}(d_f - d_i)$

4. **The equation for velocity with constant acceleration is useful to relate position, velocity, and constant acceleration without including** time.

5. **Complete the following table.**

$p.68$

Equations of Motion for Constant Acceleration		
Equation	**Variables To Derive**	**Initial Conditions Present**
$v_f = v_i + at$	t_f, v_f, $\bar{a}$	v_i
$d_f = d_i + v_i t_f + \frac{1}{2}\bar{a}t_f^2$	t_f, d_f, $\bar{a}$	d_i, v_i
$v_f^2 = v_i^2 + 2\bar{a}(d_f - d_i)$	d_f, v_f, $\bar{a}$	d_i, v_i

6. **Identify the equation describing a particular aspect of motion with constant acceleration.**

Equation

1. Velocity as a function of time $v_f = v_i + at$
2. Displacement as a function of time $d_f = d_i + v_i t_f + \frac{1}{2}\bar{a}t_f^2$
3. Velocity as a function of displacement $v_f^2 = v_i^2 + 2\bar{a}(d_f - d_i)$