1.5 Assignment: The Kinematics Equations

Name: _____

1. Rearrange the following equations for the indicated variable.

a. $\vec{v}_{Ave} = \frac{\Delta \vec{d}}{\Delta t}$ $\Delta t = ?$ $\Delta t = \frac{\Delta \vec{d}}{\vec{v}}$

b. $\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$ $v_f = ?$ $\vec{v}_f = \vec{a}t + \vec{v}_i$

c. $2ad = v_f^2 - v_i^2$ $v_f = ?$ $\vec{v}_f = \sqrt{\vec{v}_i^{\,2} + 2\vec{a}\vec{d}}$

d. $\Delta \vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ $v_i = ?$ $\vec{v}_i = \frac{\Delta \vec{d} - \frac{1}{2}\vec{a}t^2}{t}$

e. $\Delta \vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ $a = ?$ $\vec{a} = \frac{2(\Delta \vec{d} - \vec{v}_i t)}{t^2}$

f. $\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$ $v_i = ?$ $\vec{v}_i = \vec{v}_f - \vec{a}t$

g. $\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$ $\Delta t = ?$ $\Delta t = \frac{\vec{v}_f - \vec{v}_i}{\vec{a}}$

h. If $v_i = 0$ then $\Delta d = ?$ for $\Delta \vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

$\Delta \vec{d} = \frac{1}{2}\vec{a}t^2$

i. If $v_i = 0$ then $a = ?$ for $\Delta \vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

$\vec{a} = \frac{2\vec{d}}{t^2}$

j. If $v_i = 0$ then $\Delta t = ?$ for $\Delta \vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

$t = \sqrt{\frac{2\vec{d}}{\vec{a}}}$

k. If $v_f = 0$ then $v_i = ?$ for $\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\vec{d}$

$\vec{V}_i = \sqrt{-2\vec{a}\vec{d}}$

2. A car traveling at 60 m/s accelerates at +3.0 m/s² for 9.0 s. How far does the car travel in this time? (6.6×10^2 m)

$\vec{V}_i = +60 m/s$
$\vec{a} = +3.0 m/s^2$
$t = 9.0 s$
$\vec{d} = ?$

$\Delta \vec{d} = \vec{V}_i t + \frac{1}{2}\vec{a}t^2$
$= (+60 m/s)(9.0 s) + (\frac{1}{2})(+3.0 m/s^2)(9.0 s)^2$

$\Delta \vec{d} = +6.6 \times 10^2 m$

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3. A car starting from rest travels 1296 m with an acceleration of 32 m/s². How long does it take for the car to travel that distance? (9.0 s)

$\vec{V}_i = 0 m/s$
$\vec{d} = +1296 m$
$\vec{a} = +32 m/s^2$
$t = ?$

$\Delta \vec{d} = \cancel{\vec{V}_i t}^{0} + \frac{1}{2}\vec{a}t^2$
$1296 m = (\frac{1}{2})(32 m/s^2)t^2$
$\frac{1296}{16} = \frac{16t^2}{16}$
$t^2 = 81$
$t = \sqrt{81}$

$t = 9.0 s$

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4. A car travels 1760 m over 10.0 s. If the acceleration was -20.0 m/s², what was the initial velocity? (+276 m/s)

$\vec{d} = +1760\text{ m}$
$t = 10.0\text{ s}$
$\vec{a} = -20.0\text{ m/s}^2$
$\vec{V_i} = ?$

$\Delta\vec{d} = \vec{V_i}t + \frac{1}{2}\vec{a}t^2$

$1760 = \vec{V_i}(10.0) + (\frac{1}{2})(-20.0)(10.0)^2$

$1760 = 10\vec{V_i} - 1000$
$+1000 \quad +1000$

$\frac{2760}{10} = \frac{10V_i}{10}$

$\vec{V_i} = +276\text{ m/s}$

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5. A car traveling at 60.0 m/s suddenly has its brakes applied bringing the car to a stop after 4.00 s. How far did the car travel in this time? (+120 m)

$\vec{V_i} = +60.0\text{ m/s}$
$\vec{V_f} = 0\text{ m/s}$
$t = 4.00\text{ s}$
$\vec{d} = ?$

$\Delta\vec{d} = \left(\frac{\vec{V_f} + \vec{V_i}}{2}\right)t$

$= \left(\frac{0 + 60.0\text{ m/s}}{2}\right)(4.00\text{ s})$

$\Delta\vec{d} = +120\text{ m}$

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6. A car traveling at 100 m/s comes to a stop in 200 m. How long did it take for the car to come to a stop? (4.00 s)

$\vec{V_i} = +100\text{ m/s}$
$\vec{V_f} = 0\text{ m/s}$
$\vec{d} = +200\text{ m}$
$t = ?$

$\Delta\vec{d} = \left(\frac{\vec{V_f} + \vec{V_i}}{2}\right)t$

$200 = \left(\frac{100 + 0}{2}\right)t$

$t = 4.00\text{ s}$

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7. A bullet leaves a rifle barrel with a speed of 350 m/s. If the length of the barrel is 0.75 m, determine the acceleration of the bullet while it was in the barrel. (8.2×10^4 m/s²)

$\vec{V}_i = 0$ m/s
$\vec{V}_f = +350$ m/s
$\vec{d} = +0.75$ m
$\vec{a} = ?$

$$\vec{a} = \frac{\vec{V}_f^{\,2} - \vec{V}_i^{\,2}}{2\vec{d}}$$

$$\vec{a} = \frac{350^2 - 0^2}{(2)(0.75)}$$

$$\vec{a} = +8.2 \times 10^4 \text{ m/s}^2$$

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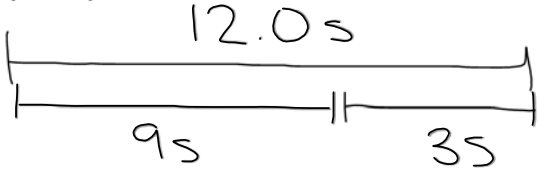
8. An object traveling at 10.0 m/s accelerates at 5.00 m/s² for 12.0 s. How far does the object travel in the last three seconds? (188 m)



$\vec{V}_i = +10.0$ m/s
$\vec{a} = +5.00$ m/s²
$t = 12.0$ s, 9.0 s

$\vec{d}_{total} = \vec{d}_{12} - \vec{d}_9$

$\vec{d}_{12} = (10.0)(12.0) + (\frac{1}{2})(5.00)(12)^2$

$\vec{d}_{12} = 480$ m

$\vec{d}_9 = (10)(9) + (\frac{1}{2})(5)(9)^2$

$\vec{d}_9 = 292.5$ m

$d_{total} = 480 - 292.5$

$= 188$ m

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