Physics 20 - Lesson 7
Acceleration

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1) /4

$\vec{v}_1 = 0$
$\vec{v}_2 = 100\,{}^{km}/_{h}$ ✓
$\Delta t = 1\text{min}$
$\vec{a} = ?$

$\vec{a} = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \dfrac{100\,{}^{km}/_{h} - 0}{1\text{min}}$ ✓ ✓ $\boxed{\vec{a} = +\dfrac{100\,{}^{km}/_{h}}{\text{min}}}$ ✓

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2) /4

$\vec{v}_1 = 30\,{}^{m}/_{s}$
$\vec{v}_2 = 10\,{}^{m}/_{s}$ ✓
$\Delta t = 5.0s$
$\vec{a} = ?$

$\vec{a} = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \dfrac{10\,{}^{m}/_{s} - 30\,{}^{m}/_{s}}{5.0s}$ ✓ ✓ $\boxed{\vec{a} = -4.0\,{}^{m}/_{s^2}}$ ✓

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3) /4

$\vec{v}_1 = 200\,{}^{km}/_{h}$
$\vec{v}_2 = ?$
$\Delta t = 60s$
$\vec{a} = 5\dfrac{{}^{km}/_{h}}{s}$ ✓

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t = 200\,{}^{km}/_{h} + 5\dfrac{{}^{km}/_{h}}{s}(60s)$ ✓ ✓ $\boxed{\vec{v}_2 = +500\,{}^{km}/_{h}}$ ✓

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4) /4

$\vec{v}_1 = 50\,{}^{m}/_{s}$ ✓
$\vec{v}_2 = 80\,{}^{m}/_{s}$
$\Delta t = ?$
$\vec{a} = 4\,{}^{m}/_{s^2}$

$\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \dfrac{80\,{}^{m}/_{s} - 50\,{}^{m}/_{s}}{4\,{}^{m}/_{s^2}}$ ✓ ✓ $\boxed{\Delta t = 7.5s}$ ✓

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5) /4

$\vec{v}_1 = 80\,{}^{m}/_{s}$ ✓
$\vec{v}_2 = 40\,{}^{m}/_{s}$
$\Delta t = ?$
$\vec{a} = -4\,{}^{m}/_{s^2}$

$\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \dfrac{40\,{}^{m}/_{s} - 80\,{}^{m}/_{s}}{-4\,{}^{m}/_{s^2}}$ ✓ ✓ $\boxed{\Delta t = 10s}$ ✓

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6) /4

$\vec{v}_1 = ?$
$\vec{v}_2 = 90\,{}^{m}/_{s}$
$\Delta t = 9s$
$\vec{a} = 3\,{}^{m}/_{s^2}$ ✓

$\vec{a} = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t}$
$\vec{v}_1 = \vec{v}_2 - \vec{a}\Delta t$ ✓
$\vec{v}_1 = 90\,{}^{m}/_{s} - (3\,{}^{m}/_{s^2})(9.0s) = \boxed{63\,{}^{m}/_{s}}$ ✓ ✓

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7) /4

$\vec{v}_1 = ?$
$\vec{v}_2 = 95\,{}^{m}/_{s}$
$\Delta t = 5.0s$ ✓
$\vec{a} = -5.0\,{}^{m}/_{s^2}$

$\vec{v}_1 = \vec{v}_2 - \vec{a}\Delta t = 95\,{}^{m}/_{s} - (-5.0\,{}^{m}/_{s^2})(5.0s)$ ✓ ✓ $\boxed{\vec{v}_1 = +120\,{}^{m}/_{s}}$ ✓

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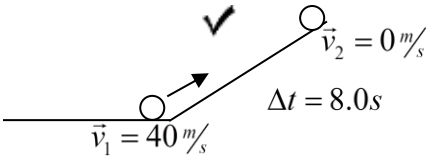
8)



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a) $\vec{a} = \dfrac{\vec{v}_2 - v_1}{\Delta t} = \dfrac{0\ ^m/_s - 40\ ^m/_s}{8.0s}$ $\boxed{\vec{a} = -5.0\ ^m/_{s^2}}$

b) $\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t = 40\ ^m/_s + (-5\ ^m/_{s^2})(6.5s)$ $\boxed{\vec{v}_2 = +7.5\ ^m/_s}$

c) $\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t = 40\ ^m/_s + (-5\ ^m/_{s^2})(11s)$ $\boxed{\vec{v}_2 = -15\ ^m/_s}$

9)

$\vec{v}_1 = -35\ ^m/_s$
$\vec{v}_2 = ?$
$\Delta t = 5.0s$
$\vec{a} = -9.81\ ^m/_{s^2}$

/4

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t = -35\ ^m/_s + (-9.81\ ^m/_{s^2})(5s)$

$\boxed{\vec{v}_2 = -84.1\ ^m/_s}$

$\boxed{\vec{v}_2 = 84.1\ ^m/_s \text{ down}}$

10)

Mass does not matter

$\vec{v}_1 = 80\ ^m/_s$
$\vec{a} = -9.81\ ^m/_{s^2}$

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a) at the top $\vec{v}_2 = 0$ and $\Delta t = 3$

$\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \dfrac{0\ ^m/_s - 80.0\ ^m/_s}{-9.81\ ^m/_{s^2}}$ $\boxed{\Delta t = 8.15s}$

b) $\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \dfrac{-80\ ^m/_s - 80.0\ ^m/_s}{-9.81\ ^m/_{s^2}}$ $\Delta t = 16.3s$

c)

$\Delta t = 11.0s$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$\vec{v}_2 = (80.0m/s) + (-9.81m/s^2)(11.0s)$

$\boxed{\vec{v}_2 = -27.9m/s}$

$\boxed{\vec{v}_2 = 27.9m/s \text{ down}}$

11)

Acceleration is the change in the velocity of the stones. Each stone is changing velocity at the same rate, whether gaining speed while accelerating down or accelerating down when the stone is moving up.

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12)

A projectile experiences the same downward acceleration due to gravity whether it is moving up or coming down. Therefore, the time up will be the same as the time down. The times would be different if the projectile experienced different accelerations for going up and going down.

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13)

As the equation shows, the time that a projectile is in the air depends only on the initial velocity and the acceleration. Note that the final velocity equals the initial velocity, except for direction.

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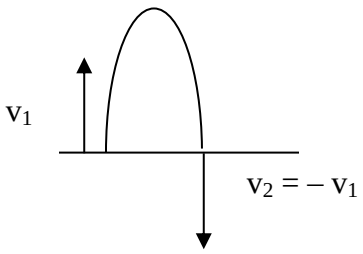

$\vec{a} = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t}$

$\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}}$

$\Delta t = \dfrac{-\vec{v}_1 - \vec{v}_1}{\vec{a}}$