Physics 20 - Lesson 8
Acceleration and Displacement I

/ 54

1) /11

a) $t = \dfrac{d}{v_{avg}}$

b) $v_2 = v_1 + a\Delta t$ c) $v_2 = \pm\sqrt{v_1^2 + 2a\Delta d}$ d) $v_1 = \dfrac{d - \frac{1}{2}a\Delta t^2}{t}$

e) $a = \dfrac{d - v_1\Delta t}{\frac{1}{2}t^2}$

f) $v_1 = v_2 - a\Delta t$

g) $t = \dfrac{v_2 - v_1}{a}$

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

i) $a = \dfrac{2d}{t^2}$

j) $t = \sqrt{\dfrac{2d}{a}}$

k) $v_1 = \sqrt{-2ad}$

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2) /4

$\vec{v}_1 = 60\,^m/_s$
$\Delta\vec{d} = ?$
$\Delta t = 9.0s$
$\vec{a} = 3.0\,^m/_{s^2}$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta\vec{d} = (60\,^m/_s)(9.0s) + \frac{1}{2}(3\,^m/_{s^2})(9.0s)^2$
$\boxed{\Delta\vec{d} = 661.5m}$

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3) /4

$\vec{v}_1 = 0$
$\Delta\vec{d} = 1296m$
$\Delta t = ?$
$\vec{a} = 32\,^m/_{s^2}$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta t = \sqrt{\dfrac{2d}{a}}$
$\Delta t = \sqrt{\dfrac{2\times 1296m}{32\,^m/_{s^2}}}$
$\boxed{\Delta t = 9.0s}$

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4) /7

$\vec{v}_1 = 0$
$\vec{v}_2 = ?$
$\Delta\vec{d} = -20m$
$\Delta t = ?$
$\vec{a} = -9.81\,^m/_{s^2}$

$\vec{v}_2{}^2 = \vec{v}_1{}^2 + a\Delta d$
$\vec{v}_2 = \sqrt{0 + 2(-9.81\,^m/_{s^2})(-20m)}$
$\boxed{\vec{v}_2 = -19.8\,^m/_s}$
$\boxed{\vec{v}_2 = 19.8\,^m/_s \text{ down}}$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta t = \sqrt{\dfrac{2d}{a}}$
$\Delta t = \sqrt{\dfrac{2\times(-20m)}{-9.81\,^m/_{s^2}}}$
$\boxed{\Delta t = 2.02s}$

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5) /4

$\vec{v}_1 = ?$
$\Delta\vec{d} = 1760m$
$\Delta t = 10s$
$\vec{a} = -20\,^m/_{s^2}$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\vec{v}_1 = \dfrac{d - \frac{1}{2}a\Delta t^2}{t}$
$\vec{v}_1 = \dfrac{1760m - \frac{1}{2}(-20\,^m/_{s^2})(10s)^2}{10s}$
$\boxed{\vec{v}_1 = +276\,^m/_s}$

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6) /4

$\vec{v}_1 = 60\,{}^{m}\!/_{s}$
$\vec{v}_2 = 0$
$\Delta\vec{d} = ?$
$\Delta t = 4.0s$

$$\Delta\vec{d} = \left(\frac{\vec{v}_1 + \vec{v}_2}{2}\right)\Delta t$$
$$\Delta\vec{d} = \left(\frac{60\,{}^{m}\!/_{s} + 0}{2}\right)4.0s$$
$$\boxed{\Delta\vec{d} = +120m}$$

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7) /4

$\vec{v}_1 = 100\,{}^{m}\!/_{s}$
$\vec{v}_2 = 0$
$\Delta\vec{d} = 200m$
$\Delta t = ?$

$$\Delta\vec{d} = \left(\frac{\vec{v}_1 + \vec{v}_2}{2}\right)\Delta t$$
$$\Delta t = \frac{2\Delta d}{\vec{v}_1 + \vec{v}_2}$$
$$\Delta t = \frac{2(200m)}{100\,{}^{m}\!/_{s} + 0}$$
$$\boxed{\Delta t = 4.0s}$$

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8) /7

$\vec{v}_1 = 11\,{}^{m}\!/_{s}$
$\vec{v}_2 = 0$
$\Delta\vec{d} = ?$
$\Delta t_{total} = ?$
$\vec{a} = -9.81\,{}^{m}\!/_{s^2}$

$$\vec{v}_2{}^2 = \vec{v}_1{}^2 + 2\vec{a}\Delta\vec{d}$$
$$\Delta\vec{d} = \frac{\vec{v}_2{}^2 - \vec{v}_1{}^2}{2\vec{a}}$$
$$\Delta\vec{d} = \frac{0 - (11\,{}^{m}\!/_{s})^2}{2(-9.81\,{}^{m}\!/_{s^2})}$$
$$\boxed{\Delta\vec{d} = +6.17m}$$

$$a = \frac{v_2 - v_1}{\Delta t}$$
$$\Delta t = \frac{v_2 - v_1}{a}$$
$$\Delta t = \frac{0 - 11\,{}^{m}\!/_{s}}{-9.81\,{}^{m}\!/_{s^2}}$$
$$\Delta t = 1.12s$$

$$\Delta t_{total} = 2 \times 1.12s$$
$$\boxed{\Delta t_{total} = 2.24s}$$

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9) /4

$\vec{v}_1 = 0$
$\vec{v}_2 = 350\,{}^{m}\!/_{s}$
$\Delta\vec{d} = 0.75m$
$\vec{a} = ?$

$$\vec{v}_2{}^2 = \vec{v}_1{}^2 + 2a\Delta d$$
$$a = \frac{\vec{v}_2{}^2 - \vec{v}_1{}^2}{2\Delta d}$$
$$a = \frac{350\,{}^{m}\!/_{s}{}^2 - 0}{2 \times 0.75m}$$
$$\boxed{a = +8.17 \times 10^4\,{}^{m}\!/_{s}}$$

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10) /5

$\vec{v}_1 = 10\,{}^{m}\!/_{s}$
$\Delta\vec{d} = ? = \Delta\vec{d}_{12} - \Delta\vec{d}_{9}$
$\Delta t = 12.0s$
$\vec{a} = 5.0\,{}^{m}\!/_{s^2}$

$$\Delta\vec{d} = \Delta d_{12} - \Delta d_{9}$$
$$\Delta\vec{d} = (\vec{v}_1\Delta t_{12} + \tfrac{1}{2}a\Delta t_{12}{}^2) - (\vec{v}_1\Delta t_{9} + \tfrac{1}{2}a\Delta t_{9}{}^2)$$
$$\Delta\vec{d} = \left[(10\,{}^{m}\!/_{s})(12.0s) + \tfrac{1}{2}(5.0\,{}^{m}\!/_{s^2})(12.0s)^2\right] - \left[(10\,{}^{m}\!/_{s})(9.0s) + \tfrac{1}{2}(5.0\,{}^{m}\!/_{s^2})(9.0s)^2\right]$$
$$\boxed{\Delta\vec{d} = +187.5m}$$
