Physics 20 - Lesson 9
Acceleration and Displacement II

Possible 61 / 55

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1) /10

$\vec{v}_1 = 35.0\,{}^{m}\!/_{s}$
$\Delta\vec{d} = ?$
$\vec{a} = -9.81\,{}^{m}\!/_{s^2}$

a)

$a = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t}$
$\vec{v}_2 = \vec{v} + a\Delta t$
$\vec{v}_2 = 35\,{}^{m}\!/_{s} + (-9.81\,{}^{m}\!/_{s^2})3s$
$\boxed{\vec{v}_2 = +5.57\,{}^{m}\!/_{s}}$

b)

$\vec{v}_2 = \vec{v} + a\Delta t = 35\,{}^{m}\!/_{s} + (-9.81\,{}^{m}\!/_{s^2})5s$
$\boxed{\vec{v}_2 = -14.1\,{}^{m}\!/_{s}}$

c)

$\vec{v}_2{}^2 = \vec{v}_1{}^2 + 2a\Delta d$
$\Delta d = \dfrac{-\vec{v}_1{}^2}{2\vec{a}} = \dfrac{-(35\,{}^{m}\!/_{s})^2}{2(-9.81\,{}^{m}\!/_{s^2})} = \boxed{+62.4m}$

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2) /7

$\vec{v}_1 = 50\,{}^{m}\!/_{s}$
$\vec{v}_2 = 0$
$\Delta\vec{d} = 80.0m$
$\vec{a} = ?$
$\vec{v}_{2.5} = ?$

Find Acceleration

$\vec{v}_2{}^2 = \vec{v}_1{}^2 + 2\vec{a}\Delta d$
$\vec{a} = \dfrac{0 - \vec{v}^2}{2\Delta d} = \dfrac{-(50\,{}^{m}\!/_{s})^2}{2\times 80.0m} = -15.6\,{}^{m}\!/_{s^2}$

Find Velocity

$a = \dfrac{\vec{v}_2 - \vec{v}_1}{\Delta t}$
$\vec{v}_2 = \vec{v} + a\Delta t$
$\vec{v}_2 = 50\,{}^{m}\!/_{s} + (-15\,{}^{m}\!/_{s^2})2.5s$
$\boxed{\vec{v}_2 = +10.9\,{}^{m}\!/_{s}}$

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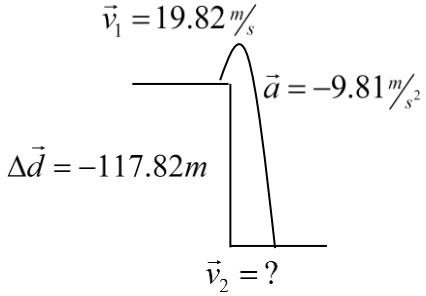
3) /7



Find v_2

$\vec{v}_2{}^2 = \vec{v}_1{}^2 + 2\vec{a}\Delta d$
$\vec{v}_2 = -\sqrt{(19.62\,{}^{m}\!/_{s})^2 + 2(-9.81\,{}^{m}\!/_{s^2})(-117.82m)}$
$\vec{v}_2 = -51.9\,{}^{m}\!/_{s}$

Find t

$\Delta t = \dfrac{v_2 - v_1}{a} = \dfrac{-51.9\,{}^{m}\!/_{s} - 19.62\,{}^{m}\!/_{s}}{-9.81\,{}^{m}\!/_{s^2}} = \boxed{7.29s}$

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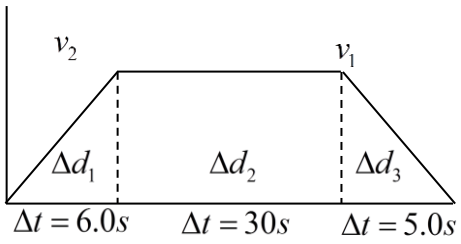
4) /5

$\vec{v}_1 = 0$
$\Delta t_6 = 6.0s$
$\Delta t_5 = 5.0s$
$\vec{a} = -9.81\,{}^{m}\!/_{s^2}$

$\Delta\vec{d} = \Delta d_6 - \Delta d_5$
$\Delta\vec{d} = \frac{1}{2}a\Delta t_6{}^2 - \frac{1}{2}a\Delta t_5{}^2$
$\Delta\vec{d} = \frac{1}{2}a(\Delta t_6{}^2 - \Delta t_5{}^2)$
$\Delta\vec{d} = \frac{1}{2}(-9.81\,{}^{m}\!/_{s^2})(6s^2 - 5s^2)$
$\boxed{\Delta\vec{d} = -53.96\,m}$
or
$\boxed{\Delta\vec{d} = 53.96\,m\ down}$

5)



/10

$\vec{v}_1 = 0$
$\vec{v}_2 = ?$
$\Delta d = ?$
$\Delta t = 6.0s$
$\vec{a} = 2.0\,{}^{m}\!/_{s^2}$

$d = \Delta d_1 + \Delta d_2 + \Delta d_3$
$d = 36m + 360m + 30m$
$\boxed{d = 4.3\times10^2 m}$

$\vec{v}_2 = \vec{v} + a\Delta t$
$\vec{v}_2 = 0 + (2.0m/s^2)(5.0s)$
$\vec{v}_2 = 12m/s$

$\Delta\vec{d}_1 = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta\vec{d}_1 = 0 + \frac{1}{2}(2.0m/s^2)(6.0s)^2$
$\Delta\vec{d}_1 = 36m$

$\Delta\vec{d}_2 = v_{ave}\times\Delta t = (12.0m/s)(30.0s)$
$\Delta\vec{d}_2 = 360m$

$\Delta\vec{d}_3 = \left(\frac{v_1 + v_2}{2}\right)\Delta t = \left(\frac{12m/s + 0}{2}\right)5.0s$
$\Delta\vec{d}_3 = 30m$

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6)

a) $\vec{v} = 25\,{}^{m}\!/_{s}$
$\Delta\vec{d} = ?$
$\Delta t = 0.80s$

$\Delta d = \vec{v}\Delta t$
$\Delta d = (25\,{}^{m}\!/_{s})(0.80s)$
$\boxed{\Delta d = 20m}$

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b) $\vec{v}_1 = 25\,{}^{m}\!/_{s}$
$\vec{v}_2 = 0$
$\Delta\vec{d} = ?$
$a = -9.3\,{}^{m}\!/_{s^2}$

$\Delta d = \frac{\vec{v}_2{}^2 - \vec{v}_1{}^2}{2a} = \frac{0 - (25\,{}^{m}\!/_{s})^2}{2(-9.3\,{}^{m}\!/_{s^2})}$
$\Delta d = 34m$
$\Delta d_{total} = 20m + 34m = \boxed{54m}$

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7)

$\vec{v}_1 = -6\,{}^{m}\!/_{s}$
$\Delta t = 3.0s$
$\Delta\vec{d} = ?$
$a = -9.81\,{}^{m}\!/_{s^2}$

/4

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta\vec{d} = (-6.0\,{}^{m}\!/_{s})(3.0s) + \frac{1}{2}(-9.81\,{}^{m}\!/_{s^2})(3.0s)^2$
$\boxed{\Delta\vec{d} = -62m}$

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8)

$\vec{v}_1 = 10.0\,{}^{m}\!/_{s}$
$\Delta t = 5.0s$
$\Delta\vec{d} = ?$
$a = -9.81\,{}^{m}\!/_{s^2}$

/4

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta\vec{d} = (10.0\,{}^{m}\!/_{s})(5.0s) + \frac{1}{2}(-9.81\,{}^{m}\!/_{s^2})(5.0s)^2$
$\boxed{\Delta\vec{d} = -72.6m}$

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9) Bonus /6

$\vec{v} = 0$
$\Delta\vec{d} = 77m$
$\Delta t_6 = 6.0s$
$\Delta t_5 = 5.0s$
$\vec{a} = ?$

$\Delta\vec{d} = \Delta d_6 - \Delta d_5$
$\Delta\vec{d} = \frac{1}{2} a\Delta t_6^{\,2} - \frac{1}{2} a\Delta t_5^{\,2}$
$\Delta\vec{d} = \frac{1}{2} a(\Delta t_6^{\,2} - \Delta t_5^{\,2})$
$77 = \frac{1}{2} a(6^2 - 5^2)$
$77 = \frac{1}{2} a(36 - 25)$
$77 = \frac{1}{2} a(11)$
$\frac{77 \times 2}{11} = a$
$\boxed{\vec{a} = +14\,{}^{m}/_{s^2}}$