Constant Acceleration Wordproblems Answer Key

① $v_i = 44\text{m/s}$ $v_f = 22\text{m/s}$ $t = 11\text{s}$ $\Delta x = ?$

1st: find a. $a = \frac{v_f - v_i}{t} = \frac{22\text{m/s} - 44\text{m/s}}{11\text{s}} = -2\text{m/s}^2$

To use: $v_f^2 = v_i^2 + 2a\Delta x$

$(22\text{m/s})^2 = (44\text{m/s})^2 + 2(-2\text{m/s}^2)\Delta x$

$484\frac{m^2}{s^2} = 1{,}936\frac{m^2}{s^2} + (-4\frac{m}{s^2})\Delta x$

$-1936 \quad -1{,}936$

$\frac{-1{,}452\frac{m^2}{s^2}}{-4\text{m/s}^2} = \frac{-4\frac{m}{s^2}\Delta x}{-4\text{m/s}^2}$

$\Delta x = 363\text{m}$

– OR – use: $x_f = x_i + v_i t + \frac{1}{2}at^2$

$x_f = 0 + 44\frac{m}{s}(11s) + \frac{1}{2}(-2\frac{m}{s^2})(11s)^2$

$x_f = 484m + \frac{1}{2}(242m)$

$x_f = 363m$
$\parallel$
Δx

② $v_i = 15\text{m/s}$ $v_f = 25\text{m/s}$ $\Delta x = 125\text{m}$ $t = ?$

1st use $v_f^2 = v_i^2 + 2a\Delta x$ to solve for a

$(25\text{m/s})^2 = (15\text{m/s})^2 + 2a(125\text{m})$

$625\frac{m^2}{s^2} = 225\frac{m^2}{s^2} + 250\text{m}\cdot a$

$-225 \quad -225$

$\frac{400\frac{m^2}{s^2}}{250m} = \frac{250m\cdot a}{250m}$

$a = 1.6\text{m/s}^2$

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

$t \cdot 1.6\text{m/s}^2 = \frac{25\frac{m}{s} - 15\frac{m}{s}}{t} \cdot t$

$\frac{t \cdot 1.6\text{m/s}^2}{1.6\text{m/s}^2} = \frac{10\frac{m}{s}}{1.6\text{m/s}^2}$

$t = 6.25s$

(3) $V_f = 7.5 m/s$ $t = 4.5s$ $\Delta X = 19m$ $V_i = ?$

* Since acceleration is constant, average velocity is the average of V_f & V_i which is $\frac{V_f + V_i}{2}$

$\therefore AvgV = \frac{\Delta X}{t} \Rightarrow t \cdot \frac{V_f + V_i}{2} = \frac{\Delta X}{t} \cdot t$

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

$$\frac{19m}{4.5s} = \frac{\left(\frac{7.5\frac{m}{s} + V_i}{2}\right)(4.5s)}{4.5s}$$

$$2 \cdot 4.2\frac{m}{s} = \frac{7.5m/s + V_i}{2} \cdot 2$$

$$8.4\frac{m}{s} = 7.5\frac{m}{s} + V_i$$

$$-7.5m/s \quad -7.5m/s$$

$$\boxed{V_i = 0.94 m/s}$$

(4) $V_i = 0m/s$ $a = 3\frac{m}{s^2}$ $t = 10s$ $\Delta X = ?$ $V_f = ?$

* use $x_f = x_i + V_i t + \frac{1}{2}at^2$

$-x_i \quad -x_i$

* $x_f - x_i = \Delta X$ so

$$\Delta X = V_i t + \frac{1}{2}at^2$$

$$\Delta X = 0m/s(10s) + \frac{1}{2}(3\frac{m}{s^2})(10s)^2$$

$$\boxed{\Delta X = 150m}$$

now find V_f.. using either $\Delta X = \frac{V_f + V_i}{2} \cdot t$ -OR- $V_f^2 = V_i^2 + 2a\Delta X$

$$V_f^2 = 0m/s^2 + 2(3\frac{m}{s^2})(150m)$$

$$\sqrt{V_f^2} = \sqrt{900\frac{m^2}{s^2}}$$

$$\boxed{V_f = 30\frac{m}{s}}$$

⑤ uniform acceleration = constant acceleration.

$V_f = 61\,m/s \quad V_i = 0\,m/s \quad a = 2.5\,m/s^2$

$t = ? \qquad \Delta x = ?$

$a = \frac{V_f - V_i}{t} \quad$ so $t \cdot 2.5\,\frac{m}{s^2} = \frac{61\,m/s - 0\,m/s}{t} \cdot t$

$\frac{m}{s} \cdot \frac{s^2}{m}$

$t = \frac{61\,m/s}{2.5\,\frac{m}{s^2}} = \boxed{24.4\,s}$

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

$\Delta x = \frac{1}{2}(2.5\,m/s^2)(24.4\,s)^2$

$\boxed{\Delta x = 744.2\,m}$

⑥ $V_f = 0\,\frac{m}{s} \quad V_i = 25\,\frac{m}{s} \quad t = 5\,s$

$a = \frac{V_f - V_i}{t} = \frac{0\,\frac{m}{s} - 25\,\frac{m}{s}}{5\,s} = \boxed{-5\,m/s^2}$

⑦ $a = 1.6\,m/s^2 \quad t = ? \quad V_i = 22\,\frac{m}{s} \quad V_f = 31\,\frac{m}{s}$

$t = \frac{V_f - V_i}{a} = \frac{31\,m/s - 22\,m/s}{1.6\,m/s^2} = \boxed{5.6\,s}$

⑧ $\Delta x = 50\,m \quad V_i = 25\,m/s \quad V_f = 0\,m/s \quad a = ?$

use $V_f^2 = V_i^2 + 2a\Delta x$

$0\,\frac{m}{s} = (25\,\frac{m}{s})^2 + 2a(50\,m)$

$0\,\frac{m}{s} = 625\,\frac{m^2}{s^2} + 100\,m\,a$

$\frac{-625\,\frac{m^2}{s^2}}{100\,m} = a$

$\boxed{a = -6.25\,\frac{m}{s^2}}$

(9) $V_i = 12\frac{m}{s}$ $V_f = 25\frac{m}{s}$ $t = 6s$ $\Delta x = ?$

$$\Delta x = \frac{V_f + V_i}{2}(t) = \frac{12\frac{m}{s} + 25\frac{m}{s}}{2} \cdot 6s = \boxed{111m}$$

(10) $\Delta x = 80m$ $a = -7\frac{m}{s^2}$ $V_i = ?$ $V_f = 0m/s$

use $V_f^2 = V_i^2 + 2a\Delta x$

$$0m/s = V_i^2 + 2(-7\frac{m}{s^2})(80m)$$

$$0\frac{m}{s} = V_i^2 - 1{,}120\frac{m^2}{s^2}$$

$$\sqrt{1{,}120\frac{m^2}{s^2}} = \sqrt{V_i^2}$$

$$\boxed{V_i = 33.5m/s}$$

(11) $V_i = 25m/s$ $t = 0.75s$ $a = -10m/s^2$

$V_f = 0m/s$ * Find Δx (distance car needs to come to a stop)

$$\Delta x = V_i t + \frac{1}{2}at^2$$

$$\Delta x = 25\frac{m}{s}(0.75s) + \frac{1}{2}(-10\frac{m}{s^2})(0.75s)^2$$

$$\Delta x = 18.75m - 3.75m$$

$$\boxed{\Delta x = 15m}$$