Kinematics Worksheet 1

(1) $v = \frac{\Delta d}{\Delta t} = \frac{20}{2.35} = 12.8 \text{ m/s}$

(2) $v = \frac{\Delta d}{\Delta t} = \frac{280 \text{ km}}{3 \text{ h}} = 93 \text{ km/h}$

(3) $v_i = 0$
$v_f = 27 \text{ m/s}$
$t = 3 \text{ s}$

$v_f = v_i + at$
$a = \frac{v_f}{t} = \frac{27}{3} = 9.0 \text{ m/s}^2$

(4) $v_i = 0$
$a = 190 \text{ m/s}^2$
$t = 2.4 \text{ s}$
$v_f = ?$

$v_f = v_i + at$
$= 190(2.4) = 456 \text{ m/s}$

(5) $v_i = 15 \text{ m/s}$
$a = 3.5 \text{ m/s}^2$
$t = 5.0 \text{ s}$
$v_f = ?$

$v_f = v_i + at$
$= 15 + (3.5)(5)$
$= 32.5 \text{ m/s}$

(6) $v_i = 23 \text{ m/s}$
$a = -0.25 \text{ m/s}^2$
$v_f = 0$
$d = ?$

$v_f^2 = v_i^2 + 2ad$
$d = \frac{-v_i^2}{2a} = \frac{-(23)^2}{2(-.25)} = 1058 \text{ m}$

(7) $v_i = 12 \text{ m/s}$
$v_f = 26 \text{ m/s}$
$t = 14 \text{ s}$
$d = ?$

$d = \left(\frac{v_i + v_f}{2}\right) t$
$= \left(\frac{12 + 26}{2}\right) 14 = 266 \text{ m}$

(8) $v_i = 0$

$a = 3.2\ m/s^2$

$t = 3.0\ s$

(a) $V_f = V_i + at$

$= 0 + (3.2\ m/s^2)(3.0\ s)$

$= \underline{9.6\ m/s}$

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

$= \left(\frac{0 + 9.6\ m/s}{2}\right)(3.0\ s)$

$= \underline{14.4\ m}$

(b) $V_{avg} = \frac{\Delta d}{\Delta t} = \frac{14.4\ m}{3.0\ s} = \underline{4.8\ m/s}$

(9) $V_i = 12\ m/s$

$V_f = 0$

$d = 541\ m$

$a = ?$

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

$541\ m = \left(\frac{12\ m/s + 0}{2}\right)t$

$t = 90.17\ s$

$V_f = V_i + at$

$0 = 12\ m/s + a(90.17\ s)$

$a = \underline{-0.13\ m/s^2}$

(10) $V_f = 0$

$a = -9.4\ m/s^2$

$d = 34\ m$

$V_i = ?$

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

$34 = \left(\frac{V_i + 0}{2}\right)t$

$68 = V_i t$

$\frac{68}{V_i} = t$

$V_f = V_i + at$

$0 = V_i + (-9.4)t$

$0 = V_i + -9.4\left(\frac{68}{V_i}\right)$

$V_i = \frac{639.2}{V_i}$

$V_i^2 = 639.2$

$V_i = \underline{25.3\ m/s}$

(11) $v_i = 0$

$v_f = 25\ m/s$

$a = 0.15\ m/s^2$

$d = ?$

$v_f = v_i + at$

$25\ m/s = 0 + (0.15\ m/s^2)t$

$t = 166.67\ s$

$d = \left(\frac{v_i + v_f}{2}\right)t$

$= \left(\frac{0 + 25\ m/s}{2}\right)166.67\ s$

$d = 2083\ m$

(12) $v_f = 53\ m/s$

$d = 120\ m$

(a) $v_i = 0$ $\quad d = \left(\frac{v_i + v_f}{2}\right)t$

$120\ m = \left(\frac{0 + 53\ m/s}{2}\right)t$

$t = 4.53\ s$

$v_f = v_i + at$

$53\ m/s = 0 + a(4.53\ s)$

$a = 11.7\ m/s^2$

(b) using acceleration from (a)

$v_f = v_i + at$

$85\ m/s = 0 + (11.7\ m/s^2)t$

$t = 7.26\ s$

$d = \left(\frac{v_i + v_f}{2}\right)t$

$= \left(\frac{0 + 85\ m/s}{2}\right)7.26\ s$

$= 308\ m$

(13) $v = \frac{\Delta d}{\Delta t}$

$8.3\ min(60) = 498\ s$

$3 \times 10^8\ m/s = \frac{\Delta d}{498\ s}$

$\Delta d = 1.5 \times 10^{11}\ m$

(14) $v_i = 55 \text{ km/h} \left(\frac{1000 \text{ m/km}}{3600 \text{ s/hr}}\right) = 15.278 \text{ m/s}$

Constant velocity

$V = \frac{\Delta d}{\Delta t}$

$15.278 \text{ m/s} = \frac{\Delta d}{0.75}$

$\Delta d = \underline{11.5 \text{ m}}$

(15) $a = -3.0 \times 10^2 \text{ m/s}^2$

$v_i = 110 \text{ km/h} = 30.56 \text{ m/s}$

$v_f = 0$

$d = ?$

$v_f = v_i + at$

$0 = (30.56 \text{ m/s}) + (-3.0 \times 10^2 \text{ m/s}^2)t$

$t = -0.102 \text{ s}$

$d = \left(\frac{v_i + v_f}{2}\right) t$

$= \left(\frac{(30.56 \text{ m/s}) + 0}{2}\right)(0.102 \text{ s})$

$\underline{d = 1.6 \text{ m}}$

(16) $V_i = 15\ m/s$

$V_f = 25\ m/s$

$d = 125\ m$

$t = ?$

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

$t = \frac{2d}{V_i + V_f} = \frac{2(125)}{15+25} = 6.25 = \underline{6.3\ s}$

(17) (a) $V_i = 2\ m/s$

$a = -0.5\ m/s^2$

$t = 2.0\ s$

$V_f = ?$

$V_f = V_i + at$

$= 2 + (-.5)(2)$

$= \underline{1.0\ m/s}$

(b) $V_f = V_i + at$

$= 2 + (-.5)(6)$

$= \underline{-1.0\ m/s}$ (This means that it will stop and start to roll back down the hill.)

(18) $V_i = 0$

$a = 5.0\ m/s^2$

$d = 5 \times 10^2\ m$

$V_f = ?$

$V_f^2 = V_i^2 + 2ad$

$V_f = \sqrt{2ad}$

$= \sqrt{2(5)(5\times10^2)}$

$V_f = \underline{102\ m/s}$

(19) (a) $v_i = 6\ m/s$

$v_f = 0$

$t = 1.2\ s$

$d = ?$

$$d = \left(\frac{v_i + v_f}{2}\right) t$$

$$= \frac{v_i t}{2} = \frac{6(1.2)}{2} = \underline{3.6\ m}$$

(b) $v_f = v_i + at$

$$a = \frac{v_f - v_i}{t} = \frac{-v_i}{t} = \frac{-6}{1.2} = \underline{-5\ m/s^2}$$

(20) $v_i = 0$

$v_f = 61\ m/s$

$a = 2.5\ m/s^2$

$d = 1820\ m$

$t = ?$

$$v_f = v_i + at$$

$$t = \frac{v_f}{a} = \frac{61}{2.5} = \underline{24\ s}$$

(21) $v_i = 22\ m/s$

$v_f = 3.0\ m/s$

$a = -2.1\ m/s^2$

$t = ?$

$$v_f = v_i + at$$

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

$$= \frac{3 - 22}{-2.1}$$

$$\underline{t = 9.0\ s}$$

(22) (a) $V_i = 0$

$a = 3.0\ m/s^2$

$t = 30\ s$

$d = ?$

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

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

$= \frac{1}{2}(3)(30)^2 = \underline{1350\ m}$

(b) $V_f = V_i + at$

$V_f = (3)(30) = \underline{90\ m/s}$

(23) (a) $V_i = 11.4\ m/s$

$a = -3.8\ m/s^2$

$V_f = 0$

$d = ?$

$V_f^2 = V_i^2 + 2ad$

$d = \frac{-V_i^2}{2a} = \frac{-(11.4)^2}{2(-3.8)} = 17.1$

The vehicle stops in 17.1 m so the ranger comes within $20 - 17.1 = \underline{2.9\ m}$ of the deer.

(b) $t = ?$

$V_f = V_i + at$

$t = \frac{-V_i}{a} = \frac{-11.4}{-3.8} = \underline{3.0\ s}$

(24) (a)

Friend (A)	Bicyclist (B)
$v = 3.5$ m/s	$v_i = 0$
$a = 0$	$a = 2.4$ m/s^2

She catches her friend when they are both at the same place (d is equal) at the same time (t is equal)

$d_A = v_A t_A + \frac{1}{2} a_A t_A^2$ $\quad d_B = v_B t + \frac{1}{2} a_B t_B^2$

$$v_A t = \frac{1}{2} a_B t^2$$

$$t = \frac{2 v_A}{a_B} = \frac{2(3.5)}{2.4} = 2.92 \text{ s}$$

But, she waited 2 seconds before starting. Therefore it takes her 4.92 s to catch her friend.

(b) $d_B = \frac{1}{2} a_B t_B^2$

$= \frac{1}{2}(2.4)(2.92)^2$

$= \underline{10.2 \text{ m}}$

*note, she only cycled for 2.92 seconds.

(c) $v_f = v_i + at$

$= (2.4)(2.92)$

$= \underline{7.0 \text{ m/s}}$