Kinematics Worksheet 3

(1) $v = 1.1 \times 10^{-2}$ m/s
$d = 1.5$ m
$t = ?$

$v = \frac{d}{t}$

$t = \frac{d}{v} = \frac{1.5}{1.1 \times 10^{-2}} = 136$

$= 140$ s

(2)

Cheetah		prey
$v_c = 0$		$v_p = 9.0$ m/s
$a_c = ?$		$a_c = 0$
d	=	d
$t = 3$	=	$t = 3$

$d = v_c t + \frac{1}{2} a t^2$ $\quad$ $d = v_p t + \frac{1}{2} a t^2$

$\frac{1}{2} a_c t^2 = v_p t$

$a_c = \frac{2 v_p}{t} = \frac{2(9)}{3} = 6.0$ m/s^2

(3) $v_i = 0$

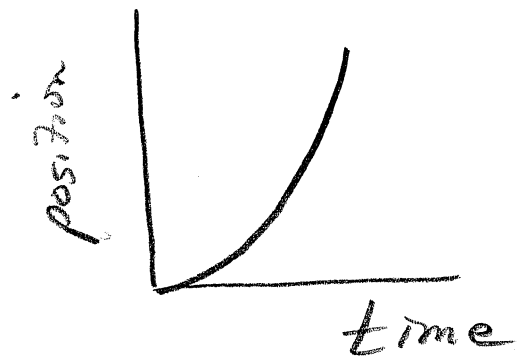
$a = 4.50\ m/s^2$

$t = 2.40\ s$

(a) $v_f = v_i + at$

$= 4.5(2.4) = 10.8\ m/s$

(b)



(4) $a = -2.1 \times 10^4\ m/s^2$

$t = 1.85 \times 10^{-3}\ s$

$v_f = 0$

$v_i = ?$

$v_f = v_i + at$

$v_i = -at = -(-2.1 \times 10^4)(1.85 \times 10^{-3})$

$v_i = 38.85 = \underline{38.9\ m/s}$

(5) $a = 6.2 \times 10^5 \text{ m/s}^2$

$t = 8.10 \times 10^{-7} \text{ s}$

$v_i = 0$

$v_f = ?$

$v_f = v_i + at = (6.2 \times 10^5)(8.1 \times 10^{-7})$

$= 502.2 = \underline{502 \text{ m/s}}$

(6) $v_i = 0$

$v_f = 62 \text{ m/s}$

$a = 31 \text{ m/s}^2$

$d = ?$

$v_f^2 = v_i^2 + 2ad$

$d = \frac{v_f^2}{2a} = \frac{(62)^2}{2(31)}$

$\underline{d = 62 \text{ m}}$

(7) $v_i = 0$

$a = -9.8 \text{ m/s}^2$

$t = 6.8 \text{ s}$

(a) $d = ?$

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

$= \frac{1}{2}(-9.8)(6.8)^2 = -226.38$

The height is 230 m.

(b) $v_f = v_i + at$

$= (-9.8)(6.8) = -66.64 = \underline{-67 \text{ m/s}}$

or 67 m/s down

(8) $v_i = 234\ m/s$

$a = -9.8\ m/s^2$

(a) $v_f = 0$

$d = ?$

$v_f^2 = v_i^2 + 2ad$

$d = \frac{-v_i^2}{2a} = \frac{-(234)^2}{2(-9.8)} = 2795.67$

$d = 2790\ m$

(b) from top of path

$v_i = 0$

$a = -9.8\ m/s^2$

$d = -2795.67$

$v_f = ?$

$v_f^2 = v_i^2 + 2ad$

$v_f = \sqrt{2ad}$

$= \sqrt{2(-9.8)(-2795.67)}$

$v_f = 234\ m/s$

(c) $v_i = 234\ m/s$

$a = -9.8\ m/s$

$d = 0$ (up and down)

$t = ?$

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

$t = \frac{-2v_i}{a} = \frac{-2(234)}{-9.8} = 47.76 = 48\ s$

(9) $v_i = ?$

$v_f = 15\ m/s$

$a = -9.8\ m/s^2$

$t = 2.0\ s$

$v_f = v_i + at$

$v_i = v_f - at$

$= 15 - (-9.8)2$

$v_i = 34.6 = \underline{35\ m/s}$

(10) $v_i = ?$

$a = -9.8\ m/s^2$

$d = 0$

$t = 8.0\ s$

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

$v_i = -\frac{1}{2} at = -\frac{1}{2}(-9.8)(8)$

$v_i = 39.2 = \underline{39\ m/s}$

(11) $v_i = 15\ m/s$

$t = 20\ s$

$d = 0$

$a = ?$

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

$a = \frac{-2v_i}{t} = \frac{-2(15)}{20} = \underline{-1.5\ m/s^2}$

(12) $v_i = 2.5\ m/s$

$a = -9.8\ m/s^2$

$d = -3.00\ m$

$t = ?$

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

$-3 = 2.5t + \frac{1}{2}(-9.8)t^2$

$4.9t^2 - 2.5t - 3 = 0$

$$t = \frac{2.5 \pm \sqrt{(-2.5)^2 - 4(4.9)(-3)}}{2(4.9)}$$

$\underline{t = 1.08\ s}$

(13)

Stone

$V_i = 0$

$a = -9.8\ m/s^2$

$d = -75\ m$

$t = ?$

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

$t = \frac{2d}{a} = \frac{2(-75)}{-9.8} = 15.31\ s$

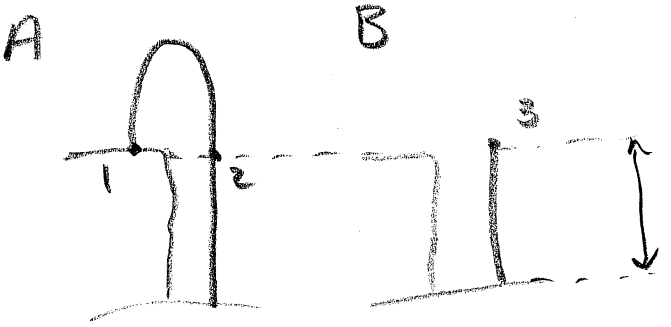
Boat

The boat moved from 7.00 m to 4.00 m during the time the rock fell.

$d = v_i t$ ~~$+ \frac{1}{2} a t^2$~~ $a = 0$ (constant speed)

$v_i = \frac{d}{t} = \frac{7-4}{15.31} = 0.200\ m/s$

(14)



Gun A - The speed of the bullet at points 1 and 2 is the same. At 1 it is up and at 2 it is going down.

Gun B - The speed of the bullet at point 3 is the same as at points 1 and 2.

14 Therefore the time for the bullet to go from the top of the cliff to the bottom is the same.

Bullet has to go up and down first. Therefore, this is how much later it will hit the ground.

$v = 30 \text{ m/s}$

$a = -9.8 \text{ m/s}^2$

$d = 0$

$t = ?$

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

$t = -\frac{2v_i}{a} = \frac{-2(30)}{-9.8} = \underline{6.12 \text{ s}}$

(15) Time for the block to fall from 53 to 2 m.

$v_i = 0$

$a = -9.8\ m/s^2$

$d = -51\ m$

$t = ?$

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

$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(-51)}{-9.8}} = 3.23 s$

Time for the block to fall from 53 - 14 m.

$v_i = 0$

$a = -9.8\ m/s^2$

$d = -39\ m$

$t = ?$

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

$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(-39)}{-9.8}} = 2.82 s$

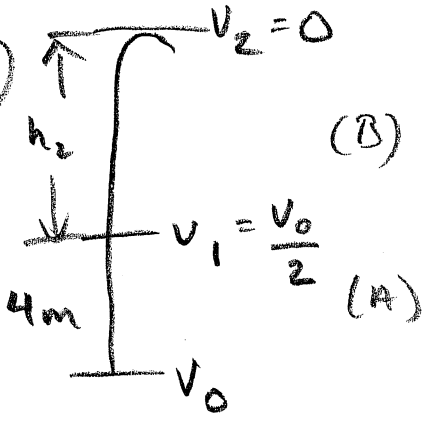
The time to fall from 14 to 2 m is

therefore

$3.23 - 2.82 = 0.41$

The man has <u>0.41s</u> to get out of the way.

(16)



$a = -9.8\ m/s^2$

(A) $V_i = V_0$

$V_f = \frac{V_0}{2}$

$a = -9.8\ m/s^2$

$d = 4\ m$

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

$\left(\frac{V_0}{2}\right)^2 = V_0^2 + 2(-9.8)(4)$

$\frac{-3V_0^2}{4} = -78.4$

$V_0 = 10.22\ m/s$

(B) $V_i = \frac{10.22}{2} = 5.11\ m/s$

$V_f = 0$

$a = -9.8\ m/s^2$

$d = ?$

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

$d = \frac{-V_i^2}{2a} = \frac{-(5.11)^2}{2(-9.8)}$

$d = 1.33\ m$

The total height is $4 + 1.33 = \underline{5.33\ m}$

(17) (a) average velocity is the slope

A: $\bar{v} = \frac{40-10}{1.5-0} = 20 \text{ m/s}$

B: $\bar{v} = \frac{20-10}{2.5-1.5} = 10 \text{ m/s}$

C: $\bar{v} = \frac{40-20}{3-2.5} = 40 \text{ m/s}$

(b) The displacement for the whole trip is zero, therefore the average velocity is zero.

(18) acceleration is the slope.

(a) A: $\bar{a} = \frac{40-0}{20-0} = 2 \text{ m/s}^2$

B: $\bar{a} = 0$

C: $\bar{a} = \frac{80-40}{60-50} = 4 \text{ m/s}^2$

(b) $\bar{a} = \frac{80-0}{60-0} = 1.3 \text{ m/s}^2$

(c) displacement is area.

$d = \frac{40(20)}{2} + 40(30) + \frac{40(10)}{2} + 40(10)$

$d = 2200 \text{ m}$

(19) $v_i = 4.6\ m/s$

$v_f = 0$

$a = -9.8\ m/s^2$

$d = ?$

$v_f^2 = v_i^2 + 2ad$

$d = \frac{-v_i^2}{2a} = \frac{-(4.6)^2}{2(-9.8)}$

$d = 1.08 = \underline{1.1\ m}$

(20)

A	B
$v = ?$	$v_i = 0$
$a = 0$	$v_f = ?$
$d = 460\ m$	$a = ?$
$t = 210\ s$	$d = 460\ m$
	$t = 210\ s$

(a) $d = v_i t + \frac{1}{2}at^2$

$v_i = \frac{d}{t} = \frac{460}{210}$

$v_i = \underline{3.8\ m/s}$

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

$v_f = \frac{2d}{t} = \frac{2(460)}{210} = \underline{4.4\ m/s}$

(c) $v_f = v_i + at$

$a = \frac{v_f}{t} = \frac{4.4}{210} = \underline{0.021\ m/s^2}$