Kinematics Problems
(Algebraic Manipulation)

(1) bunny

$u = 0$

$a = a$

$s = d$

$t \rightarrow$ time for the turtle to travel 2m.

$= \frac{2}{v}$

$s = ut + \frac{1}{2}at^2$

$t = \frac{s}{u} = \frac{2m}{v}$

$s = \cancel{ut} + \frac{1}{2}at^2$

$a = \frac{2s}{t^2} = \frac{2d}{\left(\frac{2}{v}\right)^2} = \frac{2dv^2}{4} = \underline{\frac{dv^2}{2}}$

(2) truck

v

$s = ?$

t

You

$u = 0$

$a = -g$

$s = -h$

$t =$

must be the same

$s = vt$

$s = ut + \frac{1}{2}at^2$

$-h = \frac{1}{2}(-g)t^2$

$t = \sqrt{\frac{2h}{g}}$

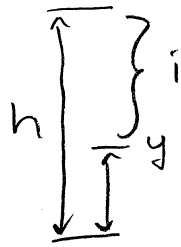
$s = v\sqrt{\frac{2h}{g}}$

(3) $u = 0$

$a = -g$

$s = -(h - y)$ ←

$v = ?$



$$v^2 = u^2 + 2as$$

$$= 2(+g)(+(h-y))$$

$$v = -\sqrt{2g(h-y)}$$

* the velocity must be negative since the ball is falling.

(4) (a) Rock A

$u = 0$

$a = -g$

$s = -h$

$t = ?$

$$s = ut + \frac{1}{2}at^2$$

$$+h = \frac{1}{2}(+g)t^2$$

$$t = \sqrt{\frac{2h}{g}}$$

(b) Rock B

$u = -v$

$a = -g$

$s = -h$

$t = ?$

$$s = ut + \frac{1}{2}at^2$$

$$+h = +vt + \frac{1}{2}(+g)t^2$$

$$\frac{1}{2}gt^2 + vt - h = 0$$

$$t = \frac{-v \pm \sqrt{v^2 - 4(\frac{1}{2}g)(-h)}}{2(\frac{1}{2}g)}$$

$$= \frac{-v \pm \sqrt{v^2 + 2gh}}{g}$$

since time must be positive it must be

$$t = \frac{-v + \sqrt{v^2 + 2gh}}{g}$$

(5)

Car 1

$u = v$

$a = 0$

$s = d$

$t = x + t$

$s = ut + \frac{1}{2}at^2$

$d = v(x + t)$

$d = vx + vt$

$\frac{d - vt}{v} = x$

Car 2

$u = v$

$a = a$

$s = d$

$t = x$

$s = ut + \frac{1}{2}at^2$

$d = vx + \frac{1}{2}ax^2$

$d = v\left(\frac{d - vt}{v}\right) + \frac{1}{2}a\left(\frac{d - vt}{v}\right)^2$

$vt = \frac{1}{2}a\left(\frac{d - vt}{v}\right)^2$

$$a = \frac{2v^3t}{(d - vt)^2}$$