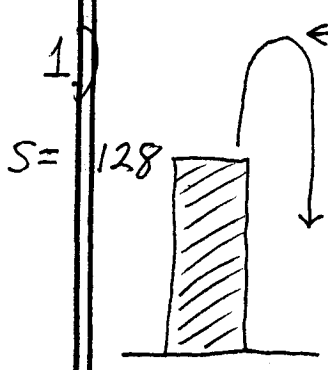
Gravity Problems

1.)



$s(t) = -16t^2 + v_0 t + s_0 \rightarrow$

$\boxed{s(t) = -16t^2 + 112t + 128}$

$\xrightarrow{D}$ $\boxed{s'(t) = -32t + 112}$

a.) highest point: $s'(t) = 0$

$\rightarrow -32t + 112 = 0 \rightarrow t = \frac{112}{32} = \underline{3.5 \text{ sec}} \rightarrow$

$s(3.5) = -16(3.5)^2 + 112(3.5) + 128 = \boxed{324 \text{ ft.}}$

b.) hit ground: $s(t) = 0 \rightarrow$

$-16t^2 + 112t + 128 = 0 \rightarrow -16(t^2 - 7t - 8) = 0 \rightarrow$

$-16(t-8)(t+1) = 0 \rightarrow t = -1$ (NO) or

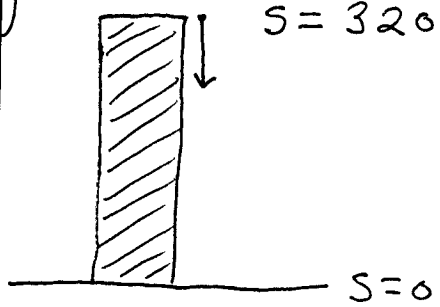
$\boxed{t = 8 \text{ sec}}$

c.) i.) $s'(3) = -32(3) + 112 = 16$ ft./sec

ii.) $s'(4) = -32(4) + 112 = -16$ ft./sec.

iii.) $s'(8) = -32(8) + 112 = -144$ ft./sec.

2.)



$s(t) = -16t^2 + v_0 t + s_0 \rightarrow$

$\boxed{s(t) = -16t^2 - 16t + 320} \rightarrow$

$\boxed{s'(t) = -32t - 16}$

a.) hit ground: $s(t) = 0 \rightarrow$

$-16t^2 - 16t + 320 = 0 \rightarrow -16(t^2 + t - 20) = 0 \rightarrow$

$-16(t-4)(t+5) = 0 \rightarrow t = -5$ (NO) or

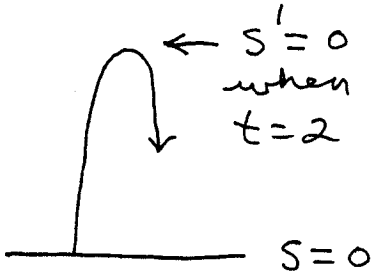
$t = 4$ sec.

b.) i.) $s'(1) = -32(1) - 16 = -48$ ft./sec.

ii.) $s'(2) = -32(2) - 16 = -80$ ft./sec.

iii.) $s'(4) = -32(4) - 16 = -144$ ft./sec.

3.)



$s(t) = -16t^2 + v_0 t + s_0 \rightarrow$

$\boxed{s(t) = -16t^2 + v_0 t} \rightarrow$

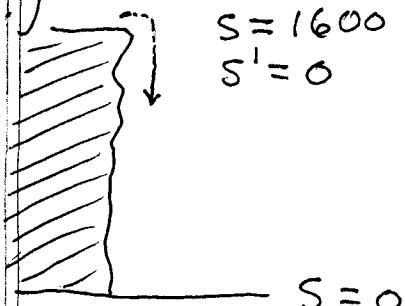
$\boxed{s'(t) = -32t + v_0}$

and $s'(2) = 0 \rightarrow -32(2) + v_0 = 0$

$\rightarrow$ b.) $v_0 = 64$ ft./sec.

a.) $s(2) = -16(2)^2 + 64(2) = 64$ ft.

4.)



$s(t) = -16t^2 + v_0 t + s_0 \rightarrow$

$\boxed{s(t) = -16t^2 + 1600} \rightarrow$

$\boxed{s'(t) = -32t}$

a.) hit ground: $s(t) = 0 \rightarrow$

$-16t^2 + 1600 = 0 \rightarrow 16t^2 = 1600 \rightarrow t^2 = 100 \rightarrow$

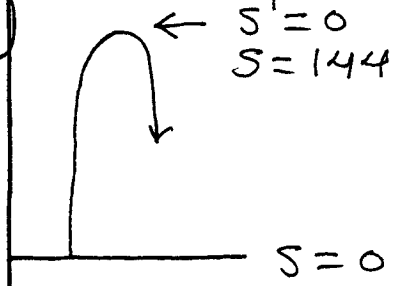
$\boxed{t = 10 \text{ sec.}}$

b.) i.) $s'(5) = -32(5) = -160$ ft./sec.

ii.) $s'(10) = -32(10) = \boxed{-320 \text{ ft./sec}}$;

$\frac{-320 \text{ ft.}}{\text{sec}} \cdot \frac{1 \text{ mi}}{5280 \text{ ft.}} \cdot \frac{3600 \text{ sec.}}{1 \text{ hr.}} \approx \boxed{-218.2 \text{ mph}}$

5.)



$s(t) = -16t^2 + V_0 t + S_0 \rightarrow$

$\boxed{s(t) = -16t^2 + V_0 t} \rightarrow$

$\boxed{s'(t) = -32t} + V_0;$

Let $t = T$ be time required to reach highest point. Then

$$\left.\begin{aligned} s'(T) &= -32T + V_0 = 0 \\ s(T) &= -16T^2 + V_0 T = 144 \end{aligned}\right\} \rightarrow$$

$\boxed{V_0 = 32T} \xrightarrow{(SUB)} -16T^2 + (32T)T = 144 \rightarrow$

$16T^2 = 144 \rightarrow T^2 = 9 \rightarrow T = 3$ sec.

a.) $T = 3$ sec

c.) $V_0 = 32T = 32(3) = 96$ ft./sec.

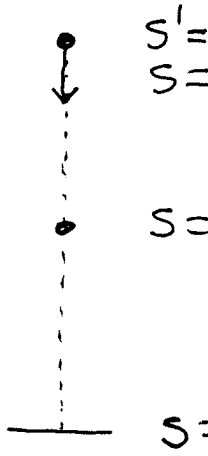
b.) hit ground: $s(t) = 0 \rightarrow$

$-16t^2 + 96t = 0 \rightarrow 16t(6-t) = 0 \rightarrow$

$t = 0$ and $\boxed{t = 6 \text{ sec.}}$

d.) You know.

6.)



$s(t) = -16t^2 + V_0 t + S_0 \rightarrow$

$\boxed{s(t) = -16t^2 + 8000} \rightarrow$

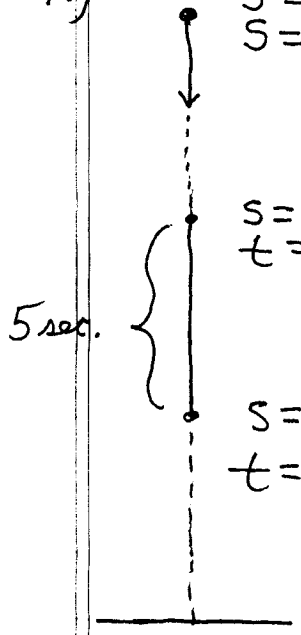
$\boxed{s'(t) = -32t}$

a.) $s(t) = 1600 \rightarrow -16t^2 + 8000 = 1600$

$\rightarrow 16t^2 = 6400 \rightarrow t^2 = 400 \rightarrow$ $\boxed{t = 20 \text{ sec.}}$

b.) $s'(20) = -32(20) = -640$ ft./sec.

7.)



$s(t) = -16t^2 + v_0 t + s_0 \rightarrow$

$s'(t) = -32t + v_0$

a.) $s'(10) = -400 \rightarrow$

$-32(10) + v_0 = -400 \rightarrow$

$\boxed{v_0 = -80 \text{ ft./sec.}}$

b.) $\left.\begin{matrix} s(T) = 4000 \\ s(T+5) = 2400 \end{matrix}\right\} \rightarrow$

$\left.\begin{matrix} -16T^2 - 80T + s_0 = 4000 \\ -16(T+5)^2 - 80(T+5) + s_0 = 2400 \end{matrix}\right\} \rightarrow$

$\boxed{s_0 = 4000 + 80T + 16T^2} \rightarrow$ (SUB) $\rightarrow$

$-16(T^2 + 10T + 25) - 80T - 400$

$+ (4000 + 80T + 16T^2) = 2400 \rightarrow$

$-16T^2 - 160T - 400 - 80T - 400$

$+4000 + 80T + 16T^2 = 2400 \rightarrow$

$160T = 800 \rightarrow$ $\boxed{T = 5 \text{ sec.}} \rightarrow$

$s_0 = 4000 + 80(5) + 16(5)^2 \rightarrow$

$\boxed{s_0 = 4800 \text{ ft.}}$

c.) $s(t) = -16t^2 - 80t + 4800$

strike ground: $s(t) = 0 \rightarrow$

$-16t^2 - 80t + 4800 = 0 \rightarrow$

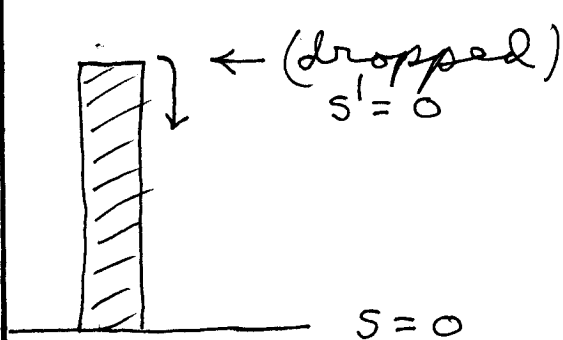
$-16(t^2 + 5t - 300) = 0 \rightarrow$

$-16(t - 15)(t + 20) = 0 \rightarrow$

$t = 15$ sec. ; $t \neq -20$

d.) Snapple Peach Ice Tea

8.)



Let H be height of building. Then

$s'(t) = -16t^2 + (0)t + H \rightarrow$

$\boxed{s(t) = -16t^2 + H}$ D →

$\boxed{s'(t) = -32t}$;

a.) Given $s(5) = 0$ ft. $\rightarrow -16(5)^2 + H = 0$

$\rightarrow \boxed{H = 400 \text{ ft}}$

b.) $s'(1) = -32(1) =$ (−32 ft./sec.) ;

$s'(3) = -32(3) =$ (−96 ft./sec.)

c.) $s'(5) = -32(5) =$ (−160 ft./sec.)

$= \frac{-160 \text{ ft.}}{\text{sec.}} \times \frac{1 \text{ mi.}}{5280 \text{ ft.}} \times \frac{3600 \text{ sec.}}{1 \text{ hr.}} \approx$ (109.1 mph)