Lab 1 Key

1. a) Since the height is given in feet, we'll use $\boxed{a(t) = -32 \text{ ft/s}^2}$. Then $v(t) = -32t + C$ ft/sec. But we know $v(0) = 0$ since the rock was <u>dropped</u>. So $C = 0 \rightarrow \boxed{v(t) = -32t \text{ ft/s}}$
Finally, $s(t) = -32(\tfrac{1}{2}t^2) + C = -16t^2 + C$ ft. But we know $s(0) = 400$. So $-16 \cdot 0^2 + C = 400 \rightarrow C = 400 \rightarrow$
$\boxed{s(t) = -16t^2 + 400 \text{ ft}}$

b) It hits the ground when $s(t) = 0$
$-16t^2 + 400 = 0 \rightarrow 400 = 16t^2 \rightarrow t^2 = 25 \rightarrow t = \boxed{5 \text{ sec}}$
At that time, it's going $V(5) = -32(5) = \boxed{-160 \text{ ft/s}}$, or 160 ft/s downward

2. a) Here, we use $a(t) = -9.8 \text{ m/s}^2$
So $v(t) = -9.8t + C$, but $v(0) = 10$, so $-9.8(0) + C = 10 \rightarrow$
$C = 10 \rightarrow v(t) = -9.8t + 10$ m/s
Then $s(t) = -9.8(\tfrac{1}{2}t^2) + 10t + C = -4.9t^2 + 10t + C$.
But $s(0) = 2$ so $-4.9(0^2) + 10(0) + C = 2 \rightarrow C = 2 \rightarrow$
$\boxed{s(t) = -4.9t^2 + 10t + 2 \text{ m}}$

b) Its max height is reached when $v(t) = 0$
$-9.8t + 10 = 0$
$9.8t = 10$
$t \approx 1.02 \rightarrow s(1.02) = -4.9(1.02)^2 + 10(1.02) + 2 \approx 7.1$
It reaches a max height of $\boxed{7.1\text{m after } 1.02\text{s}}$

3. a) Here, we know $a(t) = -9.8 \text{ m/s}^2$, $s(0) = 100$, and $s(8) = 0$
Since $v(t) = -9.8t + C$, that means $s(t) = -4.9t^2 + Ct + D$.
So we have $-4.9(0^2) + C(0) + D = 100 \rightarrow D = 100$. Then
$-4.9(8^2) + C(8) + 100 = 0 \rightarrow 8C - 213.6 = 0 \rightarrow C = 26.7$.
That means the initial velocity $v(0)$ is $\boxed{26.7 \text{m/s}}$

b) Again, max height is reached when $v(t) = 0$
$-9.8t + 26.7 = 0$
$t \approx 2.72 \rightarrow s(2.72) = -4.9(2.72)^2 + 26.7(2.72) + 100 \approx \boxed{136.4\text{m}}$