2-5 Derivatives as rates of change

Problem 1)

A particle is moving along the z axis such that its position is given by $s = t^3 + 6t^2 + 9t$

a) How often does the particle stop moving?
b) What is the particle's acceleration at each of these moments?
c) Find the speed each time the particle stops accelerating.
d) At t=5 is the particle speeding up? Or slowing down?
e) Find the total distance the particle moved from t=0 to t=2

Problem 2)

The equations $s = 1.86t^2$ and $s = 11.44t^2$ are the freefall equations for Mars and Jupiter respectively. Where s is the distance from original drop in meters, and t is the time that passes in seconds.

a) How long does it take a rock to reach $27.8\ \mathrm{m/s}$ on each planet?
b) Which rock travels farther (if any) before it reaches this speed?

Problem 3)

A bactericide was added in order to try and quell a bacteria population inside of a test broth. The population continued to grow for a while before the bactericide started working (the goal is to kill off the bacteria). The growth of the population was given by $p = 192300 + 10t^3 - 20t^4$, where t is the time in hours

a) When did the bactericide start working?
b) What was the rate of change of the population 5 hours after application of the bactericide?
c) Would the starting population of bacteria change the time when the bactericide started working? Why, why not?

Answer Key

1)
   a. Twice
   b. -6 and 12
   c. Speed is 2
   d. Speeding up
   e. 320
2)
   a. 7.47 seconds and 1.22 seconds
   b. The mars rock
3)
   a. $\frac{1}{4}$ hours
   b. -9250 bacteria/hour
   c. No