**Name:** Solutions _____ / 25

There are 25 points possible on this quiz. No aids (book, calculator, etc.) are permitted. Show all work for full credit.

1. **[8points]** A small bug is crawling along a branch of a tree. The bug's distance, in millimeters, from the trunk after $t$ seconds is given by the function

$$s(t) = 8t - 3t^2 + \frac{1}{3}t^3.$$

**a**. What is the velocity of the bug at time $t$?

$v(t) = s'(t) = 8 - 6t + t^2$

**b**. When is the bug at rest?

Want $t$ when $v=0$. So $0 = 8 - 6t + t^2 = (t-2)(t-4)$

answer: at $t=2$ sec and $t=4$ sec

**c**. What is the acceleration of the bug when it's at rest?

$a(t) = v'(t) = s''(t) = -6 + 2t$

$a(2) = -6+4 = -2$ mm/s$^2$, $a(4) = -6+8 = 2$ mm/s$^2$

**d**. At time $t = 3$, is the bug moving toward the trunk or away from the trunk? Justify your answer.

$v(3) = 8 - 18 + 9 = -1 < 0$

So the bug is moving toward the trunk because $s(t)$ is decreasing

2. **[2 points]** Let $P$ denote the population of an invasive species of fish that is growing over time, $t$. Suppose the population $P$ grows at a rate proportional its size. What can you say about the function $P(t)$?

- $P(t) = P_0 e^{kt}$.
- or $P(t)$ grows exponentially

3. **[6points]** The edge of a cube was found to be 5 meters with a possible error in measurement of 0.1 meter. Use differentials to estimate the maximum possible error in computing the surface area of the cube. Include units with your answer.

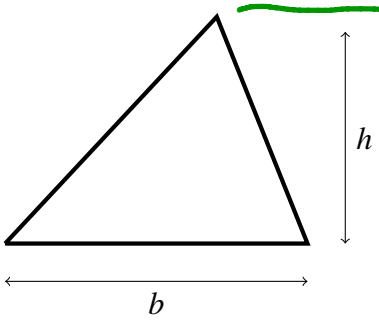
$s=5 \quad ds=\frac{1}{10}$

$A=6s^2$

$dA=6\cdot 2s\cdot ds$

$dA=12\cdot 5\cdot \frac{1}{10}=\boxed{6\ m^2}$

4. **[9points]** The altitude (height, $h$) of a triangle is increasing at at rate of 2 cm/sec while the area of the triangle is decreasing at a rate of 1 $cm^2$/sec. At what rate is the base, $b$, of the triangle changing with the altitude is 10 cm and the area is 100 $cm^2$? Give units.




1. Given $\frac{dh}{dt}=2$ and $\frac{dA}{dt}=-1$

2. Want $\frac{db}{dt}$.

3. Use $A=\frac{1}{2}bh$

aside: When $h=10$ and $A=100$, $100=\frac{1}{2}b\cdot 10$. So $b=20$.

4. $\frac{dA}{dt}=\frac{1}{2}\left(\frac{db}{dt}h+b\cdot\frac{dh}{dt}\right)$

5. $-1=\frac{1}{2}\left(\frac{db}{dt}\cdot 10+20\cdot 2\right)$

$-2=10\frac{db}{dt}+40$

$\frac{db}{dt}=\frac{-42}{10}=-4.2$ cm/sec