Name: _____ **/ 20**

20 points possible. No aids (book, calculator, etc.) are permitted. You need not simplify, but show all work and use proper notation for full credit.

1. [8 points] For each function below, find its derivative. **No credit** will be given unless sufficient work is given to justify your answer. You do not need to simplify your answer.

a. $f(x) = x\sin(x) + 3\tan(x)$

b. $g(t) = (t^3 - 2)^2 \sec(t)$

c. $f(x) = x^3 e^{-1/x}$

d. $s(t) = \dfrac{\cos\left(3t^2\right)}{1-t}$

2. [8 points] A circular blot of ink is growing. Its radius r in centimeters at time $t \geq 0$ seconds is

$$r(t) = 5 - \frac{9}{2}(1+t)^{-2}$$

a. What is the radius of the blot at time $t = 2$ second? Your answer should include **units**.

b. What is the average rate of change of the radius of the blot from time $t = 0$ to time $t = 2$ seconds? Be sure to include **units** in your answer.

c. What is the instantaneous rate of change of the radius of the blot at time $t = 1$ second? Again, include **units** in your answer.

3. [4 points] The position of an object is $s(t) = \sqrt{2t^2 - 3t + 8}$ meters at time $t \geq 0$ seconds. At what time, if any, is the instantaneous velocity of the particle equal to 0?