Name: _____

Please show all work and justify your answers.

1. (10 pts.) Position of an ant is given as a function of time by $x(t) = t^2$, $y(t) = t^3$.
   (a) Where is the ant at $t = 2$?
   (b) Find the equation of the tangent line to the ant's path at that point.
   (c) Find parametric formulas for the tangent line.
   (d) Sketch the ant's path and the tangent line.
   (e) What is the ant's speed at $t = 2$?

2. (10 pts.) Hourly fuel cost to propel HMS Rustbucket is proportional to the square of its speed. At 20 miles per hour the hourly fuel cost is \$200. Fixed hourly costs total \$800. What speed minimizes total cost per distance travelled?

3. (10 pts.) The rate of leakage of sludge from a refinery into a lake is periodically measured. Tabulated results (shown below) indicate that the rate of leakage is monotonically increasing.

time (days)	0	1	2	3
rate (kg/day)	6	7	9	12

   (a) Find upper and lower estimates on the amount of sludge leaked during the 3 days.
   (b) How often should measurements have been made in order for upper and lower estimates to differ by 1 kg?

4. (10 pts.) Evaluate the following integrals

   (a) $\int_1^4 \left[\sqrt{t} + t^3\right] dt$ (b) $\int_0^{\frac{\pi}{4}} \sin(2t)\, dt$ (c) $\int \frac{1+t}{t^2}\, dt$ (d) $\int 3^{2t}\, dt$

5. (10 pts.) Ice starts forming on lake Baikal at a rate proportional to the square root of time. After 2 hours, the ice is 1.5 cm thick. How thick is the ice 8 hours after it started forming?

1	2	3	4	5	total (50)	(%)