**Calculus I, Math 170, Kriloff**
**Exam 3**

Show **all** work completely on the pages below for full credit. **Simplify** when possible. Use **complete sentences** and **correct notation** throughout. When finished, **check** your work.

1. (20 points) Find or evaluate the following integrals or state that they do not exist and explain why. Show all work and give an exact answer when appropriate for full credit.

   (a) $\int (1+3\cos\theta)^5 \sin\theta \, d\theta$

   (b) $\int_1^3 \frac{3x+1}{\sqrt{x}} \, dx$

   (c) $\int_0^2 \frac{1}{x^2-1} \, dx$

2. (6 points) If $\int_3^6 f(t)\,dt = -5$, find $\int_6^3 (4+2f(t))\,dt$ using properties of integrals.

3. A man wants to fence a rectangular area of 20 square feet adjacent to a wall. He will use fence that costs \$5 per foot for the two opposite sides and fence that costs \$6 per foot on the remaining side between them. Find the dimensions that will minimize the cost of the fence.

   (a) (3 points) Draw a diagram illustrating the problem and mark choices of variables on the diagram.

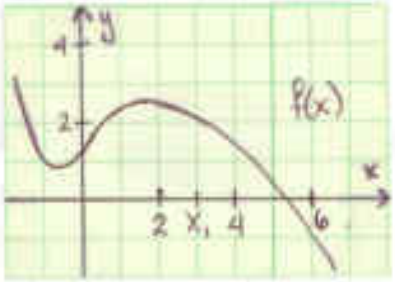
   (b) (5 points) State what is given and what you are to find, introducing and describing any variables needed to do so.

   (c) (3 points) Write an expression for the quantity to be optimized using the variables.

   (d) (2 points) Use the given information to write an equation that relates the variables.

   (e) (4 points) Use part (d) to write the quantity to be optimized as a function of one variable **and** write the domain of this function then **stop**. Do **not** finish solving.

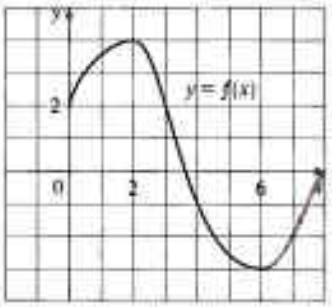
4. (6 points) The graph of a function $f$ and $x_1 = 3$, a first approximation to its root, are shown.




   (a) Draw on the graph how to find the second approximation $x_2$ using Newton's method.
   $x_2 \approx$ _____

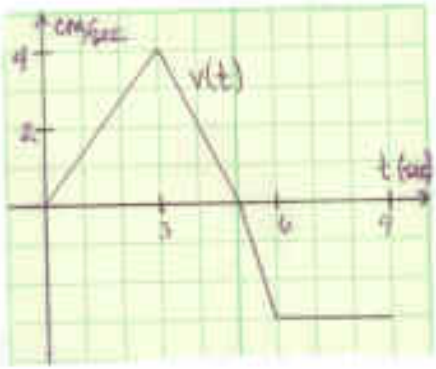
   (b) Was $x_1 = 3$ a good first choice to use in Newton's method? Why or why not?

5. (9 points) By reading values from the graph, use 4 rectangles and midpoints to give an estimate for $\int_0^8 f(x)\,dx$. **Also** draw the approximating rectangles on the graph.




6. (7 points) Write an expression for $\int_2^9 (\sqrt{x}+4x^3)\,dx$ as a limit of a Riemann sum using **left** endpoints. Do not attempt to evaluate the limit.

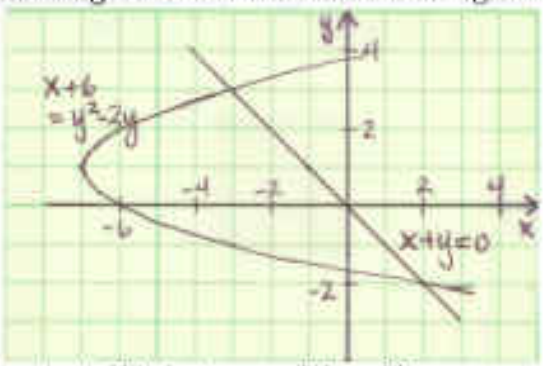
7. (11 points) A particle is moving with velocity $v(t)$ cm/sec, as shown in the graph.




   (a) Write an expression for the displacement of the particle during the first 9 seconds **and** find this displacement using the graph.

   (b) Write an expression for the total distance travelled by the particle during the first 9 seconds **and** find this distance using the graph.

8. (7 points) Set up, but **do not evaluate** a definite integral to find the area of the region shown in the graph.




Replace with question related to 2.3/4.5 or 4.4

9. (12 points) For each of the following statements, state if it is true or false. If true, **explain why**, if false, **give a counterexample** to prove the statement is false. Assume $f$ and $g$ are continuous and all integrals exist.

(a) $\displaystyle\int_{-3}^{3} f(x)\,dx = 2\int_{0}^{3} f(x)\,dx$

(b) $\displaystyle\int_{a}^{b} f(x)\,dx \int_{a}^{b} g(x)\,dx = \int_{a}^{b} [f(x)g(x)]\,dx$

(c) For $a > 0$, $\displaystyle\frac{d}{dx}\int_{a}^{x} \cos(\sqrt{t})\,dt = \cos(\sqrt{x})$

10. (5 points) Carefully and precisely state Part I of the Fundamental Theorem of Calculus.