

Print Your name _____

Sign Your name _____

I accept full responsibility under the Haverford Honor System for my conduct on this exam.

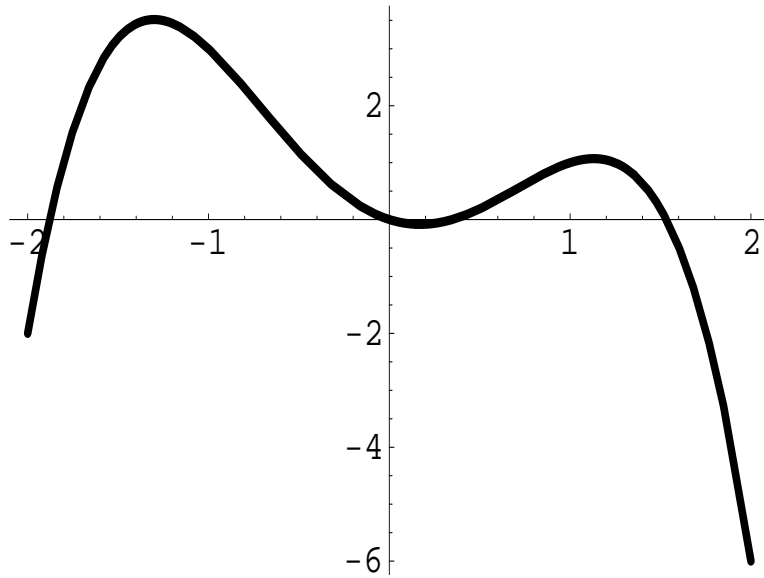
Instructions: This is an open book exam. You may use your class notes, handouts, homework and textbook. Calculators are permitted. Answer all questions on the exam sheet, in the space provided. Partial credit will be given for work which is clearly explained. The questions count different amounts, as indicated. Hand in exam sheet with honor pledge signed. If there is any question about interpreting these instructions, please ask.

Time limit: 55 minutes. Total: 35 points.

1. (5 points) Estimate the derivative of $f(x) = \sqrt{x}$ at $x = 4$ to two decimal place accuracy (that is, estimate $f'(4)$). Be sure to show your work.

2. (10 points)

- (a) Sketch the derivative of the function whose graph is given below.
- (b) Sketch the second derivative of the function whose graph is given below
- (c) Explain, in a few English sentences, how the properties of your first and second derivative graphs are reflected in the graph of the original function. Focus on peaks, valleys, intervals of increase and decrease, concavity and points of inflection.



3. (5 points) A hazardous waste leak is discovered at an industrial dump site. Suppose that the rate $r(t)$, in gallons per day, at which pollutants are leaking from the dump is given by

$$r(t) = \frac{100}{1+t}$$

where t is measured in days from when the leak was discovered.

- (a) Write down an integral that represents the total amount of pollutants that leak in the first 6 days.
- (b) Write down an OVERESTIMATE of this integral using 3 rectangles. Be sure to show your work.
- (c) Explain how you know that the answer you give in part b) is an OVERESTIMATE.

4. (3 points each) Answer each TRUE or FALSE. If true, supply a short explanation. If false, provide an explanation or specific counterexample. Answers without explanations will not get any points.
- (a) (TRUE or FALSE?) If a function is always concave down then its derivative is negative.
 - (b) (TRUE or FALSE?) If a function has $f'(5) = 0$ then the graph of $f(x)$ has a peak or valley when $x = 5$.
 - (c) (TRUE or FALSE?) If a smooth function has a peak or valley in the graph of $f(x)$ when $x = 5$ then $f'(5) = 0$.
 - (d) (TRUE or FALSE?) If the graph of f is INCREASING between $x = 1$ and $x = 2$, then the righthand sum is always an underestimate of $\int_1^2 f(x) dx$.
 - (e) (TRUE or FALSE?) The function $f(x) = x^2$ has a positive derivative when $x = 4$.

END OF EXAM