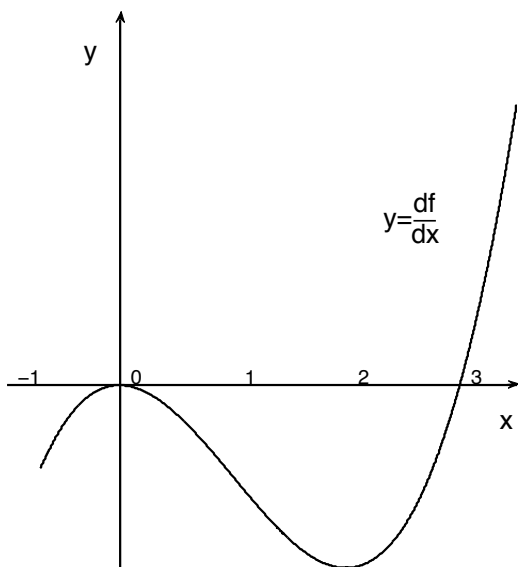


Duration: 50 minutes

Instructions: On the front of your bluebook print (1) your name, (2) your student ID number, (3) your discussion section number and instructor's name (Devin Greene or Lei, Yue), and (4) a grading table. Show all work in your bluebook and **BOX IN YOUR FINAL ANSWERS** where appropriate.

Answer all questions, without the use of notes, books or calculators. Partial credit will be awarded for correct work, unless otherwise specified. The total number of points is 100.

- (20 points: 10 each) The equation $\sin(x + y^2) = y$ implicitly defines y as a function of x close to the point $(\pi, 0)$.
 - Calculate y' .
 - Use tangent line approximation at the point $(\pi, 0)$ to estimate y when $x = 3$. (You may need some of these quantities: $\sin 0 = 0 = \sin \pi$, $\cos 0 = 1$ and $\cos \pi = -1$. If you cannot solve part (a), pretend that the answer is $y' = \frac{x + \cos(y)}{2 + y^2}$.)
- (15 points) A farmer with 710 ft of fencing wants to enclose a rectangular area and then divide it into four pens with fencing parallel to one side of the rectangle. What is the largest possible total area of the four pens?
- (15 points) Find the limit $\lim_{x \rightarrow \infty} \frac{2 - 3x^2}{5x^2 + 4x}$.
- (15 points) The perimeter of a square is increasing at a rate of 5 cm/min. How fast is the area increasing when the perimeter is 40 cm?
- (15 points) A particle moving on a straight line has acceleration function $a(t) = \cos(t)$. Its initial velocity is $v(0) = 1$ and its initial position is $s(0) = 0$. Find the position function $s(t)$.
- (20 points total) The graph of the **first derivative** $f'(x) = \frac{df}{dx}$ is given below.



- (6 points) At what values of x does $f(x)$ have a local maximum or minimum?
- (7 points) On what interval(s) is $f(x)$ concave up? concave down?
- (7 points) Sketch a graph of $f(x)$ reflecting your answers to part (a) and (b).