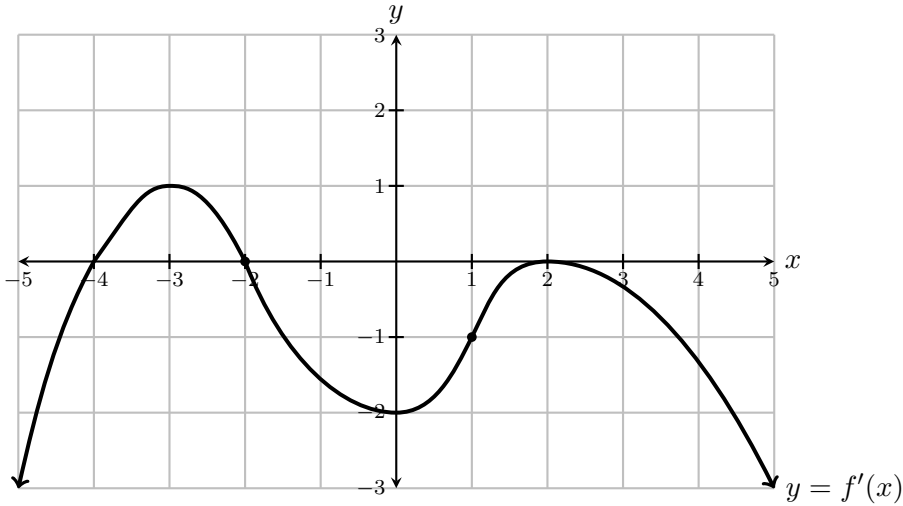1. (10 pts.) The graph $y = f'(x)$ of **the derivative** of a function $f(x)$ is shown. Answer the questions about $f(x)$.

(a) State the intervals on which the function $f(x)$ increases.

(b) State the intervals on which the function $f(x)$ decreases.

(c) State the intervals on which the function $f(x)$ is concave up.

(d) State the intervals on which the function $f(x)$ is concave down.

(e) Suppose $f(0) = 0$. Using the above information (and coordinate axis), sketch the graph of $f(x)$.

2. (15 pts.) Find and identify all relative extrema of the function $f(x) = 2 - 3x^4 - 8x^3 - 6x^2$ on the interval $\mathbb{R} = (-\infty, \infty)$. State the extrema in the coordinate form (x, y).

3. (15 pts.) US Postal Service regulations state that the length plus girth of a package cannot exceed 108 inches. You must mail a package whose width and height are equal, and with the greatest possible volume. Find the dimensions of the package.

Height

GIRTH

max. length plus girth is 108"

Width

Length

Answer:

length = _____

width = height = _____

4. (20 points) Evaluate the following limits.

(a) $\displaystyle\lim_{x \to \pi} \frac{1 + \cos x}{(\pi - x)^2} =$

(b) $\displaystyle\lim_{x \to \infty} x e^{-x} =$

5. (24 points) Find the indicated indefinite integrals.

(a) $\displaystyle\int \left(7 + 7x + \sqrt[5]{x^2} \right) dx =$

(b) $\displaystyle\int \left(e^{4x} + 4\cos x + 20 \right) dx =$

(c) $\displaystyle\int \frac{2x}{x^2}\, dx =$

6. (8 pts.) Is the equation $\displaystyle\int (1 + \ln x)\, dx = x + \ln x + C$ true or false? Justify your answer.

7. (8 pts.) Suppose $f(x)$ is a function for which $f'(x) = -\sin(x)$ and $f(2\pi/3) = -3$. Find $f(x)$.