

Problem Set 3

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Problem 1. Sketch the graphs of the following functions by using the first derivative; in particular find the intervals on which each function is increasing and those on which it is decreasing, and critical points. Also use the second derivative to find where the function is concave up or concave down and use these facts to sort out critical points i.e. if they are maxima, minima or inflection point.

1. $f(x) = 2x^3 + 3x^2 - 12x$

3. $f(x) = x - \frac{1}{x}$

2. $f(x) = \frac{9}{x^2+9}$

Problem 2. For the cost and price functions given, find the production level that maximizes profit.

- **Cost function:** $C(x) = 750 + 140x - 0.2x^2 + \frac{1}{30}x^3$

- **Revenue function:** $P(x) = 80 - 0.01x$

Problem 3. Find the linear approximation of $f(x) = \frac{1}{x}$ at $x = -1$

Problem 4. Compute the integrals. Be sure to include the constant of integration on each answer.

- $\int 4x^5 + 6x - 5dx$

- $\int x^2\sqrt{x}dx$

Problem 5. Compute the indefinite integrals by the method of substitution.

- $\int \sqrt{3-2x}dx$

- $\int \frac{4x}{\sqrt{x^2+1}} dx$

Problem 6. Compute the definite integrals by the method of substitution. Do not forget about changing the limits of integration.

- $\int_1^2 \frac{(2x+1)dx}{\sqrt{x^2+x+2}}$

- $\int_1^e \frac{\sqrt{\ln x} dx}{x}$

Problem 7. Compute the definite integrals by parts. Do not forget about computing the limits of integration for each part.

- $\int_1^2 \ln x$

- $\int_0^1 x^2 e^x dx$