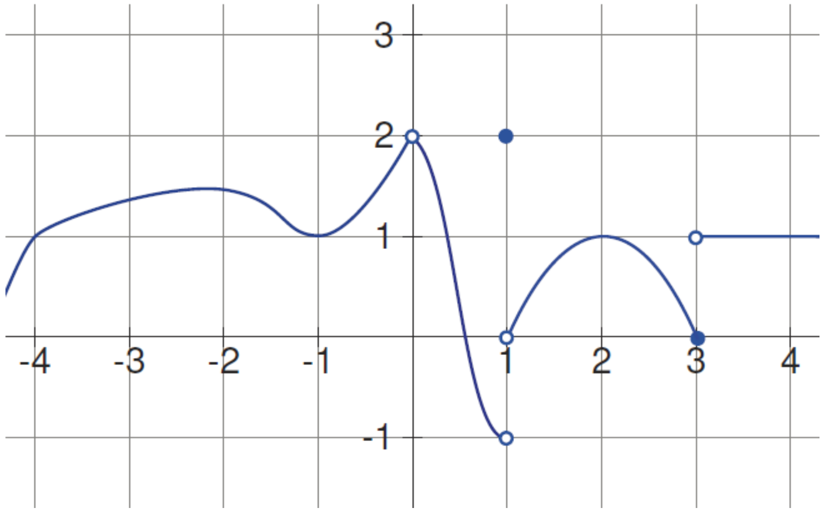
(15) 1. Calculate the following limits.

(a) $\lim_{x \to -1} \frac{x}{\sqrt{x^2 - x}}$

(b) $\lim_{x \to \infty} \frac{-x^3 + x^2 - 10x + 11}{-x^3 - 7x^2 - 5}$

(c) $\lim_{x \to 4} \frac{x^2 + x - 20}{x^2 - 10x + 24}$

(16) 2. Suppose that the graph of $y = f(x)$ is as given below. Use the graph to find the following limits. If a limit does not exist, write "DNE".



(a) $\lim_{x\to 1^+} f(x) =$

(c) $\lim_{x\to 2} f(x) =$

(b) $\lim_{x\to 3} f(x) =$

(d) $\lim_{x\to -1^-} f(x) =$

(28) 3. Compute the derivative of the following functions. **Do not** simplify.

(a) $f(x) = \dfrac{4\sqrt{x} + 3x + 1}{x^2 - 3}$

(b) $f(x) = (x^2 + 1)\ln(3x^2 + x)$

(c) $f(x) = \dfrac{e^{-x^3}}{x^4}$

(d) $f(x) = \sqrt[3]{x^3 + 12x - 1}$

(10) 4. Find the equation of the tangent line to the graph of the function

$f(x) = \frac{2}{x+1}$ where x=1. State your final answer in slope-intercept form.

(12) 5. The revenue function *R(x)*, in thousands of dollars, from the sale of *x* items is given by

$R(x) = 1200\sqrt{x^2 - 0.1x}$.

Find the rate at which *R(x)* is changing when 30 units have been sold.

(16) 6. Given the two functions:

$$f(x) = -2x^2 + 3x \text{ and } g(x) = x^3$$

(a) Find the ordered pairs where *f* and *g* intersect.

(b) Find the area bounded by the graphs of *f* and *g*. (*Hint*: Draw a sketch first.)

(14) 7. Suppose the ***DERIVATIVE*** of a certain function, $f(x)$, is given by

$$f'(x) = \frac{(x-1)^2}{x(x-3)}.$$

(a) Give the intervals over which f is increasing.

(b) Give the intervals over which f is decreasing.

(28) 8. Compute the following integrals.

(a) $\int \left(5x^{1/2} + 10 - \frac{4}{x^3} \right) dx$

(d) $\int \frac{dx}{x \ln x}$

(c) $\int_0^4 \frac{x}{\sqrt{x^2+9}} dx$

(d) $\int xe^{-2x}\, dx$ (Use integration by parts.)

(10) 9. Find the producers' surplus at a price level of x=\$55 for the Supply function

$$S(x) = 15 + 0.1x + 0.003x^2 .$$

(15)10. Let

$$f(x, y) = -6x^2y + 3x^5 + \frac{x^3}{y} + e^{y^2} .$$ Find:

(a) f_y

(b) f_{yx}

(c) $f_{yx}(2,-1)$

(12)11. Find and identify the absolute minimum and maximum values of the function

$$f(x) = x^4 - 8x^2 - 4$$

on the interval [-1, 3]. Give both coordinates.

(12)12. Let

$$f(x, y) = 2y^3 - 6xy - x^2 .$$

The critical points of $f(x, y)$ are (0, 0), (9, -3). Identify each critical point as a relative minimum, a relative maximum, or a saddle point.

(12)13. A manufacturing firm has budgeted \$60,000 per month for labor and materials. If \$$x$ thousand is spent on labor and \$$y$ thousand is spent on materials, and if the monthly output (in units) is given by

$$N(x, y) = 4xy - 8x,$$

then how should the \$60,000 be allocated to labor and materials in order to maximize N? Use the method of Lagrange multipliers. What is the maximum N?