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

(a) $f(x) = -3x^4 + 6\sqrt{x} + 10$

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

(c) $f(x) = \frac{e^x+1}{e^x-1}$

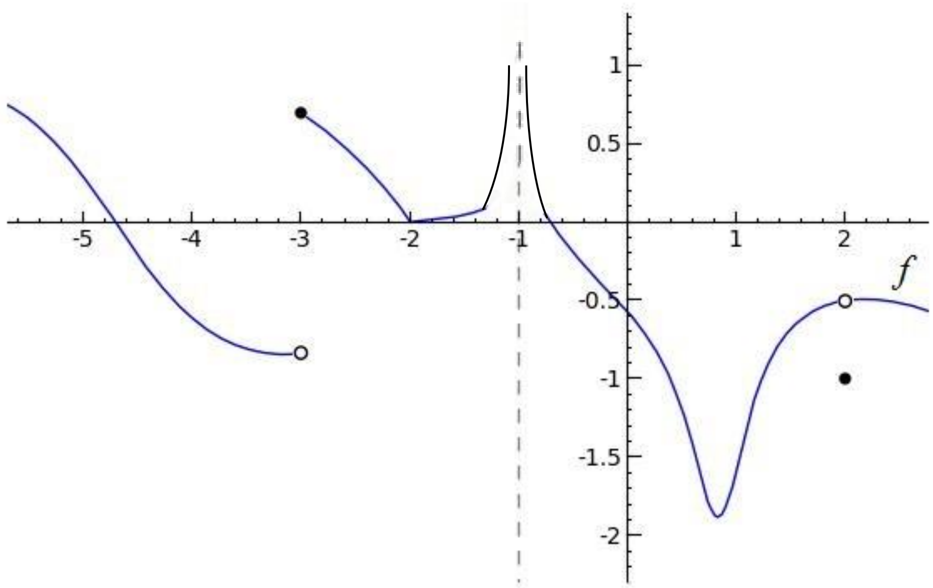
(d) $f(x) = \sqrt{10 + x^3}$

(10) 2. Calculate the following limits.

(a) $\lim_{x \to -1} \frac{x^2+3x-4}{x^2-x}$

(b) $\lim_{x \to \infty} \frac{1+x-x^3}{8x^4-5}$

(16) 3. 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".



****There is a vertical asymptote at *x* = -1.**

(a) $\lim_{x \to -3^+} f(x) =$

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

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

(d) Is f continuous at x = -1?

(12) 4. Find the equation of the tangent line to the graph of the function $f(x) = \frac{3}{x-1}$ at the point (2,3). State your answer in slope-intercept form.

(12) 5. Ultra Mobile has costs that are given by

$$C(x) = 2000 + 90x + 0.2x^2$$

and price given by

$$p(x) = 210 - 0.3x$$

where x is the number of SIM cards produced. What is the number of SIM cards that Ultra Mobile must produce and sell in order to maximize profit? (Recall that the revenue is $R(x)=px$.) You must prove this using a derivative test.

(20) 6. Given the function $f(x) = \frac{3x}{x+1}$

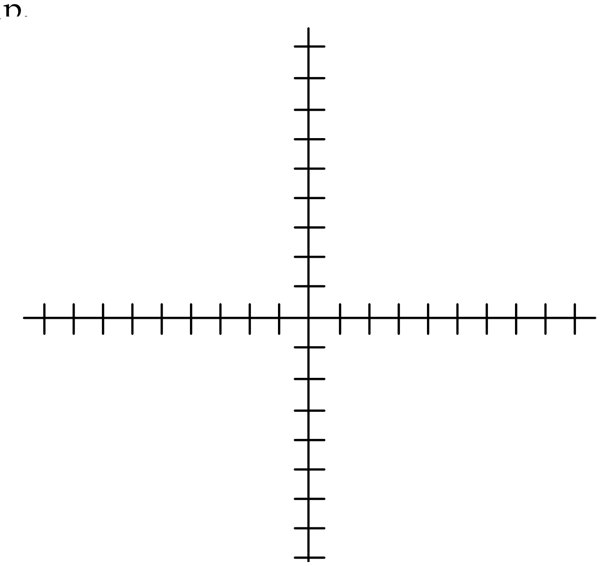
(a) State the domain of *f*.

(b) Find the vertical asymptote(s).

(c) Find the horizontal asymptote(s).

(d) Give the intervals over which *f* is increasing.

(e) Give the intervals over which *f* is concave up.



(f) Sketch on the above axes the graph of *f(x)*. Draw the asymptotes as dashed lines. Mark the *x*- and *y*- intercepts. Plot additional points as needed.

(21) 7. Compute the following integrals.

(a) $\int \left(4x^{1/2} + \frac{3}{x^2} - 12x\right) dx$

(b) $\int xe^{-3x} dx$ (Use integration by parts.)

(c) $\int_2^5 \frac{2x}{\sqrt{x^2+12}} dx$

(16) 8. Given the two functions:

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

(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.)

(12) 9. According to the U.S. Census Bureau, the population of the United States can be approximated by

$$P(t) = 282.3e^{0.01t}$$

where P is in millions and t is the number of years since 2000.

Find the average value of the population from 2002 to 2006 (i.e. from t = 2 to t = 6).

(15) 10. Let

$$f(x, y) = -x^2y - 4x^4 + \frac{x}{y} \quad . \quad \text{Find:}$$

(a) f_y

(b) f_{yx}

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

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

$$f(x) = x^3 - 2x^2 - 4x + 4$$

on the interval [0, 3]. Give both coordinates.

(12) 12. Let

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

The critical points of $f(x, y)$ are (0, 0), (1, 1). Identify each critical point as a relative minimum, a relative maximum, or a saddle point, showing work using the *D*-test.

(14) 13. Suppose x TV's are produced at one factory, and y TV's are produced at a second factory.

Use the method of Lagrange multipliers to find the minimum value of the company's cost function

$$C(x, y) = 6x^2 + 12y^2$$

subject to the constraint that 90 TV's are produced total, i.e. $x + y = 90$.