

This test is closed-book and closed-notes. No calculator is allowed for this test. For full credit show all of your work (legibly!), unless otherwise specified.

1. **(13 points)** Let $f(x) = 8 - 2x - 3x^2$.

(a) **(9 points)** Using the difference quotient, determine the formula for $f'(x)$.

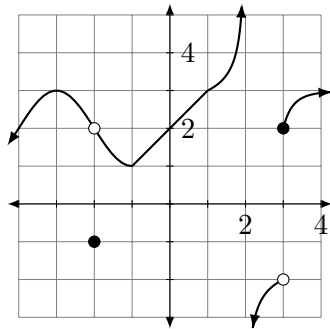
(b) **(4 points)** Find the equation of the tangent line to $f(x)$ at the point $(2, -8)$.

2. **(9 points)** Let $f(x) = \begin{cases} px & \text{if } x \leq -3 \\ x^2 - 2 & \text{if } -3 < x < 2 \\ x^3 + q & \text{if } x \geq 2 \end{cases}$.

What choices of p and q will make this function continuous everywhere?

1	/ 13
2	/ 9
3	/ 9
4	/ 10
5	/ 10
6	/ 16
7	/ 9
8	/ 24
Σ	/100

3. (9 points) For the plot of $f(x)$ shown below, indicate whether or not each of the following quantities can be evaluated. If they can be evaluated, compute their values. If they cannot be evaluated, give an idiomatic “value” if possible, and if not, explicitly say so. You need not show work.



$$\lim_{x \rightarrow -3} f(x)$$

$$f(-3)$$

$$\lim_{x \rightarrow -2} f(x)$$

$$f(-2)$$

$$\lim_{x \rightarrow 2^+} f(x)$$

$$\lim_{x \rightarrow 2} f(x)$$

$$\lim_{x \rightarrow 3} f(x)$$

$$f(3)$$

$$\lim_{x \rightarrow +\infty} f(x)$$

4. (10 points) Given the function $f(x) = \frac{8x^2 \arctan x - 7x}{x^2 - 7x + 12}$, answer the following questions preparatory to sketching the functions.

(a) (3 points) On which intervals is the function continuous?

(b) (7 points) Describe, either in words or symbolically, the long-term behavior of the function in each direction.

5. (10 points) Answer the following questions.

(a) (5 points) A ball is rolling down a hill such that its position along the hill after t seconds is $3t^2 + 5t - 2\sqrt{t} + 4$ meters. What is its *velocity* after 4 seconds?

(b) (5 points) For the function $f(x) = 2x^5 - 7e^x + \frac{2}{x}$, calculate its second derivative $f''(x)$.

6. **(16 points)** Answer the following questions.

(a) **(4 points)** Given $f(r) = 3r^5 - 2e^r + \frac{7}{\sqrt{r}}$, find $f'(r)$.

(b) **(6 points)** Determine $\frac{d}{dt} \frac{t^4 - 2t + 1}{e^t - 7t^3}$.

(c) **(4 points)** For $y = (e^x - 7x^2)(e^x + 12\sqrt{x})$, find $\frac{dy}{dx}$.

7. **(9 points)** Let $g(t) = 13 - \frac{3t}{2}$.

(a) **(1 point)** Find $\lim_{t \rightarrow 4} g(t)$.

(b) **(8 points)** Using epsilon-delta methods, justify your result above.

8. **(24 points)** Evaluate the following limits; when a limit can not be evaluated, explicitly say so or discuss its behavior.

(a) **(4 points)** $\lim_{t \rightarrow 9} \frac{t^3 - \sqrt{t}}{t^2 - 10t + 9}$.

(b) **(4 points)** $\lim_{y \rightarrow -3} \frac{2y^2 - 18}{y^2 - y - 12}$.

(c) **(4 points)** $\lim_{z \rightarrow +\infty} \frac{2 + 4z^2 - 8z^4}{2z^5 - 4z^3}$.

(d) **(4 points)** $\lim_{s \rightarrow -\infty} \frac{s^9 - 4s + 1}{13 - 4s^9}$.

(e) **(4 points)** $\lim_{x \rightarrow 1} \frac{x^2 - \arcsin x}{x^3 - 2x - 4}$.

(f) **(4 points)** $\lim_{q \rightarrow -\infty} \frac{3 + q^2 - q^4}{7 - q}$.