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. **(10 points)** Answer the following questions.

   (a) **(5 points)** For the function $g(x) = \frac{2}{\sqrt{x}} - 6x^4 + 2x$, calculate its second derivative $g''(x)$.

   (b) **(5 points)** The height of a skydiver in meters t seconds after jumping out of a plane is given by the formula $14000 - 5t^2 + 2t\sqrt{t}$. How quickly is this skydiver moving after 9 seconds?

2. **(9 points)** Let $g(x) = \begin{cases} \sqrt[3]{x} & \text{if } x \leq 8 \\ ax & \text{if } 8 < x \leq 12 \\ \sqrt{x+b} & \text{if } x > 12 \end{cases}$.

   What choices of a and b will make this function continuous everywhere?

1	/ 10
2	/ 9
3	/ 19
4	/ 9
5	/ 24
6	/ 16
7	/ 9
8	/ 10
Σ	/100

3. **(13 points)** Let $f(x) = 5x^2 - 3x - 7$.

   (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 $(-2, 19)$.

4. **(9 points)** Let $f(x) = 8x - 3$.

   (a) **(1 point)** Find $\lim_{x \to -1} f(x)$.

   (b) **(8 points)** For a choice of $\epsilon = 0.2$, what value of δ suffices to satisfy the conditions set by the epsilon-delta conception of the limit? Show your work or justify your answer.

5. **(24 points)** Evaluate the following limits; when a limit can not be evaluated, explicitly say so or discuss its behavior.

   (a) **(4 points)** $\lim_{u \to +\infty} \frac{1-2u^2-u^4}{5+u+3u^4}$.

   (b) **(4 points)** $\lim_{x \to 1} e^{x^3-x}$.

   (c) **(4 points)** $\lim_{t \to -3} \frac{t^2-9}{t^2+2t-3}$.

   (d) **(4 points)** $\lim_{s \to -\infty} \frac{3-s^2}{2s^3+4s-3}$.

   (e) **(4 points)** $\lim_{x \to 4} \frac{x^2+3x}{x^2-x-12}$.

   (f) **(4 points)** $\lim_{r \to \infty} \frac{r^4-3r^2+r}{r^3-r+2}$.

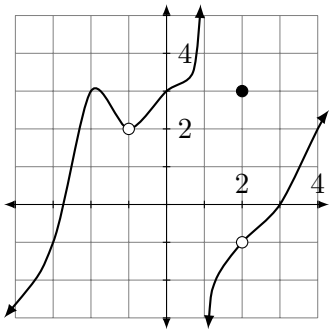
6. **(16 points)** Answer the following questions.

   (a) **(6 points)** Given $f(u) = \frac{e^u + u^4}{u - 3u^2}$, find $f'(u)$.

   (b) **(6 points)** Determine $\frac{d}{ds}\left[4e^s\left(\sqrt{s} + \frac{1}{s}\right)\right]$.

   (c) **(4 points)** For $y = 4x^3 - 7\sqrt[3]{x} + 2 + \frac{6}{x^3}$, find $\frac{dy}{dx}$.

7. **(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.



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

$f(-3)$

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

$f(-2)$

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

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

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

$f(3)$

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

8. **(10 points)** Given the function $f(x) = \frac{5 - 2x^3}{x^2 - 3x}$, answer the following questions.

   (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.