• Read the instructions to each question carefully – be sure to fully answer the question that is asked.

• Show all work and calculations. Provide all necessary reasoning. This way you may still get partial credits in case your final answer is wrong.

• You may not use a calculator while taking this exam.

• You are supposed to obey the honor code while taking this test.

Total points: _____ /100

Signature

________________________________________
1. (20pts) Consider the function $f(x)$ whose graph is given below.

(a) Find $\lim_{x \to 2} f(x)$. If the limit does not exist, explain why.

(b) Find $\lim_{x \to -3} f(x)$. If the limit does not exist, explain why.

(c) Tell for which points (if any) $f$ is discontinuous and why.

(d) Tell for which points (if any) $f$ is not differentiable and why.
2. (20pts) Match the following graphs with the functions \( f(x), g(x), h(x), m(x), p(x), \) and \( q(x) \) featuring the following properties:

(a) \( f'(0) < 0, \ f''(0) > 0, \)

(b) \( g(0) > 0, \ g'(0) = 0, \)

(c) \( h(0) < 0, \ h'(0) > 0, \)

(d) \( m'(0) > 0, \ m''(0) < 0, \)

(e) \( p(0) < 0, \ p''(0) > 0, \)

(f) \( q'(0) = 0, \ q''(0) = 0, \)
3. (25pts) The percentage of alcohol in the blood $t$ hours after consuming a drink is modeled by 
$C(t) = \frac{1}{2}te^{-t/2}$.

(a) Compute the rate of change of the alcohol percentage in the blood.

(b) Determine the critical points of $C(t)$, where $C(t)$ is increasing and where $C(t)$ is decreasing.

(c) Determine the intervals where $C(t)$ is concave up and where $C(t)$ is concave down. Find all the inflection points.

(d) Find the maximum value of the percentage of alcohol in the first 10 hours after consuming the drink (i.e., for $t$ in the interval $[0, 10]$).
4. (20pts) Find the derivatives of each of the following functions. State each of the differentiation rules that you use.

(a) \( f(x) = \tan(2x + x^2) \)

(b) \( g(x) = \ln \frac{x-1}{x} \)

♥ Compute the horizontal asymptote of \( g(x) \) (show your work).
5. (15pts) Let \( f(x) = x^2 + 1 \).

(a) Using only the definition of the derivative, compute \( f'(1) \). Then check your answer using the differentiation rules.

(b) Find the equation of the tangent line to the graph of \( f \) in the point \( (1, f(1)) \).