



2. Consider the function  $y = e^{-x^2}$
- Find and classify any critical points **(3 points)**
  - Find any asymptotes and analyze the end behavior of the function **(2 points)**
  - Find any points of inflection and the intervals that the function is concave up or concave down. **(3 points)**
  - Sketch a graph of this function using the information above **(3 points)**

3. Use optimization techniques to determine the point(s) on the graph of  $y = x^2 + 1$  that are closest to the point  $(0,2)$  (**5 points**)

4. Find the absolute maximum and absolute minimum of the function  $y = (x + 1)^{4/3}$  on the range  $-9 \leq x \leq 0$ . (**5 points**)

5. Suppose that  $f(x) = \sec(x)\sin(x)$ . Find the equation of the tangent line to  $f(x)$  at the point on the curve where  $x = \pi/6$  **(5 points)**

6. Find the average value of the function  $y = \frac{3x}{(x^2+1)^2}$  over the range  $0 \leq x \leq 2$  **(3 points)**

7. Evaluate the following integrals **(6 points)**:

a.  $\int \sin(\pi x) \cos(\pi x) dx$

b.  $\int \frac{(2x-\sqrt{x})^2}{\sqrt{x}} dx$

8. Evaluate the following integrals (**9 points**):

a.  $\int \frac{e^{3x}}{3e^{-x}} dx$

b.  $\int_0^1 \frac{e^x}{e^x+1} dx$

c.  $\int \frac{\ln(x)}{x} dx$

9. Evaluate the following limits (**16 points**).

a.  $\lim_{x \rightarrow 0} x \csc(x)$

c.  $\lim_{x \rightarrow \infty} \frac{x^2}{xe^{-x}}$

b.  $\lim_{x \rightarrow 9} \frac{\sqrt{x}-3}{x-9}$

d.  $\lim_{x \rightarrow 0} \frac{\tan(3x)}{x}$

10. Find the derivative  $y'(x)$  for the following (**12 points**):

a.  $y = \sin(3x)\arcsin(3x) + 2C$  (where  $C$  is an unknown constant)

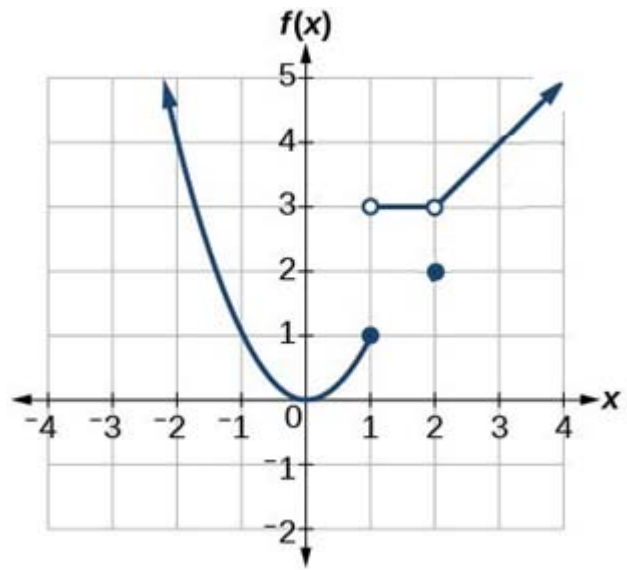
b.  $y = \tan[\sqrt[3]{1-x}]$

c.  $y = \frac{\ln(x)}{x^2+1}$



11. A function  $f(x)$  is graphed, as shown below. Find the following (12 points):

- Find  $\lim_{x \rightarrow 1} f(x)$  showing right and left limits
- Find  $f(1)$  and state why or why not the function is continuous here.
- Find  $\lim_{x \rightarrow 2} f(x)$  showing right and left limits
- Find  $f(2)$  and state why or why not the function is continuous here.
- Find the derivative  $f'(2.7)$
- $\int_{2.5}^{3.5} f(x) dx$



12. Suppose that an isosceles right triangle is slowly expanding outwards with both legs of the triangle increasing at a rate of 10 cm/min. At the moment that the legs are 2 cm, how fast is the hypotenuse increasing in length? Fully simplify your answer. **(5 points)**

13. Find the derivative  $y'(x)$  for the following **(8 points)**:

a.  $y = x^2y^2 + e^{5x}$

b.  $y = x^x$