SHOW ALL YOUR WORK!!

1. (15 pts.) Use the graph of $f(x)$ shown below to answer the following questions. Assume that the graph continues to infinity in all directions. If a limit does not exist, compute both one sided limits.

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

   ii) $\lim_{x \to -1} f(x)$

   iii) $\lim_{x \to 1} f(x)$

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

   v) What value of $f(1)$ would make $f$ continuous at $x = 1$?
2. Compute the following limits. You may use any methods, but you must show your work.

(a) (10 pts.) \( \lim_\limits{x \to 0^+} \frac{\ln x}{x} \)

(b) (10 pts.) \( \lim_\limits{x \to 2} \frac{x^2 - 1}{x^2 - 2x + 2} \)

3. Find \( \frac{dy}{dx} \) for each of the following functions

(a) (10 pts.) \( y = (\csc x)^{\sec x} \)

(b) (10 pts.) \( x^3y^2 + 5 = \frac{2x}{y} + y \)

4. (10 pts.) Find the equation of the line tangent to \( f(x) = \ln(\tan(x)) \) at the point where \( x = \pi/4 \).

5. (10 pts.) Use differentials to approximate the value of \( \sqrt{10012} \).

6. (15 pts.) A 10 foot long plank is sliding down a wall as shown in the picture at right. The angle between the plank and the floor is changing at a rate of \( -\cos \theta \) m/s. The plank forms triangle with the wall and floor. What is the rate of change of the area of the triangle at the instant that the plank hits the floor?

7. (10 pts.) Find the global minimum and global maximum of \( f(x) = \sin x + \cos^2 x \) on the domain \([-\pi, \pi]\).

8. (10 pts.) Suppose that \( f(x) = ax^2 + bx + c \) has a critical point at \((-1, 3)\) and its graph passes through \((0, 0)\). What are \( a \), \( b \) and \( c \)?

9. For the function \( f(x) = \frac{x^2 - x}{x^2 - 2x + 2} \)

(a) (15 pts.) Find the intervals on which \( f \) is increasing and those on which it is decreasing. Show your work. Calculator approximations will not suffice.

(b) (15 pts.) Find the intervals on which \( f \) is concave up and those on which it is concave down. Show your work. Calculator approximations will not suffice.

(c) (5 pts.) Graph the function. Your graph must include exact asymptotes, exact roots, and exact information from parts (a) and (b) above.
10. (15 pts.) A wire 40 inches long is cut into two pieces. One is folded into a square and the other is wound into a circle as shown below. What is the maximum possible total area of the circle and the square?

11. (10 pts.) Suppose that $f'(x) = \cos(2x) + \sin x$ and $f(\pi/4) = 3/2$. Find a formula for $f$.

12. (10 pts.) Compute $\int (\sin x)e^{\cos x} \, dx$

13. (10 pts.) Compute $\int_{-2}^{3} \frac{x}{x^2 + 1} \, dx$

14. (10 pts.) The rate of change of the price of a certain commodity over the next $t$ days is given by $r(t) = 1.1t \sin(t^2/10)$ dollars per ton per day. If the price is currently $32.25 per ton, what will be the maximum price attained during the coming week?