Read each problem carefully. Show all your work for each problem! No Calculators!

1. (10) Find the linear approximation of the function \( f(x) = \sin(x) \) about the point \( a = 0 \), and then about the point \( a = \pi/6 \).

2. (15) Find \( dy/dx \) for the following:

   \( a) \ y = \tan^2(x)\sec(x^2), \quad (b) \ y = \cos(\sin(\sqrt{x})), \quad (c) \ y'^2 = 3x - x\sin(y) \).

3. (15) A rectangular poster is to contain 50 in\(^2\) of printed matter, with 4 in. margins at the top and bottom, and 2 in. margins on each side. What are the dimensions of the poster which will require the least amount of paper?

4. (15) Show that the function \( f(x) = x^3 - 10x + 5 \) has a root in the interval \([0,1]\). Find an approximation to this root using Newton’s Method. Use \( x_0 = 0 \) and calculate the first two iterations, i.e., \( x_1 \) and \( x_2 \).

5. (10) Find all horizontal, vertical and slant asymptotes for the following functions:

   \( a) \ y = \frac{x^2 + 1}{x^2 + 7x}, \quad (b) \ y = \frac{1 - x^3}{x^2 - 6x} \).

6. (10) A 20 ft. ladder is leaning against a building. If the bottom of the ladder is sliding along the level pavement directly away from the building at 1 ft/s, how fast is the top of the ladder moving down when the foot of the ladder is 5 ft from the wall?

7. (15) For the function below, find all of the following if they exist: (i) all local extrema, (ii) points of inflection, (iii) intervals where the function is increasing or decreasing, (iv) intervals of upward and downward concavity, and (v) all asymptotes. Also, sketch a plot of the curve \( y = f(x) \).

   \( f(x) = \frac{x^2}{4 - x^2} \).

8. (10) A ball is thrown straight up from the ground into the air with an initial velocity of 52 ft/s. The ball is observed by a man standing on the ground 30 ft. from the spot directly beneath the ball. At what rate is the distance between the man and the ball changing after 2 s? Recall \( y = -\frac{1}{2}gt^2 + v_0t + y_0 \), and use \( g = 32\text{ft/s}^2 \).