Calculators, Mobile Phones and Pagers are not allowed
Answer the following questions

1. (3 pts.) Let

$$f(x) = \begin{cases} x & \text{, if } x \leqslant -\pi, \\ \dfrac{x}{x + \sin x} & \text{, if } -\pi < x < 0, \\ \dfrac{1}{2 - x} & \text{, if } x > 0. \end{cases}$$

Classify the discontinuities of f as removable, jump or infinite.

2. (3 pts.) Find the horizontal asymptotes, if any, for the graph of

$$f(x) = \frac{\sqrt{x+2} - 2}{x + 2}.$$

3. (3 pts.) Use the definition of the derivative to find $f'(1)$, where $f(x) = \sqrt{3x + 1}$.

4. (3 pts.) Use differentials to approximate the change in $y = \dfrac{x}{\sqrt[3]{x^2 + 2}}$, when x changes from 5 to 4.9

5. Let $f(x) = x^3 + 3x^2 - 9x + 1$.

   (a) (3 pts.) Find the local extrema of f.

   (b) (3 pts.) Find the intervals on which the graph of f is concave upward. What are the points of inflection?

6. 4 pts.) Find the dimensions of the rectangle of maximum area whose diagonal is 2 ft.

7. Evaluate the following integrals (3 points each):

   (a) $\displaystyle\int (1 + \cos^2 x)^3 \sin 2x \, dx.$ (b) $\displaystyle\int_1^3 |x - 2| \, dx.$ (c) $\displaystyle\int_{-1}^1 \sqrt{1 - x^2} \, dx.$

8. (3 pts.) Find the arc length of the graph of $f(x) = 2\displaystyle\int_1^{\sqrt{x}} t\sqrt{t^4 - 1} \, dt$ from $x = 1$ to $x = 4$.

9. Let R be the region bounded by the graphs of $y + x^2 - 2x = 0$ and $y + 2x = 0$.

   (a) (3 pts.) Find the area of the region R.

   (b) (3 pts.) Set up an integral that can be used to find the volume of the solid generated by revolving R about the line $y = 1$.