Motivate all your answers.
The use of electronic devices is not allowed.

1. Define $P(-1, 1, 1)$, $Q(1, 3, 0)$, and $R(-2, 1, 2)$.

 (a) [1 pt] Calculate $\overrightarrow{PQ} \times \overrightarrow{PR}$.

 (b) [2 pt] Find an equation for the plane that contains the points P, Q and R.

 (c) [2 pt] In the triangle PQR, calculate the angle at vertex P.

2. [3 pt] Calculate
$$\lim_{x \to 1} \frac{x - 1}{x - \sqrt{x}}.$$

3. Define
$$f(x) = \begin{cases} \tan^{-1}\left(\dfrac{1}{x}\right) & \text{if } x \neq 0, \\[2mm] -\dfrac{\pi}{2} & \text{if } x = 0. \end{cases}$$

 (a) [2 pt] Show that $\lim\limits_{x \to 0^-} f(x) = f(0)$.

 (b) [2 pt] Is f continuous at 0? Motivate your answer.

4. [4 pt] Find the absolute extreme values of the function
$$f(x) = x - 2\sqrt{x}$$
on the interval $[0, 9]$.

5. [3 pt] Calculate
$$\lim_{(x,y) \to (0,0)} \frac{x\sqrt{|y|}}{\sqrt{x^2 + y^2}},$$
or show that this limit does not exist.

6. [3 pt] Find an equation for the tangent plane to the graph of the function
$$f(x, y) = x^3 + x^2 y - y^2$$
at the point $(1, -1, -1)$.

Simplify the equation as much as possible.

Total: 22 points