(10 pts) 1. (a) State the Mean Value Theorem.
   (b) State the definition of a continuous function $f$ at a point $a$.

(10 pts) 2. Show that $\cos\left(\frac{1}{x}\right)$ is continuous on the interval $(0, 1)$ but not uniformly continuous on the same interval. You can use any available theorems you learned in class.

(10 pts) 3. Consider the following set
   
   $$A = (-1, 0) \cup \left\{\frac{1}{n}, n = 1, 2, \ldots\right\}$$

   Determine if the set is open, closed, has isolated points or not. Provide explanation for each answer. Find all the limit points of the set. Find the closure of $A$.

(10 pts) 4. Prove using the definition of the derivative that
   
   $$(x^3)' = 3x^2.$$ 

(10 pts) 5. Let $g$ be a differentiable function function on interval $[0, 2]$. Suppose we know that $g(0) = 2$, $g(1) = -1$, $g(2) = 1$.
   (a) Show that there exists a point $a \in [0, 2]$ such that $g(a) = 0$;
   (b) Show that there exists a point $b \in [0, 2]$ such that $g'(b) = -1/2$;
   (c) Show that there exists a point $c \in [0, 2]$ such that $g'(c) = 0$;