1)  a) Assuming the derivative of $e^x$ is $e^x$, find the derivative of $\log(x)=\log_e(x)=\ln(x)$ using the theorem about derivatives of inverse functions. (In this course, $e$ is the only base we use.)

   b) Compute the derivative of the following function using properties of derivatives such as the chain rule: $f(x)=x^{1/x}$. Hint: Recall that the definition of $x^a$ for $x>0$ is $x^a=e^{a \log x}$.

2) Assume that $f$ and $g$ are functions on the open interval $(a,b)$. Assume that both $f$ and $g$ are differentiable at $x \in (a,b)$. Suppose $c$ is a real constant. Prove using the definition of derivative that:

   a) $(f+g)'(x)=f'(x)+g'(x)$.

   b) Using mathematical induction, prove the formula for the derivative of $x^n$, for $n=1,2,3,...$.

3)  a) Define $f(x) = x \sin(1/x)$ if $x \neq 0$ and $f(0)=0$. Show that $f(x)$ is not differentiable at $x=0$ but $f(x)$ is continuous at $x=0$.

   b) Discuss the differentiability of the floor function $[x]=\lfloor x \rfloor$=the largest integer $\leq x$, for all real numbers $x$.

4)  a) Suppose that a continuous function $f$ on $[a,b]$ is differentiable on $(a,b)$ and that the derivative $f'(x)$ is bounded (above and below) on $(a,b)$. Prove that then $f$ is uniformly continuous on $[a,b]$.

   Hint. Use the mean value theorem.

   b) First Derivative Test. Consider the function $f(x)=x^{1/x}$ from problem 1b). Find all relative and absolute extrema for this function on $(0,\infty)$. Also find the glb and lub of $\{f(x)|x\}$, if possible. Sketch the function.