1. (a)For $x > 1$, find $\frac{d}{dx}[(\ln x)^{\ln x}]$.
   (b)Evaluate $\int_1^e \frac{\ln u}{u} du$.
   (c)Evaluate $\int_0^4 f(x)dx$, where $f(x) = \begin{cases} 2x+1, & 0 \leq x \leq 1 \\ 3e^{x-1}, & 2 < x \leq 4. \end{cases}$
2. If function f is one-to-one and continuous on open interval (a, b), then f either increases throughout (a, b) or it decreases throughout (a, b).
3. Prove or disprove that the range of $y = \ln x$ is $(-\infty, \infty)$.
4. For $x \in R$, prove $\frac{d}{dx}(e^x) = e^x$.
5. Prove that $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$ $\forall x \in R$.
6. Prove that $\tanh^{-1} x = \frac{1}{2}\ln(\frac{1+x}{1-x})$ $\forall x \in (-1, 1)$.
7. For $x, y \in R$, prove that $\sinh(x + y) = \sinh(x)\cosh(y) + \cosh(x)\sinh(y)$.
8. Prove that $f(x) > 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + ... + \frac{x^n}{n!}$ $\forall x > 0$ & $n \in N$, where $f(x)$ is the inverse function of $\ln x$.