Calculators and Mobile Phones are not allowed.

1. Let $f(x) = \dfrac{\pi + \cos^{-1} x}{-\pi + \cos^{-1} x}$.

   i) Find the domain of f and show that f^{-1} exists.

   ii) Find $f^{-1}(x)$ and state the domain and range of f^{-1}.

   (4 Points)

2. Find $\dfrac{dy}{dx}$ if, $y = \dfrac{\sqrt[3]{\cosh x + \tanh x}\ (1 + \sin(e^{-2x}))}{|x - \cosh x|^{x^3}}$.

   (4 Points)

3. Prove that

   a) $\ln(xy) = \ln x + \ln y, \quad x, y > 0$.

   b) $\dfrac{\coth(2\ln x) + 1}{\coth(2\ln x) - 1} = x^4$.

   (2pts Each)

4. Solve the equation: $2^{3x} + 2^{5x} + 2^{7x} = 3$.

   (4 Points)

5. Evaluate the following integrals:

   i) $\displaystyle\int x \tanh(\ln x)\ dx$.

   ii) $\displaystyle\int \dfrac{1}{(1 + \cos^2 x)\csc x}\ dx$.

   iii) $\displaystyle\int (3^{-x} - 2^{x-1})^2\ dx$.

   (3 Points Each)