Midterm 2 **Time: 50min**

1. Differentiate:

<div style="text-align:center">

a) $y = \cos x^{\sin x}$ **b)** $y = \sin^{-1} x$

</div>

2. Find

<div style="text-align:center">

a) $\displaystyle\int \ln(2x)\,dx$ **b)** $\displaystyle\int \sin^3 x\,dx$

c) $\displaystyle\int_0^1 \frac{dx}{\sqrt{1-x}}$ **d)** $\displaystyle\int \frac{x-7}{x^2-x-12}\,dx$

</div>

3. Find

<div style="text-align:center">

a) $\displaystyle\lim_{x\to 0}(\cos x)^{\frac{1}{x}}$ **b)** $\displaystyle\lim_{x\to 0}\left(x\ln x^2\right)$

</div>

4. a) Find a formula for the general term for the sequence

$$\frac{-1}{4},\ \frac{2}{8},\ \frac{-3}{16},\ \frac{4}{32},\ \frac{-5}{64},\ldots$$

and determine whether or not it converges.

b) Show that, for all integrers n,

$$\ln n < 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n-1}.$$

What does this say about whether or not the series $\sum_{n=0}^{\infty} \frac{1}{n}$ converges.

Problem 2 is worth 40 points, and the rest are 20 points each.

LATEX $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$ $\mathcal{MG}$