Name:

Instructions:

- **Answer 8 out of the 10 problems**. There will be no bonus marks for attempting more than 8 problems. Before you hand in your exam, tell me the two problems you do not want graded:

  Do not grade problems ____ and ____.

- The exam is out of 200 marks.
- You have 120 minutes to complete the exam (15 minutes per question).
- You must work alone, without *Mathematica* or calculators.
- You must show the procedure you used to solve the problem.
- Good Luck!

Useful Relations:

- Trigonometric Identities:

$1 + \cot^2 x = \csc^2 x$	$\cos^2 x + \sin^2 x = 1$
$\sin x \cos x = \frac{1}{2} \sin 2x$	$\cos^2 x = \frac{1}{2}(1 + \cos 2x)$
$\sin(x + y) = \sin x \cos y + \cos x \sin y$	$\cos 2x = 1 - 2\sin^2 x$
$\cos(x + y) = \cos x \cos y - \sin x \sin y$	$\cos 2x = \cos^2 x - \sin^2 x$
$\sin x \cos y = \frac{1}{2}[\sin(x + y) + \sin(x - y)]$	$\sin^2 x = \frac{1}{2}(1 - \cos 2x)$
$\cos x \cos y = \frac{1}{2}[\cos(x + y) + \cos(x - y)]$	$\sec^2 x - \tan^2 x = 1$
$\sin x \sin y = \frac{1}{2}[\cos(x + y) - \cos(x - y)]$	

- $(ds)^2 = (dx)^2 + (dy)^2$
- $A = \displaystyle\int_a^b \frac{1}{2} r^2 d\theta$
- $L = \displaystyle\int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\, d\theta$
- Geometric series $\displaystyle\sum_{n=1}^{\infty} ar^{n-1}$ converges to $a/(1 - r)$ if $|r| < 1$
- The p-series $\displaystyle\sum_{n=1}^{\infty} 1/n^p$ is convergent if $p > 1$
- $\displaystyle\frac{1}{1 - x} = \sum_{n=0}^{\infty} x^n, \quad |x| < 1$