Concepts of Mathematics - MA2030A
Course Work 2.

MaRK
pjoy

This is the second piece of coursework for my part of this course.
All assignments must be signed-in by
noon on Thursday 13th January 2011.

Please note that your answers should be **clear**, **concise** and **accurate** mathematical justifications/proofs. You do not need to typeset your answers but any handwritten coursework that is illegible risks scoring 0 marks.

A. 40 marks You are given four digits (all strictly positive, i.e. greater than 0) arranged in a square with a *distinct* digit from 1 to 9 in each quarter. For example:

5	6
3	2

You make this arrangement into 4 integers by reading horizontally and vertically and then adding these numbers up, to get the sum S. So, in the above example,

$$S = 56 + 32 + 53 + 62 = 203. \tag{1}$$

In how many different ways can you fill in such a square so that $S = 150$?
For example, here is one way

3	3
5	1

B. 40 marks In the above example $S = 150$. Clearly

$$44 \leq S \leq 396. \tag{2}$$

For how many values of S satisfying the inequality (2) can a square **not** be constructed. For example, it is not possible to construct a square with $S = 47$.
Whilst you may be able to write a computer program or use an EXCEL spreadsheet to get the answers to A and B, I will only give marks for algebraic and therefore mathematical arguments to support your answers. Don't attempt to answer these questions by trial and error it will take you a very long time!
C. 20 marks Prove, by induction that

$$1^2 - 2^2 + 3^2 - 4^2 + \ldots + (2n+1)^2 = (n+1)(2n+1).$$

Find the sum of the first m terms of the series

$$1^2 - 2^2 + 3^2 - 4^2 + \ldots,$$

when m is any positive integer, odd or even.