$\overline{}$ for $n = 1, 2, 3, 4, 5, 6.$
x_n

(b) Show that $y_n^2 = 2x_n^2 + (-1)^n.$

(c) Explain why the ratio $\frac{y_n}{x_n}$ is a good approximation to $\sqrt{2}.$

4. Given a triangle with two equal medians, prove the triangle is isoceles.

5. For any integer $n+1, \ldots, 2n$ with n a natural number, consider its greatest odd divisor. Prove that the sum of all these divisors equals n^2.

6. Merlin summons the n knights of Camelot for a conference. Each day, he assigns them to the n seats at the Round Table. From the second day on, any two neighbours may interchange their seats if they were not neighbours on the first day. The knights try to sit in some cyclic order which has already occurred before on an earlier day. If they succeed, then the conference comes to an end when the day is over. What is the maximum number of days for which Merlin can guarantee that the conference will last?

Senior Questions

1. Given $a^2 = (a-b)^2 + 2ab - b^2$ for a, b postive, prove that

$$2(\sqrt{N+1} - 1) < \sum_{n=1}^{N} \frac{1}{\sqrt{n}} < 2\sqrt{N}$$

[1] Some of the problems here come from T. Gagen, Uni. of Syd. and from E. Szekeres , Macquarie Uni. Problem 4 provided by G. Liang, problems 5 and 6 are from the Tournment of Towns

and y_n by $x_1 = y_1 = 1$ and for $n > 1$; $x_n = x_{n-1} + y_{n-1}$; $y_n =$

and deduce that the sum of the first million terms of

$$\frac{1}{\sqrt{1}} + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} +$$

is between 1998 and 2000.

2. An ordinary six-sided die is rolled ten times. Find the probability that five different faces come up twice each.