Medieval Mathematics

1 Problems

- 1. For the Fibonacci sequence, with the recursion relation $u_{n+1} = u_n + u_{n-1}$, make the model $u_n = r^n$. Determine r.
- 2. For the Fibonacci sequence prove the formula $u_{n+1}^2 = u_n u_{n+2} + (-1)^n$.
- 3. For the general form general form of the Fibonacci sequence: Given a, b, and c. Let $x_0 = a$ and $x_1 = b$. Define $x_{n+2} = cx_{n+1} + cx_n$. Compute several terms of this sequence collecting powers of c. Determine a pattern of the coefficients that involves the terms of Pascal's triangle.
- 4. Show that the cubic equation

$$x^3 + 2x^2 + 10x = 20$$

can have no solution of the form $a + \sqrt{b}$, where a and b are **positive** rationals.

5. Complete the argument in conjunction with the Mean Speed Rule, namely that the viewpoint from the illustration



Halves Area 1st half^{Time} Area 2nd half = 1 : 3 **Thirds:** A_{1st} : A_{2nd} : A_{3rd} = 1 : 3 : 5 **Fourths:** A_{1st} : A_{2nd} : A_{3rd} : A_{4th} = 1 : 3 : 5 : 7 and so on leads to establishing that the distance travelled by an object under uniform acceleration is proportional to the square of the time.

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- 6. Oresme also summed $\frac{2\cdot 3}{4} + \frac{2\cdot 3}{16} + \frac{2\cdot 3}{64} + \dots + \frac{2\cdot 3}{4^n} + \dots = 2$. Prove this geometrically, if possible.
- 7. Cite other epochs of mathematical development where its decline can be attributed to religious or political calamity. Compare the medieval period with these periods. (You may need to do extra background reading.)