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FIBONACCI SUMMATIONS INVOLVING A POWER OF A RATIONAL NUMBER
SUMMARY

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The formulas pertain to generalized Fibonacci numbers with given T_1 and T_2 and with

(1) $$T_{n+1} = T_n + T_{n-1}$$

and with generalized Lucas numbers defined by

(2) $$V_n = T_{n+1} + T_{n-1} \quad .$$

Starting with a finite difference relation such as

(3) $$\Delta (b/a)^k T_{2k} T_{2k+2} = (b^k/a^{k+1}) T_{2k+2} (b T_{2k+4} - a T_{2k})$$

values of b and a are selected which lead to a single generalized Fibonacci or Lucas number for the term in parentheses. Thus for $b = 2$, $a = 13$, the quantity in parentheses is $3 T_{2k-3}$. Using the finite difference approach leads to a formula

(4) $$\sum_{k=1}^{n} (2/13)^k T_{2k} T_{2k+5} = (1/3) \left[(2^{n+1}/13^n) T_{2n+5} T_{2n+7} - 2 T_5 T_7 \right].$$

Formulas are also developed with terms in the denominator.

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