



## On New Identities for the Pochhammer $k$ -Symbol and Catalan-Type Numbers

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### Abstract

In this paper, we present six new identities involving the Pochhammer  $k$ -symbol, using the recurrence relation for the Pochhammer  $k$ -symbol, which were obtained by Chammam and Khelif in [1]. Based on these six identities, we also obtain six new identities for the Fuss-Catalan-Qi numbers, which were derived using the relationship between the Pochhammer  $k$ -symbol and the Fuss-Catalan-Qi numbers, established by Chammam and Khelif in the same article. As an application, we derive several results related to Catalan-Qi numbers, Catalan numbers, Touchard's identity and Koshy's identity, which were previously presented by Mahmoud and Qi in [2].

**Keywords:** Pochhammer  $k$ -symbol, Gamma function, Catalan-Qi numbers, generalized hypergeometric series.

### References:

- [1] W. Chammam and M. Khelif, Several formulas and identities related to the Pochhammer  $k$ -symbol and application to a case of the Fuss-Catalan-Qi numbers. *Indian J Pure Appl Math.* 56 (2024), 10 pp.
- [2] M. Mahmoud and F. Qi, Three identities of the Catalan-Qi numbers. *Mathematics* 4 (2016), no. 2, 35, 7 pp.