Conventional solution and proof

Distributing each term and collecting equal powers gives

$$\boxed{A(x)B(x) = 56x^6 - 8x^5 - 34x^4 - 53x^3 - 9x^2 + 63x - 30.}$$

In ascending coefficient order, $a = (-10, 1, -1, 7)$ and $b = (3, -6, 0, 8)$. The coefficient formula $c_k = \sum_{i+j=k} a_i b_j$ yields $(-30, 63, -9, -53, -34, -8, 56)$. This proves the product coefficient by coefficient. Evaluating at any seven distinct points, multiplying the paired values and interpolating gives the same degree-at-most-six polynomial by uniqueness of polynomial interpolation.

Structural or analytic derivation

Pad both vectors to length eight. For $\omega = e^{2\pi i/8}$, evaluate with an eight-point DFT, multiply componentwise, and apply its inverse. Since the linear product has degree six, no coefficient wraps modulo $x^8 - 1$. Root-of-unity orthogonality proves that the inverse recovers exactly the displayed convolution in exact arithmetic. The supplied numerical test rounds only after comparing with the exact coefficient calculation.

Comparative cost and preferred method

The generic coefficient algorithm uses 16 scalar products for the 4×4 convolution, of which four vanish because one input coefficient is zero. An eight-point transform introduces complex operations and setup, so direct multiplication is preferable here. For degree-bound n inputs, the same transform construction reduces generic dense convolution from $\Theta(n^2)$ to $O(n \log n)$ arithmetic; this asymptotic statement does not predict a gain for cubics.