

Pensieve Header: Experiments with "Collect".

t1 = Expand[Normal[Series[E^((a + b) x), {x, 0, 5}]]] + O[x]^6

$$1 + (a + b) x + \frac{1}{2} (a^2 + 2 a b + b^2) x^2 + \frac{1}{6} (a^3 + 3 a^2 b + 3 a b^2 + b^3) x^3 + \frac{1}{24} (a^4 + 4 a^3 b + 6 a^2 b^2 + 4 a b^3 + b^4) x^4 + \frac{1}{120} (a^5 + 5 a^4 b + 10 a^3 b^2 + 10 a^2 b^3 + 5 a b^4 + b^5) x^5 + O[x]^6$$

t2 = Expand[Normal[t1]]

$$1 + a x + b x + \frac{a^2 x^2}{2} + a b x^2 + \frac{b^2 x^2}{2} + \frac{a^3 x^3}{6} + \frac{1}{2} a^2 b x^3 + \frac{1}{2} a b^2 x^3 + \frac{b^3 x^3}{6} + \frac{a^4 x^4}{24} + \frac{1}{6} a^3 b x^4 + \frac{1}{4} a^2 b^2 x^4 + \frac{1}{6} a b^3 x^4 + \frac{b^4 x^4}{24} + \frac{a^5 x^5}{120} + \frac{1}{24} a^4 b x^5 + \frac{1}{12} a^3 b^2 x^5 + \frac{1}{12} a^2 b^3 x^5 + \frac{1}{24} a b^4 x^5 + \frac{b^5 x^5}{120}$$

t3 = Collect[t2, x]

$$1 + (a + b) x + \left(\frac{a^2}{2} + a b + \frac{b^2}{2} \right) x^2 + \left(\frac{a^3}{6} + \frac{a^2 b}{2} + \frac{a b^2}{2} + \frac{b^3}{6} \right) x^3 + \left(\frac{a^4}{24} + \frac{a^3 b}{6} + \frac{a^2 b^2}{4} + \frac{a b^3}{6} + \frac{b^4}{24} \right) x^4 + \left(\frac{a^5}{120} + \frac{a^4 b}{24} + \frac{a^3 b^2}{12} + \frac{a^2 b^3}{12} + \frac{a b^4}{24} + \frac{b^5}{120} \right) x^5$$

t4 = Collect[t2, x, Simplify]

$$1 + (a + b) x + \frac{1}{2} (a + b)^2 x^2 + \frac{1}{6} (a + b)^3 x^3 + \frac{1}{24} (a + b)^4 x^4 + \frac{1}{120} (a + b)^5 x^5$$

t5 = t2 /. x^p_ -> x[p]

$$1 + a x[1] + b x[1] + \frac{1}{2} a^2 x[2] + a b x[2] + \frac{1}{2} b^2 x[2] + \frac{1}{6} a^3 x[3] + \frac{1}{2} a^2 b x[3] + \frac{1}{2} a b^2 x[3] + \frac{1}{6} b^3 x[3] + \frac{1}{24} a^4 x[4] + \frac{1}{6} a^3 b x[4] + \frac{1}{4} a^2 b^2 x[4] + \frac{1}{6} a b^3 x[4] + \frac{1}{24} b^4 x[4] + \frac{1}{120} a^5 x[5] + \frac{1}{24} a^4 b x[5] + \frac{1}{12} a^3 b^2 x[5] + \frac{1}{12} a^2 b^3 x[5] + \frac{1}{24} a b^4 x[5] + \frac{1}{120} b^5 x[5]$$

t6 = Collect[t5, _x, Factor]

$$1 + (a + b) x[1] + \frac{1}{2} (a + b)^2 x[2] + \frac{1}{6} (a + b)^3 x[3] + \frac{1}{24} (a + b)^4 x[4] + \frac{1}{120} (a + b)^5 x[5]$$