

`a3``a3``(x + y)5``(x + y)5``K = X[1, 5, 2, 4] X[3, 1, 4, 6] X[5, 3, 6, 2]``X[1, 5, 2, 4] X[3, 1, 4, 6] X[5, 3, 6, 2]``K``X[1, 5, 2, 4] X[3, 1, 4, 6] X[5, 3, 6, 2]``(x + y)5 /. 5 → 6``(x + y)6``z = Expand[(x + y)5] (* Gonzalo says its the binoimial formula *)``x5 + 5 x4 y + 10 x3 y2 + 10 x2 y3 + 5 x y4 + y5``z /. 5 → 6``x6 + 6 x4 y + 10 x3 y2 + 10 x2 y3 + 6 x y4 + y6``"Trist5" /. 5 → 6``Trist5``5 Trist /. 5 → 7``7 Trist``5 Trist /. Trist → Etienne``5 Etienne``StringReplace["Trist5", "5" → "7"]``Trist7``z``x5 + 5 x4 y + 10 x3 y2 + 10 x2 y3 + 5 x y4 + y5``z /. _ → t``t``z /. _Symbol → t``t[t[t, 5], t[5, t[t, 4], t], t[10, t[t, 3], t[t, 2]],
t[10, t[t, 2], t[t, 3]], t[5, t, t[t, 4]], t[t, 5]]``z /. x | y → t``32 t5`

$l = \{1, 2, 3\}$

$\{1, 2, 3\}$

$l /. n_Integer \rightarrow n^2$

$\{1, 4, 9\}$

$l /. K_Integer \rightarrow K^2$

$\{X[1, 5, 2, 4]^2 X[3, 1, 4, 6]^2 X[5, 3, 6, 2]^2,$
 $X[1, 5, 2, 4]^2 X[3, 1, 4, 6]^2 X[5, 3, 6, 2]^2, X[1, 5, 2, 4]^2 X[3, 1, 4, 6]^2 X[5, 3, 6, 2]^2\}$

$l /. K_Integer \Rightarrow K^2$

$\{1, 4, 9\}$

$K_Integer \rightarrow K^2$

$K_Integer \rightarrow X[1, 5, 2, 4]^2 X[3, 1, 4, 6]^2 X[5, 3, 6, 2]^2$

$K_Integer \Rightarrow K^2$

$K_Integer \Rightarrow K^2$

$t1 =$

$K /. X[i_Integer, j_Integer, k_Integer, l_Integer] \Rightarrow AP[i, j] P[k, l] + BP[j, k] P[i, l]$

$(BP[1, 4] P[3, 6] + AP[3, 1] P[4, 6])$

$(AP[1, 5] P[2, 4] + BP[1, 4] P[5, 2]) (BP[3, 6] P[5, 2] + AP[5, 3] P[6, 2])$

$\{Etienne1, Etienne1\}$

$\{Etienne1, Etienne\}$

$t1 = K /. X[i_, j_, k_, l_] \Rightarrow AP[i, j] P[k, l] + BP[j, k] P[i, l]$

$(BP[1, 4] P[3, 6] + AP[3, 1] P[4, 6])$

$(AP[1, 5] P[2, 4] + BP[1, 4] P[5, 2]) (BP[3, 6] P[5, 2] + AP[5, 3] P[6, 2])$

$t2 = \text{Expand}[t1]$

$AB^2 P[1, 4] P[1, 5] P[2, 4] P[3, 6]^2 P[5, 2] + A^2 BP[1, 5] P[2, 4] P[3, 1] P[3, 6] P[4, 6] P[5, 2] +$
 $B^3 P[1, 4]^2 P[3, 6]^2 P[5, 2]^2 + AB^2 P[1, 4] P[3, 1] P[3, 6] P[4, 6] P[5, 2]^2 +$

$A^2 BP[1, 4] P[1, 5] P[2, 4] P[3, 6] P[5, 3] P[6, 2] +$

$A^3 P[1, 5] P[2, 4] P[3, 1] P[4, 6] P[5, 3] P[6, 2] +$

$AB^2 P[1, 4]^2 P[3, 6] P[5, 2] P[5, 3] P[6, 2] + A^2 BP[1, 4] P[3, 1] P[4, 6] P[5, 2] P[5, 3] P[6, 2]$

$t3 = t2 /. P[i_, j_] P[j_, k_] \Rightarrow P[i, k]$

$AB^2 P[1, 2] P[1, 4] P[2, 4] P[3, 6]^2 + A^2 BP[2, 4] P[3, 5] P[3, 6] P[4, 6] P[5, 2] +$

$B^3 P[1, 4]^2 P[3, 6]^2 P[5, 2]^2 + AB^2 P[3, 4] P[3, 6] P[4, 6] P[5, 2]^2 +$

$A^2 BP[1, 3] P[1, 4] P[2, 4] P[3, 6] P[6, 2] + A^3 P[2, 4] P[3, 5] P[4, 6] P[5, 3] P[6, 2] +$

$A^2 BP[3, 4] P[4, 6] P[5, 2] P[5, 3] P[6, 2] + AB^2 P[1, 4]^2 P[5, 2] P[5, 6] P[6, 2]$

$t3 = t2 //. P[i_, j_] P[j_, k_] \Rightarrow P[i, k]$

$A^2 BP[1, 4]^2 + A^3 P[2, 2] P[3, 3] + A^2 BP[3, 6]^2 + AB^2 P[1, 4]^2 P[3, 6]^2 + A^2 BP[5, 2]^2 +$

$AB^2 P[1, 4]^2 P[5, 2]^2 + AB^2 P[3, 6]^2 P[5, 2]^2 + B^3 P[1, 4]^2 P[3, 6]^2 P[5, 2]^2$

```
t4 = t3 /. {P[i_, j_] ^2 -> d, P[i_, i_] -> d}
3 A^2 B d + A^3 d^2 + 3 A B^2 d^2 + B^3 d^3
```

```
t5 = Simplify[t4 /. {B -> 1/A, d -> -A^2 - 1/A^2}]
- 1/A^9 + 1/A + A^3 + A^7
```

```
K17 = X[1, 12, 2, 13] X[3, 8, 4, 9] X[5, 1, 6, 16] X[7, 2, 8, 3]
      X[9, 15, 10, 14] X[11, 4, 12, 5] X[13, 7, 14, 6] X[15, 11, 16, 10]
X[1, 12, 2, 13] X[3, 8, 4, 9] X[5, 1, 6, 16] X[7, 2, 8, 3]
X[9, 15, 10, 14] X[11, 4, 12, 5] X[13, 7, 14, 6] X[15, 11, 16, 10]
```

```
t1 = K17 /. X[i_, j_, k_, l_] -> AP[i, j] P[k, l] + BP[j, k] P[i, l]
(BP[1, 6] P[5, 16] + AP[5, 1] P[6, 16]) (BP[2, 8] P[7, 3] + AP[7, 2] P[8, 3])
(AP[3, 8] P[4, 9] + BP[3, 9] P[8, 4]) (AP[1, 12] P[2, 13] + BP[1, 13] P[12, 2])
(BP[4, 12] P[11, 5] + AP[11, 4] P[12, 5]) (BP[7, 14] P[13, 6] + AP[13, 7] P[14, 6])
(AP[9, 15] P[10, 14] + BP[9, 14] P[15, 10]) (BP[11, 16] P[15, 10] + AP[15, 11] P[16, 10])
```

```
t2 = Expand[t1]
```

```
A^3 B^5 P[1, 6] P[1, 12] P[2, 8] P[2, 13] P[3, 8] P[4, 9] P[4, 12] P[5, 16]
P[7, 3] P[7, 14] P[9, 15] P[10, 14] P[11, 5] P[11, 16] P[13, 6] P[15, 10] +
... 254 ... + A^5 B^3 ... 14 ... P[15, 11] P[16, 10]
```

large output	show less	show more	show all	set size limit...
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```
Plus[5, 6]
```

```
11
```

```
Attributes[Plus]
```

```
{Flat, Listable, NumericFunction, OneIdentity, Orderless, Protected}
```

```
{P[1, 2], P[2, 1]}
```

```
{P[1, 2], P[2, 1]}
```

```
SetAttributes[P, Orderless]
```

```
{P[1, 2], P[2, 1]}
```

```
{P[1, 2], P[1, 2]}
```

```
SetAttributes[P, Orderless];
```

```
t3 = t2 //. P[i_, j_] P[j_, k_] -> P[i, k];
```

```
Short[t3]
```

```
B^8 P[6, 13]^2 <<1>>^2 <<1>>^2 P[10, <<2>>]^2 P[11, 16]^2 + <<102>> + <<1>>
```

```
t4 = t3 /. {P[i_, j_] ^2 -> d, P[i_, i_] -> d}
37 A^4 B^4 d + 47 A^5 B^3 d^2 + 47 A^3 B^5 d^2 + 27 A^6 B^2 d^3 + 32 A^4 B^4 d^3 + 27 A^2 B^6 d^3 +
8 A^7 B d^4 + 9 A^5 B^3 d^4 + 9 A^3 B^5 d^4 + 8 A B^7 d^4 + A^8 d^5 + A^6 B^2 d^5 + A^4 B^4 d^5 + A^2 B^6 d^5 + B^8 d^5
```

```
t5 = Simplify[t4 /. {B -> 1/A, d -> -A^2 - 1/A^2}]
- 1/A^18 (1 - 2 A^4 + 2 A^8 - A^12 + A^16 + A^20 - A^24 + 2 A^28 - 2 A^32 + A^36)
```

```
n = 3; a = n; a
3
```

```
n = 3; a = n; n = 5; a
3
```

```
Clear[a, n]
```

```
{a, n}
{a, n}
```

```
n = 3; a := n; n = 5; a
5
```

```
KB[K_] := (
  t1 = K /. X[i_, j_, k_, L_] -> AP[i, j] P[k, L] + BP[j, k] P[i, L];
  t2 = Expand[t1];
  SetAttributes[P, Orderless];
  t3 = t2 //. P[i_, j_] P[j_, k_] -> P[i, k];
  t4 = t3 /. {P[i_, j_] ^2 -> d, P[i_, i_] -> d};
  Simplify[t4 /. {B -> 1/A, d -> -A^2 - 1/A^2}]
)
```

```
KB[K17]
```

```
- 1/A^18 (1 - 2 A^4 + 2 A^8 - A^12 + A^16 + A^20 - A^24 + 2 A^28 - 2 A^32 + A^36)
```

```
K
```

```
X[1, 5, 2, 4] X[3, 1, 4, 6] X[5, 3, 6, 2]
```

```
KB[K]
```

```
- 1/A^9 + 1/A + A^3 + A^7
```

```
t2
```

```
A^2 B P[1, 4] P[1, 5] P[2, 4] P[2, 6] P[3, 5] P[3, 6] +
A B^2 P[1, 4]^2 P[2, 5] P[2, 6] P[3, 5] P[3, 6] + A B^2 P[1, 4] P[1, 5] P[2, 4] P[2, 5] P[3, 6]^2 +
B^3 P[1, 4]^2 P[2, 5]^2 P[3, 6]^2 + A^3 P[1, 3] P[1, 5] P[2, 4] P[2, 6] P[3, 5] P[4, 6] +
A^2 B P[1, 3] P[1, 4] P[2, 5] P[2, 6] P[3, 5] P[4, 6] +
A^2 B P[1, 3] P[1, 5] P[2, 4] P[2, 5] P[3, 6] P[4, 6] + A B^2 P[1, 3] P[1, 4] P[2, 5]^2 P[3, 6] P[4, 6]
```

KB[K17]

$$-\frac{1}{A^{18}} (1 - 2A^4 + 2A^8 - A^{12} + A^{16} + A^{20} - A^{24} + 2A^{28} - 2A^{32} + A^{36})$$

Length[t2]

256

lhs = KB[X[8, 4, 5, 9] X[6, 1, ar, 9] X[ar, 2, 3, 8]]

$$A^3 P[1, 6] P[2, 5] P[3, 4] + AP[1, 6] P[2, 3] P[4, 5] + \\ AP[1, 2] P[3, 4] P[5, 6] + \frac{1}{A} (P[1, 2] P[3, 6] P[4, 5] + P[1, 4] P[2, 3] P[5, 6])$$

t1

$$(AP[4, 8] P[5, 9] + BP[4, 5] P[8, 9]) \\ (AP[2, ar] P[3, 8] + BP[2, 3] P[8, ar]) (BP[1, ar] P[6, 9] + AP[1, 6] P[9, ar])$$

t2

$$A^2 BP[1, ar] P[2, ar] P[3, 8] P[4, 8] P[5, 9] P[6, 9] + \\ AB^2 P[1, ar] P[2, ar] P[3, 8] P[4, 5] P[6, 9] P[8, 9] + \\ AB^2 P[1, ar] P[2, 3] P[4, 8] P[5, 9] P[6, 9] P[8, ar] + \\ B^3 P[1, ar] P[2, 3] P[4, 5] P[6, 9] P[8, 9] P[8, ar] + \\ A^3 P[1, 6] P[2, ar] P[3, 8] P[4, 8] P[5, 9] P[9, ar] + \\ A^2 BP[1, 6] P[2, ar] P[3, 8] P[4, 5] P[8, 9] P[9, ar] + \\ A^2 BP[1, 6] P[2, 3] P[4, 8] P[5, 9] P[8, ar] P[9, ar] + \\ AB^2 P[1, 6] P[2, 3] P[4, 5] P[8, 9] P[8, ar] P[9, ar]$$

t3

$$A^3 P[1, 6] P[2, 5] P[3, 4] + 2A^2 BP[1, 6] P[2, 3] P[4, 5] + \\ B^3 P[1, 6] P[2, 3] P[4, 5] + AB^2 P[1, 2] P[3, 6] P[4, 5] + AB^2 P[1, 4] P[2, 3] P[5, 6] + \\ A^2 BP[1, 2] P[3, 4] P[5, 6] + AB^2 P[1, 6] P[2, 3] P[4, 5] P[9, ar]^2$$

t4

$$A^3 P[1, 6] P[2, 5] P[3, 4] + 2A^2 BP[1, 6] P[2, 3] P[4, 5] + \\ B^3 P[1, 6] P[2, 3] P[4, 5] + AB^2 d P[1, 6] P[2, 3] P[4, 5] + \\ AB^2 P[1, 2] P[3, 6] P[4, 5] + AB^2 P[1, 4] P[2, 3] P[5, 6] + A^2 BP[1, 2] P[3, 4] P[5, 6]$$

rhs = KB[X[2, 7, ar, 1] X[6, ar, 12, 5] X[12, 7, 3, 4]]

$$A^3 P[1, 6] P[2, 5] P[3, 4] + AP[1, 6] P[2, 3] P[4, 5] + \\ AP[1, 2] P[3, 4] P[5, 6] + \frac{1}{A} (P[1, 2] P[3, 6] P[4, 5] + P[1, 4] P[2, 3] P[5, 6])$$

lhs

$$A^3 P[1, 6] P[2, 5] P[3, 4] + AP[1, 6] P[2, 3] P[4, 5] + \\ AP[1, 2] P[3, 4] P[5, 6] + \frac{1}{A} (P[1, 2] P[3, 6] P[4, 5] + P[1, 4] P[2, 3] P[5, 6])$$

lhs == rhs

True

ew65