

Expansion of 4 – vector in accelerator coordinates

A1 and A3

In[1]:= **n = 4;**

In[2]:= **A1 = Normal[Series[Integrate[ε * Bs[ε * x, ε * y, ε * t], y], {ε, 0, n}]] / 2**

$$\text{Out[2]= } \frac{1}{2} \left(y \varepsilon \text{Bs}[0, 0, 0] + \varepsilon^2 \left(t y \text{Bs}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} y^2 \text{Bs}^{(0,1,0)}[0, 0, 0] + x y \text{Bs}^{(1,0,0)}[0, 0, 0] \right) + \right. \\ \left. \frac{1}{6} \varepsilon^3 \left(3 t^2 y \text{Bs}^{(0,0,2)}[0, 0, 0] + 3 t y^2 \text{Bs}^{(0,1,1)}[0, 0, 0] + y^3 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 6 t x y \text{Bs}^{(1,0,1)}[0, 0, 0] + 3 x y^2 \text{Bs}^{(1,1,0)}[0, 0, 0] + 3 x^2 y \text{Bs}^{(2,0,0)}[0, 0, 0] \right) + \frac{1}{24} \varepsilon^4 \right. \\ \left. \left(4 t^3 y \text{Bs}^{(0,0,3)}[0, 0, 0] + 6 t^2 y^2 \text{Bs}^{(0,1,2)}[0, 0, 0] + 4 t y^3 \text{Bs}^{(0,2,1)}[0, 0, 0] + y^4 \text{Bs}^{(0,3,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 12 t^2 x y \text{Bs}^{(1,0,2)}[0, 0, 0] + 12 t x y^2 \text{Bs}^{(1,1,1)}[0, 0, 0] + 4 x y^3 \text{Bs}^{(1,2,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 12 t x^2 y \text{Bs}^{(2,0,1)}[0, 0, 0] + 6 x^2 y^2 \text{Bs}^{(2,1,0)}[0, 0, 0] + 4 x^3 y \text{Bs}^{(3,0,0)}[0, 0, 0] \right) \right)$$

In[3]:= **A3 = -Normal[Series[Integrate[ε * Bs[ε * x, ε * y, ε * t], x], {ε, 0, n}]] / 2**

$$\text{Out[3]= } \frac{1}{2} \left(-x \varepsilon \text{Bs}[0, 0, 0] - \varepsilon^2 \left(t x \text{Bs}^{(0,0,1)}[0, 0, 0] + x y \text{Bs}^{(0,1,0)}[0, 0, 0] + \frac{1}{2} x^2 \text{Bs}^{(1,0,0)}[0, 0, 0] \right) - \right. \\ \left. \frac{1}{6} \varepsilon^3 \left(3 t^2 x \text{Bs}^{(0,0,2)}[0, 0, 0] + 6 t x y \text{Bs}^{(0,1,1)}[0, 0, 0] + 3 x y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 3 t x^2 \text{Bs}^{(1,0,1)}[0, 0, 0] + 3 x^2 y \text{Bs}^{(1,1,0)}[0, 0, 0] + x^3 \text{Bs}^{(2,0,0)}[0, 0, 0] \right) - \right. \\ \left. \frac{1}{24} \varepsilon^4 \left(4 t^3 x \text{Bs}^{(0,0,3)}[0, 0, 0] + 12 t^2 x y \text{Bs}^{(0,1,2)}[0, 0, 0] + 12 t x y^2 \text{Bs}^{(0,2,1)}[0, 0, 0] + \right. \right. \\ \left. \left. 4 x y^3 \text{Bs}^{(0,3,0)}[0, 0, 0] + 6 t^2 x^2 \text{Bs}^{(1,0,2)}[0, 0, 0] + 12 t x^2 y \text{Bs}^{(1,1,1)}[0, 0, 0] + \right. \right. \\ \left. \left. 6 x^2 y^2 \text{Bs}^{(1,2,0)}[0, 0, 0] + 4 t x^3 \text{Bs}^{(2,0,1)}[0, 0, 0] + 4 x^3 y \text{Bs}^{(2,1,0)}[0, 0, 0] + x^4 \text{Bs}^{(3,0,0)}[0, 0, 0] \right) \right) \\ - \frac{1}{2} x \varepsilon \text{Bs}[0, 0, 0]$$

In[4]:= **Normal[Series[ε * Bs[ε * x, ε * y, ε * t], {ε, 0, n - 1}]]**

$$\text{Out[4]= } \varepsilon \text{Bs}[0, 0, 0] + \varepsilon^2 \left(t \text{Bs}^{(0,0,1)}[0, 0, 0] + y \text{Bs}^{(0,1,0)}[0, 0, 0] + x \text{Bs}^{(1,0,0)}[0, 0, 0] \right) + \\ \frac{1}{2} \varepsilon^3 \left(t^2 \text{Bs}^{(0,0,2)}[0, 0, 0] + 2 t y \text{Bs}^{(0,1,1)}[0, 0, 0] + y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \\ \left. 2 t x \text{Bs}^{(1,0,1)}[0, 0, 0] + 2 x y \text{Bs}^{(1,1,0)}[0, 0, 0] + x^2 \text{Bs}^{(2,0,0)}[0, 0, 0] \right)$$

In[5]:= **-D[A3, x]**

$$\text{Out[5]} = \frac{1}{2} \left(\varepsilon \text{Bs}[0, 0, 0] + \varepsilon^2 \left(t \text{Bs}^{(0,0,1)}[0, 0, 0] + y \text{Bs}^{(0,1,0)}[0, 0, 0] + x \text{Bs}^{(1,0,0)}[0, 0, 0] \right) + \right. \\ \left. \frac{1}{6} \varepsilon^3 \left(3 t^2 \text{Bs}^{(0,0,2)}[0, 0, 0] + 6 t y \text{Bs}^{(0,1,1)}[0, 0, 0] + 3 y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 6 t x \text{Bs}^{(1,0,1)}[0, 0, 0] + 6 x y \text{Bs}^{(1,1,0)}[0, 0, 0] + 3 x^2 \text{Bs}^{(2,0,0)}[0, 0, 0] \right) + \frac{1}{24} \varepsilon^4 \right. \\ \left. \left(4 t^3 \text{Bs}^{(0,0,3)}[0, 0, 0] + 12 t^2 y \text{Bs}^{(0,1,2)}[0, 0, 0] + 12 t y^2 \text{Bs}^{(0,2,1)}[0, 0, 0] + 4 y^3 \text{Bs}^{(0,3,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 12 t^2 x \text{Bs}^{(1,0,2)}[0, 0, 0] + 24 t x y \text{Bs}^{(1,1,1)}[0, 0, 0] + 12 x y^2 \text{Bs}^{(1,2,0)}[0, 0, 0] + \right. \right. \\ \left. \left. 12 t x^2 \text{Bs}^{(2,0,1)}[0, 0, 0] + 12 x^2 y \text{Bs}^{(2,1,0)}[0, 0, 0] + 4 x^3 \text{Bs}^{(3,0,0)}[0, 0, 0] \right) \right)$$

In[6]:=

D[A1, y] - D[A3, x] - Normal[Series[ε * Bs[ε * x, ε * y, ε * t], {ε, 0, n}]]

$$\text{Out[6]} = -\frac{1}{2} \varepsilon^3 \left(t^2 \text{Bs}^{(0,0,2)}[0, 0, 0] + 2 t y \text{Bs}^{(0,1,1)}[0, 0, 0] + y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \\ \left. 2 t x \text{Bs}^{(1,0,1)}[0, 0, 0] + 2 x y \text{Bs}^{(1,1,0)}[0, 0, 0] + x^2 \text{Bs}^{(2,0,0)}[0, 0, 0] \right) + \\ \frac{1}{6} \varepsilon^3 \left(3 t^2 \text{Bs}^{(0,0,2)}[0, 0, 0] + 6 t y \text{Bs}^{(0,1,1)}[0, 0, 0] + 3 y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] + \right. \\ \left. 6 t x \text{Bs}^{(1,0,1)}[0, 0, 0] + 6 x y \text{Bs}^{(1,1,0)}[0, 0, 0] + 3 x^2 \text{Bs}^{(2,0,0)}[0, 0, 0] \right) - \\ \frac{1}{6} \varepsilon^4 \left(t^3 \text{Bs}^{(0,0,3)}[0, 0, 0] + 3 t^2 y \text{Bs}^{(0,1,2)}[0, 0, 0] + 3 t y^2 \text{Bs}^{(0,2,1)}[0, 0, 0] + y^3 \text{Bs}^{(0,3,0)}[0, 0, 0] + \right. \\ \left. 3 t^2 x \text{Bs}^{(1,0,2)}[0, 0, 0] + 6 t x y \text{Bs}^{(1,1,1)}[0, 0, 0] + 3 x y^2 \text{Bs}^{(1,2,0)}[0, 0, 0] + \right. \\ \left. 3 t x^2 \text{Bs}^{(2,0,1)}[0, 0, 0] + 3 x^2 y \text{Bs}^{(2,1,0)}[0, 0, 0] + x^3 \text{Bs}^{(3,0,0)}[0, 0, 0] \right) + \frac{1}{24} \varepsilon^4 \\ \left(4 t^3 \text{Bs}^{(0,0,3)}[0, 0, 0] + 12 t^2 y \text{Bs}^{(0,1,2)}[0, 0, 0] + 12 t y^2 \text{Bs}^{(0,2,1)}[0, 0, 0] + 4 y^3 \text{Bs}^{(0,3,0)}[0, 0, 0] + \right. \\ \left. 12 t^2 x \text{Bs}^{(1,0,2)}[0, 0, 0] + 24 t x y \text{Bs}^{(1,1,1)}[0, 0, 0] + 12 x y^2 \text{Bs}^{(1,2,0)}[0, 0, 0] + \right. \\ \left. 12 t x^2 \text{Bs}^{(2,0,1)}[0, 0, 0] + 12 x^2 y \text{Bs}^{(2,1,0)}[0, 0, 0] + 4 x^3 \text{Bs}^{(3,0,0)}[0, 0, 0] \right)$$

In[7]:= **Coefficient[A1, ε]**

$$\text{Out[7]} = \frac{1}{2} y \text{Bs}[0, 0, 0]$$

In[8]:= **Coefficient[A3, ε]**

$$\text{Out[8]} = -\frac{1}{2} x \text{Bs}[0, 0, 0]$$

A2

In[9]:= **m = 4;**

A21 = Normal[

Series[Integrate[$\epsilon * ((1 + K * \epsilon * x) * By[\epsilon * x, 0, \epsilon * t] + \kappa * \epsilon * x * Bs[\epsilon * x, 0, \epsilon * t])$, x], { $\epsilon, 0, m$ }]]

$$\begin{aligned} \text{Out[10]} = & x \epsilon \text{By}[0, 0, 0] + \frac{1}{2} \epsilon^2 \left(x^2 \kappa \text{Bs}[0, 0, 0] + K x^2 \text{By}[0, 0, 0] + 2 t x \text{By}^{(0,0,1)}[0, 0, 0] + x^2 \text{By}^{(1,0,0)}[0, 0, 0] \right) + \\ & \frac{1}{6} \epsilon^3 \left(3 t x^2 \kappa \text{Bs}^{(0,0,1)}[0, 0, 0] + 3 K t x^2 \text{By}^{(0,0,1)}[0, 0, 0] + 3 t^2 x \text{By}^{(0,0,2)}[0, 0, 0] + \right. \\ & \quad \left. 2 x^3 \kappa \text{Bs}^{(1,0,0)}[0, 0, 0] + 2 K x^3 \text{By}^{(1,0,0)}[0, 0, 0] + 3 t x^2 \text{By}^{(1,0,1)}[0, 0, 0] + x^3 \text{By}^{(2,0,0)}[0, 0, 0] \right) + \\ & \frac{1}{24} \epsilon^4 \left(6 t^2 x^2 \kappa \text{Bs}^{(0,0,2)}[0, 0, 0] + 6 K t^2 x^2 \text{By}^{(0,0,2)}[0, 0, 0] + 4 t^3 x \text{By}^{(0,0,3)}[0, 0, 0] + \right. \\ & \quad \left. 8 t x^3 \kappa \text{Bs}^{(1,0,1)}[0, 0, 0] + 8 K t x^3 \text{By}^{(1,0,1)}[0, 0, 0] + 6 t^2 x^2 \text{By}^{(1,0,2)}[0, 0, 0] + \right. \\ & \quad \left. 3 x^4 \kappa \text{Bs}^{(2,0,0)}[0, 0, 0] + 3 K x^4 \text{By}^{(2,0,0)}[0, 0, 0] + 4 t x^3 \text{By}^{(2,0,1)}[0, 0, 0] + x^4 \text{By}^{(3,0,0)}[0, 0, 0] \right) \end{aligned}$$

In[11]:= **A22 = -Normal[Series[Integrate[$\epsilon * (Bx[0, \epsilon * y, \epsilon * t] - \kappa * \epsilon * y * Bs[\epsilon * x, 0, \epsilon * t])$, y], { $\epsilon, 0, m$ }]]**

$$\begin{aligned} \text{Out[11]} = & -y \epsilon \text{Bx}[0, 0, 0] - \epsilon^2 \left(-\frac{1}{2} y^2 \kappa \text{Bs}[0, 0, 0] + t y \text{Bx}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} y^2 \text{Bx}^{(0,1,0)}[0, 0, 0] \right) - \\ & \frac{1}{6} \epsilon^3 \left(-3 t y^2 \kappa \text{Bs}^{(0,0,1)}[0, 0, 0] + 3 t^2 y \text{Bx}^{(0,0,2)}[0, 0, 0] + \right. \\ & \quad \left. 3 t y^2 \text{Bx}^{(0,1,1)}[0, 0, 0] + y^3 \text{Bx}^{(0,2,0)}[0, 0, 0] - 3 x y^2 \kappa \text{Bs}^{(1,0,0)}[0, 0, 0] \right) - \\ & \frac{1}{24} \epsilon^4 \left(-6 t^2 y^2 \kappa \text{Bs}^{(0,0,2)}[0, 0, 0] + 4 t^3 y \text{Bx}^{(0,0,3)}[0, 0, 0] + 6 t^2 y^2 \text{Bx}^{(0,1,2)}[0, 0, 0] + 4 t y^3 \right. \\ & \quad \left. \text{Bx}^{(0,2,1)}[0, 0, 0] + y^4 \text{Bx}^{(0,3,0)}[0, 0, 0] - 12 t x y^2 \kappa \text{Bs}^{(1,0,1)}[0, 0, 0] - 6 x^2 y^2 \kappa \text{Bs}^{(2,0,0)}[0, 0, 0] \right) \end{aligned}$$

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In[12]:= A23 = Integrate[
  Integrate[D[Normal[Series[(1 + K*ε*x) * By[ε*x, ε*y, ε*t] + κ*ε*x*Bs[ε*x, ε*y, ε*t],
    {ε, 0, m - 1}]], Y], x], Y] / 2 -
  -Integrate[Integrate[D[Normal[Series[(1 + K*ε*x) * Bx[ε*x, ε*y, ε*t] -
    κ*ε*y*Bs[ε*x, ε*y, ε*t], {ε, 0, m - 1}]], x], x], Y] / 2
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$$\text{Out[12]} = \frac{1}{2} \left(\frac{1}{2} x^2 y \varepsilon^2 \kappa \text{Bs}^{(0,1,0)} [0, 0, 0] + x y \varepsilon \text{By}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} K x^2 y \varepsilon^2 \text{By}^{(0,1,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} t x^2 y \varepsilon^3 \kappa \text{Bs}^{(0,1,1)} [0, 0, 0] + t x y \varepsilon^2 \text{By}^{(0,1,1)} [0, 0, 0] + \frac{1}{2} K t x^2 y \varepsilon^3 \text{By}^{(0,1,1)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} t^2 x y \varepsilon^3 \text{By}^{(0,1,2)} [0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \kappa \text{Bs}^{(0,2,0)} [0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{By}^{(0,2,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{4} K x^2 y^2 \varepsilon^3 \text{By}^{(0,2,0)} [0, 0, 0] + \frac{1}{2} t x y^2 \varepsilon^3 \text{By}^{(0,2,1)} [0, 0, 0] + \frac{1}{6} x y^3 \varepsilon^3 \text{By}^{(0,3,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{3} x^3 y \varepsilon^3 \kappa \text{Bs}^{(1,1,0)} [0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{By}^{(1,1,0)} [0, 0, 0] + \frac{1}{3} K x^3 y \varepsilon^3 \text{By}^{(1,1,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} t x^2 y \varepsilon^3 \text{By}^{(1,1,1)} [0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{By}^{(1,2,0)} [0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{By}^{(2,1,0)} [0, 0, 0] \right) + \\ \frac{1}{2} \left(K x y \varepsilon \text{Bx} [0, 0, 0] + K t x y \varepsilon^2 \text{Bx}^{(0,0,1)} [0, 0, 0] + \frac{1}{2} K t^2 x y \varepsilon^3 \text{Bx}^{(0,0,2)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} K x y^2 \varepsilon^2 \text{Bx}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} K t x y^2 \varepsilon^3 \text{Bx}^{(0,1,1)} [0, 0, 0] + \frac{1}{6} K x y^3 \varepsilon^3 \text{Bx}^{(0,2,0)} [0, 0, 0] - \right. \\ \left. \frac{1}{2} x y^2 \varepsilon^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] + x y \varepsilon \text{Bx}^{(1,0,0)} [0, 0, 0] + K x^2 y \varepsilon^2 \text{Bx}^{(1,0,0)} [0, 0, 0] - \right. \\ \left. \frac{1}{2} t x y^2 \varepsilon^3 \kappa \text{Bs}^{(1,0,1)} [0, 0, 0] + t x y \varepsilon^2 \text{Bx}^{(1,0,1)} [0, 0, 0] + K t x^2 y \varepsilon^3 \text{Bx}^{(1,0,1)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} t^2 x y \varepsilon^3 \text{Bx}^{(1,0,2)} [0, 0, 0] - \frac{1}{3} x y^3 \varepsilon^3 \kappa \text{Bs}^{(1,1,0)} [0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{Bx}^{(1,1,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} K x^2 y^2 \varepsilon^3 \text{Bx}^{(1,1,0)} [0, 0, 0] + \frac{1}{2} t x y^2 \varepsilon^3 \text{Bx}^{(1,1,1)} [0, 0, 0] + \frac{1}{6} x y^3 \varepsilon^3 \text{Bx}^{(1,2,0)} [0, 0, 0] - \right. \\ \left. \frac{1}{4} x^2 y^2 \varepsilon^3 \kappa \text{Bs}^{(2,0,0)} [0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{Bx}^{(2,0,0)} [0, 0, 0] + \frac{1}{2} K x^3 y \varepsilon^3 \text{Bx}^{(2,0,0)} [0, 0, 0] + \right. \\ \left. \frac{1}{2} t x^2 y \varepsilon^3 \text{Bx}^{(2,0,1)} [0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{Bx}^{(2,1,0)} [0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{Bx}^{(3,0,0)} [0, 0, 0] \right)$$

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In[13]:= A2 = A21 + A22 + ε * A23
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$$\begin{aligned}
\text{Out[13]} = & -y \varepsilon \text{Bx}[0, 0, 0] + x \varepsilon \text{By}[0, 0, 0] - \\
& \varepsilon^2 \left(-\frac{1}{2} y^2 \varkappa \text{Bs}[0, 0, 0] + t y \text{Bx}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} y^2 \text{Bx}^{(0,1,0)}[0, 0, 0] \right) - \\
& \frac{1}{6} \varepsilon^3 \left(-3 t y^2 \varkappa \text{Bs}^{(0,0,1)}[0, 0, 0] + 3 t^2 y \text{Bx}^{(0,0,2)}[0, 0, 0] + \right. \\
& \quad \left. 3 t y^2 \text{Bx}^{(0,1,1)}[0, 0, 0] + y^3 \text{Bx}^{(0,2,0)}[0, 0, 0] - 3 x y^2 \varkappa \text{Bs}^{(1,0,0)}[0, 0, 0] \right) + \\
& \frac{1}{2} \varepsilon^2 \left(x^2 \varkappa \text{Bs}[0, 0, 0] + K x^2 \text{By}[0, 0, 0] + 2 t x \text{By}^{(0,0,1)}[0, 0, 0] + x^2 \text{By}^{(1,0,0)}[0, 0, 0] \right) - \\
& \frac{1}{24} \varepsilon^4 \left(-6 t^2 y^2 \varkappa \text{Bs}^{(0,0,2)}[0, 0, 0] + 4 t^3 y \text{Bx}^{(0,0,3)}[0, 0, 0] + 6 t^2 y^2 \text{Bx}^{(0,1,2)}[0, 0, 0] + 4 t y^3 \right. \\
& \quad \left. \text{Bx}^{(0,2,1)}[0, 0, 0] + y^4 \text{Bx}^{(0,3,0)}[0, 0, 0] - 12 t x y^2 \varkappa \text{Bs}^{(1,0,1)}[0, 0, 0] - 6 x^2 y^2 \varkappa \text{Bs}^{(2,0,0)}[0, 0, 0] \right) + \\
& \frac{1}{6} \varepsilon^3 \left(3 t x^2 \varkappa \text{Bs}^{(0,0,1)}[0, 0, 0] + 3 K t x^2 \text{By}^{(0,0,1)}[0, 0, 0] + 3 t^2 x \text{By}^{(0,0,2)}[0, 0, 0] + \right. \\
& \quad \left. 2 x^3 \varkappa \text{Bs}^{(1,0,0)}[0, 0, 0] + 2 K x^3 \text{By}^{(1,0,0)}[0, 0, 0] + 3 t x^2 \text{By}^{(1,0,1)}[0, 0, 0] + x^3 \text{By}^{(2,0,0)}[0, 0, 0] \right) + \\
& \varepsilon \left(\frac{1}{2} \left(\frac{1}{2} x^2 y \varepsilon^2 \varkappa \text{Bs}^{(0,1,0)}[0, 0, 0] + x y \varepsilon \text{By}^{(0,1,0)}[0, 0, 0] + \frac{1}{2} K x^2 y \varepsilon^2 \text{By}^{(0,1,0)}[0, 0, 0] + \right. \right. \\
& \quad \frac{1}{2} t x^2 y \varepsilon^3 \varkappa \text{Bs}^{(0,1,1)}[0, 0, 0] + t x y \varepsilon^2 \text{By}^{(0,1,1)}[0, 0, 0] + \frac{1}{2} K t x^2 y \varepsilon^3 \text{By}^{(0,1,1)}[0, 0, 0] + \\
& \quad \frac{1}{2} t^2 x y \varepsilon^3 \text{By}^{(0,1,2)}[0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \varkappa \text{Bs}^{(0,2,0)}[0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{By}^{(0,2,0)}[0, 0, 0] + \\
& \quad \frac{1}{4} K x^2 y^2 \varepsilon^3 \text{By}^{(0,2,0)}[0, 0, 0] + \frac{1}{2} t x y^2 \varepsilon^3 \text{By}^{(0,2,1)}[0, 0, 0] + \frac{1}{6} x y^3 \varepsilon^3 \text{By}^{(0,3,0)}[0, 0, 0] + \\
& \quad \frac{1}{3} x^3 y \varepsilon^3 \varkappa \text{Bs}^{(1,1,0)}[0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{By}^{(1,1,0)}[0, 0, 0] + \frac{1}{3} K x^3 y \varepsilon^3 \text{By}^{(1,1,0)}[0, 0, 0] + \\
& \quad \left. \left. \frac{1}{2} t x^2 y \varepsilon^3 \text{By}^{(1,1,1)}[0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{By}^{(1,2,0)}[0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{By}^{(2,1,0)}[0, 0, 0] \right) \right) + \\
& \frac{1}{2} \left(K x y \varepsilon \text{Bx}[0, 0, 0] + K t x y \varepsilon^2 \text{Bx}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} K t^2 x y \varepsilon^3 \text{Bx}^{(0,0,2)}[0, 0, 0] + \right. \\
& \quad \frac{1}{2} K x y^2 \varepsilon^2 \text{Bx}^{(0,1,0)}[0, 0, 0] + \frac{1}{2} K t x y^2 \varepsilon^3 \text{Bx}^{(0,1,1)}[0, 0, 0] + \frac{1}{6} K x y^3 \varepsilon^3 \text{Bx}^{(0,2,0)}[0, 0, 0] - \\
& \quad \frac{1}{2} x y^2 \varepsilon^2 \varkappa \text{Bs}^{(1,0,0)}[0, 0, 0] + x y \varepsilon \text{Bx}^{(1,0,0)}[0, 0, 0] + K x^2 y \varepsilon^2 \text{Bx}^{(1,0,0)}[0, 0, 0] - \\
& \quad \frac{1}{2} t x y^2 \varepsilon^3 \varkappa \text{Bs}^{(1,0,1)}[0, 0, 0] + t x y \varepsilon^2 \text{Bx}^{(1,0,1)}[0, 0, 0] + K t x^2 y \varepsilon^3 \text{Bx}^{(1,0,1)}[0, 0, 0] + \\
& \quad \frac{1}{2} t^2 x y \varepsilon^3 \text{Bx}^{(1,0,2)}[0, 0, 0] - \frac{1}{3} x y^3 \varepsilon^3 \varkappa \text{Bs}^{(1,1,0)}[0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{Bx}^{(1,1,0)}[0, 0, 0] + \\
& \quad \frac{1}{2} K x^2 y^2 \varepsilon^3 \text{Bx}^{(1,1,0)}[0, 0, 0] + \frac{1}{2} t x y^2 \varepsilon^3 \text{Bx}^{(1,1,1)}[0, 0, 0] + \frac{1}{6} x y^3 \varepsilon^3 \text{Bx}^{(1,2,0)}[0, 0, 0] - \\
& \quad \frac{1}{4} x^2 y^2 \varepsilon^3 \varkappa \text{Bs}^{(2,0,0)}[0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{Bx}^{(2,0,0)}[0, 0, 0] + \frac{1}{2} K x^3 y \varepsilon^3 \text{Bx}^{(2,0,0)}[0, 0, 0] + \\
& \quad \left. \left. \frac{1}{2} t x^2 y \varepsilon^3 \text{Bx}^{(2,0,1)}[0, 0, 0] + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{Bx}^{(2,1,0)}[0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{Bx}^{(3,0,0)}[0, 0, 0] \right) \right) + \\
& \frac{1}{24} \varepsilon^4 \left(6 t^2 x^2 \varkappa \text{Bs}^{(0,0,2)}[0, 0, 0] + 6 K t^2 x^2 \text{By}^{(0,0,2)}[0, 0, 0] + 4 t^3 x \text{By}^{(0,0,3)}[0, 0, 0] + \right. \\
& \quad 8 t x^3 \varkappa \text{Bs}^{(1,0,1)}[0, 0, 0] + 8 K t x^3 \text{By}^{(1,0,1)}[0, 0, 0] + 6 t^2 x^2 \text{By}^{(1,0,2)}[0, 0, 0] + \\
& \quad \left. 3 x^4 \varkappa \text{Bs}^{(2,0,0)}[0, 0, 0] + 3 K x^4 \text{By}^{(2,0,0)}[0, 0, 0] + 4 t x^3 \text{By}^{(2,0,1)}[0, 0, 0] + x^4 \text{By}^{(3,0,0)}[0, 0, 0] \right)
\end{aligned}$$

In[14]:= **Simplify[%]**Out[14]= $\frac{1}{24} \varepsilon$

$$\begin{aligned}
& (-Y (4 (6 Bx[0, 0, 0] + t \varepsilon (6 Bx^{(0,0,1)} [0, 0, 0] + t \varepsilon (3 Bx^{(0,0,2)} [0, 0, 0] + t \varepsilon Bx^{(0,0,3)} [0, 0, 0]))) - 6 \\
& \quad Y \varepsilon (\kappa (2 Bs[0, 0, 0] + t \varepsilon (2 Bs^{(0,0,1)} [0, 0, 0] + t \varepsilon Bs^{(0,0,2)} [0, 0, 0])) - \\
& \quad \quad 2 Bx^{(0,1,0)} [0, 0, 0] - t \varepsilon (2 Bx^{(0,1,1)} [0, 0, 0] + t \varepsilon Bx^{(0,1,2)} [0, 0, 0])) + \\
& \quad 4 Y^2 \varepsilon^2 (Bx^{(0,2,0)} [0, 0, 0] + t \varepsilon Bx^{(0,2,1)} [0, 0, 0]) + Y^3 \varepsilon^3 Bx^{(0,3,0)} [0, 0, 0]) + \\
& 2 x (12 By[0, 0, 0] + K Y \varepsilon (6 Bx[0, 0, 0] + \varepsilon (6 t Bx^{(0,0,1)} [0, 0, 0] + 3 t^2 \varepsilon Bx^{(0,0,2)} [0, 0, 0] + \\
& \quad 3 Y Bx^{(0,1,0)} [0, 0, 0] + 3 t Y \varepsilon Bx^{(0,1,1)} [0, 0, 0] + Y^2 \varepsilon Bx^{(0,2,0)} [0, 0, 0])) + \varepsilon (2 t^3 \varepsilon^2 \\
& \quad By^{(0,0,3)} [0, 0, 0] + 3 t^2 \varepsilon (2 By^{(0,0,2)} [0, 0, 0] + Y \varepsilon (By^{(0,1,2)} [0, 0, 0] + Bx^{(1,0,2)} [0, 0, 0]))) + \\
& 3 t (4 By^{(0,0,1)} [0, 0, 0] + Y \varepsilon (2 By^{(0,1,1)} [0, 0, 0] + 2 Bx^{(1,0,1)} [0, 0, 0] + Y \varepsilon (By^{(0,2,1)} [0, 0, 0] + \\
& \quad \kappa Bs^{(1,0,1)} [0, 0, 0] + Bx^{(1,1,1)} [0, 0, 0]))) + Y (6 By^{(0,1,0)} [0, 0, 0] + \\
& \quad 6 Bx^{(1,0,0)} [0, 0, 0] + 3 Y \varepsilon (By^{(0,2,0)} [0, 0, 0] + \kappa Bs^{(1,0,0)} [0, 0, 0] + Bx^{(1,1,0)} [0, 0, 0]) + \\
& \quad Y^2 \varepsilon^2 (By^{(0,3,0)} [0, 0, 0] - 2 \kappa Bs^{(1,1,0)} [0, 0, 0] + Bx^{(1,2,0)} [0, 0, 0])))) + \\
& 3 x^2 \varepsilon (4 By^{(1,0,0)} [0, 0, 0] + 4 t \varepsilon By^{(1,0,1)} [0, 0, 0] + 2 t^2 \varepsilon^2 By^{(1,0,2)} [0, 0, 0] + \\
& \quad K (4 By[0, 0, 0] + \varepsilon (2 t^2 \varepsilon By^{(0,0,2)} [0, 0, 0] + \\
& \quad \quad 2 t (2 By^{(0,0,1)} [0, 0, 0] + Y \varepsilon (By^{(0,1,1)} [0, 0, 0] + 2 Bx^{(1,0,1)} [0, 0, 0])) + Y (2 By^{(0,1,0)} [0, \\
& \quad \quad 0, 0] + 4 Bx^{(1,0,0)} [0, 0, 0] + Y \varepsilon (By^{(0,2,0)} [0, 0, 0] + 2 Bx^{(1,1,0)} [0, 0, 0]))) + \\
& \quad 2 Y \varepsilon By^{(1,1,0)} [0, 0, 0] + 2 t Y \varepsilon^2 By^{(1,1,1)} [0, 0, 0] + Y^2 \varepsilon^2 By^{(1,2,0)} [0, 0, 0] + \\
& \quad \kappa (4 Bs[0, 0, 0] + \varepsilon (2 t^2 \varepsilon Bs^{(0,0,2)} [0, 0, 0] + 2 t (2 Bs^{(0,0,1)} [0, 0, 0] + Y \varepsilon Bs^{(0,1,1)} [0, 0, 0]) + \\
& \quad \quad Y (2 Bs^{(0,1,0)} [0, 0, 0] + Y \varepsilon (Bs^{(0,2,0)} [0, 0, 0] + Bs^{(2,0,0)} [0, 0, 0])))) + \\
& \quad 2 Y \varepsilon Bx^{(2,0,0)} [0, 0, 0] + 2 t Y \varepsilon^2 Bx^{(2,0,1)} [0, 0, 0] + Y^2 \varepsilon^2 Bx^{(2,1,0)} [0, 0, 0]) + \\
& 2 x^3 \varepsilon^2 (2 \kappa (2 Bs^{(1,0,0)} [0, 0, 0] + 2 t \varepsilon Bs^{(1,0,1)} [0, 0, 0] + Y \varepsilon Bs^{(1,1,0)} [0, 0, 0]) + \\
& \quad K (4 By^{(1,0,0)} [0, 0, 0] + 4 t \varepsilon By^{(1,0,1)} [0, 0, 0] + 2 Y \varepsilon By^{(1,1,0)} [0, 0, 0] + 3 Y \varepsilon Bx^{(2,0,0)} [0, 0, 0]) + \\
& \quad 2 By^{(2,0,0)} [0, 0, 0] + 2 t \varepsilon By^{(2,0,1)} [0, 0, 0] + \\
& \quad Y \varepsilon By^{(2,1,0)} [0, 0, 0] + Y \varepsilon Bx^{(3,0,0)} [0, 0, 0]) + \\
& x^4 \varepsilon^3 (3 \kappa Bs^{(2,0,0)} [0, 0, 0] + 3 K By^{(2,0,0)} [0, 0, 0] + By^{(3,0,0)} [0, 0, 0]))
\end{aligned}$$

In[15]:= **Coefficient[A2, \varepsilon]**Out[15]= $-Y Bx[0, 0, 0] + x By[0, 0, 0]$

Electric field

In[16]:= **k = 4;**

$\phi 1 = -\text{Normal}[\text{Series}[\text{Integrate}[\varepsilon * \text{Ex}[\varepsilon * \mathbf{x}, \mathbf{0}, \varepsilon * \mathbf{t}], \mathbf{x}], \{\varepsilon, \mathbf{0}, \mathbf{k}\}] +$
 $-\text{Normal}[\text{Series}[\text{Integrate}[\varepsilon * \text{Ey}[\mathbf{0}, \varepsilon * \mathbf{y}, \varepsilon * \mathbf{t}], \mathbf{y}], \{\varepsilon, \mathbf{0}, \mathbf{k}\}]$

Out[17]=
$$-x \varepsilon \text{Ex}[0, 0, 0] - y \varepsilon \text{Ey}[0, 0, 0] - \varepsilon^2 \left(t y \text{Ey}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0, 0, 0] \right) -$$

$$\frac{1}{6} \varepsilon^3 \left(3 t^2 y \text{Ey}^{(0,0,2)}[0, 0, 0] + 3 t y^2 \text{Ey}^{(0,1,1)}[0, 0, 0] + y^3 \text{Ey}^{(0,2,0)}[0, 0, 0] \right) - \frac{1}{24} \varepsilon^4$$

$$\left(4 t^3 y \text{Ey}^{(0,0,3)}[0, 0, 0] + 6 t^2 y^2 \text{Ey}^{(0,1,2)}[0, 0, 0] + 4 t y^3 \text{Ey}^{(0,2,1)}[0, 0, 0] + y^4 \text{Ey}^{(0,3,0)}[0, 0, 0] \right) -$$

$$\varepsilon^2 \left(t x \text{Ex}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0, 0, 0] \right) -$$

$$\frac{1}{6} \varepsilon^3 \left(3 t^2 x \text{Ex}^{(0,0,2)}[0, 0, 0] + 3 t x^2 \text{Ex}^{(1,0,1)}[0, 0, 0] + x^3 \text{Ex}^{(2,0,0)}[0, 0, 0] \right) - \frac{1}{24} \varepsilon^4$$

$$\left(4 t^3 x \text{Ex}^{(0,0,3)}[0, 0, 0] + 6 t^2 x^2 \text{Ex}^{(1,0,2)}[0, 0, 0] + 4 t x^3 \text{Ex}^{(2,0,1)}[0, 0, 0] + x^4 \text{Ex}^{(3,0,0)}[0, 0, 0] \right)$$

In[18]:= **$\phi 2 = -\text{Integrate}[\text{Integrate}[\text{D}[\text{Normal}[\text{Series}[\text{Ex}[\varepsilon * \mathbf{x}, \varepsilon * \mathbf{y}, \varepsilon * \mathbf{t}], \{\varepsilon, \mathbf{0}, \mathbf{m} - 1\}]], \mathbf{y}], \mathbf{x}], \mathbf{y}] / 2 -$**
 $\text{Integrate}[\text{Integrate}[\text{D}[\text{Normal}[\text{Series}[\text{Ey}[\varepsilon * \mathbf{x}, \varepsilon * \mathbf{y}, \varepsilon * \mathbf{t}], \{\varepsilon, \mathbf{0}, \mathbf{m} - 1\}]], \mathbf{x}], \mathbf{x}], \mathbf{y}] / 2$

Out[18]=
$$\frac{1}{2} \left(-x y \varepsilon \text{Ex}^{(0,1,0)}[0, 0, 0] - t x y \varepsilon^2 \text{Ex}^{(0,1,1)}[0, 0, 0] -$$

$$\frac{1}{2} t^2 x y \varepsilon^3 \text{Ex}^{(0,1,2)}[0, 0, 0] - \frac{1}{2} x y^2 \varepsilon^2 \text{Ex}^{(0,2,0)}[0, 0, 0] - \frac{1}{2} t x y^2 \varepsilon^3 \text{Ex}^{(0,2,1)}[0, 0, 0] -$$

$$\frac{1}{6} x y^3 \varepsilon^3 \text{Ex}^{(0,3,0)}[0, 0, 0] - \frac{1}{2} x^2 y \varepsilon^2 \text{Ex}^{(1,1,0)}[0, 0, 0] - \frac{1}{2} t x^2 y \varepsilon^3 \text{Ex}^{(1,1,1)}[0, 0, 0] -$$

$$\frac{1}{4} x^2 y^2 \varepsilon^3 \text{Ex}^{(1,2,0)}[0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \text{Ex}^{(2,1,0)}[0, 0, 0] \right) +$$

$$\frac{1}{2} \left(-x y \varepsilon \text{Ey}^{(1,0,0)}[0, 0, 0] - t x y \varepsilon^2 \text{Ey}^{(1,0,1)}[0, 0, 0] - \frac{1}{2} t^2 x y \varepsilon^3 \text{Ey}^{(1,0,2)}[0, 0, 0] -$$

$$\frac{1}{2} x y^2 \varepsilon^2 \text{Ey}^{(1,1,0)}[0, 0, 0] - \frac{1}{2} t x y^2 \varepsilon^3 \text{Ey}^{(1,1,1)}[0, 0, 0] -$$

$$\frac{1}{6} x y^3 \varepsilon^3 \text{Ey}^{(1,2,0)}[0, 0, 0] - \frac{1}{2} x^2 y \varepsilon^2 \text{Ey}^{(2,0,0)}[0, 0, 0] - \frac{1}{2} t x^2 y \varepsilon^3 \text{Ey}^{(2,0,1)}[0, 0, 0] -$$

$$\frac{1}{4} x^2 y^2 \varepsilon^3 \text{Ey}^{(2,1,0)}[0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \text{Ey}^{(3,0,0)}[0, 0, 0] \right)$$

In[19]:= $\varphi t = \varphi 1 + \varepsilon * \varphi 2$

$$\begin{aligned} \text{Out[19]} = & -x \varepsilon \text{Ex}[0, 0, 0] - y \varepsilon \text{Ey}[0, 0, 0] - \varepsilon^2 \left(t y \text{Ey}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0, 0, 0] \right) - \\ & \frac{1}{6} \varepsilon^3 \left(3 t^2 y \text{Ey}^{(0,0,2)}[0, 0, 0] + 3 t y^2 \text{Ey}^{(0,1,1)}[0, 0, 0] + y^3 \text{Ey}^{(0,2,0)}[0, 0, 0] \right) - \frac{1}{24} \varepsilon^4 \\ & \left(4 t^3 y \text{Ey}^{(0,0,3)}[0, 0, 0] + 6 t^2 y^2 \text{Ey}^{(0,1,2)}[0, 0, 0] + 4 t y^3 \text{Ey}^{(0,2,1)}[0, 0, 0] + y^4 \text{Ey}^{(0,3,0)}[0, 0, 0] \right) - \\ & \varepsilon^2 \left(t x \text{Ex}^{(0,0,1)}[0, 0, 0] + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0, 0, 0] \right) - \\ & \frac{1}{6} \varepsilon^3 \left(3 t^2 x \text{Ex}^{(0,0,2)}[0, 0, 0] + 3 t x^2 \text{Ex}^{(1,0,1)}[0, 0, 0] + x^3 \text{Ex}^{(2,0,0)}[0, 0, 0] \right) - \frac{1}{24} \varepsilon^4 \\ & \left(4 t^3 x \text{Ex}^{(0,0,3)}[0, 0, 0] + 6 t^2 x^2 \text{Ex}^{(1,0,2)}[0, 0, 0] + 4 t x^3 \text{Ex}^{(2,0,1)}[0, 0, 0] + x^4 \text{Ex}^{(3,0,0)}[0, 0, 0] \right) + \\ & \varepsilon \left(\frac{1}{2} \left(-x y \varepsilon \text{Ex}^{(0,1,0)}[0, 0, 0] - t x y \varepsilon^2 \text{Ex}^{(0,1,1)}[0, 0, 0] - \frac{1}{2} t^2 x y \varepsilon^3 \text{Ex}^{(0,1,2)}[0, 0, 0] - \right. \right. \\ & \quad \frac{1}{2} x y^2 \varepsilon^2 \text{Ex}^{(0,2,0)}[0, 0, 0] - \frac{1}{2} t x y^2 \varepsilon^3 \text{Ex}^{(0,2,1)}[0, 0, 0] - \frac{1}{6} x y^3 \varepsilon^3 \text{Ex}^{(0,3,0)}[0, 0, 0] - \\ & \quad \frac{1}{2} x^2 y \varepsilon^2 \text{Ex}^{(1,1,0)}[0, 0, 0] - \frac{1}{2} t x^2 y \varepsilon^3 \text{Ex}^{(1,1,1)}[0, 0, 0] - \frac{1}{4} x^2 y^2 \varepsilon^3 \text{Ex}^{(1,2,0)}[0, 0, 0] - \\ & \quad \left. \frac{1}{6} x^3 y \varepsilon^3 \text{Ex}^{(2,1,0)}[0, 0, 0] \right) + \frac{1}{2} \left(-x y \varepsilon \text{Ey}^{(1,0,0)}[0, 0, 0] - \right. \\ & \quad t x y \varepsilon^2 \text{Ey}^{(1,0,1)}[0, 0, 0] - \frac{1}{2} t^2 x y \varepsilon^3 \text{Ey}^{(1,0,2)}[0, 0, 0] - \frac{1}{2} x y^2 \varepsilon^2 \text{Ey}^{(1,1,0)}[0, 0, 0] - \\ & \quad \frac{1}{2} t x y^2 \varepsilon^3 \text{Ey}^{(1,1,1)}[0, 0, 0] - \frac{1}{6} x y^3 \varepsilon^3 \text{Ey}^{(1,2,0)}[0, 0, 0] - \frac{1}{2} x^2 y \varepsilon^2 \text{Ey}^{(2,0,0)}[0, 0, 0] - \\ & \quad \left. \left. \frac{1}{2} t x^2 y \varepsilon^3 \text{Ey}^{(2,0,1)}[0, 0, 0] - \frac{1}{4} x^2 y^2 \varepsilon^3 \text{Ey}^{(2,1,0)}[0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \text{Ey}^{(3,0,0)}[0, 0, 0] \right) \right) \end{aligned}$$

In[20]:= $\varphi 1 = \text{Normal}[\text{Series}[\text{Integrate}[\varepsilon * (\text{Es}[0, 0, \varepsilon * t] - \text{Es}[0, 0, 0]), t], \{\varepsilon, 0, k\}]]$

$$\text{Out[20]} = \frac{1}{2} t^2 \varepsilon^2 \text{Es}^{(0,0,1)}[0, 0, 0] + \frac{1}{6} t^3 \varepsilon^3 \text{Es}^{(0,0,2)}[0, 0, 0] + \frac{1}{24} t^4 \varepsilon^4 \text{Es}^{(0,0,3)}[0, 0, 0]$$

In[21]:= $t = -\tau / c$

$$\text{Out[21]} = -\frac{\tau}{c}$$

Hamiltonian

$$\begin{aligned} \text{In[22]} = & \mathbf{H} = - (1 + \mathbf{K} * \varepsilon * \mathbf{x}) * \mathbf{p0} * \\ & \text{Sqrt}[1 + 2 * (\varepsilon * \delta - e * \varphi t / c) / \mathbf{p0} / \beta 0 + (\varepsilon * \delta - e * \varphi t / c) ^ 2 / \mathbf{p0} ^ 2 - (\varepsilon * \mathbf{P1} - e * \mathbf{A1} / c) ^ 2 / \mathbf{p0} ^ 2 - \\ & (\varepsilon * \mathbf{P3} - e * \mathbf{A3} / c) ^ 2 / \mathbf{p0} ^ 2] - e * \mathbf{A2} / c + \kappa * \varepsilon * \mathbf{x} * (\varepsilon * \mathbf{P3} - e * \mathbf{A3} / c) - \\ & \kappa * \varepsilon * \mathbf{y} * (\varepsilon * \mathbf{P1} - e * \mathbf{A1} / c) + \varepsilon * \delta / \beta 0 - e * \varphi 1 \end{aligned}$$

$$\begin{aligned}
\text{Out[22]} = & \frac{\delta \varepsilon}{\beta 0} - e \left(\frac{\varepsilon^2 \tau^2 \text{Es}^{(0,0,1)} [0, 0, 0]}{2 c^2} - \frac{\varepsilon^3 \tau^3 \text{Es}^{(0,0,2)} [0, 0, 0]}{6 c^3} + \frac{\varepsilon^4 \tau^4 \text{Es}^{(0,0,3)} [0, 0, 0]}{24 c^4} \right) + x \varepsilon \kappa \left(\text{P3} \varepsilon - \frac{1}{2 c} \right. \\
& e \left(-x \varepsilon \text{Bs} [0, 0, 0] - \varepsilon^2 \left(-\frac{x \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{c} + x y \text{Bs}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} x^2 \text{Bs}^{(1,0,0)} [0, 0, 0] \right) - \right. \\
& \frac{1}{6} \varepsilon^3 \left(\frac{3 x \tau^2 \text{Bs}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{6 x y \tau \text{Bs}^{(0,1,1)} [0, 0, 0]}{c} + 3 x y^2 \text{Bs}^{(0,2,0)} [0, 0, 0] - \right. \\
& \left. \left. \frac{3 x^2 \tau \text{Bs}^{(1,0,1)} [0, 0, 0]}{c} + 3 x^2 y \text{Bs}^{(1,1,0)} [0, 0, 0] + x^3 \text{Bs}^{(2,0,0)} [0, 0, 0] \right) - \right. \\
& \frac{1}{24} \varepsilon^4 \left(-\frac{4 x \tau^3 \text{Bs}^{(0,0,3)} [0, 0, 0]}{c^3} + \frac{12 x y \tau^2 \text{Bs}^{(0,1,2)} [0, 0, 0]}{c^2} - \frac{12 x y^2 \tau \text{Bs}^{(0,2,1)} [0, 0, 0]}{c} + \right. \\
& 4 x y^3 \text{Bs}^{(0,3,0)} [0, 0, 0] + \frac{6 x^2 \tau^2 \text{Bs}^{(1,0,2)} [0, 0, 0]}{c^2} - \\
& \frac{12 x^2 y \tau \text{Bs}^{(1,1,1)} [0, 0, 0]}{c} + 6 x^2 y^2 \text{Bs}^{(1,2,0)} [0, 0, 0] - \frac{4 x^3 \tau \text{Bs}^{(2,0,1)} [0, 0, 0]}{c} + \\
& \left. \left. \left. 4 x^3 y \text{Bs}^{(2,1,0)} [0, 0, 0] + x^4 \text{Bs}^{(3,0,0)} [0, 0, 0] \right) \right) \right) - y \varepsilon \kappa \left(\text{P1} \varepsilon - \frac{1}{2 c} \right. \\
& e \left(y \varepsilon \text{Bs} [0, 0, 0] + \varepsilon^2 \left(-\frac{y \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{c} + \frac{1}{2} y^2 \text{Bs}^{(0,1,0)} [0, 0, 0] + x y \text{Bs}^{(1,0,0)} [0, 0, 0] \right) + \right. \\
& \frac{1}{6} \varepsilon^3 \left(\frac{3 y \tau^2 \text{Bs}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{3 y^2 \tau \text{Bs}^{(0,1,1)} [0, 0, 0]}{c} + y^3 \text{Bs}^{(0,2,0)} [0, 0, 0] - \right. \\
& \left. \left. \frac{6 x y \tau \text{Bs}^{(1,0,1)} [0, 0, 0]}{c} + 3 x y^2 \text{Bs}^{(1,1,0)} [0, 0, 0] + 3 x^2 y \text{Bs}^{(2,0,0)} [0, 0, 0] \right) + \right. \\
& \frac{1}{24} \varepsilon^4 \left(-\frac{4 y \tau^3 \text{Bs}^{(0,0,3)} [0, 0, 0]}{c^3} + \frac{6 y^2 \tau^2 \text{Bs}^{(0,1,2)} [0, 0, 0]}{c^2} - \frac{4 y^3 \tau \text{Bs}^{(0,2,1)} [0, 0, 0]}{c} + \right. \\
& y^4 \text{Bs}^{(0,3,0)} [0, 0, 0] + \frac{12 x y \tau^2 \text{Bs}^{(1,0,2)} [0, 0, 0]}{c^2} - \frac{12 x y^2 \tau \text{Bs}^{(1,1,1)} [0, 0, 0]}{c} + \\
& 4 x y^3 \text{Bs}^{(1,2,0)} [0, 0, 0] - \frac{12 x^2 y \tau \text{Bs}^{(2,0,1)} [0, 0, 0]}{c} + \\
& \left. \left. \left. 6 x^2 y^2 \text{Bs}^{(2,1,0)} [0, 0, 0] + 4 x^3 y \text{Bs}^{(3,0,0)} [0, 0, 0] \right) \right) \right) - \frac{1}{c} \\
& e \left(-y \varepsilon \text{Bx} [0, 0, 0] + x \varepsilon \text{By} [0, 0, 0] - \varepsilon^2 \left(-\frac{1}{2} y^2 \kappa \text{Bs} [0, 0, 0] - \frac{y \tau \text{Bx}^{(0,0,1)} [0, 0, 0]}{c} + \right. \right. \\
& \left. \left. \frac{1}{2} y^2 \text{Bx}^{(0,1,0)} [0, 0, 0] \right) - \right. \\
& \frac{1}{6} \varepsilon^3 \left(\frac{3 y^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{c} + \frac{3 y \tau^2 \text{Bx}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{3 y^2 \tau \text{Bx}^{(0,1,1)} [0, 0, 0]}{c} + \right. \\
& \left. y^3 \text{Bx}^{(0,2,0)} [0, 0, 0] - 3 x y^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] \right) + \\
& \frac{1}{2} \varepsilon^2 \left(x^2 \kappa \text{Bs} [0, 0, 0] + \kappa x^2 \text{By} [0, 0, 0] - \frac{2 x \tau \text{By}^{(0,0,1)} [0, 0, 0]}{c} + x^2 \text{By}^{(1,0,0)} [0, 0, 0] \right) - \\
& \frac{1}{24} \varepsilon^4 \left(-\frac{6 y^2 \kappa \tau^2 \text{Bs}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{4 y \tau^3 \text{Bx}^{(0,0,3)} [0, 0, 0]}{c^3} + \right.
\end{aligned}$$

$$\begin{aligned}
& \frac{6 y^2 \tau^2 \text{Bx}^{(0,1,2)} [0, 0, 0]}{c^2} - \frac{4 y^3 \tau \text{Bx}^{(0,2,1)} [0, 0, 0]}{c} + y^4 \text{Bx}^{(0,3,0)} [0, 0, 0] + \\
& \left. \frac{12 x y^2 \tau \kappa \text{Bs}^{(1,0,1)} [0, 0, 0]}{c} - 6 x^2 y^2 \kappa \text{Bs}^{(2,0,0)} [0, 0, 0] \right) + \\
& \frac{1}{6} \varepsilon^3 \left(-\frac{3 x^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{c} - \frac{3 K x^2 \tau \text{By}^{(0,0,1)} [0, 0, 0]}{c} + \frac{3 x \tau^2 \text{By}^{(0,0,2)} [0, 0, 0]}{c^2} + 2 x^3 \right. \\
& \left. \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] + 2 K x^3 \text{By}^{(1,0,0)} [0, 0, 0] - \frac{3 x^2 \tau \text{By}^{(1,0,1)} [0, 0, 0]}{c} + x^3 \text{By}^{(2,0,0)} [0, 0, 0] \right) + \\
& \varepsilon \left(\frac{1}{2} \left(\frac{1}{2} x^2 y \varepsilon^2 \kappa \text{Bs}^{(0,1,0)} [0, 0, 0] + x y \varepsilon \text{By}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} K x^2 y \varepsilon^2 \text{By}^{(0,1,0)} [0, 0, 0] - \right. \right. \\
& \left. \frac{x^2 y \varepsilon^3 \kappa \tau \text{Bs}^{(0,1,1)} [0, 0, 0]}{2 c} - \frac{x y \varepsilon^2 \tau \text{By}^{(0,1,1)} [0, 0, 0]}{c} - \frac{K x^2 y \varepsilon^3 \tau \text{By}^{(0,1,1)} [0, 0, 0]}{2 c} + \right. \\
& \left. \frac{x y \varepsilon^3 \tau^2 \text{By}^{(0,1,2)} [0, 0, 0]}{2 c^2} + \frac{1}{4} x^2 y^2 \varepsilon^3 \kappa \text{Bs}^{(0,2,0)} [0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{By}^{(0,2,0)} [0, 0, 0] + \right. \\
& \left. \frac{1}{4} K x^2 y^2 \varepsilon^3 \text{By}^{(0,2,0)} [0, 0, 0] - \frac{x y^2 \varepsilon^3 \tau \text{By}^{(0,2,1)} [0, 0, 0]}{2 c} + \frac{1}{6} x y^3 \varepsilon^3 \text{By}^{(0,3,0)} [0, 0, 0] + \right. \\
& \left. \frac{1}{3} x^3 y \varepsilon^3 \kappa \text{Bs}^{(1,1,0)} [0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{By}^{(1,1,0)} [0, 0, 0] + \frac{1}{3} K x^3 y \varepsilon^3 \text{By}^{(1,1,0)} [0, 0, 0] - \right. \\
& \left. \frac{x^2 y \varepsilon^3 \tau \text{By}^{(1,1,1)} [0, 0, 0]}{2 c} + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{By}^{(1,2,0)} [0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{By}^{(2,1,0)} [0, 0, 0] \right) + \\
& \frac{1}{2} \left(K x y \varepsilon \text{Bx} [0, 0, 0] - \frac{K x y \varepsilon^2 \tau \text{Bx}^{(0,0,1)} [0, 0, 0]}{c} + \frac{K x y \varepsilon^3 \tau^2 \text{Bx}^{(0,0,2)} [0, 0, 0]}{2 c^2} + \right. \\
& \left. \frac{1}{2} K x y^2 \varepsilon^2 \text{Bx}^{(0,1,0)} [0, 0, 0] - \frac{K x y^2 \varepsilon^3 \tau \text{Bx}^{(0,1,1)} [0, 0, 0]}{2 c} + \frac{1}{6} K x y^3 \varepsilon^3 \text{Bx}^{(0,2,0)} [0, 0, 0] - \right. \\
& \left. \frac{1}{2} x y^2 \varepsilon^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] + x y \varepsilon \text{Bx}^{(1,0,0)} [0, 0, 0] + K x^2 y \varepsilon^2 \text{Bx}^{(1,0,0)} [0, 0, 0] + \right. \\
& \left. \frac{x y^2 \varepsilon^3 \kappa \tau \text{Bs}^{(1,0,1)} [0, 0, 0]}{2 c} - \frac{x y \varepsilon^2 \tau \text{Bx}^{(1,0,1)} [0, 0, 0]}{c} - \frac{K x^2 y \varepsilon^3 \tau \text{Bx}^{(1,0,1)} [0, 0, 0]}{c} + \right. \\
& \left. \frac{x y \varepsilon^3 \tau^2 \text{Bx}^{(1,0,2)} [0, 0, 0]}{2 c^2} - \frac{1}{3} x y^3 \varepsilon^3 \kappa \text{Bs}^{(1,1,0)} [0, 0, 0] + \frac{1}{2} x y^2 \varepsilon^2 \text{Bx}^{(1,1,0)} [0, 0, 0] + \right. \\
& \left. \frac{1}{2} K x^2 y^2 \varepsilon^3 \text{Bx}^{(1,1,0)} [0, 0, 0] - \frac{x y^2 \varepsilon^3 \tau \text{Bx}^{(1,1,1)} [0, 0, 0]}{2 c} + \frac{1}{6} x y^3 \varepsilon^3 \text{Bx}^{(1,2,0)} [0, 0, 0] - \right. \\
& \left. \frac{1}{4} x^2 y^2 \varepsilon^3 \kappa \text{Bs}^{(2,0,0)} [0, 0, 0] + \frac{1}{2} x^2 y \varepsilon^2 \text{Bx}^{(2,0,0)} [0, 0, 0] + \frac{1}{2} K x^3 y \varepsilon^3 \text{Bx}^{(2,0,0)} [0, 0, 0] - \right. \\
& \left. \frac{x^2 y \varepsilon^3 \tau \text{Bx}^{(2,0,1)} [0, 0, 0]}{2 c} + \frac{1}{4} x^2 y^2 \varepsilon^3 \text{Bx}^{(2,1,0)} [0, 0, 0] + \frac{1}{6} x^3 y \varepsilon^3 \text{Bx}^{(3,0,0)} [0, 0, 0] \right) \Bigg) + \\
& \frac{1}{24} \varepsilon^4 \left(\frac{6 x^2 \kappa \tau^2 \text{Bs}^{(0,0,2)} [0, 0, 0]}{c^2} + \frac{6 K x^2 \tau^2 \text{By}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{4 x \tau^3 \text{By}^{(0,0,3)} [0, 0, 0]}{c^3} - \right. \\
& \left. \frac{8 x^3 \kappa \tau \text{Bs}^{(1,0,1)} [0, 0, 0]}{c} - \frac{8 K x^3 \tau \text{By}^{(1,0,1)} [0, 0, 0]}{c} + \right. \\
& \left. \frac{6 x^2 \tau^2 \text{By}^{(1,0,2)} [0, 0, 0]}{c^2} + 3 x^4 \kappa \text{Bs}^{(2,0,0)} [0, 0, 0] + \right. \\
& \left. 3 K x^4 \text{By}^{(2,0,0)} [0, 0, 0] - \frac{4 x^3 \tau \text{By}^{(2,0,1)} [0, 0, 0]}{c} + x^4 \text{By}^{(3,0,0)} [0, 0, 0] \right) \Bigg) +
\end{aligned}$$

$$\begin{aligned}
& p_0 (-1 - K x \varepsilon) \sqrt{\left(1 - \frac{1}{p_0^2} \left(P_3 \varepsilon - \frac{1}{2c} e \left(-x \varepsilon \text{Bs}[0, 0, 0] - \varepsilon^2 \left(-\frac{x \tau \text{Bs}^{(0,0,1)}[0, 0, 0]}{c} + x y \right. \right. \right. \right. \\
& \quad \left. \left. \left. \text{Bs}^{(0,1,0)}[0, 0, 0] + \frac{1}{2} x^2 \text{Bs}^{(1,0,0)}[0, 0, 0] \right) - \frac{1}{6} \varepsilon^3 \left(\frac{3 x \tau^2 \text{Bs}^{(0,0,2)}[0, 0, 0]}{c^2} - \right. \right. \right. \\
& \quad \left. \left. \frac{6 x y \tau \text{Bs}^{(0,1,1)}[0, 0, 0]}{c} + 3 x y^2 \text{Bs}^{(0,2,0)}[0, 0, 0] - \frac{3 x^2 \tau \text{Bs}^{(1,0,1)}[0, 0, 0]}{c} + 3 \right. \right. \\
& \quad \left. \left. x^2 y \text{Bs}^{(1,1,0)}[0, 0, 0] + x^3 \text{Bs}^{(2,0,0)}[0, 0, 0] \right) - \frac{1}{24} \varepsilon^4 \left(-\frac{4 x \tau^3 \text{Bs}^{(0,0,3)}[0, 0, 0]}{c^3} + \right. \right. \\
& \quad \left. \left. \frac{12 x y \tau^2 \text{Bs}^{(0,1,2)}[0, 0, 0]}{c^2} - \frac{12 x y^2 \tau \text{Bs}^{(0,2,1)}[0, 0, 0]}{c} + 4 x y^3 \text{Bs}^{(0,3,0)}[0, 0, 0] + \right. \right. \\
& \quad \left. \left. \frac{6 x^2 \tau^2 \text{Bs}^{(1,0,2)}[0, 0, 0]}{c^2} - \frac{12 x^2 y \tau \text{Bs}^{(1,1,1)}[0, 0, 0]}{c} + 6 x^2 y^2 \text{Bs}^{(1,2,0)}[0, 0, 0] - \right. \right. \\
& \quad \left. \left. \frac{4 x^3 \tau \text{Bs}^{(2,0,1)}[0, 0, 0]}{c} + 4 x^3 y \text{Bs}^{(2,1,0)}[0, 0, 0] + x^4 \text{Bs}^{(3,0,0)}[0, 0, 0] \right) \right) \right)^2 - \frac{1}{p_0^2} \\
& \left(P_1 \varepsilon - \frac{1}{2c} e \left(y \varepsilon \text{Bs}[0, 0, 0] + \varepsilon^2 \left(-\frac{y \tau \text{Bs}^{(0,0,1)}[0, 0, 0]}{c} + \frac{1}{2} y^2 \text{Bs}^{(0,1,0)}[0, 0, 0] + x y \text{Bs}^{(1,0,0)}[0, \right. \right. \right. \\
& \quad \left. \left. \left. 0, 0, 0] \right) + \frac{1}{6} \varepsilon^3 \left(\frac{3 y \tau^2 \text{Bs}^{(0,0,2)}[0, 0, 0]}{c^2} - \frac{3 y^2 \tau \text{Bs}^{(0,1,1)}[0, 0, 0]}{c} + y^3 \text{Bs}^{(0,2,0)}[0, \right. \right. \right. \\
& \quad \left. \left. \left. 0, 0, 0] - \frac{6 x y \tau \text{Bs}^{(1,0,1)}[0, 0, 0]}{c} + 3 x y^2 \text{Bs}^{(1,1,0)}[0, 0, 0] + 3 x^2 y \text{Bs}^{(2,0,0)}[0, 0, 0] \right) \right) + \right. \\
& \quad \left. \frac{1}{24} \varepsilon^4 \left(-\frac{4 y \tau^3 \text{Bs}^{(0,0,3)}[0, 0, 0]}{c^3} + \frac{6 y^2 \tau^2 \text{Bs}^{(0,1,2)}[0, 0, 0]}{c^2} - \frac{4 y^3 \tau \text{Bs}^{(0,2,1)}[0, 0, 0]}{c} + \right. \right. \\
& \quad \left. \left. y^4 \text{Bs}^{(0,3,0)}[0, 0, 0] + \frac{12 x y \tau^2 \text{Bs}^{(1,0,2)}[0, 0, 0]}{c^2} - \frac{12 x y^2 \tau \text{Bs}^{(1,1,1)}[0, 0, 0]}{c} + 4 \right. \right. \\
& \quad \left. \left. x y^3 \text{Bs}^{(1,2,0)}[0, 0, 0] - \frac{12 x^2 y \tau \text{Bs}^{(2,0,1)}[0, 0, 0]}{c} + 6 x^2 y^2 \right. \right. \\
& \quad \left. \left. \text{Bs}^{(2,1,0)}[0, 0, 0] + 4 x^3 y \text{Bs}^{(3,0,0)}[0, 0, 0] \right) \right) \right)^2 + \frac{1}{p_0 \beta_0} 2 \left(\delta \varepsilon - \frac{1}{c} \right. \\
& \left. e \left(-x \varepsilon \text{Ex}[0, 0, 0] - y \varepsilon \text{Ey}[0, 0, 0] - \varepsilon^2 \left(-\frac{y \tau \text{Ey}^{(0,0,1)}[0, 0, 0]}{c} + \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0, 0, 0] \right) - \right. \right. \\
& \quad \left. \frac{1}{6} \varepsilon^3 \left(\frac{3 y \tau^2 \text{Ey}^{(0,0,2)}[0, 0, 0]}{c^2} - \frac{3 y^2 \tau \text{Ey}^{(0,1,1)}[0, 0, 0]}{c} + y^3 \text{Ey}^{(0,2,0)}[0, 0, 0] \right) - \right. \\
& \quad \left. \frac{1}{24} \varepsilon^4 \left(-\frac{4 y \tau^3 \text{Ey}^{(0,0,3)}[0, 0, 0]}{c^3} + \frac{6 y^2 \tau^2 \text{Ey}^{(0,1,2)}[0, 0, 0]}{c^2} - \frac{4 y^3 \tau \text{Ey}^{(0,2,1)}[0, 0, 0]}{c} + \right. \right. \\
& \quad \left. \left. y^4 \text{Ey}^{(0,3,0)}[0, 0, 0] \right) - \varepsilon^2 \left(-\frac{x \tau \text{Ex}^{(0,0,1)}[0, 0, 0]}{c} + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0, 0, 0] \right) - \right. \\
& \quad \left. \frac{1}{6} \varepsilon^3 \left(\frac{3 x \tau^2 \text{Ex}^{(0,0,2)}[0, 0, 0]}{c^2} - \frac{3 x^2 \tau \text{Ex}^{(1,0,1)}[0, 0, 0]}{c} + x^3 \text{Ex}^{(2,0,0)}[0, 0, 0] \right) - \right. \\
& \quad \left. \frac{1}{24} \varepsilon^4 \left(-\frac{4 x \tau^3 \text{Ex}^{(0,0,3)}[0, 0, 0]}{c^3} + \frac{6 x^2 \tau^2 \text{Ex}^{(1,0,2)}[0, 0, 0]}{c^2} - \right. \right. \\
& \quad \left. \left. \frac{4 x^3 \tau \text{Ex}^{(2,0,1)}[0, 0, 0]}{c} + x^4 \text{Ex}^{(3,0,0)}[0, 0, 0] \right) + \right.
\end{aligned}$$

$$\begin{aligned}
& \varepsilon \left(\frac{1}{2} \left(-x y \varepsilon \operatorname{Ex}^{(0,1,0)} [0, 0, 0] + \frac{x y \varepsilon^2 \tau \operatorname{Ex}^{(0,1,1)} [0, 0, 0]}{c} - \frac{x y \varepsilon^3 \tau^2 \operatorname{Ex}^{(0,1,2)} [0, 0, 0]}{2 c^2} - \right. \right. \\
& \quad \frac{1}{2} x y^2 \varepsilon^2 \operatorname{Ex}^{(0,2,0)} [0, 0, 0] + \frac{x y^2 \varepsilon^3 \tau \operatorname{Ex}^{(0,2,1)} [0, 0, 0]}{2 c} - \frac{1}{6} x y^3 \varepsilon^3 \operatorname{Ex}^{(0,3,0)} [0, 0, 0] - \\
& \quad \frac{1}{2} x^2 y \varepsilon^2 \operatorname{Ex}^{(1,1,0)} [0, 0, 0] + \frac{x^2 y \varepsilon^3 \tau \operatorname{Ex}^{(1,1,1)} [0, 0, 0]}{2 c} - \frac{1}{4} x^2 y^2 \varepsilon^3 \operatorname{Ex}^{(1,2,0)} [0, 0, 0] - \\
& \quad \left. \frac{1}{6} x^3 y \varepsilon^3 \operatorname{Ex}^{(2,1,0)} [0, 0, 0] \right) + \frac{1}{2} \left(-x y \varepsilon \operatorname{Ey}^{(1,0,0)} [0, 0, 0] + \frac{x y \varepsilon^2 \tau \operatorname{Ey}^{(1,0,1)} [0, 0, 0]}{c} - \right. \\
& \quad \frac{x y \varepsilon^3 \tau^2 \operatorname{Ey}^{(1,0,2)} [0, 0, 0]}{2 c^2} - \frac{1}{2} x y^2 \varepsilon^2 \operatorname{Ey}^{(1,1,0)} [0, 0, 0] + \frac{x y^2 \varepsilon^3 \tau \operatorname{Ey}^{(1,1,1)} [0, 0, 0]}{2 c} - \\
& \quad \frac{1}{6} x y^3 \varepsilon^3 \operatorname{Ey}^{(1,2,0)} [0, 0, 0] - \frac{1}{2} x^2 y \varepsilon^2 \operatorname{Ey}^{(2,0,0)} [0, 0, 0] + \frac{x^2 y \varepsilon^3 \tau \operatorname{Ey}^{(2,0,1)} [0, 0, 0]}{2 c} - \\
& \quad \left. \left. \left. \frac{1}{4} x^2 y^2 \varepsilon^3 \operatorname{Ey}^{(2,1,0)} [0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \operatorname{Ey}^{(3,0,0)} [0, 0, 0] \right) \right) \right) + \frac{1}{p_0^2} \\
& \left(\delta \varepsilon - \frac{1}{c} e \left(-x \varepsilon \operatorname{Ex} [0, 0, 0] - y \varepsilon \operatorname{Ey} [0, 0, 0] - \varepsilon^2 \left(-\frac{y \tau \operatorname{Ey}^{(0,0,1)} [0, 0, 0]}{c} + \frac{1}{2} y^2 \operatorname{Ey}^{(0,1,0)} [0, 0, 0] \right) - \right. \right. \\
& \quad \frac{1}{6} \varepsilon^3 \left(\frac{3 y \tau^2 \operatorname{Ey}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{3 y^2 \tau \operatorname{Ey}^{(0,1,1)} [0, 0, 0]}{c} + y^3 \operatorname{Ey}^{(0,2,0)} [0, 0, 0] \right) - \\
& \quad \frac{1}{24} \varepsilon^4 \left(-\frac{4 y \tau^3 \operatorname{Ey}^{(0,0,3)} [0, 0, 0]}{c^3} + \frac{6 y^2 \tau^2 \operatorname{Ey}^{(0,1,2)} [0, 0, 0]}{c^2} - \frac{4 y^3 \tau \operatorname{Ey}^{(0,2,1)} [0, 0, 0]}{c} + y^4 \right. \\
& \quad \left. \operatorname{Ey}^{(0,3,0)} [0, 0, 0] \right) - \varepsilon^2 \left(-\frac{x \tau \operatorname{Ex}^{(0,0,1)} [0, 0, 0]}{c} + \frac{1}{2} x^2 \operatorname{Ex}^{(1,0,0)} [0, 0, 0] \right) - \\
& \quad \frac{1}{6} \varepsilon^3 \left(\frac{3 x \tau^2 \operatorname{Ex}^{(0,0,2)} [0, 0, 0]}{c^2} - \frac{3 x^2 \tau \operatorname{Ex}^{(1,0,1)} [0, 0, 0]}{c} + x^3 \operatorname{Ex}^{(2,0,0)} [0, 0, 0] \right) - \\
& \quad \frac{1}{24} \varepsilon^4 \left(-\frac{4 x \tau^3 \operatorname{Ex}^{(0,0,3)} [0, 0, 0]}{c^3} + \frac{6 x^2 \tau^2 \operatorname{Ex}^{(1,0,2)} [0, 0, 0]}{c^2} - \frac{4 x^3 \tau \operatorname{Ex}^{(2,0,1)} [0, 0, 0]}{c} + x^4 \right. \\
& \quad \left. \operatorname{Ex}^{(3,0,0)} [0, 0, 0] \right) + \varepsilon \left(\frac{1}{2} \left(-x y \varepsilon \operatorname{Ex}^{(0,1,0)} [0, 0, 0] + \frac{x y \varepsilon^2 \tau \operatorname{Ex}^{(0,1,1)} [0, 0, 0]}{c} - \right. \right. \\
& \quad \frac{x y \varepsilon^3 \tau^2 \operatorname{Ex}^{(0,1,2)} [0, 0, 0]}{2 c^2} - \frac{1}{2} x y^2 \varepsilon^2 \operatorname{Ex}^{(0,2,0)} [0, 0, 0] + \frac{x y^2 \varepsilon^3 \tau \operatorname{Ex}^{(0,2,1)} [0, 0, 0]}{2 c} - \\
& \quad \frac{1}{6} x y^3 \varepsilon^3 \operatorname{Ex}^{(0,3,0)} [0, 0, 0] - \frac{1}{2} x^2 y \varepsilon^2 \operatorname{Ex}^{(1,1,0)} [0, 0, 0] + \frac{x^2 y \varepsilon^3 \tau \operatorname{Ex}^{(1,1,1)} [0, 0, 0]}{2 c} - \\
& \quad \left. \left. \left. \frac{1}{4} x^2 y^2 \varepsilon^3 \operatorname{Ex}^{(1,2,0)} [0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \operatorname{Ex}^{(2,1,0)} [0, 0, 0] \right) \right) + \frac{1}{2} \right. \\
& \quad \left(-x y \varepsilon \operatorname{Ey}^{(1,0,0)} [0, 0, 0] + \frac{x y \varepsilon^2 \tau \operatorname{Ey}^{(1,0,1)} [0, 0, 0]}{c} - \frac{x y \varepsilon^3 \tau^2 \operatorname{Ey}^{(1,0,2)} [0, 0, 0]}{2 c^2} - \right. \\
& \quad \frac{1}{2} x y^2 \varepsilon^2 \operatorname{Ey}^{(1,1,0)} [0, 0, 0] + \frac{x y^2 \varepsilon^3 \tau \operatorname{Ey}^{(1,1,1)} [0, 0, 0]}{2 c} - \frac{1}{6} x y^3 \varepsilon^3 \operatorname{Ey}^{(1,2,0)} [0, 0, 0] - \\
& \quad \frac{1}{2} x^2 y \varepsilon^2 \operatorname{Ey}^{(2,0,0)} [0, 0, 0] + \frac{x^2 y \varepsilon^3 \tau \operatorname{Ey}^{(2,0,1)} [0, 0, 0]}{2 c} - \\
& \quad \left. \left. \left. \frac{1}{4} x^2 y^2 \varepsilon^3 \operatorname{Ey}^{(2,1,0)} [0, 0, 0] - \frac{1}{6} x^3 y \varepsilon^3 \operatorname{Ey}^{(3,0,0)} [0, 0, 0] \right) \right) \right) \right)
\end{aligned}$$

First order terms

In[23]:= **H1 = Normal[Series[H, {ε, 0, 1}]]**

Out[23]=
$$-p_0 + \frac{\varepsilon (-c K p_0 x \beta_0 + e y \beta_0 Bx[0, 0, 0] - e x \beta_0 By[0, 0, 0] - e x Ex[0, 0, 0] - e y Ey[0, 0, 0])}{c \beta_0}$$

In[24]:= **Cx = Coefficient[H1, ε x]**

Out[24]=
$$\frac{-c K p_0 \beta_0 - e \beta_0 By[0, 0, 0] - e Ex[0, 0, 0]}{c \beta_0}$$

In[25]:= **Cy = Coefficient[H1, ε y]**

Out[25]=
$$\frac{e \beta_0 Bx[0, 0, 0] - e Ey[0, 0, 0]}{c \beta_0}$$

Second order terms

In[26]:= **H2 = Normal[Series[H, {ε, 0, 2}]]**

$$\text{Out[26]} = -p_0 + \frac{\varepsilon (-c K p_0 x \beta_0 + e y \beta_0 Bx[0, 0, 0] - e x \beta_0 By[0, 0, 0] - e x Ex[0, 0, 0] - e y Ey[0, 0, 0])}{c \beta_0} +$$

$$\varepsilon^2 \left(P_3 x x - P_1 y y - \frac{e K x y Bx[0, 0, 0]}{2 c} - \frac{e K x^2 By[0, 0, 0]}{2 c} - \frac{e y \tau Bx^{(0,0,1)}[0, 0, 0]}{c^2} + \frac{e x \tau By^{(0,0,1)}[0, 0, 0]}{c^2} - \frac{e \tau^2 Es^{(0,0,1)}[0, 0, 0]}{2 c^2} + \frac{e y^2 Bx^{(0,1,0)}[0, 0, 0]}{2 c} - \frac{e x y By^{(0,1,0)}[0, 0, 0]}{2 c} - \frac{e x y Bx^{(1,0,0)}[0, 0, 0]}{2 c} - \frac{e x^2 By^{(1,0,0)}[0, 0, 0]}{2 c} + p_0 \left(-\frac{1}{2} K x \left(\frac{2 \delta}{p_0 \beta_0} + \frac{2 e x Ex[0, 0, 0]}{c p_0 \beta_0} + \frac{2 e y Ey[0, 0, 0]}{c p_0 \beta_0} \right) \right) + \frac{1}{2} \left(\frac{\left(P_3 + \frac{e x Bs[0,0,0]}{2 c} \right)^2}{p_0^2} + \frac{\left(P_1 - \frac{e y Bs[0,0,0]}{2 c} \right)^2}{p_0^2} - \frac{\left(\delta + \frac{e x Ex[0,0,0]}{c} + \frac{e y Ey[0,0,0]}{c} \right)^2}{p_0^2} + \frac{1}{4} \left(\frac{2 \delta}{p_0 \beta_0} + \frac{2 e x Ex[0, 0, 0]}{c p_0 \beta_0} + \frac{2 e y Ey[0, 0, 0]}{c p_0 \beta_0} \right)^2 + \frac{2 e x \tau Ex^{(0,0,1)}[0, 0, 0]}{c^2 p_0 \beta_0} + \frac{2 e y \tau Ey^{(0,0,1)}[0, 0, 0]}{c^2 p_0 \beta_0} - \frac{e x y Ex^{(0,1,0)}[0, 0, 0]}{c p_0 \beta_0} - \frac{e y^2 Ey^{(0,1,0)}[0, 0, 0]}{c p_0 \beta_0} - \frac{e x^2 Ex^{(1,0,0)}[0, 0, 0]}{c p_0 \beta_0} - \frac{e x y Ey^{(1,0,0)}[0, 0, 0]}{c p_0 \beta_0} \right) \right)$$

In[27]:= **Cxx = Coefficient[H2, ε^2 x^2]**

$$\text{Out[27]} = \frac{1}{2} \left(-\frac{e K By[0, 0, 0]}{c} - \frac{e By^{(1,0,0)}[0, 0, 0]}{c} + p_0 \left(-\frac{2 e K Ex[0, 0, 0]}{c p_0 \beta_0} + \frac{1}{2} \left(\frac{e^2 Bs[0, 0, 0]^2}{2 c^2 p_0^2} - \frac{2 e^2 Ex[0, 0, 0]^2}{c^2 p_0^2} + \frac{2 e^2 Ex[0, 0, 0]^2}{c^2 p_0^2 \beta_0^2} - \frac{2 e Ex^{(1,0,0)}[0, 0, 0]}{c p_0 \beta_0} \right) \right) \right)$$

In[28]:= **Expand[Cxx]**

$$\text{Out[28]} = \frac{e^2 Bs[0, 0, 0]^2}{8 c^2 p_0} - \frac{e K By[0, 0, 0]}{2 c} - \frac{e K Ex[0, 0, 0]}{c \beta_0} - \frac{e^2 Ex[0, 0, 0]^2}{2 c^2 p_0} + \frac{e^2 Ex[0, 0, 0]^2}{2 c^2 p_0 \beta_0^2} - \frac{e By^{(1,0,0)}[0, 0, 0]}{2 c} - \frac{e Ex^{(1,0,0)}[0, 0, 0]}{2 c \beta_0}$$

In[29]:= **Cyy = Coefficient[H2, ε^2 y^2]**

$$\text{Out[29]} = \frac{1}{2} \left(\frac{e Bx^{(0,1,0)}[0, 0, 0]}{c} + \frac{1}{2} p0 \left(\frac{e^2 Bs[0, 0, 0]^2}{2 c^2 p0^2} - \frac{2 e^2 Ey[0, 0, 0]^2}{c^2 p0^2} + \frac{2 e^2 Ey[0, 0, 0]^2}{c^2 p0^2 \beta0^2} - \frac{2 e Ey^{(0,1,0)}[0, 0, 0]}{c p0 \beta0} \right) \right)$$

In[30]:= **Expand[Cyy]**

$$\text{Out[30]} = \frac{e^2 Bs[0, 0, 0]^2}{8 c^2 p0} - \frac{e^2 Ey[0, 0, 0]^2}{2 c^2 p0} + \frac{e^2 Ey[0, 0, 0]^2}{2 c^2 p0 \beta0^2} + \frac{e Bx^{(0,1,0)}[0, 0, 0]}{2 c} - \frac{e Ey^{(0,1,0)}[0, 0, 0]}{2 c \beta0}$$

In[31]:= **Cxy = Coefficient[H2, ε^2 x y]**

$$\text{Out[31]} = -\frac{e K Bx[0, 0, 0]}{2 c} - \frac{e By^{(0,1,0)}[0, 0, 0]}{2 c} - \frac{e Bx^{(1,0,0)}[0, 0, 0]}{2 c} + p0 \left(-\frac{e K Ey[0, 0, 0]}{c p0 \beta0} + \frac{1}{2} \left(-\frac{2 e^2 Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0^2} + \frac{2 e^2 Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0^2 \beta0^2} - \frac{e Ex^{(0,1,0)}[0, 0, 0]}{c p0 \beta0} - \frac{e Ey^{(1,0,0)}[0, 0, 0]}{c p0 \beta0} \right) \right)$$

In[32]:= **Expand[Cxy]**

$$\text{Out[32]} = -\frac{e K Bx[0, 0, 0]}{2 c} - \frac{e K Ey[0, 0, 0]}{c \beta0} - \frac{e^2 Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0} + \frac{e^2 Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0 \beta0^2} - \frac{e By^{(0,1,0)}[0, 0, 0]}{2 c} - \frac{e Ex^{(0,1,0)}[0, 0, 0]}{2 c \beta0} - \frac{e Bx^{(1,0,0)}[0, 0, 0]}{2 c} - \frac{e Ey^{(1,0,0)}[0, 0, 0]}{2 c \beta0}$$

In[33]:= **CxP1 = Coefficient[H2, ε^2 x P1]**

Out[33]= 0

In[34]:= **CxP3 = Expand[Coefficient[H2, ε^2 x P3]]**

$$\text{Out[34]} = \kappa + \frac{e Bs[0, 0, 0]}{2 c p0}$$

In[35]:= **CyP1 = Expand[Coefficient[H2, ε^2 y P1]]**

$$\text{Out[35]} = -\kappa - \frac{e Bs[0, 0, 0]}{2 c p0}$$

In[36]:= **CyP3 = Coefficient[H2, ε^2 y P3]**

Out[36]= 0

In[37]:= **Cxδ = Expand[Coefficient[H2, ε^2 x δ]]**

$$\text{Out[37]} = -\frac{K}{\beta0} - \frac{e Ex[0, 0, 0]}{c p0} + \frac{e Ex[0, 0, 0]}{c p0 \beta0^2}$$

In[38]:= **Cyδ = Expand[Coefficient[H2, ε^2 y δ]]**

$$\text{Out[38]} = -\frac{e Ey[0, 0, 0]}{c p0} + \frac{e Ey[0, 0, 0]}{c p0 \beta0^2}$$

In[39]:= **CP1δ = Expand[Coefficient[H2, ε^2 P1 δ]]**

Out[39]= 0

In[40]:= **CP3δ = Expand[Coefficient[H2, ε^2 P3 δ]]**

Out[40]= 0

In[41]:= **CPδδ = Expand[Coefficient[H2, ε^2 δ^2]]**

$$\text{Out[41]= } -\frac{1}{2 p_0} + \frac{1}{2 p_0 \beta_0^2}$$

In[42]:= **CPtt = Expand[Coefficient[H2, ε^2 τ^2]]**

$$\text{Out[42]= } -\frac{e \text{Es}^{(0,0,1)}[0, 0, 0]}{2 c^2}$$

In[43]:= **Cxt = Expand[Coefficient[H2, ε^2 x τ]]**

$$\text{Out[43]= } \frac{e \text{By}^{(0,0,1)}[0, 0, 0]}{c^2} + \frac{e \text{Ex}^{(0,0,1)}[0, 0, 0]}{c^2 \beta_0}$$

In[44]:= **Cyt = Expand[Coefficient[H2, ε^2 y τ]]**

$$\text{Out[44]= } -\frac{e \text{Bx}^{(0,0,1)}[0, 0, 0]}{c^2} + \frac{e \text{Ey}^{(0,0,1)}[0, 0, 0]}{c^2 \beta_0}$$

In[45]:= **CP1t = Expand[Coefficient[H2, ε^2 P1 τ]]**

Out[45]= 0

In[46]:= **CP3t = Expand[Coefficient[H2, ε^2 P3 τ]]**

Out[46]= 0

In[47]:= **Cδt = Expand[Coefficient[H2, ε^2 δ τ]]**

Out[47]= 0

Third order terms

In[48]:= **H3 = Normal[Series[H, {ε, 0, 3}]]**

$$\begin{aligned} \text{Out[48]= } & -p_0 + \frac{\varepsilon (-c K p_0 x \beta_0 + e y \beta_0 \text{Bx}[0, 0, 0] - e x \beta_0 \text{By}[0, 0, 0] - e x \text{Ex}[0, 0, 0] - e y \text{Ey}[0, 0, 0])}{c \beta_0} + \\ & \varepsilon^2 \left(P_3 x \kappa - P_1 y \kappa + \frac{e x^2 \kappa \text{Bs}[0, 0, 0]}{2 c} + \frac{e y^2 \kappa \text{Bs}[0, 0, 0]}{2 c} - \frac{e \tau^2 \text{Es}^{(0,0,1)}[0, 0, 0]}{2 c^2} + \frac{1}{c} \right. \\ & \left. e \left(-\frac{1}{2} x^2 \kappa \text{Bs}[0, 0, 0] - \frac{1}{2} y^2 \kappa \text{Bs}[0, 0, 0] - \frac{1}{2} K x^2 \text{By}[0, 0, 0] - \frac{y \tau \text{Bx}^{(0,0,1)}[0, 0, 0]}{c} + \right. \right. \end{aligned}$$

$$\begin{aligned}
& \frac{x \tau \text{By}^{(0,0,1)} [0, 0, 0]}{c} + \frac{1}{2} y^2 \text{Bx}^{(0,1,0)} [0, 0, 0] - \frac{1}{2} x y \text{By}^{(0,1,0)} [0, 0, 0] + \\
& \frac{1}{2} \left(-K x y \text{Bx} [0, 0, 0] - x y \text{Bx}^{(1,0,0)} [0, 0, 0] \right) - \frac{1}{2} x^2 \text{By}^{(1,0,0)} [0, 0, 0] \Big) + \\
p_0 & \left(-\frac{K x \left(\delta + \frac{e (x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)}{p_0 \beta_0} + \frac{1}{2} \left(\frac{\left(P_3 + \frac{e x \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} + \frac{\left(P_1 - \frac{e y \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} - \right. \right. \\
& \left. \frac{\left(\delta + \frac{e (x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2} + \frac{\left(\delta + \frac{e (x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2 \beta_0^2} - \frac{1}{c p_0 \beta_0} \right. \\
& \left. \left. 2 e \left(-\frac{x \tau \text{Ex}^{(0,0,1)} [0, 0, 0]}{c} - \frac{y \tau \text{Ey}^{(0,0,1)} [0, 0, 0]}{c} + \frac{1}{2} x y \text{Ex}^{(0,1,0)} [0, 0, 0] + \right. \right. \\
& \left. \left. \frac{1}{2} y^2 \text{Ey}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)} [0, 0, 0] + \frac{1}{2} x y \text{Ey}^{(1,0,0)} [0, 0, 0] \right) \right) \Big) \Big) + \\
\varepsilon^3 & \left(-\frac{e x^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{2 c^2} - \frac{e y^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{2 c^2} + \frac{e \tau^3 \text{Es}^{(0,0,2)} [0, 0, 0]}{6 c^3} + \right. \\
& \frac{e x^2 y \kappa \text{Bs}^{(0,1,0)} [0, 0, 0]}{2 c} + \frac{e y^3 \kappa \text{Bs}^{(0,1,0)} [0, 0, 0]}{4 c} + \\
& \frac{e x^3 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0]}{4 c} + \frac{e x y^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0]}{2 c} + \frac{1}{c} \\
& e \left(\frac{x^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{2 c} + \frac{y^2 \kappa \tau \text{Bs}^{(0,0,1)} [0, 0, 0]}{2 c} + \frac{K x^2 \tau \text{By}^{(0,0,1)} [0, 0, 0]}{2 c} + \right. \\
& \frac{y \tau^2 \text{Bx}^{(0,0,2)} [0, 0, 0]}{2 c^2} - \frac{x \tau^2 \text{By}^{(0,0,2)} [0, 0, 0]}{2 c^2} - \frac{y^2 \tau \text{Bx}^{(0,1,1)} [0, 0, 0]}{2 c} + \frac{1}{6} y^3 \text{Bx}^{(0,2,0)} [0, 0, 0] - \\
& \frac{1}{3} x^3 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] - \frac{1}{2} x y^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] - \frac{1}{3} K x^3 \text{By}^{(1,0,0)} [0, 0, 0] + \\
& \frac{x^2 \tau \text{By}^{(1,0,1)} [0, 0, 0]}{2 c} + \frac{1}{2} \left(-\frac{1}{2} x^2 y \kappa \text{Bs}^{(0,1,0)} [0, 0, 0] - \frac{1}{2} K x^2 y \text{By}^{(0,1,0)} [0, 0, 0] + \right. \\
& \left. \frac{x y \tau \text{By}^{(0,1,1)} [0, 0, 0]}{c} - \frac{1}{2} x y^2 \text{By}^{(0,2,0)} [0, 0, 0] - \frac{1}{2} x^2 y \text{By}^{(1,1,0)} [0, 0, 0] \right) + \\
& \frac{1}{2} \left(\frac{K x y \tau \text{Bx}^{(0,0,1)} [0, 0, 0]}{c} - \frac{1}{2} K x y^2 \text{Bx}^{(0,1,0)} [0, 0, 0] + \frac{1}{2} x y^2 \kappa \text{Bs}^{(1,0,0)} [0, 0, 0] - \right. \\
& K x^2 y \text{Bx}^{(1,0,0)} [0, 0, 0] + \frac{x y \tau \text{Bx}^{(1,0,1)} [0, 0, 0]}{c} - \frac{1}{2} x y^2 \text{Bx}^{(1,1,0)} [0, 0, 0] - \\
& \left. \frac{1}{2} x^2 y \text{Bx}^{(2,0,0)} [0, 0, 0] - \frac{1}{6} x^3 \text{By}^{(2,0,0)} [0, 0, 0] \right) + \\
p_0 & \left(-\frac{1}{2} K x \left(-\frac{\left(P_3 + \frac{e x \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} - \frac{\left(P_1 - \frac{e y \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} + \frac{\left(\delta + \frac{e (x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2} - \right. \right.
\end{aligned}$$

$$\begin{aligned}
& \left(\frac{\left(\delta + \frac{e(x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2 \beta_0^2} + \frac{1}{c p_0 \beta_0} \right. \\
& 2 e \left(- \frac{x \tau \text{Ex}^{(0,0,1)}[0,0,0]}{c} - \frac{y \tau \text{Ey}^{(0,0,1)}[0,0,0]}{c} + \frac{1}{2} x y \text{Ex}^{(0,1,0)}[0,0,0] + \right. \\
& \left. \left. \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0,0,0] + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0,0,0] + \frac{1}{2} x y \text{Ey}^{(1,0,0)}[0,0,0] \right) \right) + \\
& \frac{1}{3} \left(\frac{1}{2 p_0 \beta_0} \left(\delta + \frac{e(x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right) \left(- \frac{\left(P_3 + \frac{e x \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} - \right. \right. \\
& \left. \left. \frac{\left(P_1 - \frac{e y \text{Bs}[0,0,0]}{2c} \right)^2}{p_0^2} + \frac{\left(\delta + \frac{e(x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2} - \frac{\left(\delta + \frac{e(x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right)^2}{p_0^2 \beta_0^2} + \right. \right. \\
& \left. \left. \frac{1}{c p_0 \beta_0} 2 e \left(- \frac{x \tau \text{Ex}^{(0,0,1)}[0,0,0]}{c} - \frac{y \tau \text{Ey}^{(0,0,1)}[0,0,0]}{c} + \frac{1}{2} x y \text{Ex}^{(0,1,0)}[0,0,0] + \right. \right. \\
& \left. \left. \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0,0,0] + \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0,0,0] + \frac{1}{2} x y \text{Ey}^{(1,0,0)}[0,0,0] \right) \right) - \\
& \frac{3}{2} \left(- \frac{1}{p_0^2} \left(P_3 + \frac{e x \text{Bs}[0,0,0]}{2c} \right) \left(- \frac{e x \tau \text{Bs}^{(0,0,1)}[0,0,0]}{2c^2} + \frac{e x y \text{Bs}^{(0,1,0)}[0,0,0]}{2c} + \right. \right. \\
& \left. \left. \frac{e x^2 \text{Bs}^{(1,0,0)}[0,0,0]}{4c} \right) - \frac{1}{p_0^2} \left(P_1 - \frac{e y \text{Bs}[0,0,0]}{2c} \right) \right. \\
& \left. \left(\frac{e y \tau \text{Bs}^{(0,0,1)}[0,0,0]}{2c^2} - \frac{e y^2 \text{Bs}^{(0,1,0)}[0,0,0]}{4c} - \frac{e x y \text{Bs}^{(1,0,0)}[0,0,0]}{2c} \right) + \right. \\
& \left. \frac{1}{c p_0^2} 2 e \left(\delta + \frac{e(x \text{Ex}[0,0,0] + y \text{Ey}[0,0,0])}{c} \right) \left(- \frac{x \tau \text{Ex}^{(0,0,1)}[0,0,0]}{c} - \right. \right. \\
& \left. \left. \frac{y \tau \text{Ey}^{(0,0,1)}[0,0,0]}{c} + \frac{1}{2} x y \text{Ex}^{(0,1,0)}[0,0,0] + \frac{1}{2} y^2 \text{Ey}^{(0,1,0)}[0,0,0] + \right. \right. \\
& \left. \left. \frac{1}{2} x^2 \text{Ex}^{(1,0,0)}[0,0,0] + \frac{1}{2} x y \text{Ey}^{(1,0,0)}[0,0,0] \right) + \frac{1}{c p_0 \beta_0} \right. \\
& 2 e \left(\frac{x \tau^2 \text{Ex}^{(0,0,2)}[0,0,0]}{2c^2} + \frac{y \tau^2 \text{Ey}^{(0,0,2)}[0,0,0]}{2c^2} - \frac{x y \tau \text{Ex}^{(0,1,1)}[0,0,0]}{2c} - \right. \\
& \left. \frac{y^2 \tau \text{Ey}^{(0,1,1)}[0,0,0]}{2c} + \frac{1}{4} x y^2 \text{Ex}^{(0,2,0)}[0,0,0] + \frac{1}{6} y^3 \text{Ey}^{(0,2,0)}[0,0,0] - \right. \\
& \left. \frac{x^2 \tau \text{Ex}^{(1,0,1)}[0,0,0]}{2c} - \frac{x y \tau \text{Ey}^{(1,0,1)}[0,0,0]}{2c} + \frac{1}{4} x^2 y \text{Ex}^{(1,1,0)}[0,0,0] + \right. \\
& \left. \left. \frac{1}{4} x y^2 \text{Ey}^{(1,1,0)}[0,0,0] + \frac{1}{6} x^3 \text{Ex}^{(2,0,0)}[0,0,0] + \frac{1}{4} x^2 y \text{Ey}^{(2,0,0)}[0,0,0] \right) \right) \right) \right)
\end{aligned}$$

In[49]:= **Cx3 = Coefficient[H3, ε^3 x^3]; Expand[Cx3]**

$$\begin{aligned}
\text{Out[49]} = & \frac{e^2 K Bs[0, 0, 0]^2}{8 c^2 p0} - \frac{e^3 Bs[0, 0, 0]^2 Ex[0, 0, 0]}{8 c^3 p0^2 \beta0} - \frac{e^2 K Ex[0, 0, 0]^2}{2 c^2 p0} + \frac{e^2 K Ex[0, 0, 0]^2}{2 c^2 p0 \beta0^2} - \\
& \frac{e^3 Ex[0, 0, 0]^3}{2 c^3 p0^2 \beta0^3} + \frac{e^3 Ex[0, 0, 0]^3}{2 c^3 p0^2 \beta0} - \frac{e \times Bs^{(1,0,0)}[0, 0, 0]}{12 c} + \frac{e^2 Bs[0, 0, 0] Bs^{(1,0,0)}[0, 0, 0]}{8 c^2 p0} - \\
& \frac{e K By^{(1,0,0)}[0, 0, 0]}{3 c} - \frac{e K Ex^{(1,0,0)}[0, 0, 0]}{2 c \beta0} - \frac{e^2 Ex[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0} + \\
& \frac{e^2 Ex[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \frac{e By^{(2,0,0)}[0, 0, 0]}{6 c} - \frac{e Ex^{(2,0,0)}[0, 0, 0]}{6 c \beta0} \\
& \frac{e^2 K Bs[0, 0, 0]^2}{8 c^2 p0} - \frac{e^3 Bs[0, 0, 0]^2 Ex[0, 0, 0]}{8 c^3 p0^2 \beta0} - \frac{e^2 K Ex[0, 0, 0]^2}{2 c^2 p0} + \frac{e^2 K Ex[0, 0, 0]^2}{2 c^2 p0 \beta0^2} - \\
& \frac{e^3 Ex[0, 0, 0]^3}{2 c^3 p0^2 \beta0^3} + \frac{e^3 Ex[0, 0, 0]^3}{2 c^3 p0^2 \beta0} - \frac{e \times Bs^{(1,0,0)}[0, 0, 0]}{12 c} + \frac{e^2 Bs[0, 0, 0] Bs^{(1,0,0)}[0, 0, 0]}{8 c^2 p0} - \\
& \frac{e K By^{(1,0,0)}[0, 0, 0]}{3 c} - \frac{e K Ex^{(1,0,0)}[0, 0, 0]}{2 c \beta0} - \frac{e^2 Ex[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0} + \\
& \frac{e^2 Ex[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \frac{e By^{(2,0,0)}[0, 0, 0]}{6 c} - \frac{e Ex^{(2,0,0)}[0, 0, 0]}{6 c \beta0}
\end{aligned}$$

In[50]= **Cy3 = Coefficient[H3, ε^3 y^3]; Expand[Cy3]**

$$\begin{aligned}
\text{Out[50]} = & - \frac{e^3 Bs[0, 0, 0]^2 Ey[0, 0, 0]}{8 c^3 p0^2 \beta0} - \frac{e^3 Ey[0, 0, 0]^3}{2 c^3 p0^2 \beta0^3} + \frac{e^3 Ey[0, 0, 0]^3}{2 c^3 p0^2 \beta0} + \\
& \frac{e \times Bs^{(0,1,0)}[0, 0, 0]}{4 c} + \frac{e^2 Bs[0, 0, 0] Bs^{(0,1,0)}[0, 0, 0]}{8 c^2 p0} - \frac{e^2 Ey[0, 0, 0] Ey^{(0,1,0)}[0, 0, 0]}{2 c^2 p0} + \\
& \frac{e^2 Ey[0, 0, 0] Ey^{(0,1,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} + \frac{e Bx^{(0,2,0)}[0, 0, 0]}{6 c} - \frac{e Ey^{(0,2,0)}[0, 0, 0]}{6 c \beta0}
\end{aligned}$$

In[51]= **Cx2y = Coefficient[H3, ε^3 x^2 y]; Expand[Cx2y]**

$$\begin{aligned}
\text{Out[51]} = & - \frac{e^3 Bs[0, 0, 0]^2 Ey[0, 0, 0]}{8 c^3 p0^2 \beta0} - \frac{e^2 K Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0} + \frac{e^2 K Ex[0, 0, 0] Ey[0, 0, 0]}{c^2 p0 \beta0^2} - \\
& \frac{3 e^3 Ex[0, 0, 0]^2 Ey[0, 0, 0]}{2 c^3 p0^2 \beta0^3} + \frac{3 e^3 Ex[0, 0, 0]^2 Ey[0, 0, 0]}{2 c^3 p0^2 \beta0} + \frac{e \times Bs^{(0,1,0)}[0, 0, 0]}{4 c} + \\
& \frac{e^2 Bs[0, 0, 0] Bs^{(0,1,0)}[0, 0, 0]}{4 c^2 p0} - \frac{e K By^{(0,1,0)}[0, 0, 0]}{4 c} - \frac{e K Ex^{(0,1,0)}[0, 0, 0]}{2 c \beta0} - \\
& \frac{e^2 Ex[0, 0, 0] Ex^{(0,1,0)}[0, 0, 0]}{2 c^2 p0} + \frac{e^2 Ex[0, 0, 0] Ex^{(0,1,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \\
& \frac{e K Bx^{(1,0,0)}[0, 0, 0]}{2 c} - \frac{e^2 Ey[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0} + \frac{e^2 Ey[0, 0, 0] Ex^{(1,0,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \\
& \frac{e K Ey^{(1,0,0)}[0, 0, 0]}{2 c \beta0} - \frac{e^2 Ex[0, 0, 0] Ey^{(1,0,0)}[0, 0, 0]}{2 c^2 p0} + \frac{e^2 Ex[0, 0, 0] Ey^{(1,0,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \\
& \frac{e By^{(1,1,0)}[0, 0, 0]}{4 c} - \frac{e Ex^{(1,1,0)}[0, 0, 0]}{4 c \beta0} - \frac{e Bx^{(2,0,0)}[0, 0, 0]}{4 c} - \frac{e Ey^{(2,0,0)}[0, 0, 0]}{4 c \beta0}
\end{aligned}$$

In[52]:= **Cxy2 = Coefficient[H3, ε^3 x y^2]; Expand[Cxy2]**

$$\begin{aligned} \text{Out[52]} = & \frac{e^2 K Bs[0, 0, 0]^2}{8 c^2 p0} - \frac{e^3 Bs[0, 0, 0]^2 Ex[0, 0, 0]}{8 c^3 p0^2 \beta0} - \frac{e^2 K Ey[0, 0, 0]^2}{2 c^2 p0} + \\ & \frac{e^2 K Ey[0, 0, 0]^2}{2 c^2 p0 \beta0^2} - \frac{3 e^3 Ex[0, 0, 0] Ey[0, 0, 0]^2}{2 c^3 p0^2 \beta0^3} + \frac{3 e^3 Ex[0, 0, 0] Ey[0, 0, 0]^2}{2 c^3 p0^2 \beta0} - \\ & \frac{e K Bx^{(0,1,0)}[0, 0, 0]}{4 c} - \frac{e^2 Ey[0, 0, 0] Ex^{(0,1,0)}[0, 0, 0]}{2 c^2 p0} + \frac{e^2 Ey[0, 0, 0] Ex^{(0,1,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \\ & \frac{e K Ey^{(0,1,0)}[0, 0, 0]}{2 c \beta0} - \frac{e^2 Ex[0, 0, 0] Ey^{(0,1,0)}[0, 0, 0]}{2 c^2 p0} + \frac{e^2 Ex[0, 0, 0] Ey^{(0,1,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \\ & \frac{e By^{(0,2,0)}[0, 0, 0]}{4 c} - \frac{e Ex^{(0,2,0)}[0, 0, 0]}{4 c \beta0} + \frac{e x Bs^{(1,0,0)}[0, 0, 0]}{4 c} + \\ & \frac{e^2 Bs[0, 0, 0] Bs^{(1,0,0)}[0, 0, 0]}{4 c^2 p0} - \frac{e^2 Ey[0, 0, 0] Ey^{(1,0,0)}[0, 0, 0]}{2 c^2 p0} + \\ & \frac{e^2 Ey[0, 0, 0] Ey^{(1,0,0)}[0, 0, 0]}{2 c^2 p0 \beta0^2} - \frac{e Bx^{(1,1,0)}[0, 0, 0]}{4 c} - \frac{e Ey^{(1,1,0)}[0, 0, 0]}{4 c \beta0} \end{aligned}$$

In[53]:= **CP1p3 = Coefficient[H3, ε^3 P1^3]; Expand[CP1p3]**

Out[53]= 0

In[54]:= **CP3p3 = Coefficient[H3, ε^3 P3^3]; Expand[CP3p3]**

Out[54]= 0

In[55]:= **Cδ3 = Coefficient[H3, ε^3 δ^3]; Expand[Cδ3]**

$$\text{Out[55]} = -\frac{1}{2 p0^2 \beta0^3} + \frac{1}{2 p0^2 \beta0}$$

In[56]:= **Ct3 = Coefficient[H3, ε^3 τ^3]; Expand[Ct3]**

$$\text{Out[56]} = \frac{e Es^{(0,0,2)}[0, 0, 0]}{6 c^3}$$

Forth order terms

In[57]:= **H4 = Normal[Series[H, {ε, 0, 4}]]; Expand[H4]**

A very large output was generated. Here is a sample of it:

Out[57]=

$$\begin{aligned}
 & -p_0 - K p_0 x \varepsilon + \frac{P_1^2 \varepsilon^2}{2 p_0} + \frac{P_3^2 \varepsilon^2}{2 p_0} - \frac{K x \delta \varepsilon^2}{\beta_0} - \frac{\delta^2 \varepsilon^2}{2 p_0} + \frac{\delta^2 \varepsilon^2}{2 p_0 \beta_0^2} + \frac{K P_1^2 x \varepsilon^3}{2 p_0} + \ll 1156 \gg + \frac{e x^2 y \varepsilon^4 \tau E y^{(2,0,1)} [0,0,0]}{4 c^2 \beta_0} - \\
 & \frac{e x^2 y^2 \varepsilon^4 B x^{(2,1,0)} [0,0,0]}{8 c} - \frac{e x^3 y \varepsilon^4 B y^{(2,1,0)} [0,0,0]}{12 c} - \frac{e x^3 y \varepsilon^4 E x^{(2,1,0)} [0,0,0]}{12 c \beta_0} - \frac{e x^2 y^2 \varepsilon^4 E y^{(2,1,0)} [0,0,0]}{8 c \beta_0} - \\
 & \frac{e x^3 y \varepsilon^4 B x^{(3,0,0)} [0,0,0]}{12 c} - \frac{e x^4 \varepsilon^4 B y^{(3,0,0)} [0,0,0]}{24 c} - \frac{e x^4 \varepsilon^4 E x^{(3,0,0)} [0,0,0]}{24 c \beta_0} - \frac{e x^3 y \varepsilon^4 E y^{(3,0,0)} [0,0,0]}{12 c \beta_0}
 \end{aligned}$$

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In[58]:= **CP1p4 = Coefficient[H4, ε^4 P1^4]; Expand[CP1p4]**

Out[58]=

$$\frac{1}{8 p_0^3}$$

In[59]:= **CP3p4 = Coefficient[H4, ε^4 P3^4]; Expand[CP1p4]**

Out[59]=

$$\frac{1}{8 p_0^3}$$

In[60]:= **CP1p2P3p2 = Coefficient[H4, ε^4 P1^2 P3^2]; Expand[CP1p2P3p2]**

Out[60]=

$$\frac{1}{4 p_0^3}$$

In[61]:= **CP1p1P3p3 = Coefficient[H4, ε^4 P1 P3^3]; Expand[CP1p1P3p3]**

Out[61]= 0

In[62]:=

Higher orders : just for fun

In[63]:= **H6 = Normal[Series[H, {ε, 0, 6}]];**

In[64]:= **CP1p6 = Coefficient[H6, ε^6 P1^6]; Expand[CP1p6]**

Out[64]=

$$\frac{1}{16 p_0^5}$$

In[65]:= **H14 = Normal[Series[H, {ε, 0, 14}]];**

CP1p14 = Coefficient[H14, ε^14 P1^14]; Expand[CP1p14]