```
def Maxwells_Equations_in_Geom_Calculus():
    Print_Function()
    X = symbols('t x y z',real=True)
    (st4d,g0,g1,g2,g3) = Ga.build('gamma*t|x|y|z',g=[1, 1, 1, 1],coords=X)

    I = st4d.i

    B = st4d.mv('B','vector',f=True)
    E = st4d.mv('E','vector',f=True)
    B.set_coef(1,0,0)
    E.set_coef(1,0,0)
    B *= g0
    E *= g0
    J = st4d.mv('J','vector',f=True)
    F = E+I*B

    print(r'\T{Pseudo Scalar\;\;}I =',I)
    print(r'\T{Magnetic Field Bi Vector\;\;} B = \bs{B\gamma_{t}} =',B)
    print(r'\T{Electric Field Bi Vector\;\;} E = \bs{E\gamma_{t}} =',E)
    print(r'\T{Electromagnetic Field Bi Vector\;\;} F = E+IB =',F)
    print(r'\T{Four Current Density\;\;} J =',J)
    gradF = st4d.grad*F
    print(r'\T{Geom Derivative of Electomagnetic Field Bi Vector}')
    print(r'\nabla F =',gradF.Fmt(3))

    print(r'\T{Maxwell Equations}')
    print(r'\nabla F = J')
    print(r'\T{Div $E$ and Curl $H$ Equations}')
    print(r'\grade{\nabla F}{1}  J = 0 =',(gradF.get_grade(1) J).Fmt(3))
    print(r'\T{Curl $E$ and Div $B$ equations}')
    print(r'\grade{\nabla F}{3} = 0 =',(gradF.get_grade(3)).Fmt(3))
    return
```

Code Output:

Pseudo Scalar $I = \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z$

Magnetic Field Bi-Vector $B = \boldsymbol{B\gamma_t} = -B^x \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x - B^y \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y - B^z \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_z$

Electric Field Bi-Vector $E = \boldsymbol{E\gamma_t} = -E^x \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x - E^y \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y - E^z \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_z$

Electromagnetic Field Bi-Vector $F = E + IB = -E^x \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x - E^y \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y - E^z \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_z - B^z \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y + B^y \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_z - B^x \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z$

Four Current Density $J = J^t \boldsymbol{\gamma}_t + J^x \boldsymbol{\gamma}_x + J^y \boldsymbol{\gamma}_y + J^z \boldsymbol{\gamma}_z$

Geom Derivative of Electomagnetic Field Bi-Vector

$$
\begin{aligned}
\nabla F = & \left(\partial_x E^x + \partial_y E^y + \partial_z E^z\right) \boldsymbol{\gamma}_t \\
& + \left(-\partial_z B^y + \partial_y B^z - \partial_t E^x\right) \boldsymbol{\gamma}_x \\
& + \left(\partial_z B^x - \partial_x B^z - \partial_t E^y\right) \boldsymbol{\gamma}_y \\
& + \left(-\partial_y B^x + \partial_x B^y - \partial_t E^z\right) \boldsymbol{\gamma}_z \\
& + \left(-\partial_t B^z + \partial_y E^x - \partial_x E^y\right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \\
& + \left(\partial_t B^y + \partial_z E^x - \partial_x E^z\right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_z \\
& + \left(-\partial_t B^x + \partial_z E^y - \partial_y E^z\right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \\
& + \left(\partial_x B^x + \partial_y B^y + \partial_z B^z\right) \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z
\end{aligned}
$$

Maxwell Equations

$\nabla F = J$

Div E and Curl H Equations

$$
\langle \nabla F \rangle_1 - J = 0 = \begin{aligned}[t] & \left(-J^t + \partial_x E^x + \partial_y E^y + \partial_z E^z \right) \boldsymbol{\gamma}_t \\ & + \left(-J^x - \partial_z B^y + \partial_y B^z - \partial_t E^x \right) \boldsymbol{\gamma}_x \\ & + \left(-J^y + \partial_z B^x - \partial_x B^z - \partial_t E^y \right) \boldsymbol{\gamma}_y \\ & + \left(-J^z - \partial_y B^x + \partial_x B^y - \partial_t E^z \right) \boldsymbol{\gamma}_z \end{aligned}
$$

Curl E and Div B equations

$$
\langle \nabla F \rangle_3 = 0 = \begin{aligned}[t] & \left(-\partial_t B^z + \partial_y E^x - \partial_x E^y \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \\ & + \left(\partial_t B^y + \partial_z E^x - \partial_x E^z \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_z \\ & + \left(-\partial_t B^x + \partial_z E^y - \partial_y E^z \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \\ & + \left(\partial_x B^x + \partial_y B^y + \partial_z B^z \right) \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \end{aligned}
$$

```
def Dirac_Equation_in_Geom_Calculus():
    Print_Function()
    coords = symbols('t x y z',real=True)
    (st4d,g0,g1,g2,g3) = Ga.build('gamma*t|x|y|z',g=[1, 1, 1, 1],coords=coords)
    I = st4d.i

    (m,e) = symbols('m e')

    psi = st4d.mv('psi','spinor',f=True)
    A = st4d.mv('A','vector',f=True)
    sig_z = g3*g0

    print(r'\T{4 Vector  Potential\;\;}\\bs{A} =',A)
    print(r'\T{8 component  real  spinor\;\;}\bs{\psi} =',psi)

    dirac_eq = (st4d.grad*psi)*I*sig_z  e*A*psi  m*psi*g0
    dirac_eq = dirac_eq.simplify()

    print(r'\T{Dirac  Equation\;\;}\nabla  \bs{\psi}  I  \sigma_{z} e\bs{A}\bs{\psi} m\bs{\psi}\gamma_{t} = 0 =',dirac_eq.Fmt(3))

    return
```

Code Output:

4-Vector Potential
$$
bsA = \begin{aligned}[t] & A^t \boldsymbol{\gamma}_t \\ & + A^x \boldsymbol{\gamma}_x \\ & + A^y \boldsymbol{\gamma}_y \\ & + A^z \boldsymbol{\gamma}_z \end{aligned}
$$

8-component real spinor
$$
\boldsymbol{\psi} = \begin{aligned}[t] & \psi \\ & + \psi^{tx} \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \\ & + \psi^{ty} \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y \\ & + \psi^{tz} \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_z \\ & + \psi^{xy} \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \\ & + \psi^{xz} \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_z \\ & + \psi^{yz} \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \\ & + \psi^{txyz} \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \end{aligned}
$$

Dirac Equation
$$
\nabla \boldsymbol{\psi} I \sigma_z - e \boldsymbol{A} \boldsymbol{\psi} - m \boldsymbol{\psi} \gamma_t = 0 = \begin{aligned}[t] & \left(-eA^t \psi - eA^x \psi^{tx} - eA^y \psi^{ty} - eA^z \psi^{tz} - m\psi - \partial_y \psi^{tx} - \partial_z \psi^{txyz} + \partial_x \psi^{ty} + \partial_t \psi^{xy} \right) \boldsymbol{\gamma}_t \\ & + \left(-eA^t \psi^{tx} - eA^x \psi - eA^y \psi^{xy} - eA^z \psi^{xz} + m\psi^{tx} + \partial_y \psi - \partial_t \psi^{ty} - \partial_x \psi^{xy} + \partial_z \psi^{yz} \right) \boldsymbol{\gamma}_x \\ & + \left(-eA^t \psi^{ty} + eA^x \psi^{xy} - eA^y \psi - eA^z \psi^{yz} + m\psi^{ty} - \partial_x \psi + \partial_t \psi^{tx} - \partial_y \psi^{xy} - \partial_z \psi^{xz} \right) \boldsymbol{\gamma}_y \\ & + \left(-eA^t \psi^{tz} + eA^x \psi^{xz} + eA^y \psi^{yz} - eA^z \psi + m\psi^{tz} + \partial_t \psi^{txyz} - \partial_z \psi^{xy} + \partial_y \psi^{xz} - \partial_x \psi^{yz} \right) \boldsymbol{\gamma}_z \\ & + \left(-eA^t \psi^{xy} + eA^x \psi^{ty} - eA^y \psi^{tx} - eA^z \psi^{txyz} - m\psi^{xy} - \partial_t \psi + \partial_x \psi^{tx} + \partial_y \psi^{ty} + \partial_z \psi^{tz} \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \\ & + \left(-eA^t \psi^{xz} + eA^x \psi^{tz} + eA^y \psi^{txyz} - eA^z \psi^{tx} - m\psi^{xz} + \partial_x \psi^{txyz} + \partial_z \psi^{ty} - \partial_y \psi^{tz} - \partial_t \psi^{yz} \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_z \\ & + \left(-eA^t \psi^{yz} - eA^x \psi^{txyz} + eA^y \psi^{tz} - eA^z \psi^{ty} - m\psi^{yz} - \partial_z \psi^{tx} + \partial_y \psi^{txyz} + \partial_x \psi^{tz} + \partial_t \psi^{xz} \right) \boldsymbol{\gamma}_t \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \\ & + \left(-eA^t \psi^{txyz} - eA^x \psi^{yz} + eA^y \psi^{xz} - eA^z \psi^{xy} + m\psi^{txyz} + \partial_z \psi - \partial_t \psi^{tz} - \partial_x \psi^{xz} - \partial_y \psi^{yz} \right) \boldsymbol{\gamma}_x \wedge \boldsymbol{\gamma}_y \wedge \boldsymbol{\gamma}_z \end{aligned}
$$

```python
def Lorentz_Tranformation_in_Geog_Algebra():
    Print_Function()
    (alpha,beta,gamma) = symbols('alpha beta gamma')
    (x,t,xp,tp) = symbols("x t x' t'",real=True)
    (st2d,g0,g1) = Ga.build('gamma*t|x',g=[1, 1])

    from sympy import sinh,cosh

    R = cosh(alpha/2)+sinh(alpha/2)*(g0^g1)
    X = t*g0+x*g1
    Xp = tp*g0+xp*g1
    print('R =',R)

    print(r"t\bm{\gamma_{t}}+x\bm{\gamma_{x}} = t'\bm{\gamma'_{t}}+x'\bm{\gamma'_{x}} = R\lp t'\bm{\gamma_{t}}+x'\bm{\gamma_{x}}\rp R^{\dagger}")

    Xpp = R*Xp*R.rev()
    Xpp = Xpp.collect()
    Xpp = Xpp.trigsimp()
    print(r't\bm{\gamma_{t}}+x\bm{\gamma_{x}} =',Xpp)
    Xpp = Xpp.subs({sinh(alpha):gamma*beta,cosh(alpha):gamma})

    print(r'\f{\sinh}{\alpha} = \gamma\beta')
    print(r'\f{\cosh}{\alpha} = \gamma')

    print(r't\bm{\gamma_{t}}+x\bm{\gamma_{x}} =',Xpp.collect())
    return
```

Code Output:

$$R = \begin{aligned} &\cosh\left(\frac{\alpha}{2}\right) \\ &+ \sinh\left(\frac{\alpha}{2}\right)\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{x} \end{aligned}$$

$$t\boldsymbol{\gamma_{t}}+x\boldsymbol{\gamma_{x}} = t'\boldsymbol{\gamma'_{t}}+x'\boldsymbol{\gamma'_{x}} = R\left(t'\boldsymbol{\gamma_{t}}+x'\boldsymbol{\gamma_{x}}\right)R^{\dagger}$$

$$t\boldsymbol{\gamma_{t}}+x\boldsymbol{\gamma_{x}} = \begin{aligned} &\left(t'\cosh(\alpha) - x'\sinh(\alpha)\right)\boldsymbol{\gamma}_{t} \\ &+ \left(-t'\sinh(\alpha) + x'\cosh(\alpha)\right)\boldsymbol{\gamma}_{x} \end{aligned}$$

$$\sinh(\alpha) = \gamma\beta$$

$$\cosh(\alpha) = \gamma$$

$$t\boldsymbol{\gamma_{t}}+x\boldsymbol{\gamma_{x}} = \begin{aligned} &\gamma\left(-\beta x' + t'\right)\boldsymbol{\gamma}_{t} \\ &+ \gamma\left(-\beta t' + x'\right)\boldsymbol{\gamma}_{x} \end{aligned}$$

```python
def General_Lorentz_Tranformation():
    Print_Function()
    (alpha,beta,gamma) = symbols('alpha beta gamma')
    (x,y,z,t) = symbols("x y z t",real=True)
    (st4d,g0,g1,g2,g3) = Ga.build('gamma*t|x|y|z',g=[1, 1, 1, 1])

    B = (x*g1+y*g2+z*g3)^(t*g0)
    print(B)
    print(B.exp(hint='+'))
    print(B.exp(hint=' '))
```

Code Output:

$$\begin{aligned} &- tx\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{x} \\ &- ty\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{y} \\ &- tz\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{z} \end{aligned}$$

$$\cosh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)$$
$$-\frac{tx\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{x}$$
$$-\frac{ty\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{y}$$
$$-\frac{tz\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{z}$$

$$\cosh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)$$
$$-\frac{tx\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{x}$$
$$-\frac{ty\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{y}$$
$$-\frac{tz\sinh\left(\sqrt{x^{2}+y^{2}+z^{2}}\,|t|\right)}{\sqrt{x^{2}+y^{2}+z^{2}}\,|t|}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{z}$$

```python
def Lie_Group():
    Print_Function()
    coords = symbols('t x y z',real=True)
    (st4d,g0,g1,g2,g3) = Ga.build('gamma*t|x|y|z',g=[1, 1, 1, 1],coords=coords)
    I = st4d.i

    a = st4d.mv('a','vector')
    B = st4d.mv('B','bivector')
    print('a =',a)
    print('B =',B)
    print(r'a\cdot B =', a|B)
    print(r'(a\cdot B)\cdot B =',((a|B)|B).simplify().Fmt(3))
    print(r'((a\cdot B)\cdot B)\cdot B =',(((a|B)|B)|B).simplify().Fmt(3))

    return
```

Code Output:

$$a = \begin{aligned} & a^{t}\boldsymbol{\gamma}_{t} \\ & + a^{x}\boldsymbol{\gamma}_{x} \\ & + a^{y}\boldsymbol{\gamma}_{y} \\ & + a^{z}\boldsymbol{\gamma}_{z} \end{aligned}$$

$$B = \begin{aligned} & B^{tx}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{x} \\ & + B^{ty}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{y} \\ & + B^{tz}\boldsymbol{\gamma}_{t}\wedge\boldsymbol{\gamma}_{z} \\ & + B^{xy}\boldsymbol{\gamma}_{x}\wedge\boldsymbol{\gamma}_{y} \\ & + B^{xz}\boldsymbol{\gamma}_{x}\wedge\boldsymbol{\gamma}_{z} \\ & + B^{yz}\boldsymbol{\gamma}_{y}\wedge\boldsymbol{\gamma}_{z} \end{aligned}$$

$$a\cdot B = \begin{aligned} & \left(B^{tx}a^{x}+B^{ty}a^{y}+B^{tz}a^{z}\right)\boldsymbol{\gamma}_{t} \\ & + \left(B^{tx}a^{t}+B^{xy}a^{y}+B^{xz}a^{z}\right)\boldsymbol{\gamma}_{x} \\ & + \left(B^{ty}a^{t}-B^{xy}a^{x}+B^{yz}a^{z}\right)\boldsymbol{\gamma}_{y} \\ & + \left(B^{tz}a^{t}-B^{xz}a^{x}-B^{yz}a^{y}\right)\boldsymbol{\gamma}_{z} \end{aligned}$$

$$
\begin{aligned}
(a\cdot B)\cdot B = {} & \left(\left(B^{tx}\right)^2 a^t + B^{tx}B^{xy}a^y + B^{tx}B^{xz}a^z + \left(B^{ty}\right)^2 a^t - B^{ty}B^{xy}a^x + B^{ty}B^{yz}a^z + \left(B^{tz}\right)^2 a^t - B^{tz}B^{xz}a^x - B^{tz}B^{yz}a^y\right)\boldsymbol{\gamma}_t \\
& + \left(\left(B^{tx}\right)^2 a^x + B^{tx}B^{ty}a^y + B^{tx}B^{tz}a^z + B^{ty}B^{xy}a^t + B^{tz}B^{xz}a^t - (B^{xy})^2 a^x + B^{xy}B^{yz}a^z - (B^{xz})^2 a^x - B^{xz}B^{yz}a^y\right)\boldsymbol{\gamma}_x \\
& + \left(B^{tx}B^{ty}a^x - B^{tx}B^{xy}a^t + \left(B^{ty}\right)^2 a^y + B^{ty}B^{tz}a^z + B^{tz}B^{yz}a^t - (B^{xy})^2 a^y - B^{xy}B^{xz}a^z - B^{xz}B^{yz}a^x - (B^{yz})^2 a^y\right)\boldsymbol{\gamma}_y \\
& + \left(B^{tx}B^{tz}a^x - B^{tx}B^{xz}a^t + B^{ty}B^{tz}a^y - B^{ty}B^{yz}a^t + \left(B^{tz}\right)^2 a^z - B^{xy}B^{xz}a^y + B^{xy}B^{yz}a^x - (B^{xz})^2 a^z - (B^{yz})^2 a^z\right)\boldsymbol{\gamma}_z
\end{aligned}
$$

$$
\begin{aligned}
((a\cdot B)\cdot B)\cdot B = {} & ((B^{tx})^3 a^x + (B^{tx})^2 B^{ty}a^y + (B^{tx})^2 B^{tz}a^z + B^{tx}(B^{ty})^2 a^x + B^{tx}(B^{tz})^2 a^x - B^{tx}(B^{xy})^2 a^x + B^{tx}B^{xy}B^{yz}a^z - B^{tx}(B^{xz})^2 a^x - B^{tx}B^{xz}B^{yz}a^y + (B^{ty})^3 a^y + (B^{ty})^2 B^{tz}a^z + B^{ty}(B^{tz})^2 a^y - B^{ty}(B^{xy})^2 a^y - B^{ty}B^{xy}B \\
& + ((B^{tx})^3 a^t + (B^{tx})^2 B^{xy}a^y + (B^{tx})^2 B^{xz}a^z + B^{tx}(B^{ty})^2 a^t + B^{tx}B^{ty}B^{yz}a^z + B^{tx}(B^{tz})^2 a^t - B^{tx}B^{tz}B^{yz}a^y - B^{tx}(B^{xy})^2 a^t - B^{tx}(B^{xz})^2 a^t + (B^{ty})^2 B^{xy}a^y + B^{ty}B^{tz}B^{xy}a^z + B^{ty}B^{tz}B^{xz}a^y - B^{ty}B^{xz}B^{yz}a^t + (B \\
& + ((B^{tx})^2 B^{ty}a^t - (B^{tx})^2 B^{xy}a^x + B^{tx}B^{ty}B^{xz}a^z - B^{tx}B^{tz}B^{xy}a^z + B^{tx}B^{tz}B^{yz}a^x - B^{tx}B^{xz}B^{yz}a^t + (B^{ty})^3 a^t - (B^{ty})^2 B^{xy}a^x + (B^{ty})^2 B^{yz}a^z + B^{ty}(B^{tz})^2 a^t - B^{ty}B^{tz}B^{xz}a^x - B^{ty}(B^{xy})^2 a^t - B^{ty}(B^{yz})^2 a^t + (B \\
& + ((B^{tx})^2 B^{tz}a^t - (B^{tx})^2 B^{xz}a^x - B^{tx}B^{ty}B^{xz}a^y - B^{tx}B^{ty}B^{yz}a^x + B^{tx}B^{tz}B^{xy}a^y + B^{tx}B^{xy}B^{yz}a^t + (B^{ty})^2 B^{tz}a^t - (B^{ty})^2 B^{yz}a^y - B^{ty}B^{tz}B^{xy}a^x - B^{ty}B^{xy}B^{xz}a^t + (B^{tz})^3 a^t - (B^{tz})^2 B^{xz}a^x - (B^{tz})^2 B^{yz}a^y -
\end{aligned}
$$