EIGENFUNCTION

```
w[x_] := c Exp[μ x] + c Exp[-μ x]
```

INTEGRALS

In[7]:=
```
I1[x_] := Collect[ExpandAll[
    Integrate[(z'[s]/(2 μ) w[ξ] + 3 z[s] Abs[z[s]]^2/(2 μ) w[ξ] Abs[w[ξ]]^2) Exp[-μ ξ], {ξ, 0, x}]
  ], {Abs[z[s]]^2 z[s], z'[s]}]
```

In[9]:=
```
I1[x]
```

Out[9]=
$$\text{Abs}[z[s]]^2 \left(\frac{15\, c^2\, \text{Conjugate}[c]}{8\,\mu^2} - \frac{3\, c^2\, e^{-4 x \mu}\, \text{Conjugate}[c]}{8\,\mu^2} - \frac{9\, c^2\, e^{-2 x \mu}\, \text{Conjugate}[c]}{4\,\mu^2} + \frac{3\, c^2\, e^{2 x \mu}\, \text{Conjugate}[c]}{4\,\mu^2} + \frac{9\, c^2\, x\, \text{Conjugate}[c]}{2\,\mu}\right) z[s] + \left(\frac{c}{4\,\mu^2} - \frac{c\, e^{-2 x \mu}}{4\,\mu^2} + \frac{c\, x}{2\,\mu}\right) z'[s]$$

In[12]:=
```
I2[x_] :=
 - Collect[ExpandAll[
    Integrate[(z'[s]/(2 μ) w[ξ] + 3 z[s] Abs[z[s]]^2/(2 μ) w[ξ] Abs[w[ξ]]^2) Exp[μ ξ], {ξ, 0, x}]
  ], {Abs[z[s]]^2 z[s], z'[s]}]
```

In[13]:=
```
I2[x]
```

Out[13]=
$$-\text{Abs}[z[s]]^2 \left(-\frac{15\, c^2\, \text{Conjugate}[c]}{8\,\mu^2} - \frac{3\, c^2\, e^{-2 x \mu}\, \text{Conjugate}[c]}{4\,\mu^2} + \frac{9\, c^2\, e^{2 x \mu}\, \text{Conjugate}[c]}{4\,\mu^2} + \frac{3\, c^2\, e^{4 x \mu}\, \text{Conjugate}[c]}{8\,\mu^2} + \frac{9\, c^2\, x\, \text{Conjugate}[c]}{2\,\mu}\right) z[s] - \left(-\frac{c}{4\,\mu^2} + \frac{c\, e^{2 x \mu}}{4\,\mu^2} + \frac{c\, x}{2\,\mu}\right) z'[s]$$

DERIVATES OF INTEGRALS

In[26]:=
```
D[I1[x], x]
```

Out[26]=
$$\text{Abs}[z[s]]^2 \left(\frac{9\, c^2\, \text{Conjugate}[c]}{2\,\mu} + \frac{3\, c^2\, e^{-4 x \mu}\, \text{Conjugate}[c]}{2\,\mu} + \frac{9\, c^2\, e^{-2 x \mu}\, \text{Conjugate}[c]}{2\,\mu} + \frac{3\, c^2\, e^{2 x \mu}\, \text{Conjugate}[c]}{2\,\mu}\right) z[s] + \left(\frac{c}{2\,\mu} + \frac{c\, e^{-2 x \mu}}{2\,\mu}\right) z'[s]$$

In[27]:=
```
D[I2[x], x]
```

Out[27]=
$$-\text{Abs}[z[s]]^2 \left(\frac{9\, c^2\, \text{Conjugate}[c]}{2\,\mu} + \frac{3\, c^2\, e^{-2 x \mu}\, \text{Conjugate}[c]}{2\,\mu} + \frac{9\, c^2\, e^{2 x \mu}\, \text{Conjugate}[c]}{2\,\mu} + \frac{3\, c^2\, e^{4 x \mu}\, \text{Conjugate}[c]}{2\,\mu}\right) z[s] - \left(\frac{c}{2\,\mu} + \frac{c\, e^{2 x \mu}}{2\,\mu}\right) z'[s]$$

In[33]:=
```
pI1[x_] :=
  Abs[z[s]]^2 ((9 c^2 Conjugate[c])/(2 μ) + (3 c^2 E^(-4 x μ) Conjugate[c])/(2 μ) + (9 c^2 E^(-2 x μ) Conjugate[c])/(2 μ) +
    (3 c^2 E^(2 x μ) Conjugate[c])/(2 μ)) z[s] + (c/(2 μ) + (c E^(-2 x μ))/(2 μ)) z'[s]
```

In[34]:=
```
pI1[0]
```

Out[34]=
$$\frac{12\, c^2\, \text{Abs}[z[s]]^2\, \text{Conjugate}[c]\, z[s]}{\mu} + \frac{c\, z'[s]}{\mu}$$

In[35]:=
```
pI2[x_] :=
  -Abs[z[s]]^2 ((9 c^2 Conjugate[c])/(2 μ) + (3 c^2 E^(-2 x μ) Conjugate[c])/(2 μ) + (9 c^2 E^(2 x μ) Conjugate[c])/(2 μ) +
    (3 c^2 E^(4 x μ) Conjugate[c])/(2 μ)) z[s] - (c/(2 μ) + (c E^(2 x μ))/(2 μ)) z'[s]
```

FORWARD TO SYSTEM

In[36]:=
```
pI2[0]
```

Out[36]=
$$-\frac{12\, c^2\, \text{Abs}[z[s]]^2\, \text{Conjugate}[c]\, z[s]}{\mu} - \frac{c\, z'[s]}{\mu}$$

In[37]:=
```
pI1[0] + pI2[0]
```

Out[37]= 0