In[1]:=
```
Solve[
 Exp[-2 i Sqrt[2 eng] ] (Sqrt[2 eng] - i Sqrt[2 (eng - 30)] Cot[Sqrt[2 (eng - 30)]]) /
    (Sqrt[2 eng] + i Sqrt[2 (eng - 30)] Cot[Sqrt[2 (eng - 30)]]) == -Exp[i 2 d], d]
```

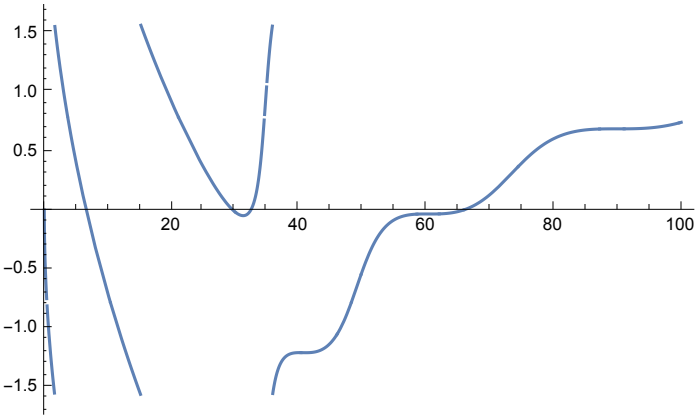
Out[1]=

$$\left\{\left\{d \to \text{ConditionalExpression}\left[-\frac{1}{2} i \left(2 i \pi C[1] + \text{Log}\left[-\left(\left(\sqrt{2}\, e^{-2 i \sqrt{2}\, \sqrt{\text{eng}}}\, \sqrt{\text{eng}}\right) \Big/ \left(\sqrt{2}\, \sqrt{\text{eng}} + i \sqrt{2}\, \sqrt{-30+\text{eng}}\, \text{Cot}\left[\sqrt{2}\, \sqrt{-30+\text{eng}}\right]\right)\right) + \left(i \sqrt{2}\, e^{-2 i \sqrt{2}\, \sqrt{\text{eng}}}\, \sqrt{-30+\text{eng}}\, \text{Cot}\left[\sqrt{2}\, \sqrt{-30+\text{eng}}\right]\right) \Big/ \left(\sqrt{2}\, \sqrt{\text{eng}} + i \sqrt{2}\, \sqrt{-30+\text{eng}}\, \text{Cot}\left[\sqrt{2}\, \sqrt{-30+\text{eng}}\right]\right)\right]\right), C[1] \in \mathbb{Z}\right]\right\}\right\}$$

In[1]:=
```
d[eng_] := -1/2 i (Log[-(Sqrt[2] E^(-2 i Sqrt[2] Sqrt[eng]) Sqrt[eng])/(Sqrt[2] Sqrt[eng] + i Sqrt[2] Sqrt[-30 + eng] Cot[Sqrt[2] Sqrt[-30 + eng]]) +
   (i Sqrt[2] E^(-2 i Sqrt[2] Sqrt[eng]) Sqrt[-30 + eng] Cot[Sqrt[2] Sqrt[-30 + eng]])/(Sqrt[2] Sqrt[eng] + i Sqrt[2] Sqrt[-30 + eng] Cot[Sqrt[2] Sqrt[-30 + eng]])])
```

In[2]:=
```
Plot[d[eng], {eng, 0, 100}]
```

Out[2]=



In[3]:=
```
diff[eng_] := D[d[eng], eng]
```

In[4]:= **diff[eng]**

Out[4]=

$$
-\left(\left(\left(i\left(\frac{2\,i\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}}{\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}-\right.\right.\right.\right.
$$

$$
\left.\left.\left.\left.e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\Big/\left(\sqrt{2}\,\sqrt{eng}\left(\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)\right)+\right.\right.\right.\right.
$$

$$
\left.\left.\left.\left(i\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)\Big/\right.\right.\right.
$$

$$
\left.\left.\left(\sqrt{2}\,\sqrt{-30+eng}\left(\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)\right)+\right.
$$

$$
\left.\left(2\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)\Big/\right.
$$

$$
\left.\left(\sqrt{eng}\left(\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)\right)-\right.
$$

$$
\left.\frac{i\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\csc\left[\sqrt{2}\,\sqrt{-30+eng}\right]^2}{\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}+\left(\sqrt{2}\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\right.\right.
$$

$$
\left.\left.\sqrt{eng}\left(\frac{1}{\sqrt{2}\,\sqrt{eng}}+\frac{i\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}{\sqrt{2}\,\sqrt{-30+eng}}-i\,\csc\left[\sqrt{2}\,\sqrt{-30+eng}\right]^2\right)\right)\Big/\right.
$$

$$
\left.\left(\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)^2-\right.
$$

$$
\left.\left(i\,\sqrt{2}\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right.\right.
$$

$$
\left.\left.\left(\frac{1}{\sqrt{2}\,\sqrt{eng}}+\frac{i\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}{\sqrt{2}\,\sqrt{-30+eng}}-i\,\csc\left[\sqrt{2}\,\sqrt{-30+eng}\right]^2\right)\right)\Big/\right.
$$

$$
\left.\left.\left(\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]\right)^2\right)\right)\Big/
$$

$$
\left(2\left(-\frac{\sqrt{2}\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\sqrt{eng}}{\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}+\right.\right.
$$

$$
\left.\left.\left.\frac{i\,\sqrt{2}\,e^{-2\,i\,\sqrt{2}\,\sqrt{eng}}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}{\sqrt{2}\,\sqrt{eng}+i\,\sqrt{2}\,\sqrt{-30+eng}\,\cot\left[\sqrt{2}\,\sqrt{-30+eng}\right]}\right)\right)\right)
$$

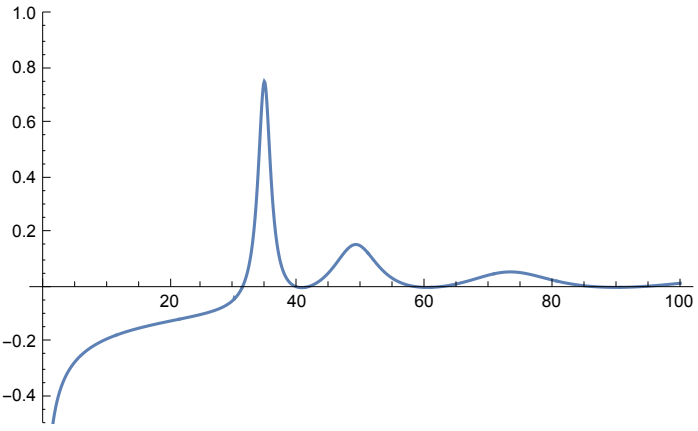
In[8]:=
$$\text{difff}[EE\_] := \left(i\, e^{2 i \sqrt{2}\, \sqrt{EE}} \left(\sqrt{2}\, \sqrt{EE} + i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right.$$
$$\left(\left(i \sqrt{2}\, e^{-2 i \sqrt{2}\, \sqrt{EE}} \left(\sqrt{2}\, \sqrt{EE} - i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right)\Big/\right.$$
$$\left(\sqrt{EE} \left(\sqrt{2}\, \sqrt{EE} + i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right) +$$
$$\left(e^{-2 i \sqrt{2}\, \sqrt{EE}} \left(\sqrt{2}\, \sqrt{EE} - i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right.$$
$$\left.\left(\frac{1}{\sqrt{2}\, \sqrt{EE}} + \frac{i \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]}{\sqrt{2}\, \sqrt{-30+EE}} - i \csc\left[\sqrt{2}\, \sqrt{-30+EE}\right]^2\right)\right)\Big/$$
$$\left(\sqrt{2}\, \sqrt{EE} + i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)^2 -$$
$$\left(e^{-2 i \sqrt{2}\, \sqrt{EE}} \left(\frac{1}{\sqrt{2}\, \sqrt{EE}} - \frac{i \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]}{\sqrt{2}\, \sqrt{-30+EE}} + i \csc\left[\sqrt{2}\, \sqrt{-30+EE}\right]^2\right)\right)\Big/$$
$$\left.\left.\left(\sqrt{2}\, \sqrt{EE} + i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right)\right)\Big/$$
$$\left(2 \left(\sqrt{2}\, \sqrt{EE} - i \sqrt{2}\, \sqrt{-30+EE}\, \cot\left[\sqrt{2}\, \sqrt{-30+EE}\right]\right)\right)$$

In[9]:=
```
N[difff[1]]
```

Out[9]=
$$-0.614259 + 0.\, i$$

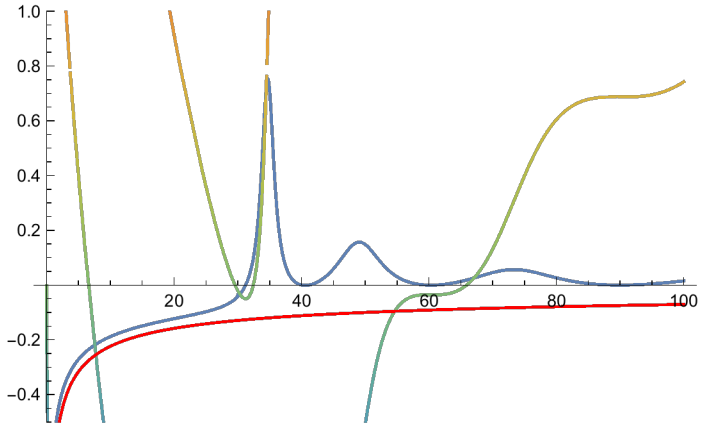
In[12]:=
```
ListLinePlot[Table[{x, N[difff[EE]] /. EE → x}, {x, 0.1, 100, 0.1}],
 PlotRange → {-0.5, 1}]
```

Out[12]=



In[14]:=
```
Show[ListLinePlot[Table[{x, N[difff[EE]] /. EE → x}, {x, 0.1, 100, 0.1}],
  PlotRange → {-0.5, 1}], Plot[d[eng], {eng, 0, 100}, ColorFunction → "Rainbow"],
 Plot[-1 / (Sqrt[2 eng]), {eng, 0, 100}, ColorFunction → Hue, PlotRange → All]]
```

Out[14]=



In[15]:=
```
Show[%14, ImageSize → Large]
```

Out[15]=