

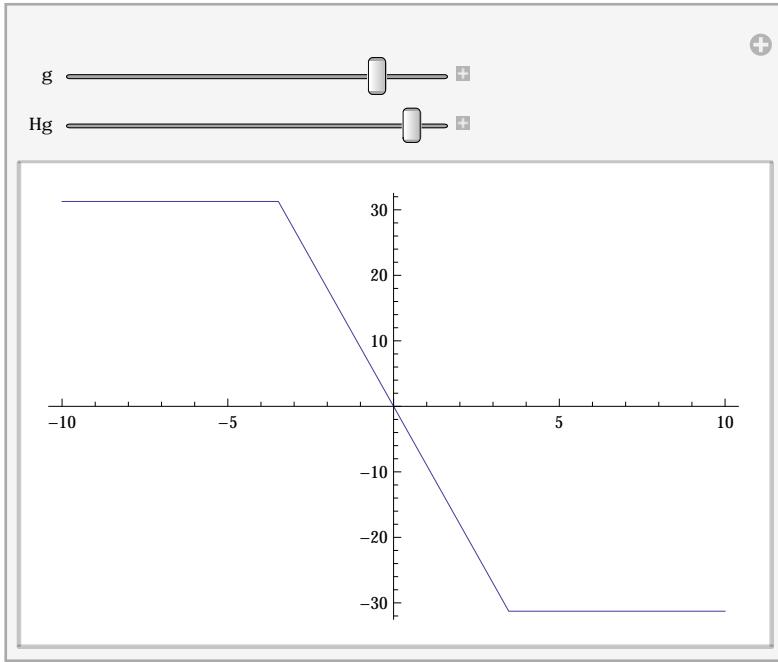
```

ClearAll
ClearAll

Φ[x_] :=
Piecewise[{{{-Hg x, -g/2 <= x <= g/2}, {-g Hg/2, x >= g/2}, {g Hg/2, x < -g/2}}]

Manipulate[Plot[
Piecewise[{{{-Hg x, -g/2 <= x <= g/2}, {-g Hg/2, x >= g/2}, {g Hg/2, x < -g/2}}], {x, -10, 10}], {g, -10, 10}, {Hg, -10, 10}]

```



$$\begin{aligned}
& \text{Integrate} \left[ \frac{y_1}{\pi} \frac{\Phi[x]}{(x_1 - x)^2 + y_1^2}, \{x, -\infty, \infty\}, \text{Assumptions} \rightarrow y_1 > 0 \right] \\
& y_1 \left( \begin{array}{ll} -Hg x & -\frac{g}{2} \leq x \leq \frac{g}{2} \\ -\frac{g Hg}{2} & x \geq \frac{g}{2} \\ \frac{g Hg}{2} & x < -\frac{g}{2} \\ 0 & \text{True} \end{array} \right) \\
& \text{Integrate} \left[ \frac{y_1}{\pi ((-x + x_1)^2 + y_1^2)}, \{x, -\infty, \infty\}, \text{Assumptions} \rightarrow y_1 > 0 \right] \\
& \text{Integrate} \left[ \frac{y_1}{\pi} \frac{\Phi[x]}{(x_1 - x)^2 + y_1^2}, \{x, -\infty, \infty\}, \text{Assumptions} \rightarrow x_1 > 0 \& y_1 > 0 \right] \\
& \begin{cases} -\frac{g Hg (\pi - 2 \operatorname{ArcCot}[\frac{2 y_1}{g - 2 x_1}] + 2 \operatorname{ArcTan}[\frac{2 y_1}{g - 2 x_1}])}{4 \pi} & g \leq 0 \\ -\frac{1}{4 \pi} Hg \left( g \pi - 2 g \operatorname{ArcCot}[\frac{2 y_1}{g - 2 x_1}] + 4 x_1 \operatorname{ArcCot}[\frac{2 y_1}{g - 2 x_1}] + 4 x_1 \operatorname{ArcCot}[\frac{2 y_1}{g + 2 x_1}] - 2 g \operatorname{ArcTan}[\frac{2 y_1}{g + 2 x_1}] - 4 y_1 \operatorname{ArcTanh}[\frac{4 g x_1}{g^2 + 4 (x_1^2 + y_1^2)}] \right) & \text{True} \end{cases}
\end{aligned}$$

```

Phi2[x1_, y1_] :=
  -  $\frac{Hg}{\pi} \left( \left( x1 + \frac{g}{2} \right) \text{ArcTan} \left[ \frac{\left( x1 + \frac{g}{2} \right)}{y1} \right] - \left( x1 - \frac{g}{2} \right) \text{ArcTan} \left[ \frac{\left( x1 - \frac{g}{2} \right)}{y1} \right] - \frac{y}{2} \text{Log} \left[ \frac{\left( x1 + \frac{g}{2} \right)^2 + y1^2}{\left( x1 - \frac{g}{2} \right)^2 + y1^2} \right] \right);$ 

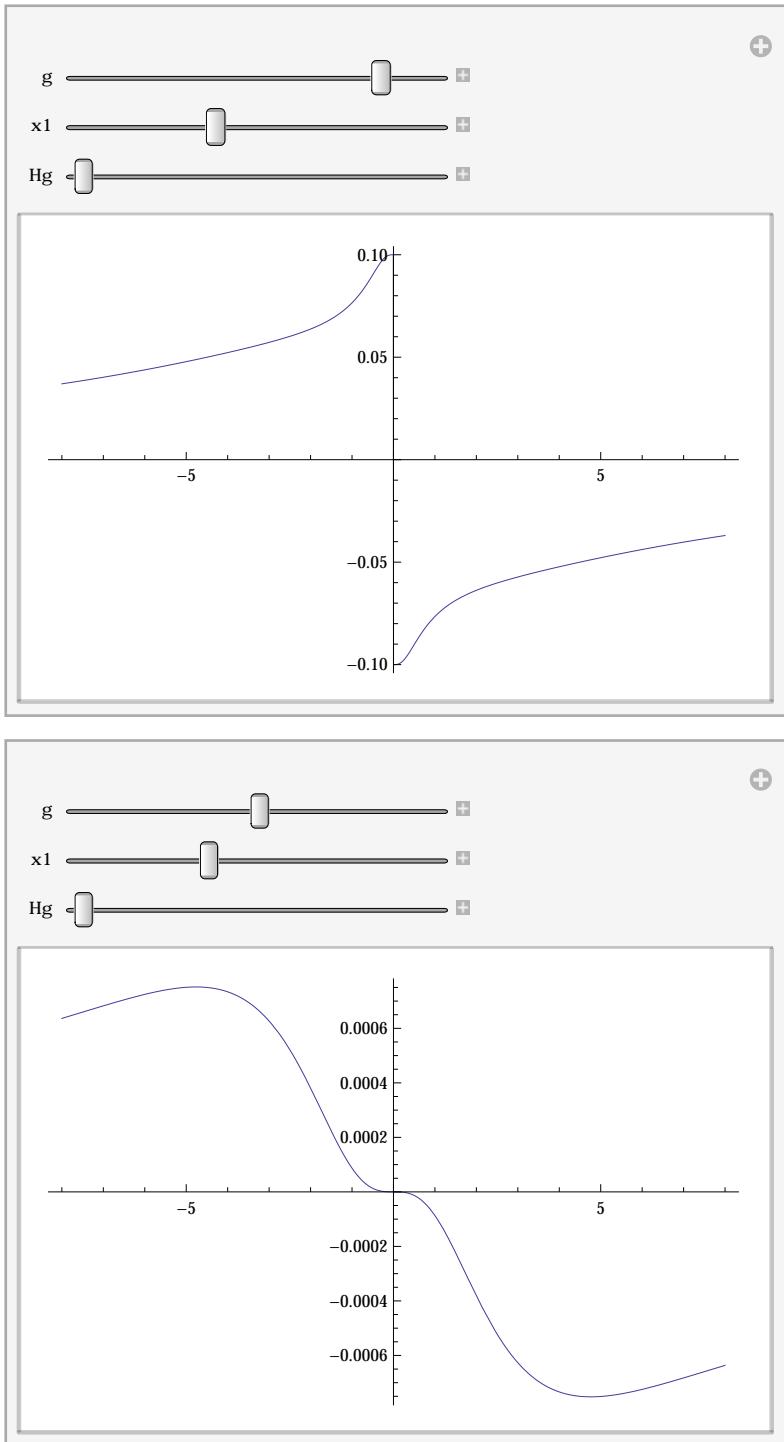
Hx[x1_, y1_] := D[Phi2, x1];
Hy[x1_, y1_] := D[Phi2, y1];
Hx[x1, y1]
0

D[ -  $\frac{Hg}{\pi}$ 
   $\left( \left( x1 + \frac{g}{2} \right) \text{ArcTan} \left[ \frac{\left( x1 + \frac{g}{2} \right)}{y1} \right] - \left( x1 - \frac{g}{2} \right) \text{ArcTan} \left[ \frac{\left( x1 - \frac{g}{2} \right)}{y1} \right] - \frac{y}{2} \text{Log} \left[ \frac{\left( x1 + \frac{g}{2} \right)^2 + y1^2}{\left( x1 - \frac{g}{2} \right)^2 + y1^2} \right] \right), x1]$ 
  -  $\frac{1}{\pi} Hg \left( - \frac{-\frac{g}{2} + x1}{\left( 1 + \frac{(-\frac{g}{2} + x1)^2}{y1^2} \right) y1} + \frac{\frac{g}{2} + x1}{\left( 1 + \frac{(\frac{g}{2} + x1)^2}{y1^2} \right) y1} - \right.$ 
     $\frac{y \left( \left( -\frac{g}{2} + x1 \right)^2 + y1^2 \right) \left( \frac{2 \left( \frac{g}{2} + x1 \right)}{\left( -\frac{g}{2} + x1 \right)^2 + y1^2} - \frac{2 \left( -\frac{g}{2} + x1 \right) \left( \left( \frac{g}{2} + x1 \right)^2 + y1^2 \right)}{\left( \left( -\frac{g}{2} + x1 \right)^2 + y1^2 \right)^2} \right)}{2 \left( \left( \frac{g}{2} + x1 \right)^2 + y1^2 \right)} -$ 
     $\left. \text{ArcTan} \left[ \frac{-\frac{g}{2} + x1}{y1} \right] + \text{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y1} \right] \right)$ 
  D[ Log[  $\left( x1 + \frac{g}{2} \right)^2 + y1^2$  ], x1 ]
   $\frac{2 \left( \frac{g}{2} + x1 \right)}{\left( \frac{g}{2} + x1 \right)^2 + y1^2}$ 
  y / 2 D[ Log[  $\left( x1 + \frac{g}{2} \right)^2 + y1^2$  ], x1 ] - y / 2 D[ Log[  $\left( x1 + \frac{g}{2} \right)^2 + y1^2$  ], x1 ]
0

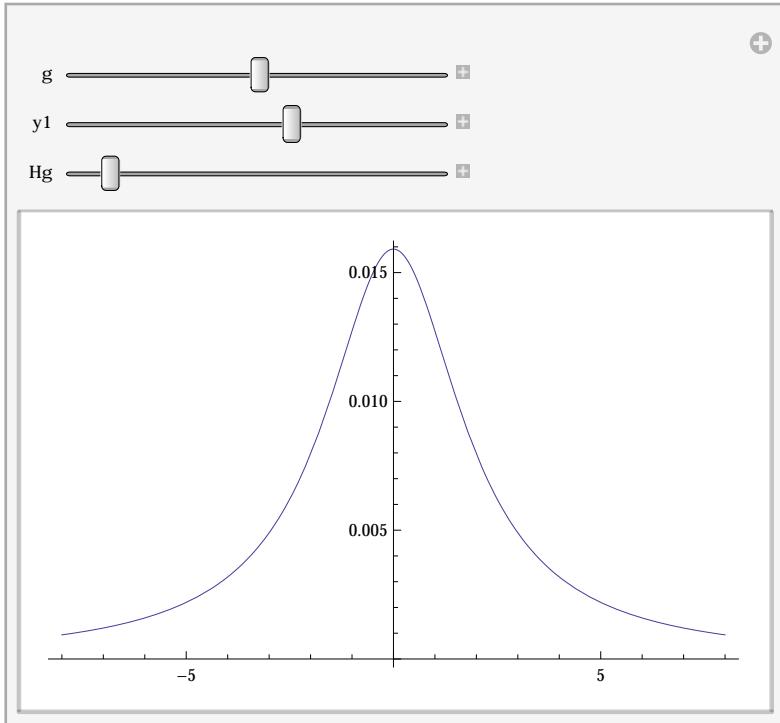
D[  $\frac{y}{2} \left( \text{Log} \left[ \left( x1 + \frac{g}{2} \right)^2 + y1^2 \right] - \text{Log} \left[ \left( x1 + \frac{g}{2} \right)^2 + y1^2 \right] \right), x1]$ 
0

```

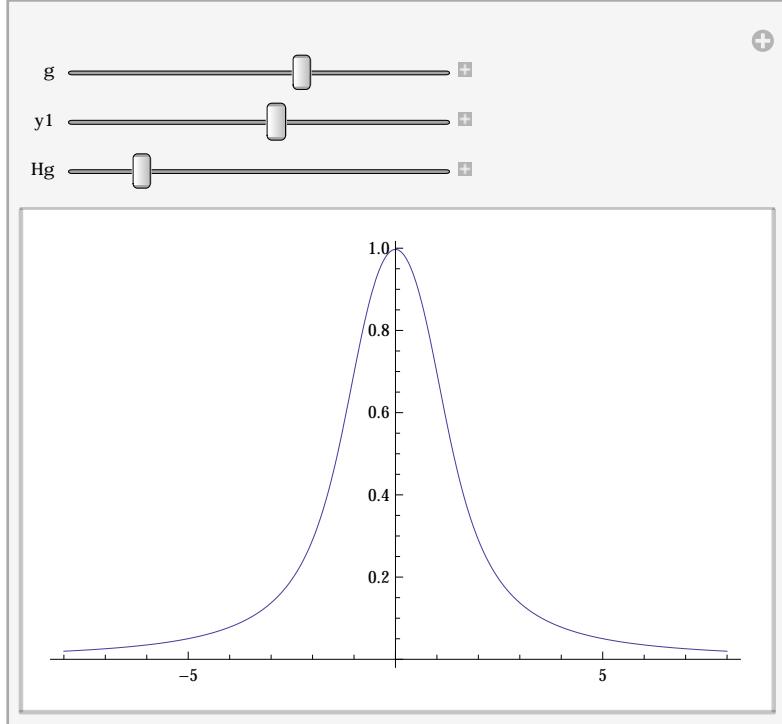
$$\begin{aligned}
& D \left[ \text{ArcTan} \left[ y1 \left( x1 + \frac{g}{2} \right) \right], x1 \right] \\
& \frac{y1}{1 + \left( \frac{g}{2} + x1 \right)^2 y1^2} \\
& D \left[ \left( x1 + \frac{g}{2} \right) \text{ArcTan} \left[ \frac{x1}{y1} + \frac{\frac{g}{2}}{y1} \right], x1 \right] \\
& \frac{\frac{g}{2} + x1}{\left( 1 + \left( \frac{g}{2 y1} + \frac{x1}{y1} \right)^2 \right) y1} + \text{ArcTan} \left[ \frac{g}{2 y1} + \frac{x1}{y1} \right] \\
& \frac{-\frac{g}{2} + x1}{\left( 1 + \left( \frac{g}{2 y1} - \frac{x1}{y1} \right)^2 \right) y1} - \text{ArcTan} \left[ \frac{g}{2 y1} - \frac{x1}{y1} \right] \\
& D \left[ \left( x1 + \frac{g}{2} \right) \text{ArcTan} \left[ \frac{x1}{y1} + \frac{\frac{g}{2}}{y1} \right], x1 \right] - D \left[ \left( x1 - \frac{g}{2} \right) \text{ArcTan} \left[ \frac{x1}{y1} - \frac{\frac{g}{2}}{y1} \right], x1 \right] \\
& - \frac{-\frac{g}{2} + x1}{\left( 1 + \left( \frac{g}{2 y1} - \frac{x1}{y1} \right)^2 \right) y1} + \frac{\frac{g}{2} + x1}{\left( 1 + \left( \frac{g}{2 y1} + \frac{x1}{y1} \right)^2 \right) y1} + \text{ArcTan} \left[ \frac{g}{2 y1} - \frac{x1}{y1} \right] + \text{ArcTan} \left[ \frac{g}{2 y1} + \frac{x1}{y1} \right] \\
& D \left[ \text{ArcTan} [2 x], x \right] \\
& D \left[ \left( x1 + \frac{g}{2} \right) \text{ArcTan} \left[ \left( \frac{x1 + g/2}{y} \right) \right], x1 \right] \\
& \frac{\frac{g}{2} + x1}{\left( 1 + \frac{\left( \frac{g}{2} + x1 \right)^2}{y^2} \right) y} + \text{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y} \right] \\
& \text{Manipulate} \left[ \right. \\
& \left. \text{Plot} \left[ -\frac{1}{\pi} Hg \left( -\frac{-\frac{g}{2} + x1}{\left( 1 + \frac{\left( -\frac{g}{2} + x1 \right)^2}{y1^2} \right) y1} + \frac{\frac{g}{2} + x1}{\left( 1 + \frac{\left( \frac{g}{2} + x1 \right)^2}{y1^2} \right) y1} - \text{ArcTan} \left[ \frac{-\frac{g}{2} + x1}{y1} \right] + \text{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y1} \right] \right), \{y1, -8, 8\}, \{g, -8, 8\}, \{x1, -10, 10\}, \{Hg, 0.1, 12\} \right]
\end{aligned}$$



```
Manipulate[Plot[{Hg / \[Pi] ArcTan[(g y1) / (x1^2 + y1^2 - (g / 2)^2)]}, {x1, -8, 8}],  
{g, -8, 8}, {y1, -10, 10}, {Hg, 0.1, 12}]
```



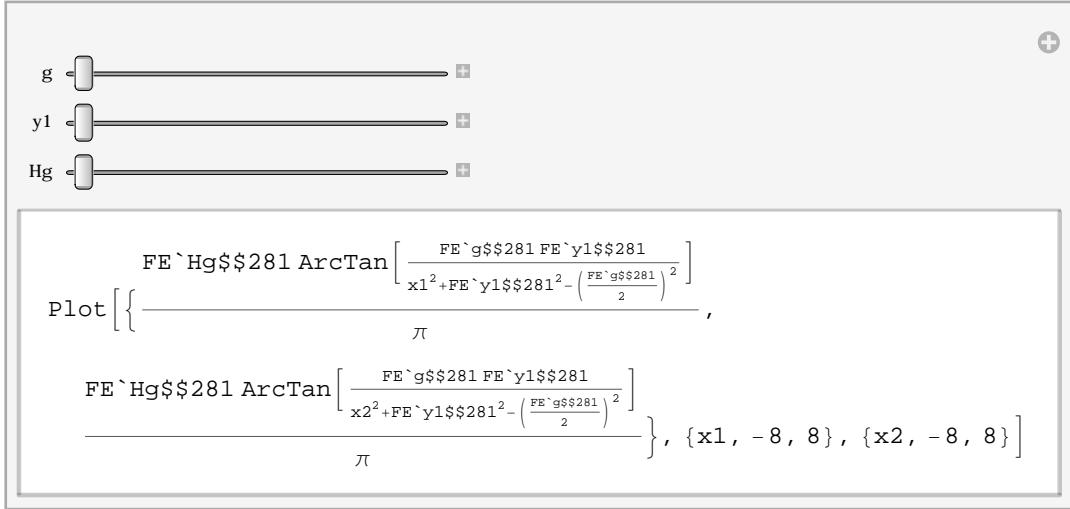
```
Manipulate[Plot[Hg / \[Pi] ArcTan[(g y1)/(x1^2 + y1^2 - (g/2)^2)], {x1, -8, 8}],  
{g, -8, 8}, {y1, -10, 10}, {Hg, 0.1, 12}]
```



```
Show[{Plot[f[x], {x, 1, 2}, PlotStyle -> Blue],  
Plot[g[x], {x, -2, -1}, PlotStyle -> Green]}, PlotRange -> All, AxesOrigin -> {0, 0}]
```

**Manipulate[**

```
Plot[{Hg / π ArcTan[(g y1)/(x12 + y12 - (g / 2)2)], Hg / π ArcTan[(g y1)/(x22 + y12 - (g / 2)2)]}, {x1, -8, 8}, {x2, -8, 8}], {g, -8, 8}, {y1, -10, 10}, {Hg, 0.1, 12}]
```



Plot::nonopt : Options expected (instead of {x2, -8, 8}) beyond position 3 in

```
Plot[{(FE`Hg\$\$281 ArcTan[FE`g\$\$281 FE`y1\$\$281]/Plus[{{3}}]), (FE`Hg\$\$281 ArcTan[FE`g\$\$281 FE`y1\$\$281]/Plus[{{3}}])}, {x1, -8, 8}, {x2, -8, 8}].
```

An option must be a rule or a list of rules. >>

$$\begin{aligned} & D\left[\left(\left(x_1 + \frac{g}{2}\right) \text{ArcTan}\left[\frac{\left(x_1 + \frac{g}{2}\right)}{y_1}\right] - \left(x_1 - \frac{g}{2}\right) \text{ArcTan}\left[\frac{\left(x_1 - \frac{g}{2}\right)}{y_1}\right]\right), x_1\right] \\ & - \frac{-\frac{g}{2} + x_1}{\left(1 + \frac{\left(\frac{g}{2} + x_1\right)^2}{y_1^2}\right) y_1} + \frac{\frac{g}{2} + x_1}{\left(1 + \frac{\left(\frac{g}{2} + x_1\right)^2}{y_1^2}\right) y_1} - \text{ArcTan}\left[\frac{-\frac{g}{2} + x_1}{y_1}\right] + \text{ArcTan}\left[\frac{\frac{g}{2} + x_1}{y_1}\right] \\ & D\left[-Hg / \text{Pi} \left(\left(x_1 + \frac{g}{2}\right) \text{ArcTan}\left[\frac{\left(x_1 + \frac{g}{2}\right)}{y_1}\right] - \left(x_1 - \frac{g}{2}\right) \text{ArcTan}\left[\frac{\left(x_1 - \frac{g}{2}\right)}{y_1}\right]\right), x_1\right] \\ & - \frac{1}{\pi} Hg \left( -\frac{-\frac{g}{2} + x_1}{\left(1 + \frac{\left(-\frac{g}{2} + x_1\right)^2}{y_1^2}\right) y_1} + \frac{\frac{g}{2} + x_1}{\left(1 + \frac{\left(\frac{g}{2} + x_1\right)^2}{y_1^2}\right) y_1} - \text{ArcTan}\left[\frac{-\frac{g}{2} + x_1}{y_1}\right] + \text{ArcTan}\left[\frac{\frac{g}{2} + x_1}{y_1}\right] \right) \end{aligned}$$

$$\nabla_{\{x1\}} \left( - \left( x1 + \frac{g}{2} \right) \operatorname{ArcTan} \left[ \frac{(x1 + \frac{g}{2})}{y1} \right] + \left( x1 - \frac{g}{2} \right) \operatorname{ArcTan} \left[ \frac{(x1 - \frac{g}{2})}{y1} \right] \right)$$

$$\left\{ \frac{-\frac{g}{2} + x1}{\left( 1 + \frac{(-\frac{g}{2} + x1)^2}{y1^2} \right) y1} + \frac{-\frac{g}{2} - x1}{\left( 1 + \frac{(\frac{g}{2} + x1)^2}{y1^2} \right) y1} + \operatorname{ArcTan} \left[ \frac{-\frac{g}{2} + x1}{y1} \right] - \operatorname{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y1} \right] \right\}$$

$$D \left[ \left( x1 + \frac{g}{2} \right) \operatorname{ArcTan} \left[ \frac{x1}{y1} + \frac{\frac{g}{2}}{y1} \right], x1 \right] -$$

$$- \frac{\left( \frac{g}{2} + x1 \right) y}{\left( \frac{g}{2} + x1 \right)^2 + y1^2} + \frac{\left( \frac{g}{2} + x1 \right) y}{\left( \frac{g}{2} + x2 \right)^2 + y2^2}$$

**Simplify[%143]**

$$-\frac{1}{\pi} Hg \left( -\frac{\operatorname{Log} \left( \frac{g}{2} + x1 \right) y}{\left( -\frac{g}{2} + x1 \right)^2 + y1^2} + \frac{\operatorname{Log} \left( -\frac{g}{2} + x1 \right) y \left( \left( \frac{g}{2} + x1 \right)^2 + y1^2 \right)}{\left( \left( -\frac{g}{2} + x1 \right)^2 + y1^2 \right)^2} + \frac{2 (g - 2 x1) y1}{g^2 - 4 g x1 + 4 (x1^2 + y1^2)} + \right.$$

$$\left. \frac{2 (g + 2 x1) y1}{g^2 + 4 g x1 + 4 (x1^2 + y1^2)} + \operatorname{ArcTan} \left[ \frac{g - 2 x1}{2 y1} \right] + \operatorname{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y1} \right] \right)$$

$$D \left[ \left( x1 - \frac{g}{2} \right) \operatorname{ArcTan} \left[ \frac{x1 - g / 2}{y1} \right], x1 \right]$$

$$\frac{-\frac{g}{2} + x1}{\left( 1 + \frac{(-\frac{g}{2} + x1)^2}{y1^2} \right) y1} + \operatorname{ArcTan} \left[ \frac{-\frac{g}{2} + x1}{y1} \right]$$

**D[ArcTan[x], x]**

$$\frac{1}{1 + x^2}$$

$$D \left[ \left( x1 + \frac{g}{2} \right) \operatorname{ArcTan} \left[ \frac{x1 + g / 2}{y1} \right], x1 \right]$$

$$\frac{\frac{g}{2} + x1}{\left( 1 + \frac{(\frac{g}{2} + x1)^2}{y1^2} \right) y1} + \operatorname{ArcTan} \left[ \frac{\frac{g}{2} + x1}{y1} \right]$$

$$\begin{aligned}
& \text{Log} \left[ \frac{\left( \mathbf{x1} + \frac{g}{2} \right)^2 + \mathbf{y1}^2}{\left( \mathbf{x1} - \frac{g}{2} \right)^2 + \mathbf{y1}^2} \right] \\
& \text{Log} \left[ \frac{\left( \frac{g}{2} + \mathbf{x1} \right)^2 + \mathbf{y1}^2}{\left( -\frac{g}{2} + \mathbf{x1} \right)^2 + \mathbf{y1}^2} \right] \\
& \text{FullSimplify} \left[ \text{Log} \left[ \frac{\left( \frac{g}{2} + \mathbf{x1} \right)^2 + \mathbf{y1}^2}{\left( -\frac{g}{2} + \mathbf{x1} \right)^2 + \mathbf{y1}^2} \right] \right] \\
& \text{Log} \left[ 1 + \frac{8 g \mathbf{x1}}{(g - 2 \mathbf{x1})^2 + 4 \mathbf{y1}^2} \right] \\
& \mathbf{D} \left[ \text{Log} \left[ 1 + \frac{8 g \mathbf{x1}}{(g - 2 \mathbf{x1})^2 + 4 \mathbf{y1}^2} \right], \mathbf{x1} \right] \\
& \frac{\frac{32 g (g - 2 \mathbf{x1}) \mathbf{x1}}{\left( (g - 2 \mathbf{x1})^2 + 4 \mathbf{y1}^2 \right)^2} + \frac{8 g}{(g - 2 \mathbf{x1})^2 + 4 \mathbf{y1}^2}}{1 + \frac{8 g \mathbf{x1}}{(g - 2 \mathbf{x1})^2 + 4 \mathbf{y1}^2}}
\end{aligned}$$

**D [**