In[ ]:= sineGaussian = A * Exp[-Γ * t^2] * Sin[2 * π * f_c * t]

Out[ ]= $A\, e^{-t^2 \Gamma}\, \mathrm{Sin}[2\,\pi\, t\, f_c]$

In[ ]:= FT = Integrate[sineGaussian * Exp[2 * π * f * I * t], {t, 0, T}]

Out[ ]= $$\frac{1}{4\sqrt{\Gamma}} A\, e^{-\frac{\pi^2 (f+f_c)^2}{\Gamma}} \sqrt{\pi} \left(\mathrm{Erfi}\left[\frac{\pi (f+f_c)}{\sqrt{\Gamma}}\right] + e^{\frac{4 f \pi^2 f_c}{\Gamma}} \left(-\mathrm{Erfi}\left[\frac{\pi (f-f_c)}{\sqrt{\Gamma}}\right] + \mathrm{Erfi}\left[\frac{f\,\pi + i\, T\,\Gamma - \pi\, f_c}{\sqrt{\Gamma}}\right]\right) - \mathrm{Erfi}\left[\frac{f\,\pi + i\, T\,\Gamma + \pi\, f_c}{\sqrt{\Gamma}}\right]\right)$$

In[ ]:= T = 1

Out[ ]= 1

f_c = 30

Out[ ]= 30

In[ ]:= Q = 1

Out[ ]= 1

In[ ]:= $\Gamma = \frac{2 * \pi * f_c}{Q}$

Out[ ]= $60\,\pi$

In[ ]:= A = 100

Out[ ]= 100

In[ ]:= sineGaussian = A * Exp[-Γ * t^2] * Sin[2 * π * f_c * t]

Out[ ]= $100\, e^{-60\,\pi\, t^2}\, \mathrm{Sin}[60\,\pi\, t]$

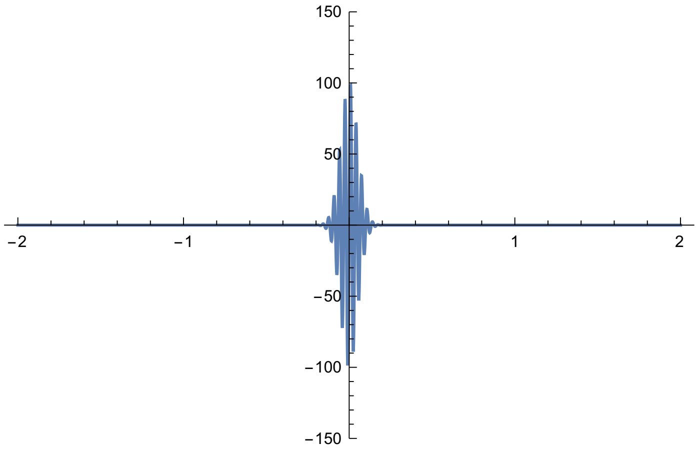
In[ ]:= FT = Integrate[sineGaussian * Exp[2 * π * f * I * t], {t, 0, T}]

Out[ ]= $$-\frac{5}{2}\sqrt{\frac{5}{3}}\; e^{-\frac{1}{60}(30+f)^2 \pi} \left(e^{2 f \pi}\left(\mathrm{Erfi}\left[\frac{1}{2}(-30+f)\sqrt{\frac{\pi}{15}}\right] - \mathrm{Erfi}\left[\frac{1}{2}((-30+60\, i)+f)\sqrt{\frac{\pi}{15}}\right]\right) - \mathrm{Erfi}\left[\frac{1}{2}(30+f)\sqrt{\frac{\pi}{15}}\right] + \mathrm{Erfi}\left[\frac{1}{2}((30+60\, i)+f)\sqrt{\frac{\pi}{15}}\right]\right)$$

In[ ]:=
```
Plot[sineGaussian, {t, -2, 2}, PlotRange → {-150, 150}]
```

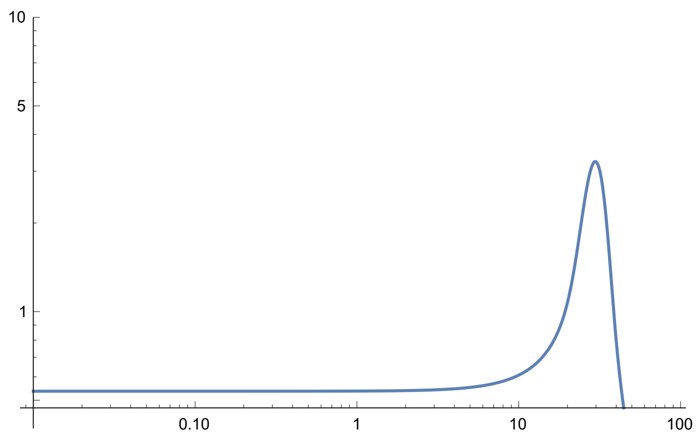
General: Exp[−753.921] is too small to represent as a normalized machine number; precision may be lost.

Out[ ]=



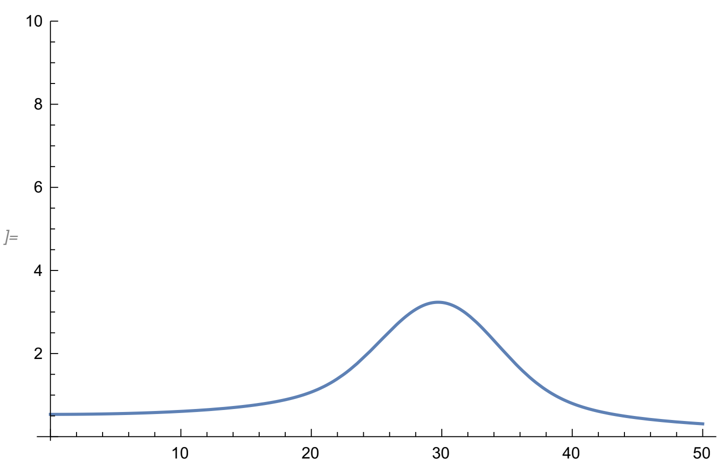
In[ ]:=
```
LogLogPlot[Abs[FT], {f, 0.01, 100}, PlotRange → {0, 10}]
```

Out[ ]=



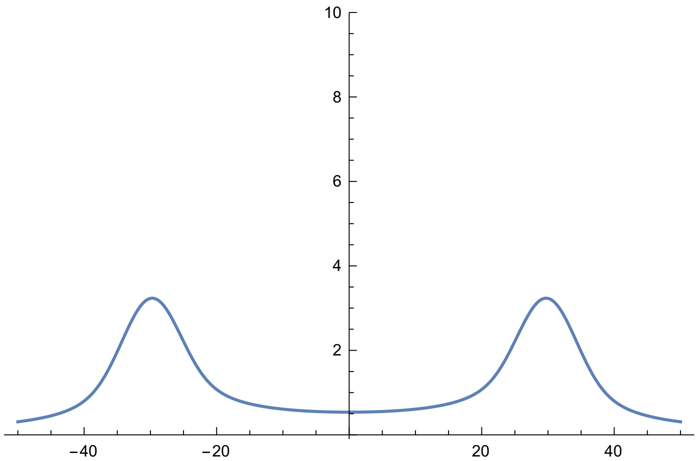
In[ ]:=
```
Plot[Abs[FT], {f, 0, 50}, PlotRange → {-0.1, 10}]
```

Out[ ]=



In[ ]:=
```
Plot[Abs[FT], {f, -50, 50}, PlotRange → {-0.1, 10}]
```

Out[ ]=



In[ ]:=
```
LogLogPlot[Abs[FourierTransform[sineGaussian, t, ω]], {ω, 0.1, 1000}]
```

Out[ ]=