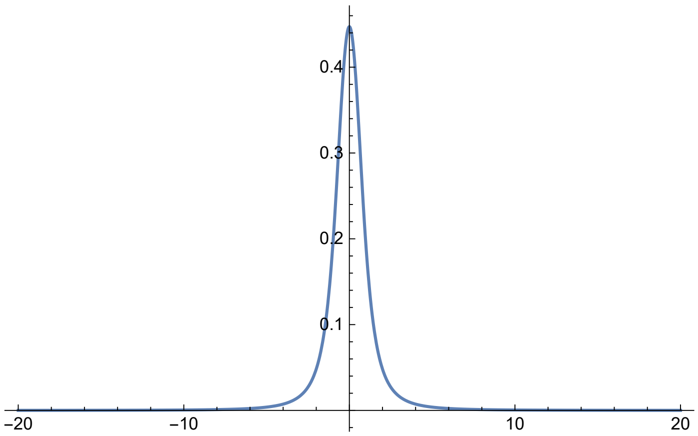
- Field of a magnetized cylinder (or equivalently, a finite solenoid)

In[1]:=
```
(* exact formula, setting mu0 = 1 and R = 1 *)
b[z_, L_] = 1/2 ((z + L/2) / Sqrt[1 + (z + L/2)^2]  -  (z - L/2) / Sqrt[1 + (z - L/2)^2])
```

Out[1]= $$\frac{1}{2}\left(-\frac{-\frac{L}{2}+z}{\sqrt{1+\left(-\frac{L}{2}+z\right)^2}}+\frac{\frac{L}{2}+z}{\sqrt{1+\left(\frac{L}{2}+z\right)^2}}\right)$$

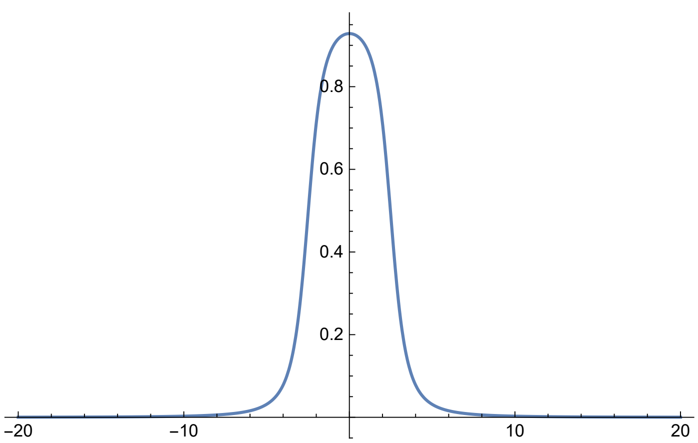
In[2]:=
```
Plot[b[z, 1], {z, -20, 20}, PlotRange → All]  (* length = 1 x radius *)
```

Out[2]=



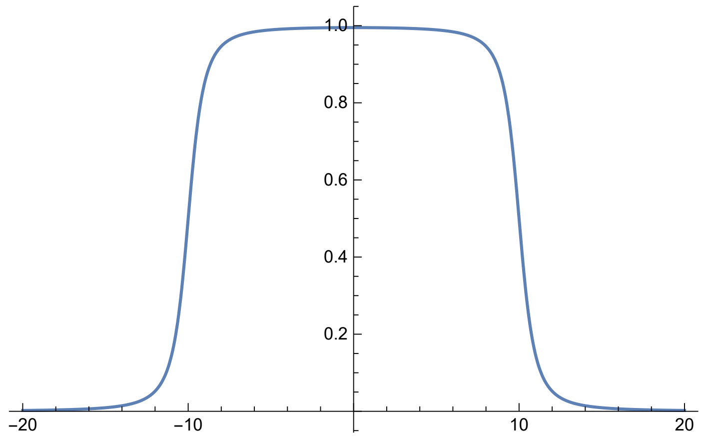
In[3]:=
```
Plot[b[z, 5], {z, -20, 20}, PlotRange → All]  (* length = 5 x radius *)
```

Out[3]=



In[4]:=
```
Plot[b[z, 20], {z, -20, 20}, PlotRange → All] (* length = 20 x radius *)
```

Out[4]=



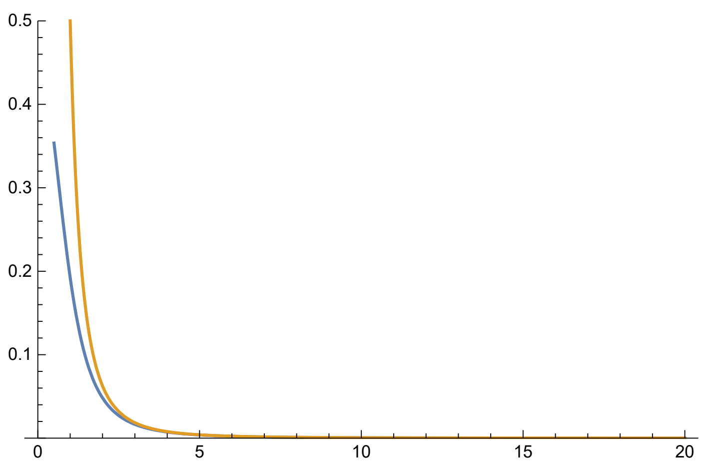
In[5]:=
```
(* approximate formula, setting mu0 = 1 and R = 1 *)
bapprox[z_, L_] = L / (2 z^3)
```

Out[5]= $\frac{L}{2\,z^3}$

In[6]:=
```
(* Some plots of field outside the cylinder, exact and also approximate dipole field *)
```

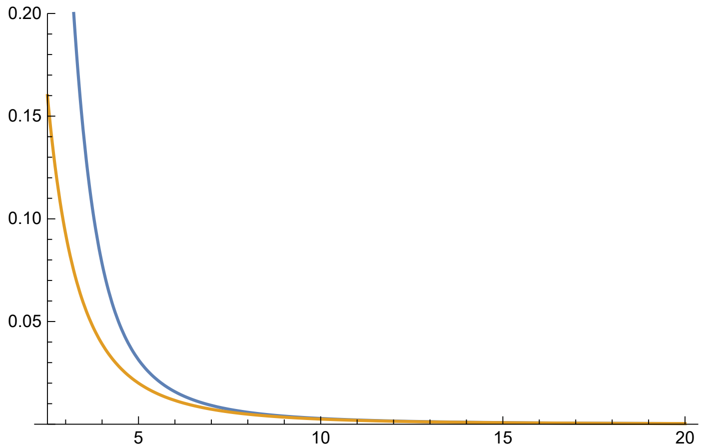
In[7]:=
```
Plot[{b[z, 1], bapprox[z, 1]}, {z, 0.5, 20}, PlotRange → {0, .5}]
(* length = 1 x radius *)
```

Out[7]=



In[8]:=
```
Plot[{b[z, 5], bapprox[z, 5]}, {z, 2.5, 20}, PlotRange → {0, .2}]
(* length = 5 x radius *)
```

Out[8]=



In[9]:=
```
Plot[{b[z, 20], bapprox[z, 20]}, {z, 10, 50}, PlotRange → {0, .012}]
(* length = 20 x radius *)
```

Out[9]=