In[53]:=
```
Remove["Global`*"]
```

A thin disk of charge q and radius R lies in a plane perpendicular to the z-axis. Every point on the charged thin ring of radius r and thickness dr is at the same distance p = sqrt(r^2 + z^2) from any point on the z-axis. The electric potential due to the thin ring at a point z along the axis is then dV = k dq/p where dq is the charge on the ring k = 1 in Gaussian units or k = 1/4 Pi e0 in SI units.

Calculate the potential V(z) from the entire disk. It will be useful to define the planar charge density σ = 1/Pi R^2.

In[54]:=
```
dV = (k dq) / p
```

Out[54]= $\frac{dq\ k}{p}$

In[55]:=
```
p = Sqrt[r^2 + z^2]
```

Out[55]= $\sqrt{r^2 + z^2}$

In[56]:=
```
dq = 2 Pi r σ
σ = q / (Pi R^2)
```

Out[56]= $2\pi r \sigma$

Out[57]= $\frac{q}{\pi R^2}$

In[58]:=
```
dV = (k dq) / p
```

Out[58]= $\frac{2 k q r}{R^2 \sqrt{r^2 + z^2}}$

In[59]:=
```
V = Integrate[dV, {r, 0, R}, Assumptions → {z > 0, R > 0}]
```

Out[59]= $\frac{2 k q \left(-z + \sqrt{R^2 + z^2}\right)}{R^2}$

Find the electric field E(z) = -dV/dz

In[60]:=
```
Ez = - D[V, z]
```

Out[60]= $-\frac{2 k q \left(-1 + \frac{z}{\sqrt{R^2+z^2}}\right)}{R^2}$

E(z) as z goes to zero

In[61]:=
```
Limit[Ez, z → 0]
```

Out[61]= $\frac{2 k q}{R^2}$

E(z) as z goes to infinity

In[62]:=
```
(Limit[Ez z^2, z → Infinity]) / z^2
```

Out[62]=

$$\frac{k\,q}{z^2}$$