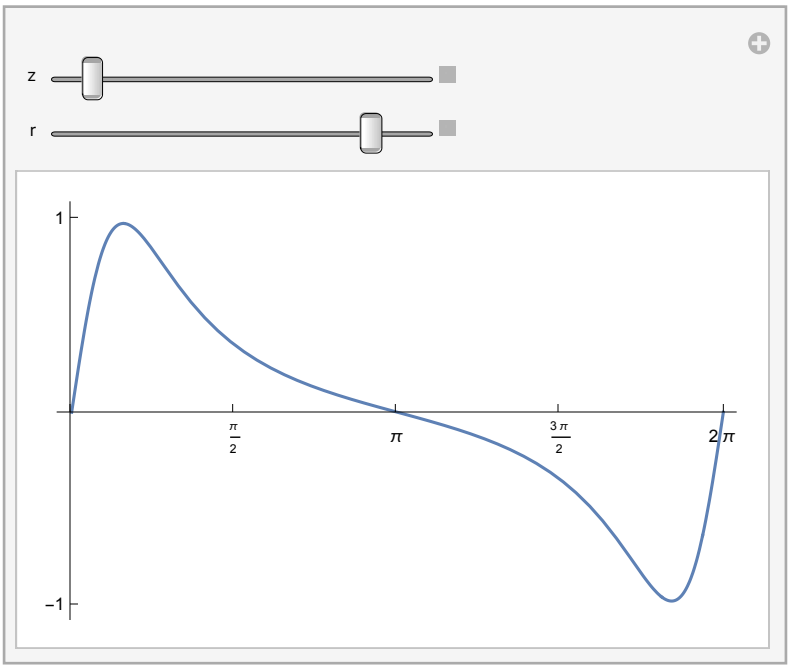
Some integrals that didn't evaluate in reasonable time numerically. Numeric integration of the same, and a Manipulate to show the integrand. Also a plot (chargeAndCurrentOnRingFig1.eps) that shows the geometry of the ring configuration and the coordinates used.

```
$Assumptions = z ∈ Reals && r ∈ Reals && r ≠ 1;

(*Integrate[ (z^2 + 1 + r^2  - 2 r  Cos[phi])^(-3/2), {phi, 0, 2 Pi}]
 Integrate[ Cos[ phi] (z^2 + 1 + r^2  - 2 r  Cos[phi])^(-3/2), {phi, 0, 2 Pi}]*)
(*Integrate[
 Sin[ phi] (z^2 + 1 + r^2  - 2 r  Cos[phi])^(-3/2), {phi, 0, 2 Pi}]*)
Integrate[ Sin[ phi] ( 1 + r^2  - 2 r Cos[phi])^(-3 / 2), {phi, 0, 2 Pi}]
(*Integrate[ E[I phi] (z^2 + 1 + r^2  - 2 r  Cos[phi])^(-3/2), {phi, 0, 2 Pi}]*)
```

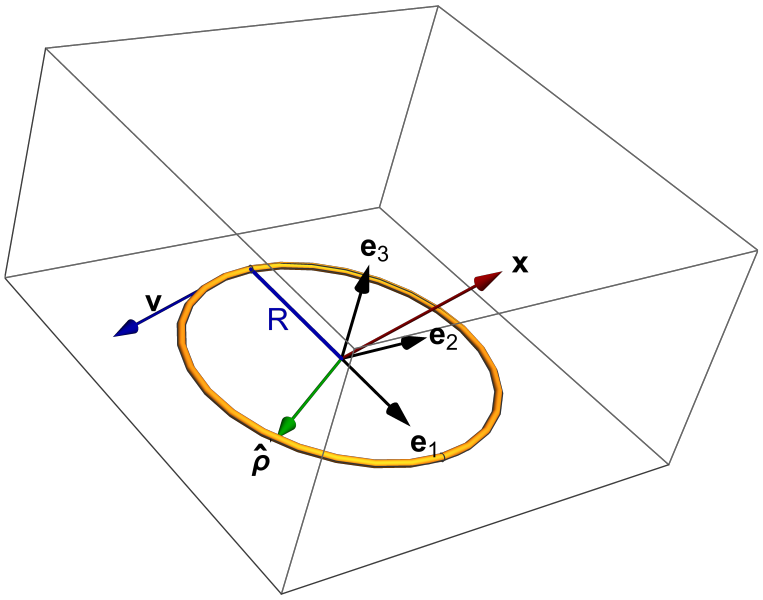
```
$Aborted
```

```
ClearAll[a, b, c]
a[u_, v_, p_: 8] := NIntegrate[
  (u^2 + 1 + v^2 - 2 v Cos[phi]) ^ (-3 / 2), {phi, 0, 2 Pi}, AccuracyGoal → p]
b[u_, v_, p_: 8] := NIntegrate[
  Cos[phi] (u^2 + 1 + v^2 - 2 v Cos[phi]) ^ (-3 / 2), {phi, 0, 2 Pi},
  AccuracyGoal → p]
c[u_, v_, p_: 8] := NIntegrate[ Sin[phi] (u^2 + 1 + v^2 - 2 v Cos[phi]) ^ (-3 / 2),
  {phi, 0, 2 Pi}, AccuracyGoal → p]

Manipulate[

 (*
 {
   (*z,
   r,*)
   a[z,r]
   ,b[z,r]
   , c[z,r]
  } // Column*)
 Plot[ Sin[p] (z^2 + 1 + r^2 - 2 r Cos[p]) ^ (-3 / 2),
  {p, 0, 2 Pi}, PlotRange → Full,
  Ticks → {{0, Pi / 2, Pi, 3 Pi / 2, 2 Pi}, {-1, 1}}]
 ,
 {z, 0, 10},
 {r, 0, 0.9}(*,*)
 (*{r,1.1,2}*)
]
```




```
ClearAll[bold, fs, te]
bold = Style[ #, Bold] &;
fs := Style[ #, FontSize → 16 ] &;
te[n_] := Subscript["e" // bold, n] // fs;

p1 = Module[{p, r, e1, e2, e3, o, x, xp, rad, phip1, phip2, es, phicap, rhocap},
  p = 40;
  rad = 1.5;
  r = {-1, 1} rad;
  o = {0, 0, 0};
  es = 0.7;
  {e1, e2, e3} = es IdentityMatrix[3];
  x = e1 + 0.5 e2 + 1.5 e3;
  phip1 = -0.33 Pi;
  phip2 = 1.1 Pi;
  xp = (e1 Cos[phip1] + e2 Sin[phip1]) / es;
  phicap[phi_] := (e2 Cos[phi] - e1 Sin[phi]) / es;
  rhocap[phi_] := (e1 Cos[phi] + e2 Sin[phi]) / es;
  Show[
   {
    RevolutionPlot3D[{(p + Cos[t]) / p, Sin[t] / p},
     {t, 0, 2 Pi}, PlotRange → {r, r, {-0.1, rad}}, Ticks → None
     , Mesh → 1],
    Graphics3D[
     {
```

```
      Black,
      Arrow[Tube[{o, e1}]],
      Arrow[Tube[{o, e2}]],
      Arrow[Tube[{o, e3}]],
      Red // Darker,
      Arrow[Tube[{o, x}]],
      Green // Darker,
      Arrow[Tube[{o, xp}]],
      Blue // Darker,
      Arrow[Tube[{rhocap[phip2], rhocap[phip2] + phicap[phip2]}]],

      Black,
      Text[te[1], 1.2 e1],
      Text[te[2], 1.2 e2],
      Text[te[3], 1.2 e3],
      Text[Superscript[OverHat["ρ"] // fs // bold, "'"], 1.2 xp],
      Text["x" // fs // bold, 1.1 x],
      Text["v" // fs // bold, 1.1 rhocap[phip2] + 0.5 phicap[phip2]],
      Blue // Darker,
      Text["R" // fs, 0.5 rhocap[1.1 Pi]],
      Thick,
      Line[{o, rhocap[1. Pi]}]
     }
    ]
   }
   , ViewPoint → {2.3, -2.4`, 2.`}
  ]
 ]
```




```
<< peeters` ;
peeters`setGitDir[ "../project/figures/GAelectrodynamics" ]
```

```
/Users/pjoot/project/figures/GAelectrodynamics
```

```
peeters`exportForLatex["chargeAndCurrentOnRingFig1", p1]
```

```
{chargeAndCurrentOnRingFig1.eps, chargeAndCurrentOnRingFig1pn.png}
```