In[22]:=
```
V := 1 / Norm[#] &(*potential of a unit charge*)
```

In[23]:=
```
r = {x, y}
```

Out[23]=
```
{x, y}
```

In[24]:=
```
V[r]
```

Out[24]=
$$\frac{1}{\sqrt{\text{Abs}[x]^2 + \text{Abs}[y]^2}}$$

In[39]:=
```
FullSimplify[V[r], Assumptions → x > 0 && y > 0]
```

Out[39]=
$$\frac{1}{\sqrt{x^2 + y^2}}$$

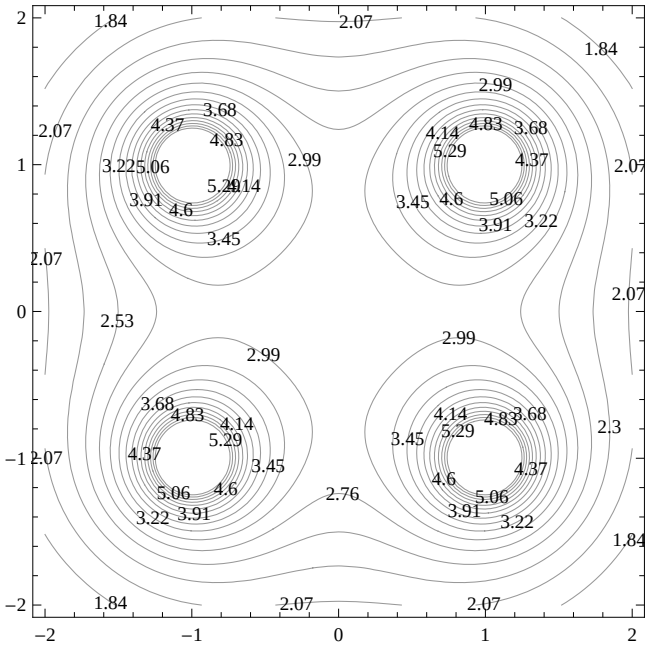
In[25]:=
```
r1 = {1, 1}; r2 = {-1, -1}; r3 = {1, -1}; r4 = {-1, 1};
```

In[54]:=
```
v = V[r - r1] + V[r - r2] + V[r - r3] + V[r - r4]; (*4 same charges*)
```

In[55]:=
```
v = FullSimplify[v, Assumptions → x > 0 && y > 0];
```

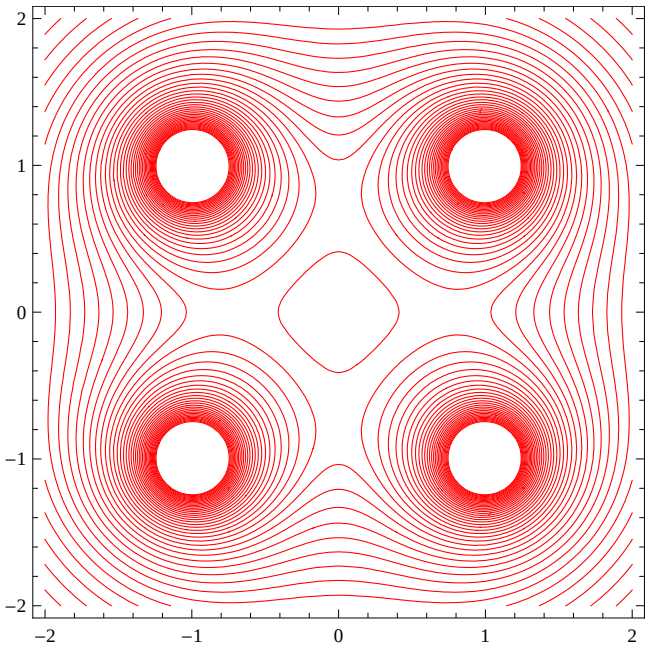
In[57]:=
```
ContourPlot[v, {x, -2, 2}, {y, -2, 2}, ContourShading → False, Contours → 16, ContourLabels → All]
```

Out[57]=



In[58]:=
```
figV = ContourPlot[v, {x, -2, 2}, {y, -2, 2},
  ContourShading → False, Contours → 40, ContourStyle → Red]
```

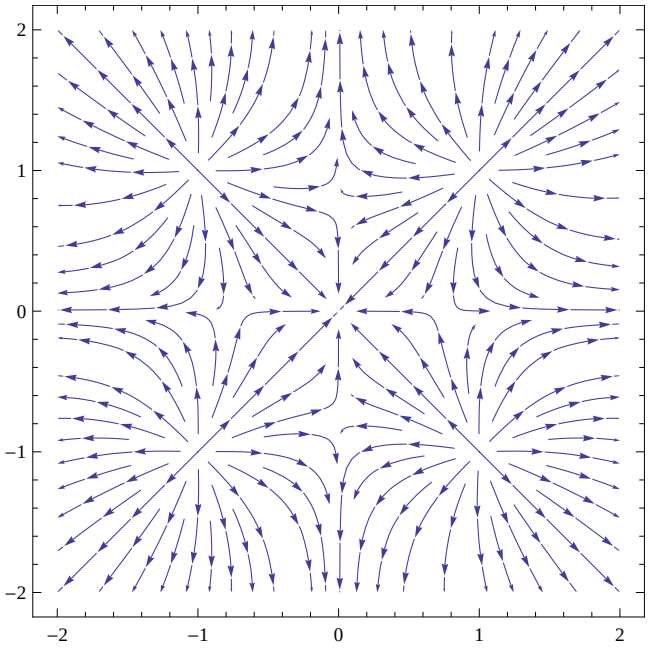
Out[58]=



In[59]:=
```
Ef = -{D[v, x], D[v, y]};
```

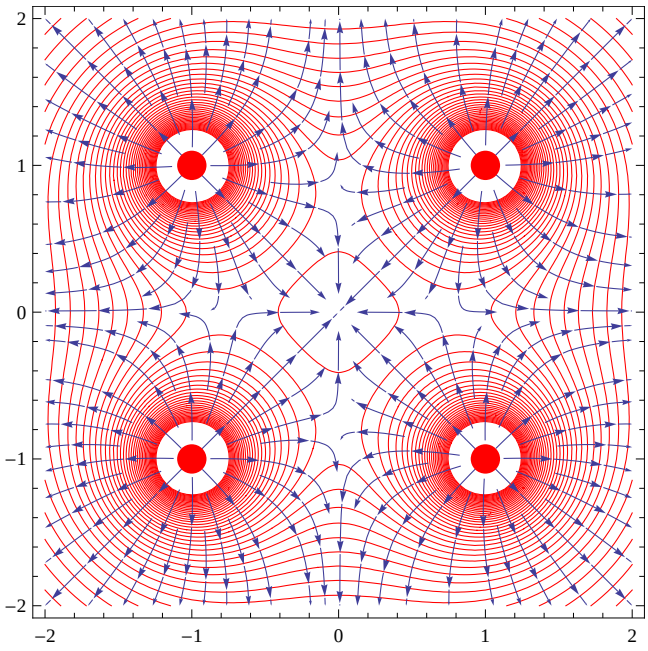
In[60]:=
```
figE = StreamPlot[Ef, {x, -2, 2}, {y, -2, 2}]
```

Out[60]=



In[62]:=
```
Show[figV, figE,
 Graphics[{{Red, Disk[r1, .1]}, {Red, Disk[r2, .1], {Red, Disk[r3, .1]}, {Red, Disk[r4, .1]}}}]]
```

Out[62]=



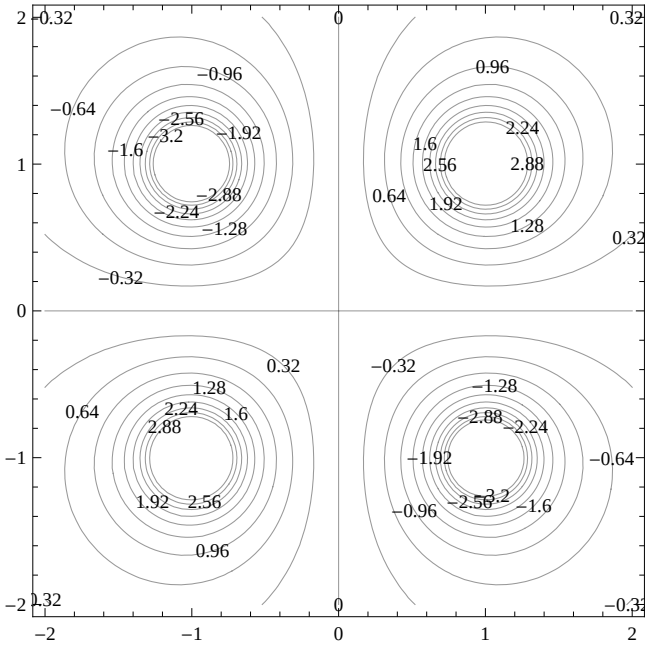

```
(*above is final plot for 4 identical charges*)
```

In[64]:=
```
v = V[r - r1] + V[r - r2] - V[r - r3] - V[r - r4]; (*2 opposite dipoles*)
```

In[65]:=
```
v = FullSimplify[v, Assumptions → x > 0 && y > 0];
```

In[66]:=
```
ContourPlot[v, {x, -2, 2}, {y, -2, 2}, ContourShading → False, Contours → 20, ContourLabels → All]
```

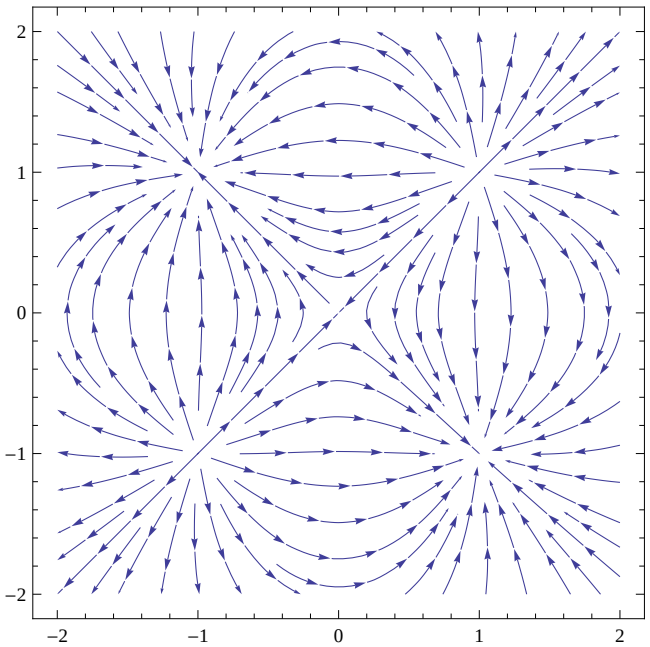
Out[66]=



In[67]:=
```
Ef = -{D[v, x], D[v, y]};
```

In[68]:=
```
figE = StreamPlot[Ef, {x, -2, 2}, {y, -2, 2}]
```

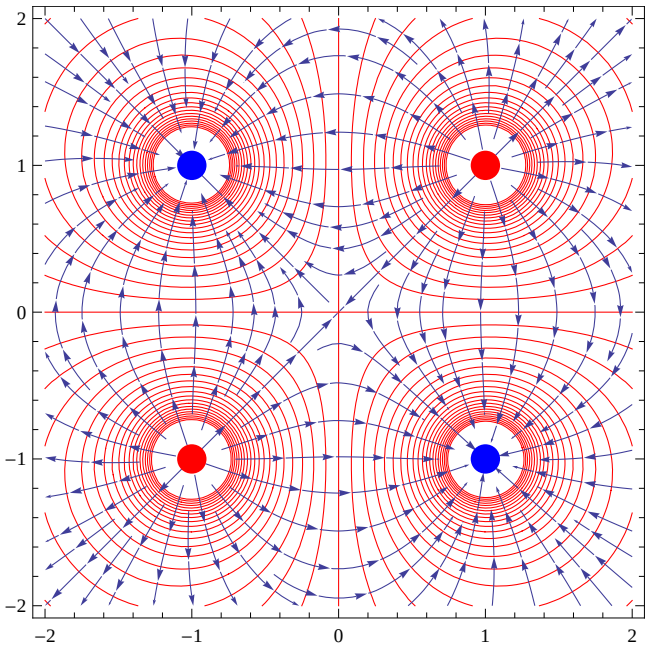
Out[68]=



In[69]:=
```
figV = ContourPlot[v, {x, -2, 2}, {y, -2, 2},
   ContourShading → False, Contours → 40, ContourStyle → Red];
```

In[70]:=
```
Show[figV, figE, Graphics[
  {{Red, Disk[r1, .1]}, {Red, Disk[r2, .1], {Blue, Disk[r3, .1]}, {Blue, Disk[r4, .1]}}}]]
```

Out[70]=



In[71]:=
```
(*above is final plot for 2 opposite dipoles -"quadrupole"*)
```

In[72]:=
```
(*below is the charged rod*)
```

In[1]:=
```
Integrate[1 / Sqrt[(x - X)^2 + y^2], {x, -1, 1}, Assumptions → X > 0 && y > 0]
```

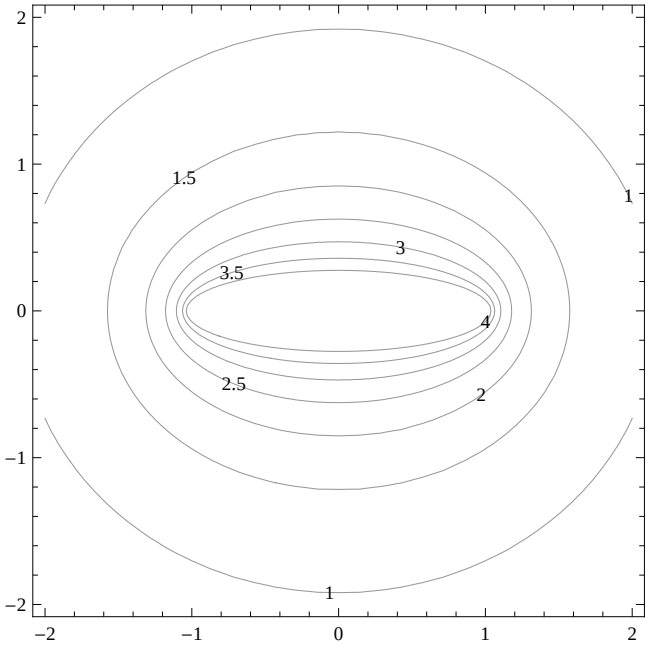
Out[1]=
$$\text{Log}\left[\frac{1}{y^2}\left(1 - X + \sqrt{(-1+X)^2 + y^2}\right)\left(1 + X + \sqrt{(1+X)^2 + y^2}\right)\right]$$

In[2]:=
```
v = %;
```

In[10]:=

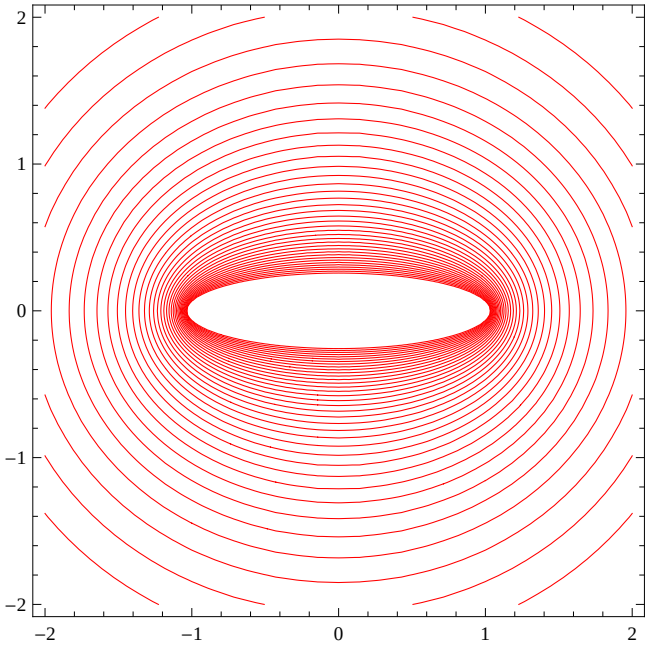
In[16]:=
```
ContourPlot[v, {X, -2, 2}, {y, -2, 2}, ContourShading → False, ContourLabels → All]
```

Out[16]=



In[17]:=
```
figV = ContourPlot[v, {X, -2, 2}, {y, -2, 2},
  ContourShading → False, Contours → 40, ContourStyle → Red]
```

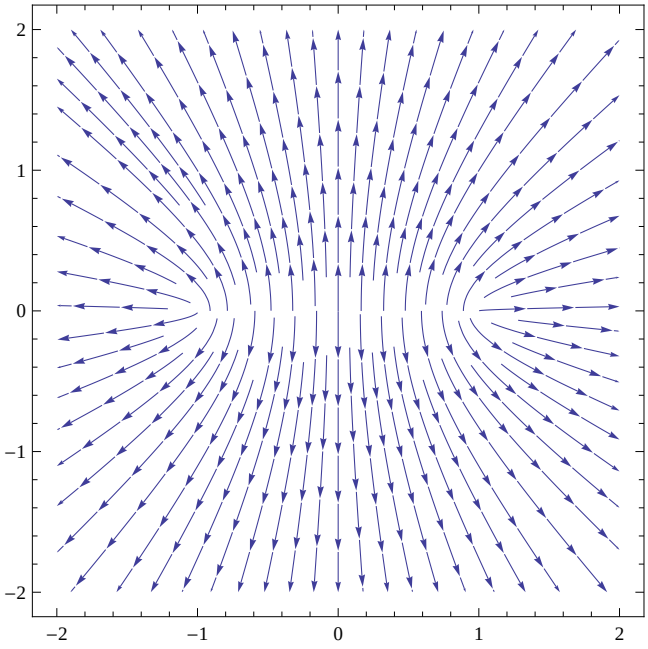
Out[17]=



In[5]:=
```
Ef = -{D[v, X], D[v, y]};
```

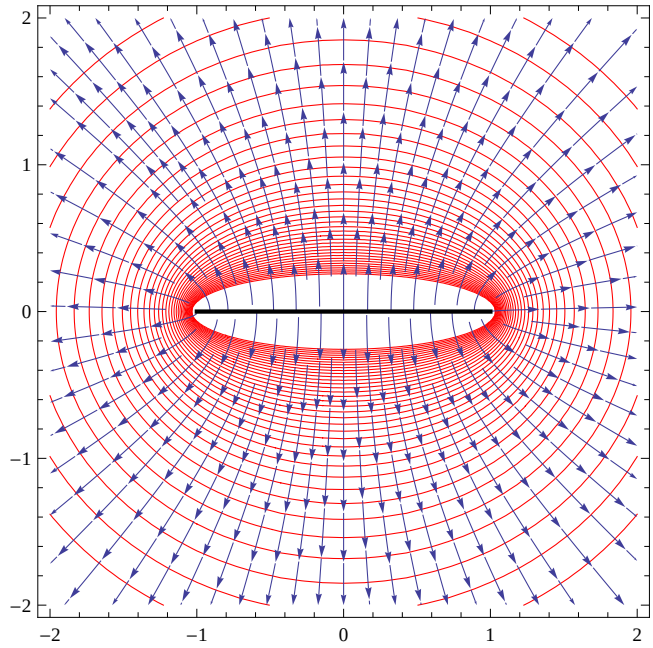
In[6]:=
```
figE = StreamPlot[Ef, {X, -2, 2}, {y, -2, 2}]
```

Out[6]=



In[20]:=
```
Show[figV, figE, Graphics[{Black, Thick, Line[{{-1, 0}, {1, 0}}]}]]
```

Out[20]=



In[73]:=
```
(*above is final plot for a rod*)
```