

Electric Potential Mapping

Enter each charge as a list: {charge, xposition, yposition}

In[104]:=

```
v[x_, y_, charges_] :=  
  Sum[charges[[i, 1]] / Sqrt[(x - charges[[i, 2]])^2 + (y - charges[[i, 3]])^2],  
    {i, 1, Length[charges]}]
```

In[105]:=

```
nMesh = 30; (* Number of mesh lines to draw *)
```

Single Positive Point Charge

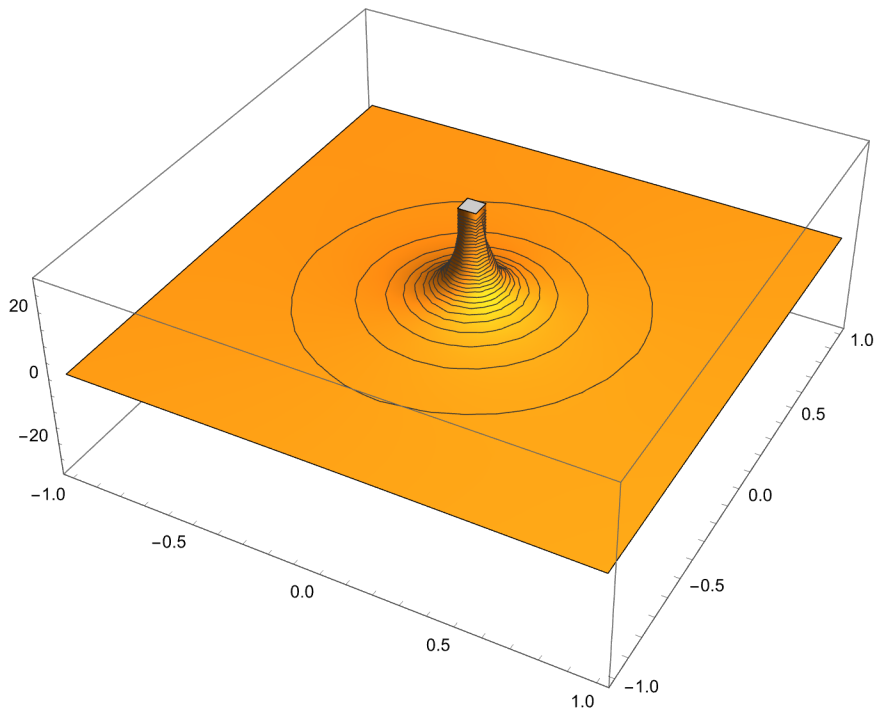
In[106]:=

```
pcharge = {{1, 0, 0}};
```

In[107]:=

```
Plot3D[v[x, y, pcharge], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},  
  ImageSize → Scaled[0.7], PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[107]:=



In[108]:=

```
cplot = ContourPlot[v[x, y, pcharge],  
  {x, -1, 1}, {y, -1, 1}, Contours → Table[v, {v, 0, 4, 0.2}]];
```

In[109]:=

```
Epcharge[x_, y_] = -Grad[v[x, y, pcharge], {x, y}]
```

Out[109]=

$$\left\{ \frac{x}{(x^2 + y^2)^{3/2}}, \frac{y}{(x^2 + y^2)^{3/2}} \right\}$$

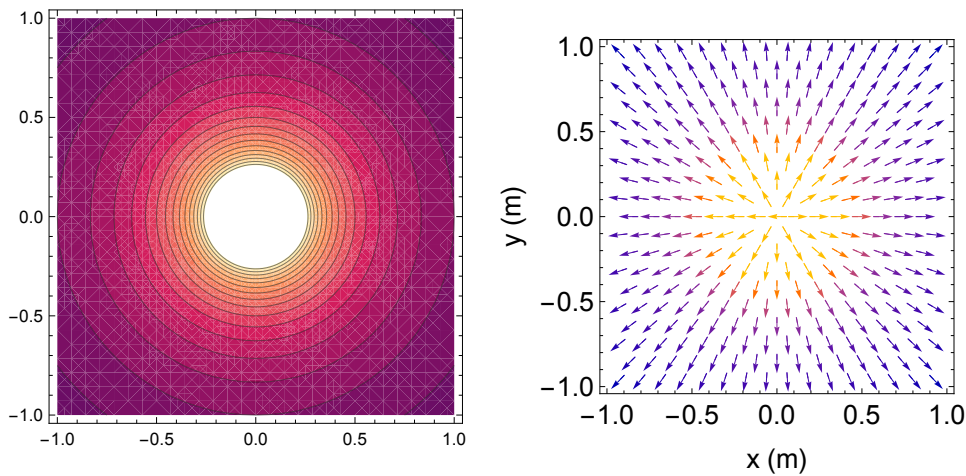
In[110]:=

```
eplot = VectorPlot[Epcharge[x, y], {x, -1, 1},
  {y, -1, 1}, AspectRatio → 1, PlotLegends → Automatic,
  Frame → True, FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger];
```

In[111]:=

```
GraphicsRow[{cplot, eplot[[1]]}, ImageSize → Scaled[0.8]]
```

Out[111]=



Single Negative Point Charge

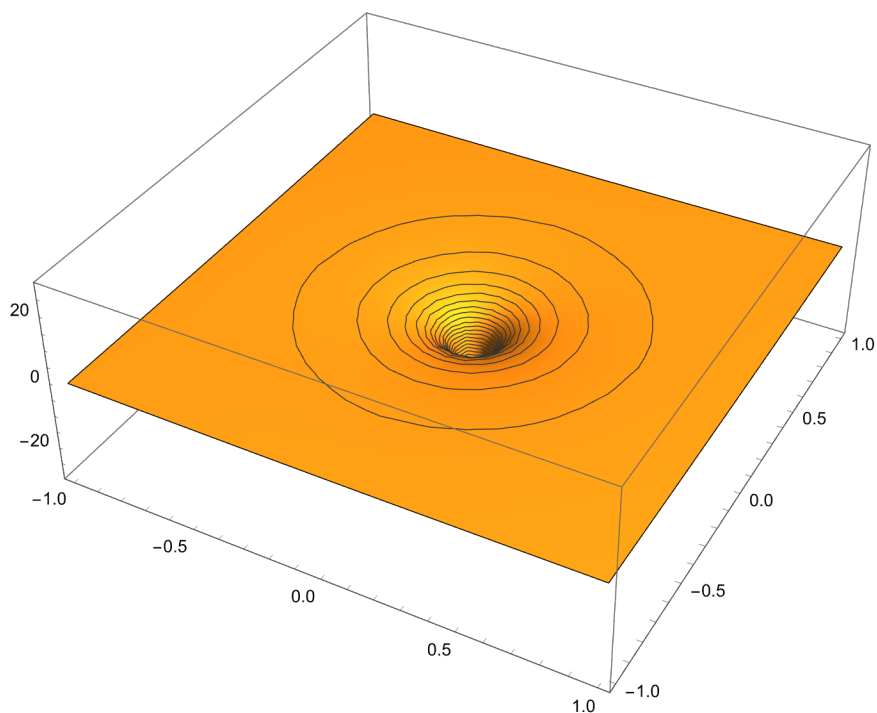
In[112]:=

```
ncharge = {{-1, 0, 0}};
```

In[113]:=

```
Plot3D[v[x, y, ncharge], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},
  ImageSize → Scaled[0.7], PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[113]=



In[114]:=

```
Encharge[x_, y_] = -Grad[v[x, y, ncharge], {x, y}]
```

Out[114]=

$$\left\{ -\frac{x}{(x^2 + y^2)^{3/2}}, -\frac{y}{(x^2 + y^2)^{3/2}} \right\}$$

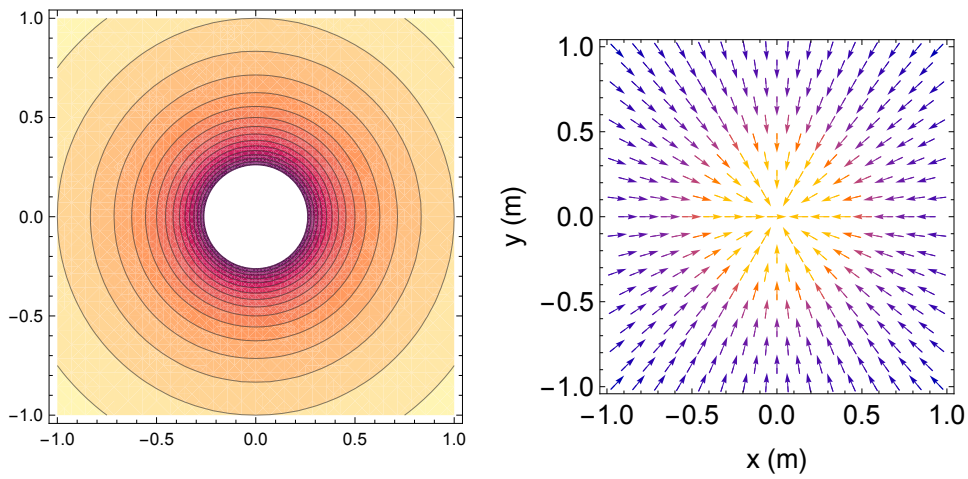
In[115]:=

```
cplot = ContourPlot[v[x, y, ncharge], {x, -1, 1},
  {y, -1, 1}, Contours → Table[v, {v, 0, -4, -0.2}]];
eplot = VectorPlot[Encharge[x, y], {x, -1, 1},
  {y, -1, 1}, AspectRatio → 1, PlotLegends → Automatic,
  Frame → True, FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger];
```

In[117]:=

```
GraphicsRow[{cplot, eplot[[1]]}, ImageSize → Scaled[0.8]]
```

Out[117]=



Dipole

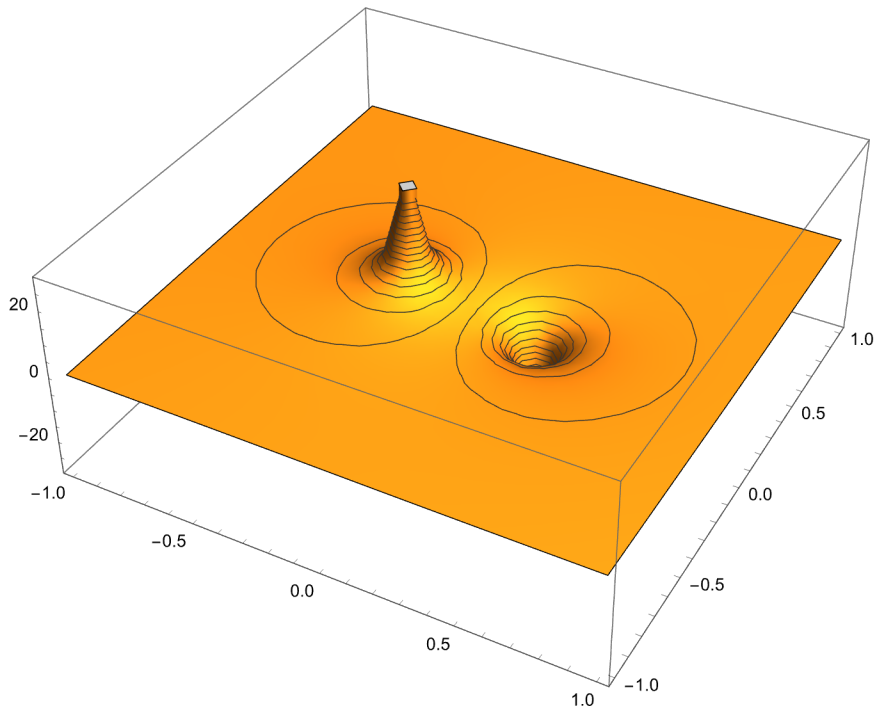
In[118]:=

```
dipole = {{1, -0.25, 0}, {-1, 0.25, 0}};
```

In[119]:=

```
Plot3D[v[x, y, dipole], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},  
ImageSize → Scaled[0.7], PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[119]=



In[120]:=

```
cplot = ContourPlot[v[x, y, dipole], {x, -1, 1},
  {y, -1, 1}, Contours → Table[v, {v, -4, 4, 0.25}]];
```

In[121]:=

```
Edipole[x_, y_] = -Grad[v[x, y, dipole], {x, y}]
```

Out[121]=

$$\left\{ -\frac{-0.25 + x}{\left((-0.25 + x)^2 + y^2\right)^{3/2}} + \frac{0.25 + x}{\left((0.25 + x)^2 + y^2\right)^{3/2}}, \right. \\ \left. -\frac{y}{\left((-0.25 + x)^2 + y^2\right)^{3/2}} + \frac{y}{\left((0.25 + x)^2 + y^2\right)^{3/2}} \right\}$$

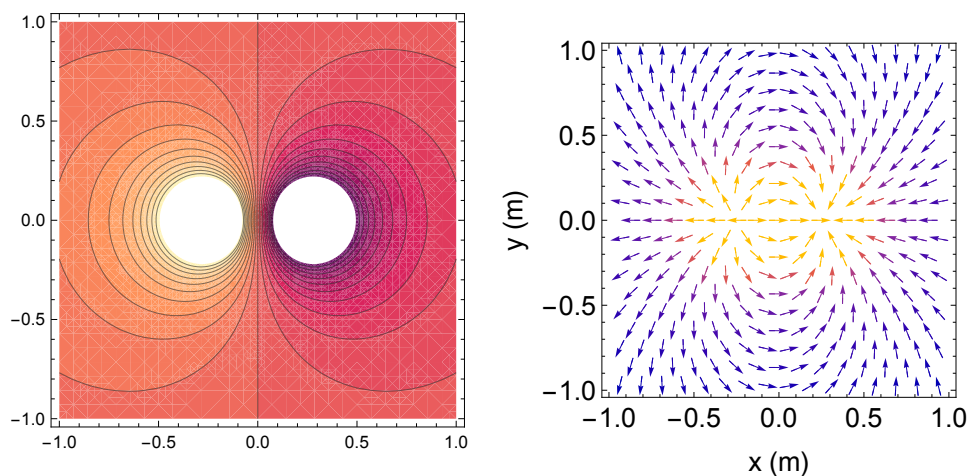
In[122]:=

```
eplot = VectorPlot[Edipole[x, y], {x, -1, 1},
  {y, -1, 1}, AspectRatio → 1, PlotLegends → Automatic,
  Frame → True, FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger];
```

In[123]:=

```
GraphicsRow[{cplot, eplot[[1]]}, ImageSize → Scaled[0.8]]
```

Out[123]=



Oppositely charged plates

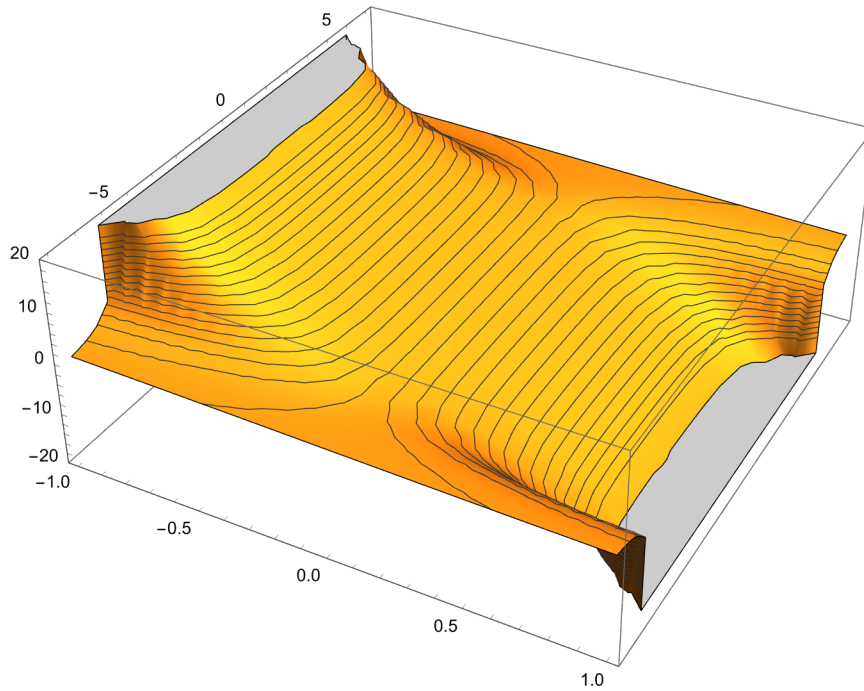
In[124]:=

```
L = 5.0;
pcharges = Table[{1, -1, y}, {y, -L, L, 0.2}];
ncharges = Table[{-1, 1, y}, {y, -L, L, 0.2}];
charges = Join[ncharges, pcharges];
```

In[128]:=

```
Plot3D[v[x, y, charges], {x, -1, 1}, {y, -(L + 2), (L + 2)},
  PlotRange → {-20, 20}, ImageSize → Scaled[0.7],
  PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[128]=



In[129]:=

```
Eplates[x_, y_] = -Grad[v[x, y, charges], {x, y}];
```

In[130]:=

```
eplot = VectorPlot[Eplates[x, y], {x, -1, 1},
  {y, -(L + 2), (L + 2)}, AspectRatio → 1, PlotLegends → Automatic,
  Frame → True, FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger];
```

In[131]:=

```

cplot = ContourPlot[v[x, y, charges], {x, -1, 1},
  {y, -(L + 2), L + 2}, Contours → Table[n, {n, -20, 20, 2}]];
GraphicsRow[{cplot, eplot[[1]]}, ImageSize → Scaled[0.8]]

```

Out[132]=

