Electric Potential Mapping

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

In[30]:=
```
v[x_, y_, charges_] :=
 Sum[charges[[i, 1]] / Sqrt[(x - charges[[i, 2]])^2 + (y - charges[[i, 3]])^2],
  {i, 1, Length[charges]}]
```

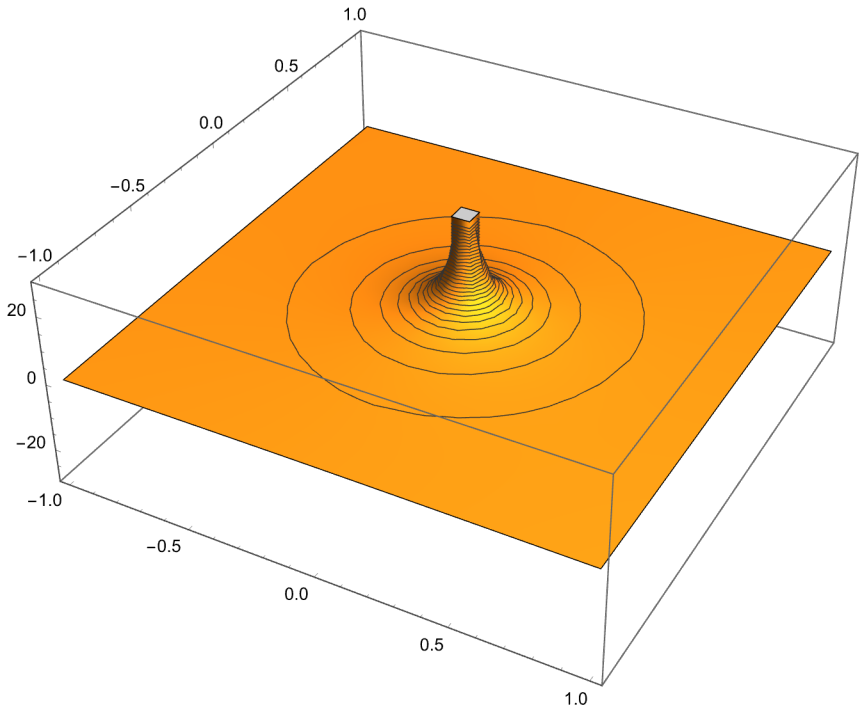
In[31]:=
```
nMesh = 30; (* Number of mesh lines to draw *)
```

Single Positive Point Charge

In[32]:=
```
pcharge = {{1, 0, 0}};
```

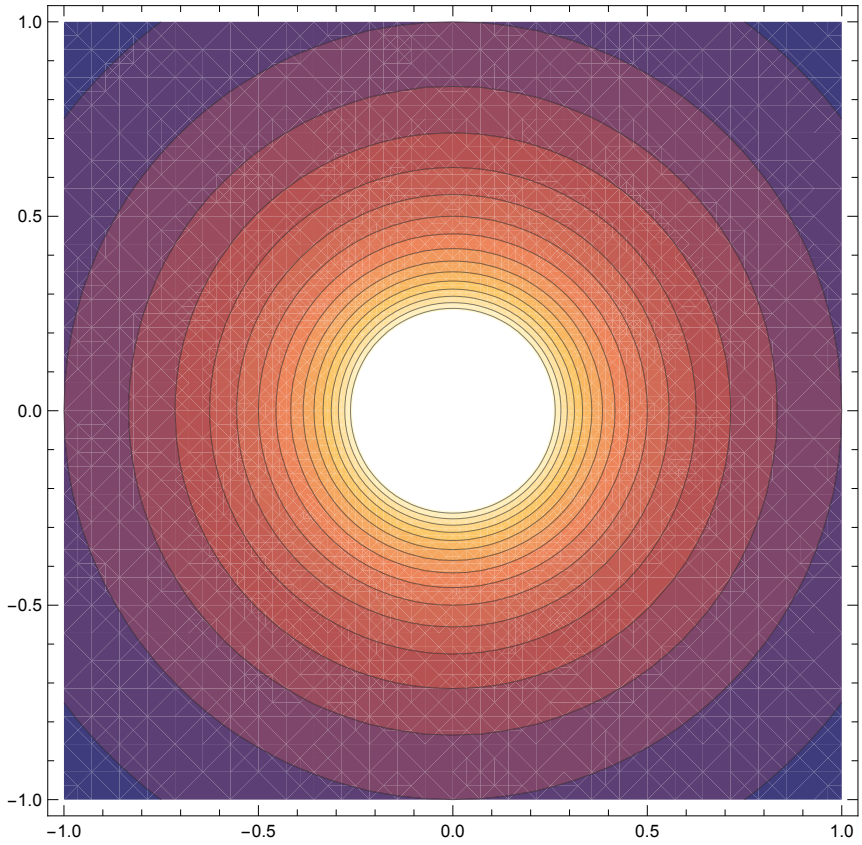
In[33]:=
```
Plot3D[v[x, y, pcharge], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},
 ImageSize → Scaled[0.7] , PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[33]=



In[34]:=
```
ContourPlot[v[x, y, pcharge], {x, -1, 1}, {y, -1, 1},
 Contours → Table[v, {v, 0, 4, 0.2}], ImageSize → Scaled[0.7]]
```

Out[34]=



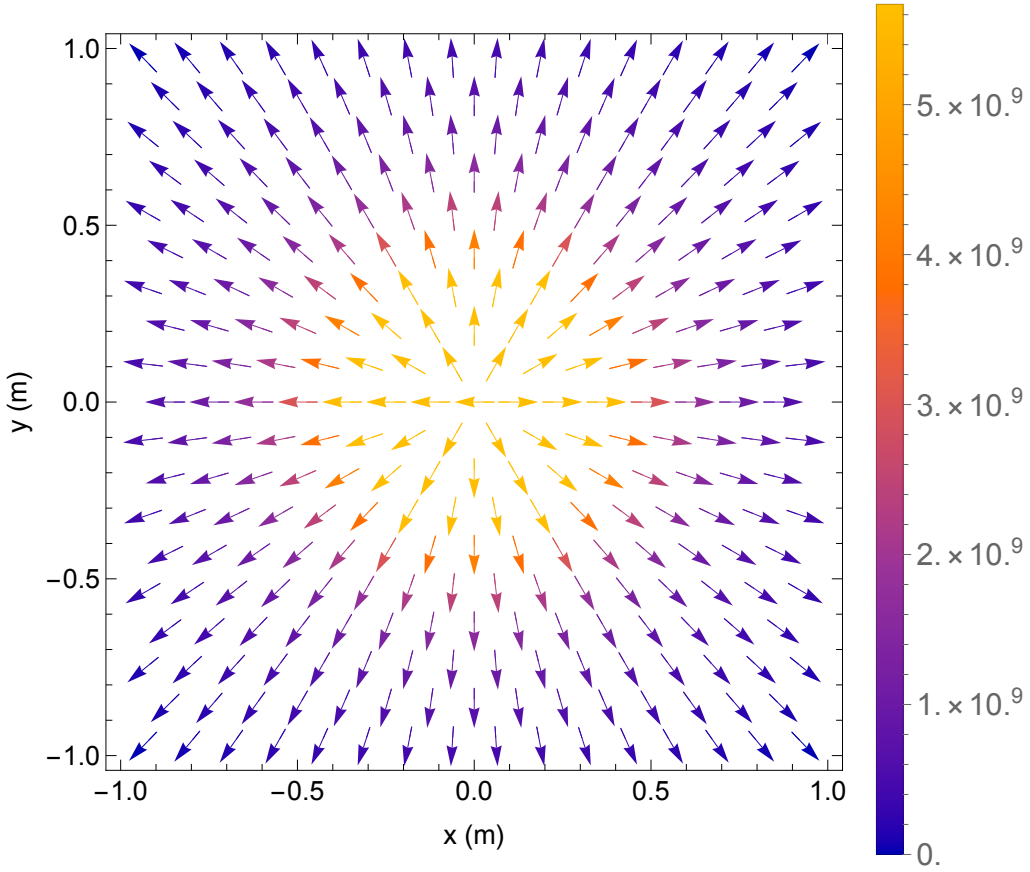
In[35]:=
```
Epcharge[x_, y_] = -Grad[v[x, y, pcharge], {x, y}]
```

Out[35]=

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

In[36]:=
```
VectorPlot[Epcharge[x, y], {x, -1, 1}, {y, -1, 1},
 AspectRatio → 1, PlotLegends → Automatic, Frame → True,
 FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger, ImageSize → Scaled[0.7]]
```

Out[36]=

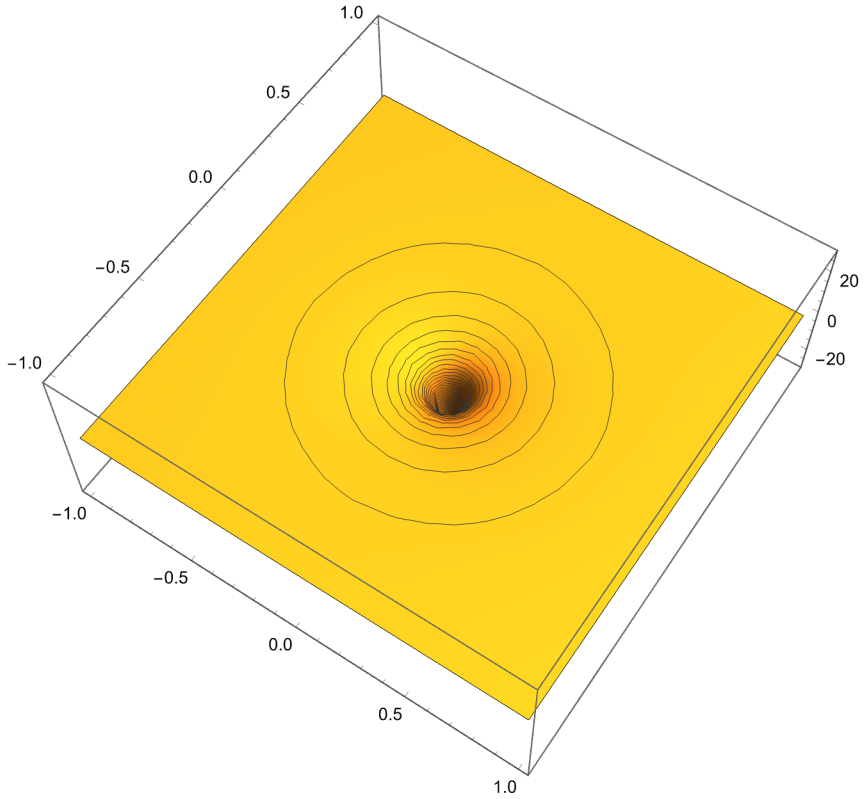


Single Negative Point Charge

In[37]:=
```
ncharge = {{-1, 0, 0}};
```

In[38]:=
```
Plot3D[v[x, y, ncharge], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},
 ImageSize → Scaled[0.7] , PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[38]=



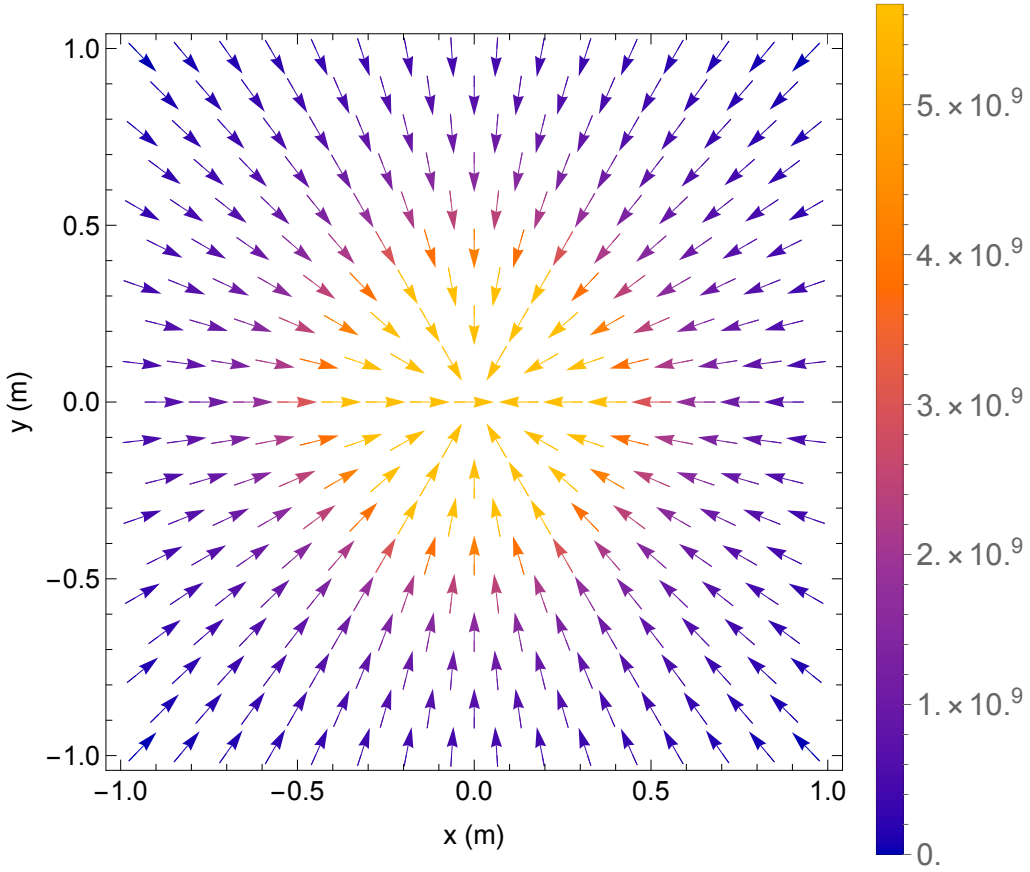
In[39]:=
```
Encharge[x_, y_] = -Grad[v[x, y, ncharge], {x, y}]
```

Out[39]=

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

In[40]:=
```
VectorPlot[Encharge[x, y], {x, -1, 1}, {y, -1, 1},
 AspectRatio → 1, PlotLegends → Automatic, Frame → True,
 FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger, ImageSize → Scaled[0.7]]
```

Out[40]=

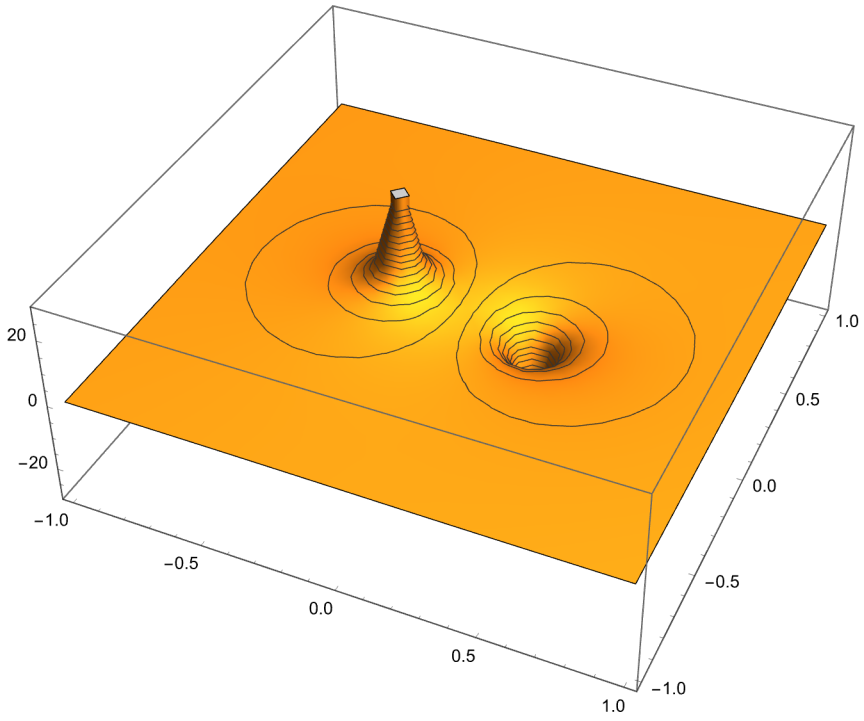


Dipole

In[41]:=
```
dipole = {{1, -0.25, 0}, {-1, 0.25, 0}};
```

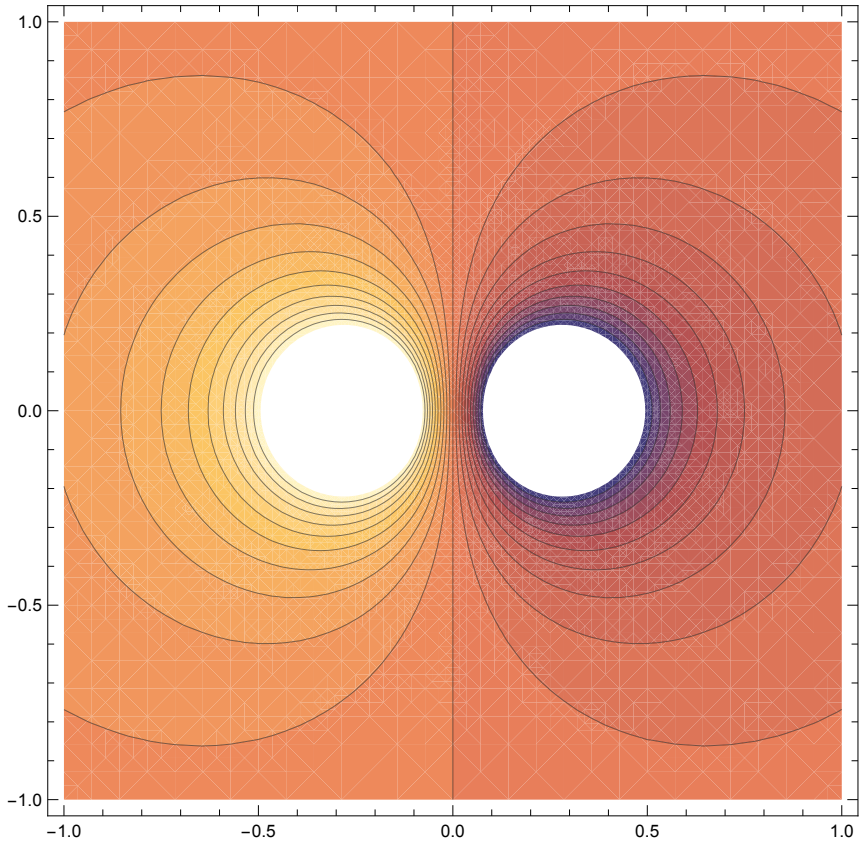
In[42]:=
```
Plot3D[v[x, y, dipole], {x, -1, 1}, {y, -1, 1}, PlotRange → {-30, 30},
 ImageSize → Scaled[0.7] , PlotTheme → "ZMesh", Mesh → nMesh]
```

Out[42]=



In[43]:=
```
ContourPlot[v[x, y, dipole], {x, -1, 1}, {y, -1, 1},
 Contours → Table[v, {v, -4, 4, 0.25}], ImageSize → Scaled[0.7]]
```

Out[43]=



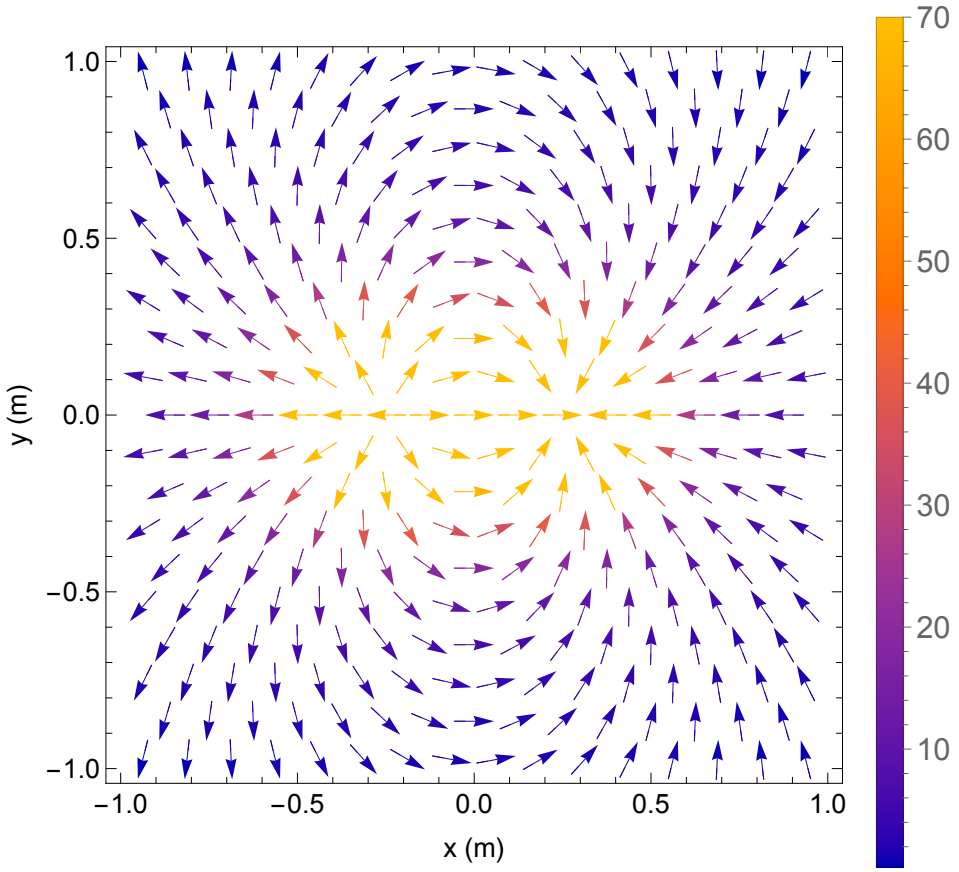
In[44]:=
```
Edipole[x_, y_] = -Grad[v[x, y, dipole], {x, y}]
```

Out[44]=

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

In[45]:=
```
VectorPlot[Edipole[x, y], {x, -1, 1}, {y, -1, 1},
 AspectRatio → 1, PlotLegends → Automatic, Frame → True,
 FrameLabel → {"x (m)", "y (m)"}, LabelStyle → Larger, ImageSize → Scaled[0.7]]
```

Out[45]=

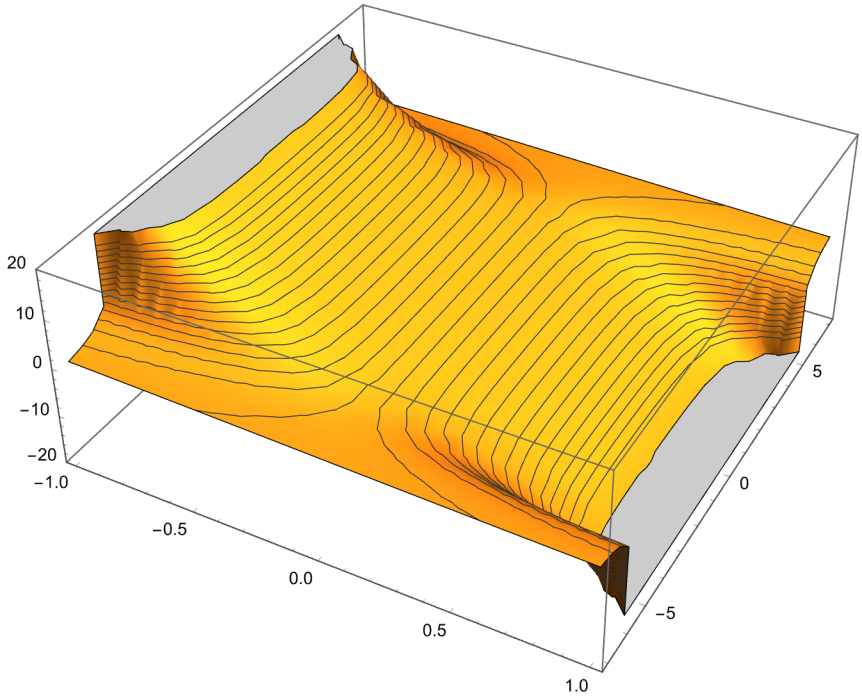


Oppositely charged plates

In[46]:=
```
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[50]:=
```
Plot3D[v[x, y, charges], {x, -1, 1}, {y, -(L + 2), (L + 2)},
 PlotRange → {-20, 20}, ImageSize → Scaled[0.7] ,
 PlotTheme → "ZMesh", Mesh → nMesh]
```

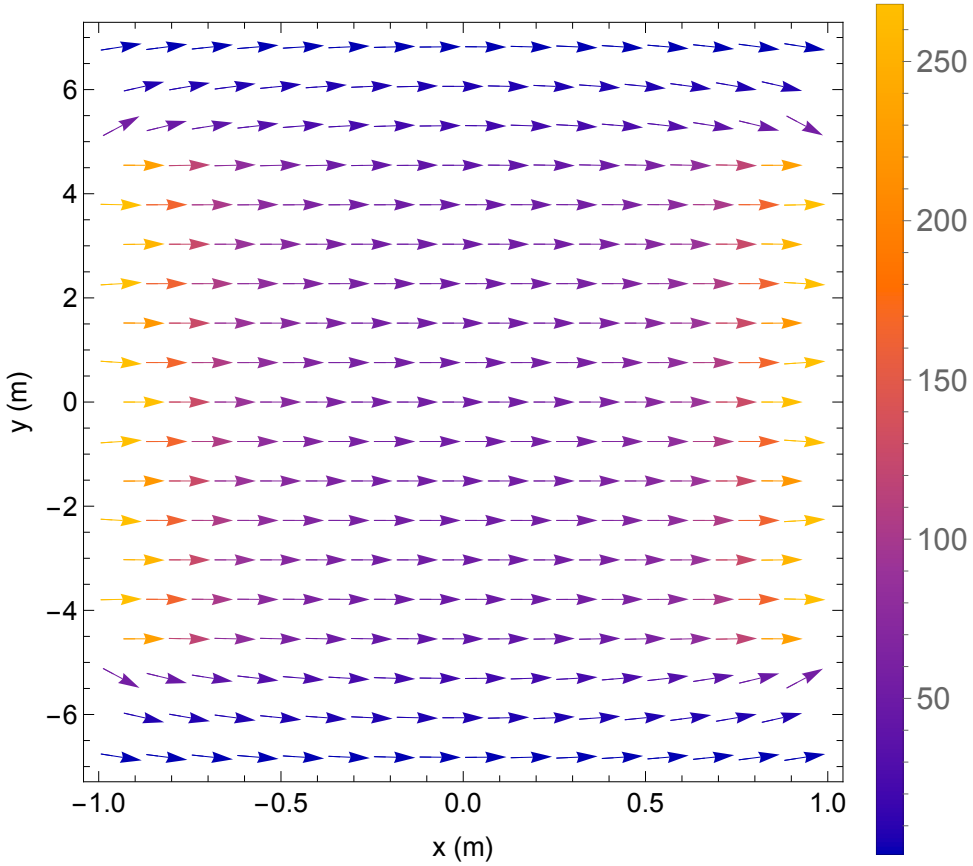
Out[50]=



In[51]:=
```
Eplates[x_, y_] = -Grad[v[x, y, charges], {x, y}];
```

In[52]:=
```
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, ImageSize → Scaled[0.7]]
```

Out[52]=



In[53]:=
```
ContourPlot[v[x, y, charges], {x, -1, 1}, {y, -(L + 2), L + 2},
 Contours → Table[n, {n, -20, 20, 2}], ImageSize → 7 * 72]
```

Out[53]=