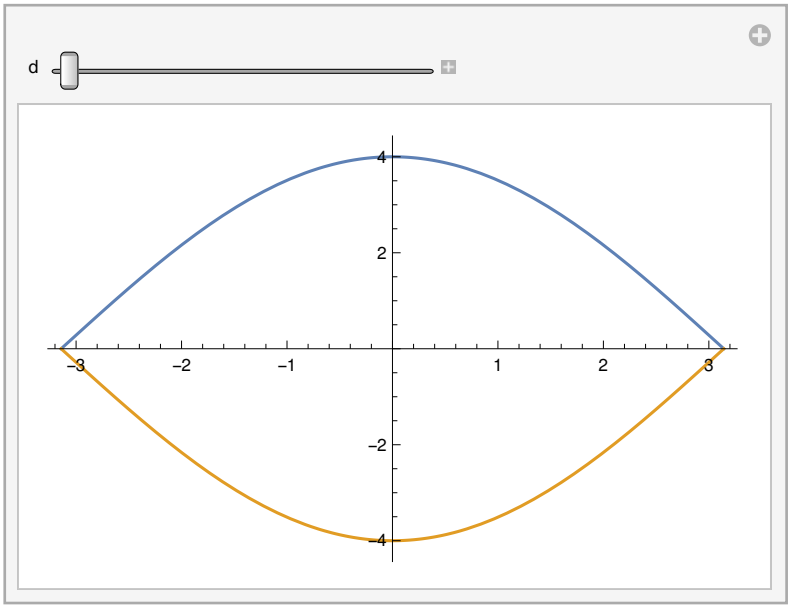
In[1]:=
```
ee[x_, y_, d_] := -Sqrt[d^2 + (4 * Cos[x / 2] * Cos[y / 2])^2];
dee[x_, y_, d_] := d / Sqrt[d^2 + (4 * Cos[x / 2] * Cos[y / 2])^2];
fermi[x_, T_] :=
  Module[{t = 0}, If[T == 0, t = HeavisideTheta[-x], t = 1 / (1 + Exp[x / T])];
   N[t]];
E0[N_, d_] := Sum[ee[2 * Pi / N * n1, 2 * Pi / N * n2, d], {n1, 0, N - 1}, {n2, 0, N - 1}] / (N * N);
M0[N_, d_] := Sum[dee[2 * Pi / N * n1, 2 * Pi / N * n2, d], {n1, 0, N - 1}, {n2, 0, N - 1}] / (N * N);
```

In[6]:=
```
E0int[d_] := NIntegrate[ee[x, y, d], {x, 0, Pi}, {y, 0, Pi}] / (Pi^2);
M0int[d_] := NIntegrate[dee[x, y, d], {x, 0, Pi}, {y, 0, Pi}] / (Pi^2);
E0Tint[d_, T_] :=
  NIntegrate[-ee[x, y, d] * Tanh[ee[x, y, d] / (2 T)], {x, 0, Pi}, {y, 0, Pi}] / (Pi^2);
M0Tint[d_, T_] := NIntegrate[-dee[x, y, d] * Tanh[ee[x, y, d] / (2 T)],
    {x, 0, Pi}, {y, 0, Pi}] / (Pi^2);
```

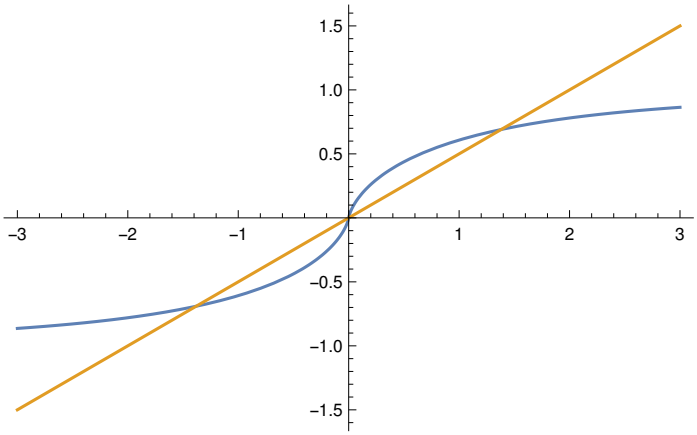
In[30]:=
```
Manipulate[Plot[{-ee[x, 0, d], ee[x, 0, d]}, {x, -Pi, Pi}], {d, 0, 4}]
```

Out[30]=



In[11]:=
```
Plot[{M0int[d], d/2}, {d, -3, 3}]
```

Out[11]=



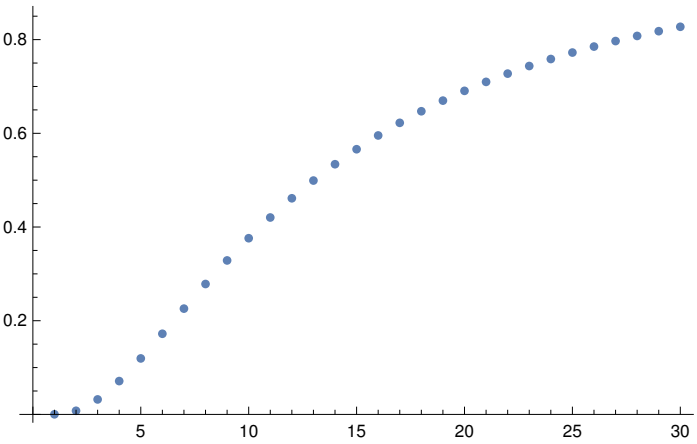
In[12]:=
```
Meq[U_] := Module[{d = 0}, sol = FindRoot[M0int[d] - d/U , {d, U}];
    (d /. sol) /U];
MTeq[U_, T_] := Module[{d = 0}, sol = FindRoot[M0Tint[d, T] - d/U, {d, U}];
    (d /. sol) /U];
```

```
M0tab = Table[Meq[n / 10], {n, 1, 30}];
```

In[15]:=
```
M0tab
ListPlot[M0tab]
```

Out[15]=
```
{0.000253206, 0.00775502, 0.0320054, 0.0711617, 0.119511, 0.172167, 0.225807,
 0.278372, 0.328674, 0.376084, 0.420325, 0.461339, 0.499193, 0.534034,
 0.566044, 0.595424, 0.62238, 0.647111, 0.66981, 0.690654, 0.70981, 0.72743,
 0.743654, 0.758608, 0.772408, 0.785157, 0.79695, 0.807871, 0.817998, 0.8274}
```

Out[16]=




```
M0tab1 = Table[{n / 100, Meq[n / 100]}, {n, 1, 30}];
```

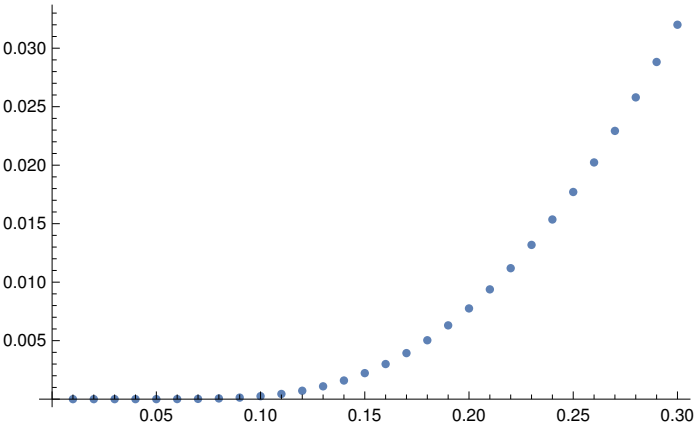
In[18]:=
```
tmp[x_] := {x[[1]], -Log[x[[2]]]};
```

In[19]:=
```
Map[tmp, M0tab1]
```

In[20]:=

In[21]:=
```
ListPlot[M0tab1]
```

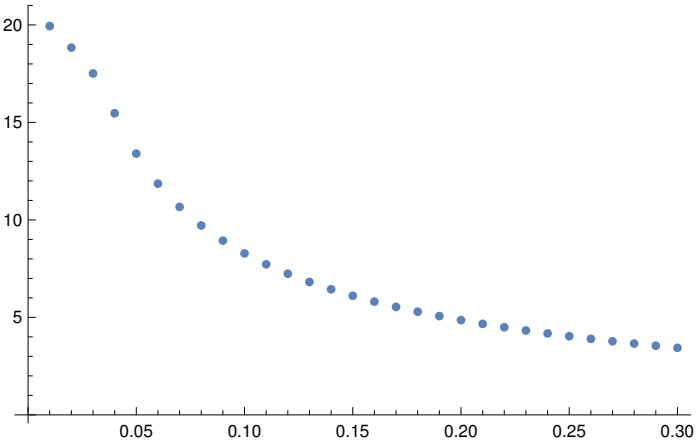
Out[21]=



In[22]:=

In[23]:=
```
ListPlot[Map[tmp, M0tab1]]
```

Out[23]=

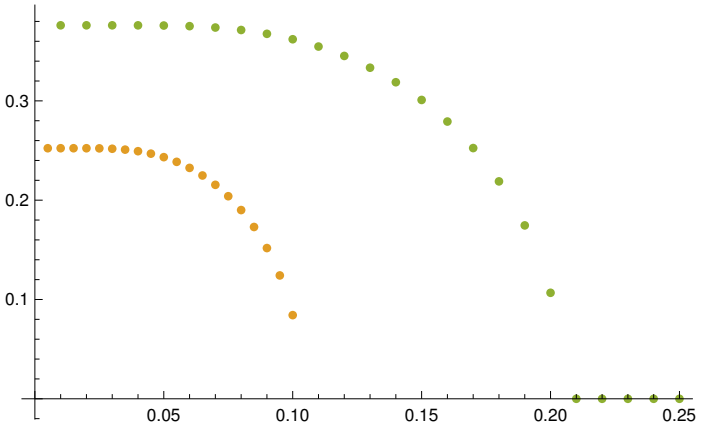


In[24]:=
```
M0TtabU1 = Table[{T / 100, MTeq[1, T / 100]}, {T, 1, 25}]

M0TtabU075 = Table[{T / 200, MTeq[0.75, T / 200]}, {T, 1, 20}];
```

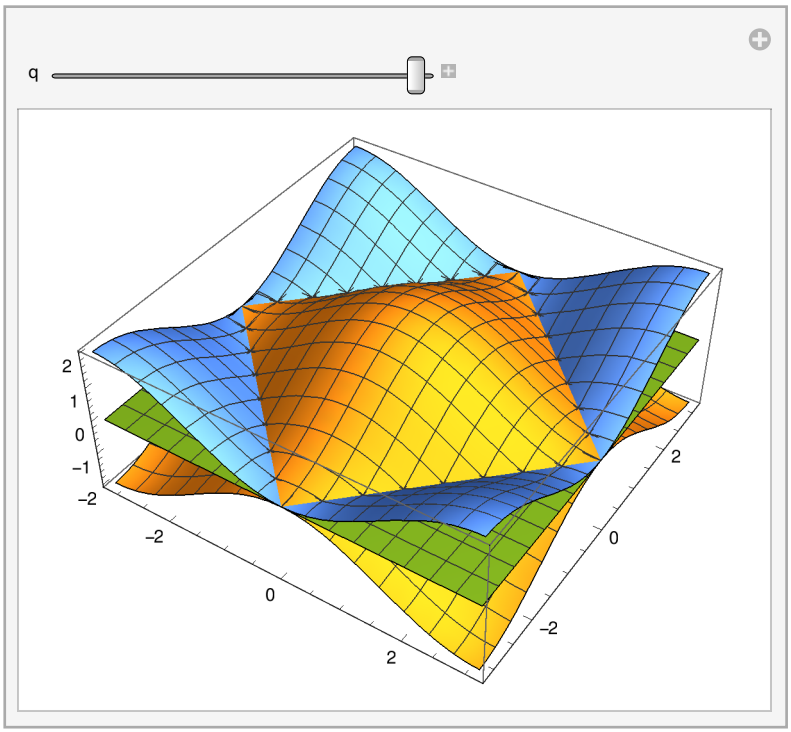
In[26]:=
```
ListPlot[{M0TtabU05, M0TtabU075, M0TtabU1}]
```

Out[26]=



In[27]:=
```
ee[x_, y_] :=
  1 * (Cos[x] + Cos[y]) + 0.0 * (Cos[2 * x + y] + Cos[2 * x - y] + Cos[2 * y + x] + Cos[2 * y - x]) +
   0.0 (Cos[2 x] + Cos[2 y]) + 0.;
Manipulate[Plot3D[{ee[x, y], ee[x + q, y + q], 0}, {x, -Pi, Pi}, {y, -Pi, Pi}], {q, 0, Pi}]
```

Out[28]=



In[29]:=
```
Manipulate[Plot3D[{ee[x, y], -ee[x, y], 0}, {x, -Pi, Pi}, {y, -Pi, Pi}], {q, 0, Pi}]
```

Out[29]=