Phasenraum-Trajektorien: (Kap 4.3, S.60)

in allen Beispielen: verallgemeinerte Koordinate sei q, verallg Impuls sei p.
in den Graphiken alles dimensionslos, habe m=1 gesetzt etc

1-dim Harmonischer Oszillator

In[1]:=

```
(*Loesung der Hamiltongleichungen mit Befehl DSolve*)
(*Anfangsbedingung zB bei t=0: q[0]=0 und p[0]=p0*)
V = m ω^2 / 2 q[t]^2;
H = p[t]^2 / 2 / m + V;
DSolve[{q'[t] == D[H, p[t]], p'[t] == -D[H, q[t]], q[0] == 0, p[0] == p0}, {q[t], p[t]}, t]
```

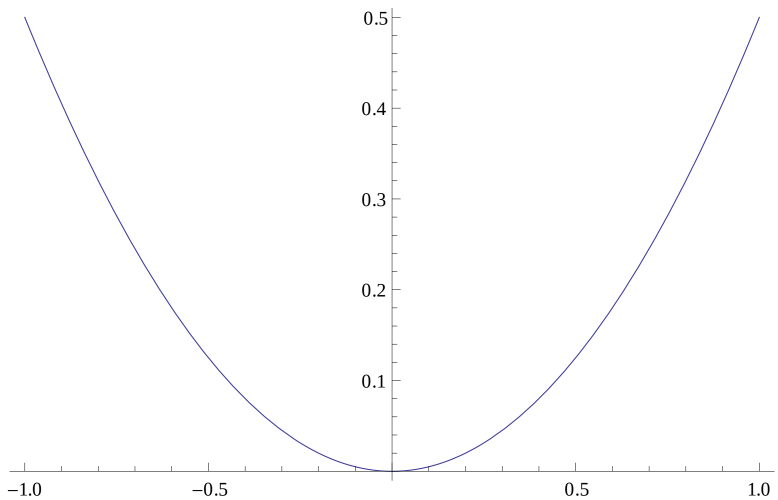
Out[3]=

$$\left\{\left\{p[t] \to p0\, \mathrm{Cos}[t\,\omega],\ q[t] \to \frac{p0\, \mathrm{Sin}[t\,\omega]}{m\,\omega}\right\}\right\}$$

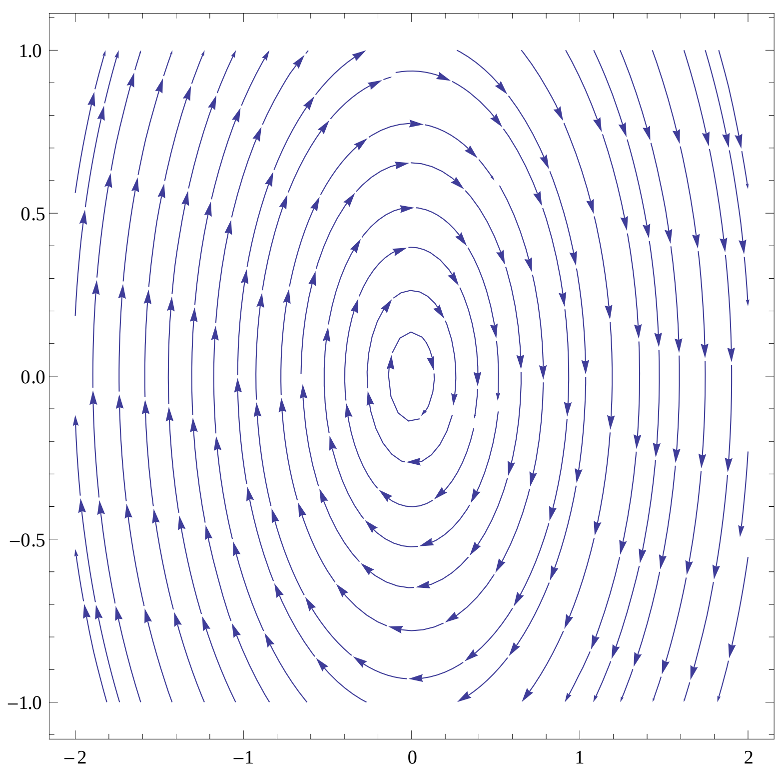
In[4]:=
```
(*Trajektorien: zeichne das Vektorfeld vf={dq/dt,dp/dt}*)
V = 1 / 2 q^2;
H = 1 / 2 p^2 + V;
vf = {D[H, p], - D[H, q]}
Plot[V, {q, -1, 1}]
StreamPlot[vf, {q, -2, 2}, {p, -1, 1}]
```

Out[6]= {p, -q}

Out[7]=



Out[8]=

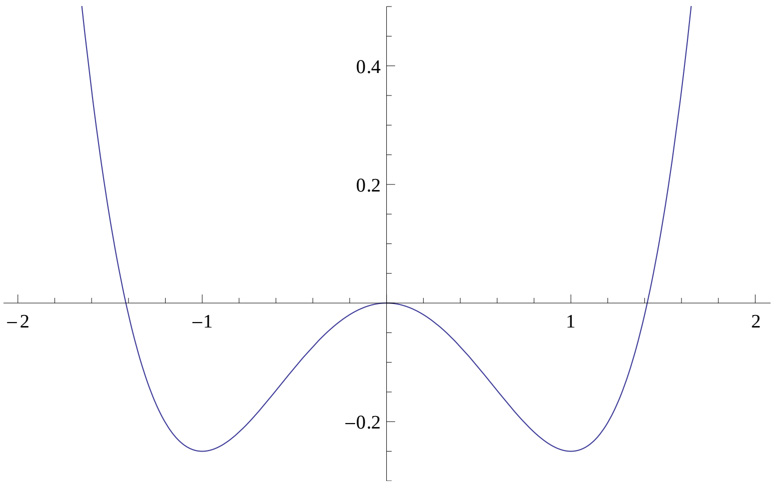


1-dim Teilchen im quartischen Potential

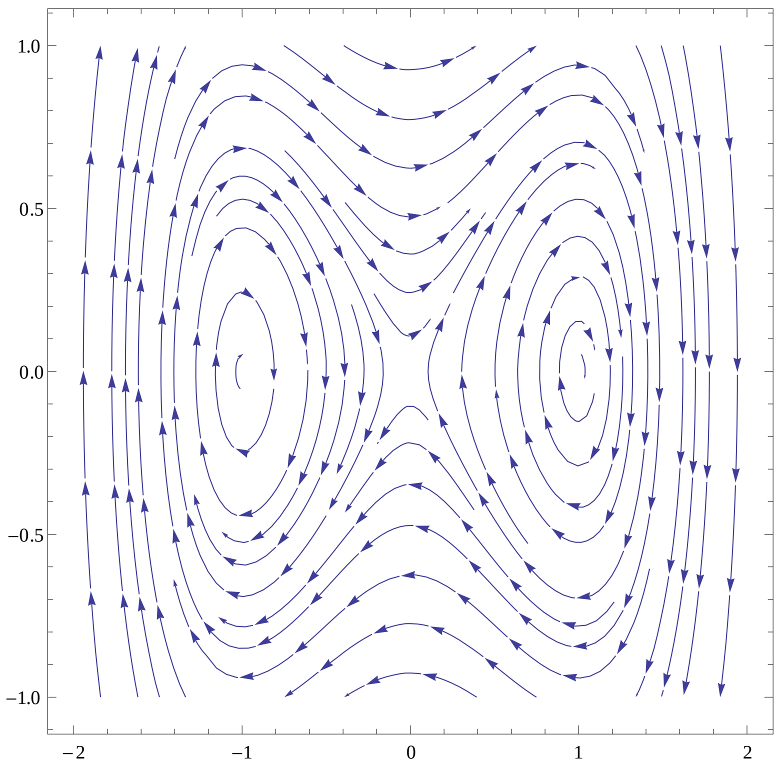
In[9]:=
```
V = q^4 / 4 - q^2 / 2;
H = 1 / 2 p^2 + V;
vf = {D[H, p], - D[H, q]}
Plot[V, {q, -2, 2}, PlotRange → {-0.3, 0.5}]
StreamPlot[vf, {q, -2, 2}, {p, -1, 1}]
```

Out[11]= $\{p, q - q^3\}$

Out[12]=



Out[13]=

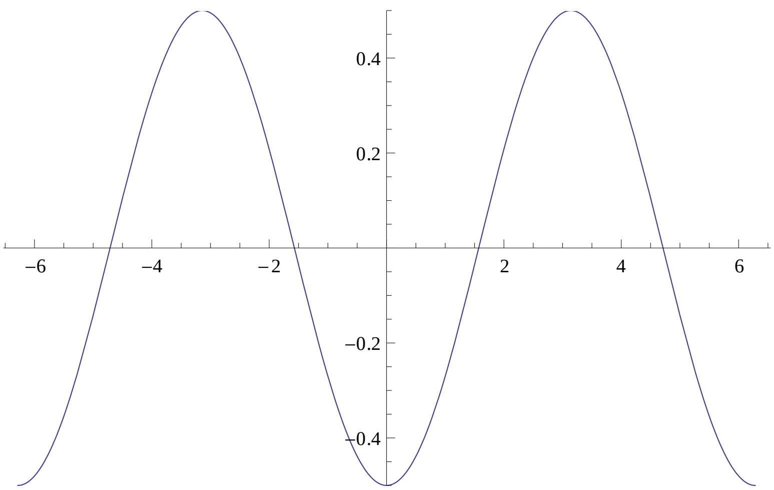


■ ebenes Pendel (hier q=θ=Auslenkung aus Ruhelage)

In[14]:=
```
V = -1 / 2 Cos[q];
H = 1 / 2 p^2 + V;
vf = {D[H, p], - D[H, q]}
Plot[V, {q, -2 Pi, 2 Pi}, PlotRange → {-0.5, 0.5}]
StreamPlot[vf, {q, -2 Pi, 2 Pi}, {p, -2, 2}]
```

Out[16]= $\left\{p, -\frac{\text{Sin}[q]}{2}\right\}$

Out[17]=



Out[18]=