```
Exit[];
```

```
$Assumptions =  r > 0 && Element[m, Integers] &&
  Element[n, Integers] && s > 0 && Element[k, Integers] && k > 0
```

r > 0 && m ∈ Integers && n ∈ Integers && s > 0 && k ∈ Integers && k > 0

```
f[r_] := {{(m - 1) / r, I * (En - r ^ p)}, {I * (En - r ^ p), -m / r}} -
  0 * IdentityMatrix[2] * I * r ^ p; f[r] // MatrixForm
```

$$\begin{pmatrix} \frac{-1+m}{r} & i\,(En - r^p) \\ i\,(En - r^p) & -\frac{m}{r} \end{pmatrix}$$

```
En = E0 + I * Ga; En =.
```

```
u = {a[n] * x ^ (2 * n), b[n] * x ^ (2 * n + 1)} * x ^s
```

$\{x^{2n+s}\, a[n],\ x^{1+2n+s}\, b[n]\}$

```
p = 2;
```

```
r[x_] := x;
```

```
g1 = Collect[Expand[Simplify[Expand[(D[u, x] - r'[x] * f[r[x]].u) * x ^ (-s + 1)]]],
   {x ^n, a[n], b[n]}];
g1 // MatrixForm
```

$$\begin{pmatrix} x^{2n}\left((1 - m + 2n + s)\, a[n] + \left(-i\, En\, x^2 + i\, x^4\right) b[n]\right) \\ x^{2n}\left(\left(-i\, En\, x + i\, x^3\right) a[n] + (x + m\, x + 2n\, x + s\, x)\, b[n]\right) \end{pmatrix}$$

```
s = -1 + m;
```

```
g2 = Table[Simplify[Sum[D[g1, {x, n2}] / n2!, {n, 0, 10}] /. x → 0], {n2, 0, 10}];
g2 // MatrixForm
```

$$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$$

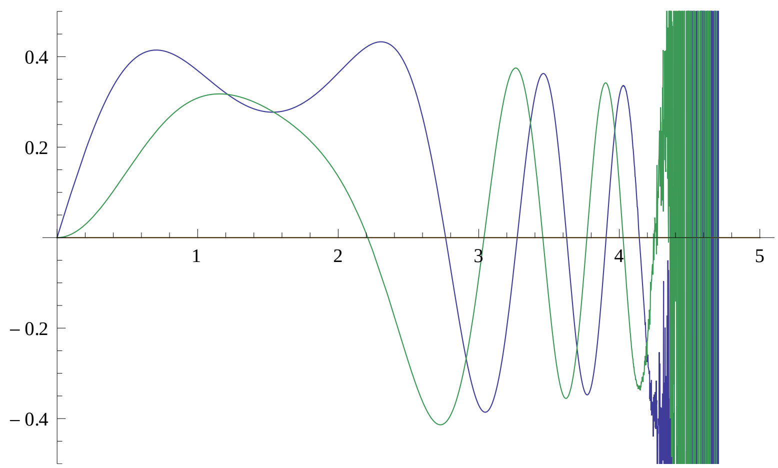
```
a[0] = 1; b[0] = i En a[0] / 2 / m; a[1] = i En b[0] / 2;
```

```
a[0] = 1; b[0] = i En a[0] / 2 / m; a[1] = i En b[0] / 2;
b[n_] := I * (En * a[n] - a[n - 1]) / 2 / (n + m);
a[n_] := Simplify[I * (En b[n - 1] - b[n - 2]) / 2 / n]
```

```
a[1]
```

$-\frac{\text{En}^2}{8}$

```
m = 2;

En =.

Un[En_, m_, nN_, x_] := Module[{n, U},
  U = {1}; AppendTo[U, -En^2/(4 m)]; AppendTo[U, En (4 + En^3 + 8 m)/(32 m (1 + m))]; G = {ⅈ En / 2 / m};

  For[n = 3, n < nN, n++,
   AppendTo[U,
     -((-1 + m + n) U[[-2 + n]] + En ((3 - 2 m - 2 n) U[[-1 + n]] + En (-2 + m + n) U[[n]])) /
       (4 n (-2 + m + n) (-1 + m + n))];
  ];
  ({1, ⅈ En / 2 / m * x} +
      Sum[{U[[n + 1]] * x ^ (2 * n), I * (En * U[[n + 1]] - U[[n]]) / 2 / (n + m) * x ^ (2 * n + 1)},
       {n, 1, nN - 1} ]) * x ^ (-1 + m) // N]

G = {Re[#], Im[#]} &[Un[3, 2, 150, x]]; Plot[G, {x, 0, 5}, PlotRange → {-0.5, 0.5}]
```




```
s
```

RungeKutta von Links

```
Exit[]
```

```
U[En_, m_, g_, X_] := Module[{n = 10, U, G},
  U = Un[En, m, n, X]; G = -Un[En, m, n + 1, X];
  While[Sqrt[Abs[Conjugate[U - G].(U - G)]] > g,
   n++;
   U = G; G = -Un[En, m, n + 1, X];

  ];
  Print[n];
  {Un[En, m, n, X], n}]
```

```
p = 2; En =.
```

```
f[r_] := {{(m - 1) / r, I * (En - r ^ p)}, {I * (En - r ^ p), -m / r}}; f[rr] // MatrixForm
```

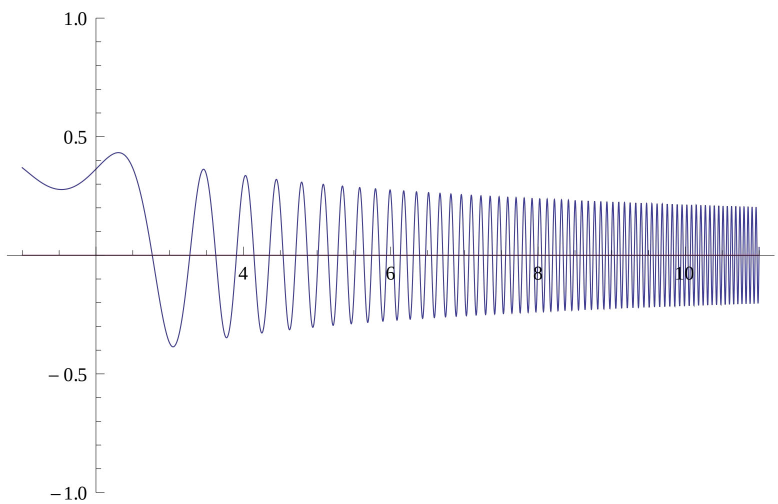
$$\begin{pmatrix} \frac{-1+m}{rr} & i\left(En - rr^2\right) \\ i\left(En - rr^2\right) & -\frac{m}{rr} \end{pmatrix}$$

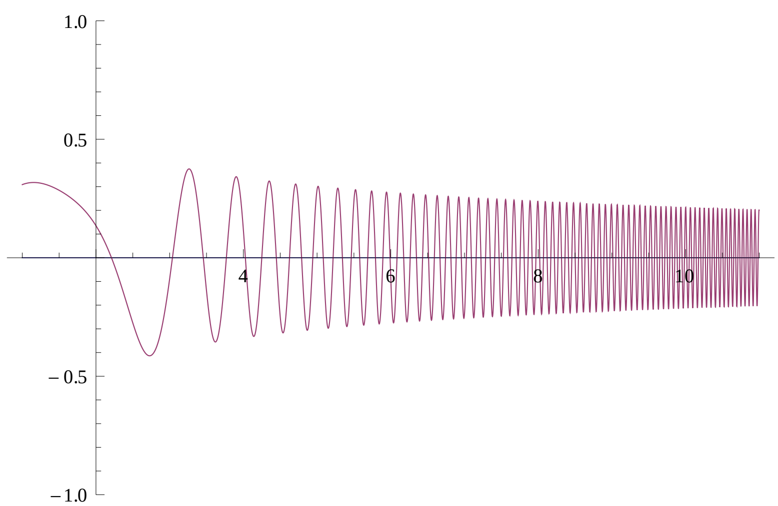
```
k = U[En, m, 10 ^ -10, r][[1]]; AppendTo[kK, { }];
```

```
$Aborted
```

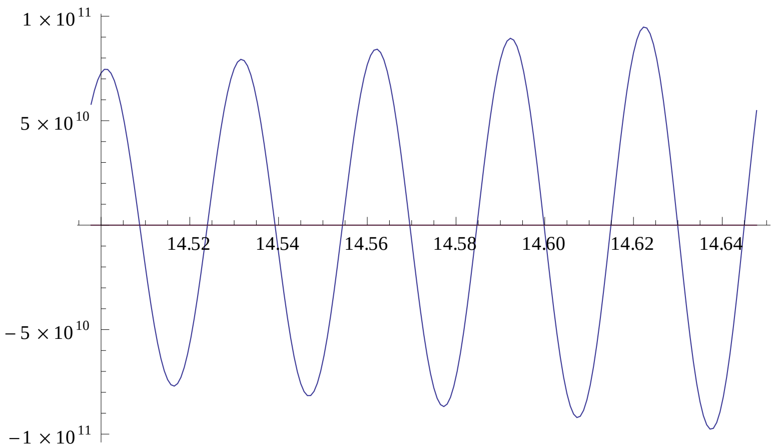
```
n = 5000; S = 1; h = 10 / n; ra = 1; En = 3; m = 2; r = 1; k = U[En, m, 10^-10, r][[1]];
kK = {{r, k}};
Do[
  k0 = h * f[r].k; k1 = h * f[r + h / 2].(k + k0 / 2);
  k2 = h * f[r + h / 2].(k + k1 / 2); k3 = h * f[r + h].(k + k2);
  k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r += h;
  AppendTo[kK, {r, k}], {n}];

ListPlot[Join[{ {#[[1]], Re[#[[2, 1]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], Im[#[[2, 1]]]} & /@ kK[[S ;; n]] // N}],
 PlotRange → {-ra, ra}, Joined → True]
ListPlot[Join[{ {#[[1]], Re[#[[2, 2]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], Im[#[[2, 2]]]} & /@ kK[[S ;; n]] // N}],
 PlotRange → {-ra, ra}, Joined → True]

m =.; r =.;
```

16

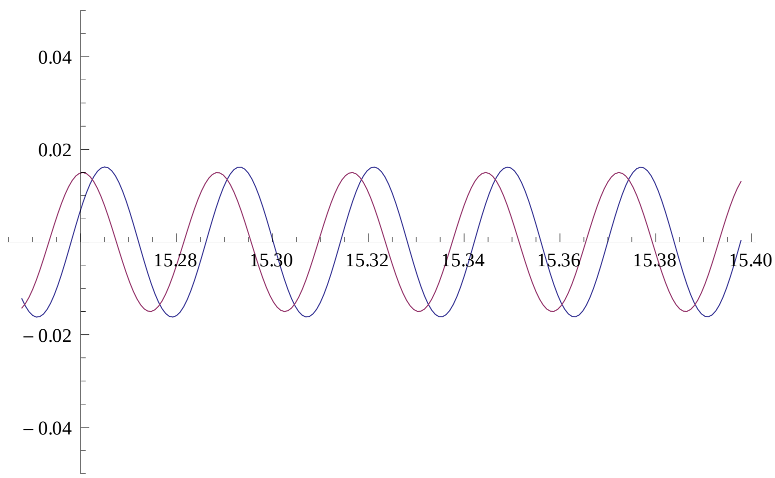




```
S = 18000; n = 200; ListPlot[Join[{ {#[[1]], Re[#[[2, 2]]]} &/@ kK[[S ;; S + n]] // N},
  { {#[[1]], 0 * Im[#[[2, 2]]]} &/@ kK[[S ;; S + n]] // N}],
 PlotRange → All, Joined → True]
```




```
S = 19000; n = 200; ListPlot[Join[{ {#[[1]], Im[#[[2, 2]]]} &/@ kK[[S ;; S + n]]},
  { {#[[1]], -0.1 * Sin[(-#^3 / 3 + 10 * #)] &[#[[1]]] * 0.15} &/@ kK[[S ;; S + n]]}],
 PlotRange → {-ra, ra}, Joined → True]
```




```
V = {{1, -1}, {1, 1}}
```

```
{{1, -1}, {1, 1}}.{F[x], g[x]}
```

```
Inverse[V].{C1, C2}
```

$$\left\{\frac{C1}{2}+\frac{C2}{2},\ -\frac{C1}{2}+\frac{C2}{2}\right\}$$

```
Expand[V.f[r].Inverse[V]] // MatrixForm
```

$$\begin{pmatrix} -i\,En-\frac{1}{2\,r}+i\,r^2 & -\frac{1}{2\,r}+\frac{m}{r} \\ -\frac{1}{2\,r}+\frac{m}{r} & i\,En-\frac{1}{2\,r}-i\,r^2 \end{pmatrix}$$

Finden und Einsetzen des Randverhaltens

```
Exit[];

$Assumptions = r > 0 && Element[m, Integers] &&
  Element[n, Integers] && s > 0 && Element[k, Integers] && k > 0
```

r > 0 && m ∈ Integers && n ∈ Integers && s > 0 && k ∈ Integers && k > 0

```
f[r_] := {{(m - 1) / r, I * (En - r ^ p)}, {I * (En - r ^ p), -m / r}} -
  0 * IdentityMatrix[2] * I * r ^ p; f[r] // MatrixForm
```

$$\begin{pmatrix} \frac{-1+m}{r} & i\,(En - r^p) \\ i\,(En - r^p) & -\frac{m}{r} \end{pmatrix}$$

```
En = E0 + I * Ga; En =.

u = {Exp[I * (F1[x])] + Exp[I * F2[x]], Exp[I * (G1[x])] + Exp[I * G2[x]]} * x ^ s
```

$$\left\{\left(e^{i F1[x]} + e^{i F2[x]}\right) x^{-1+m},\ \left(e^{i G1[x]} + e^{i G2[x]}\right) x^{-1+m}\right\}$$

```
s = m - 1
```

$-1 + m$

```
p = 2;

r[x_] := x;

g1 = -Collect[Expand[Simplify[Expand[(D[u, x] - r'[x] * f[r[x]].u) * F1[x] / u / I]]],
   {x ^ n, a[n], b[n]}]
```

$$\left\{\frac{5\, e^{i G1[x]}\, F1[x]}{e^{i F1[x]} + e^{i F2[x]}} + \frac{5\, e^{i G2[x]}\, F1[x]}{e^{i F1[x]} + e^{i F2[x]}} - x^2 \left(\frac{e^{i G1[x]}\, F1[x]}{e^{i F1[x]} + e^{i F2[x]}} + \frac{e^{i G2[x]}\, F1[x]}{e^{i F1[x]} + e^{i F2[x]}}\right) - \frac{e^{i F1[x]}\, F1[x]\, F1'[x]}{e^{i F1[x]} + e^{i F2[x]}} - \frac{e^{i F2[x]}\, F1[x]\, F2'[x]}{e^{i F1[x]} + e^{i F2[x]}},\right.$$
$$\frac{5\, e^{i F1[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} + \frac{5\, e^{i F2[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} - x^2 \left(\frac{e^{i F1[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} + \frac{e^{i F2[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}}\right) - \frac{1}{x}$$
$$\left(\frac{i\, e^{i G1[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} + \frac{i\, e^{i G2[x]}\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} - \frac{2\, i\, e^{i G1[x]}\, m\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}} - \frac{2\, i\, e^{i G2[x]}\, m\, F1[x]}{e^{i G1[x]} + e^{i G2[x]}}\right) -$$
$$\left.\frac{e^{i G1[x]}\, F1[x]\, G1'[x]}{e^{i G1[x]} + e^{i G2[x]}} - \frac{e^{i G2[x]}\, F1[x]\, G2'[x]}{e^{i G1[x]} + e^{i G2[x]}}\right\}$$

```
s = -1 + m;
```

```
g2 = Table[Simplify[Sum[D[g1, {x, n2}] / n2!, {n, 0, 10}] /. x → 0], {n2, 0, 10}];
g2 // MatrixForm
```

$$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$$

RungeKutta von Rechts

```
Exit[]
```

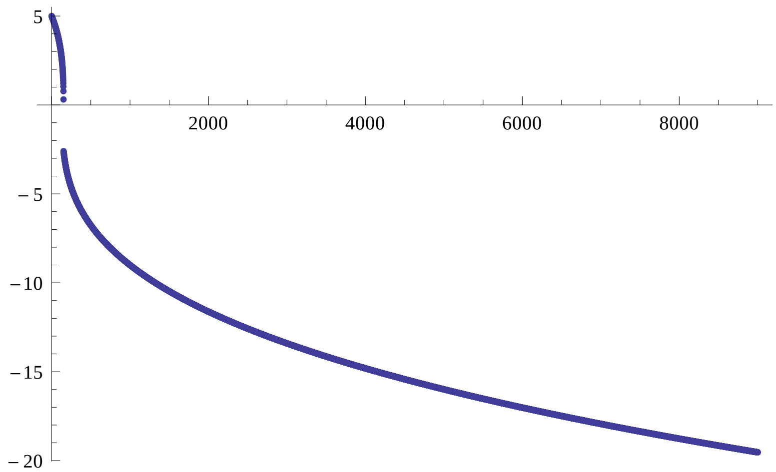
```
U[En_, m_, g_, X_] := Module[{n = 10, U, G},
  U = Un[En, m, n, X]; G = -Un[En, m, n + 1, X];
  While[Sqrt[Abs[Conjugate[U - G].(U - G)]] > g,
   n++;
   U = G; G = -Un[En, m, n + 1, X];

  ];
  Print[n];
  {Un[En, m, n, X], n}]
```

```
p = 2; En =.
```

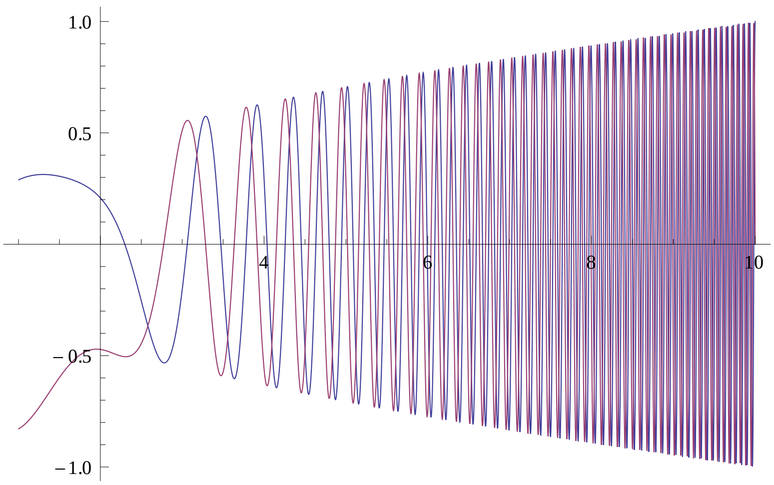
```
f[r_] := {{(m - 1) / r, I * (En - r ^ p)}, {I * (En - r ^ p), -m / r}}; f[rr] // MatrixForm
```

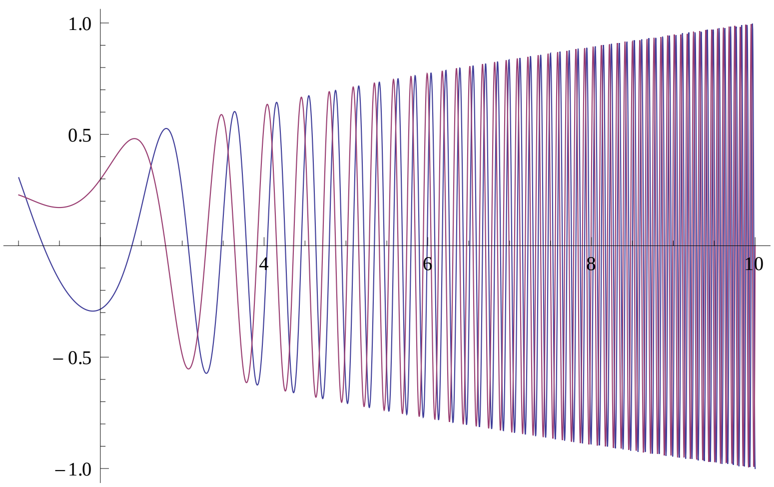
$$\begin{pmatrix} \frac{-1+m}{rr} & i\left(3 - rr^2\right) \\ i\left(3 - rr^2\right) & -\frac{m}{rr} \end{pmatrix}$$

```
r = 5 // N; k = {r}; Do[
 r -= 0.28 / r ^ 2; AppendTo[k, r]
 , {9000}]; r =.; ListPlot[k]
```



```
n = 3000; S = 1; ra = 0.05; En = 3; m = 2; r = 10 // N; h = 9 / n; k = {1, -1};
kK = {{r, k}};
Do[
  k0 = h * f[r].k; k1 = h * f[r + h / 2].(k + k0 / 2);
  k2 = h * f[r + h / 2].(k + k1 / 2); k3 = h * f[r + h].(k + k2);
  k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r -= h;
  AppendTo[kK, {r, k}], {n}];

ListPlot[Join[{ {#[[1]], Re[#[[2, 1]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], Im[#[[2, 1]]]} & /@ kK[[S ;; n]] // N}], PlotRange → All, Joined → True]
ListPlot[Join[{ {#[[1]], Re[#[[2, 2]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], Im[#[[2, 2]]]} & /@ kK[[S ;; n]] // N}], PlotRange → All, Joined → True]
r =.;
```



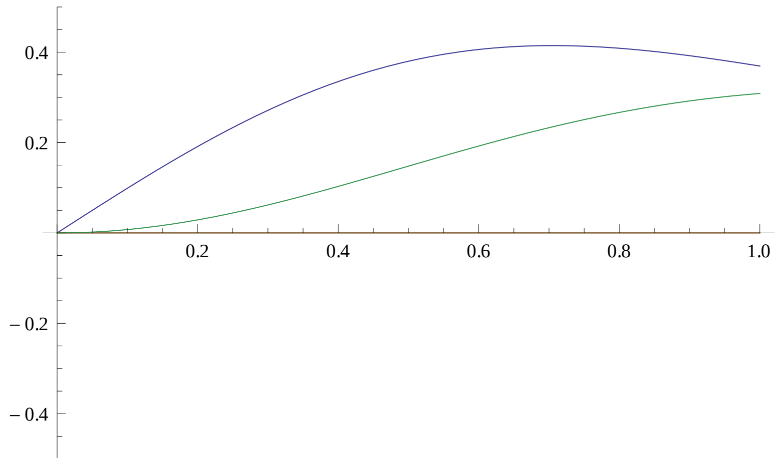


```
r = 1 // N
k = U[En, 2, 10^-10, r][[2]]; Un[En, 2, k, 1]
G = {Re[#], Im[#]} &[Un[3, 2, k, x]]; Plot[G, {x, 0, r}, PlotRange → {-0.5, 0.5}]
r =.
```

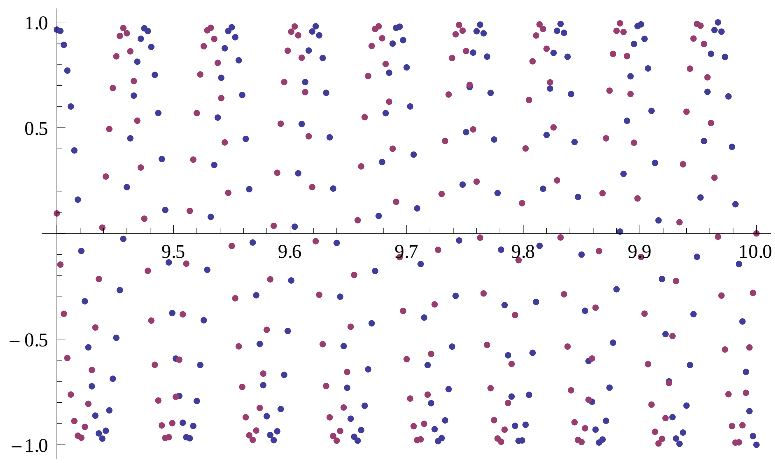
1.

19

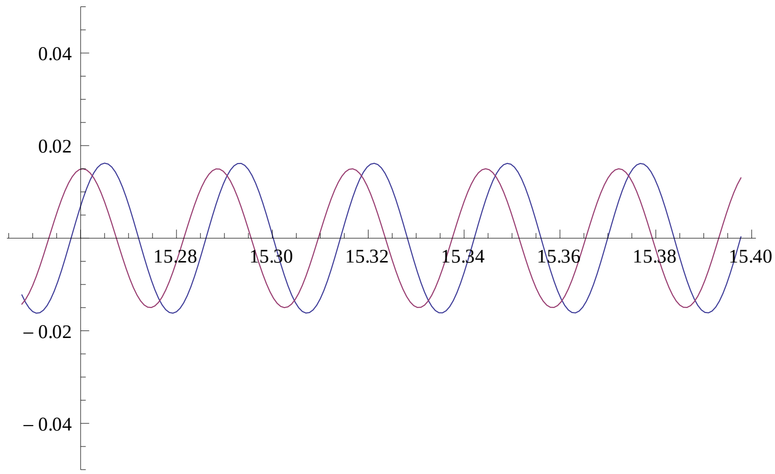
{-0.0989079, 0. + 0.0687335 ⅈ}




```
S = 1; n = 200; ListPlot[Join[{{#[[1]], Re[#[[2, 2]]]} & /@ kK[[S ;; S + n]] // N},
  {{#[[1]], Im[#[[2, 2]]]} & /@ kK[[S ;; S + n]] // N}], PlotRange → All, Joined → False]
```



```
S = 19000; n = 200; ListPlot[Join[{ {#[[1]], Im[#[[2, 2]]]} & /@ kK[[S ;; S + n]]},
  { {#[[1]], -0.1 * Sin[(-#^3 / 3 + 10 * #)] &[#[[1]]] * 0.15} & /@ kK[[S ;; S + n]]}],
 PlotRange → {-ra, ra}, Joined → True]
```




```
V = {{1, -1}, {1, 1}}

{{1, -1}, {1, 1}}.{F[x], g[x]}

Inverse[V].{C1, C2}
```

$$\left\{\frac{C1}{2}+\frac{C2}{2},\ -\frac{C1}{2}+\frac{C2}{2}\right\}$$

```
Expand[V.f[r].Inverse[V]] // MatrixForm
```

$$\begin{pmatrix} -i\,En-\frac{1}{2\,r}+i\,r^2 & -\frac{1}{2\,r}+\frac{m}{r} \\ -\frac{1}{2\,r}+\frac{m}{r} & i\,En-\frac{1}{2\,r}-i\,r^2 \end{pmatrix}$$

Nullstellensuche

```
n = 3000; S = 1; ra = 0.05; En = 5; m = 2; r = 10 // N; h = 9 / n; k = {1, -1};
Do[
  k0 = h * f[r].k; k1 = h * f[r + h / 2].(k + k0 / 2);
  k2 = h * f[r + h / 2].(k + k1 / 2); k3 = h * f[r + h].(k + k2);
  k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r -= h;
  , {n}];
Erg = k - Un[En, m, U[En, m, 10^-10, 1][[2]], 1]
```

19

$\{0.273782-0.220723\,i,\ -0.422103+0.0503209\,i\}$

```
D[f[R], En]
```

General::ivar : 5 is not a valid variable. ≫

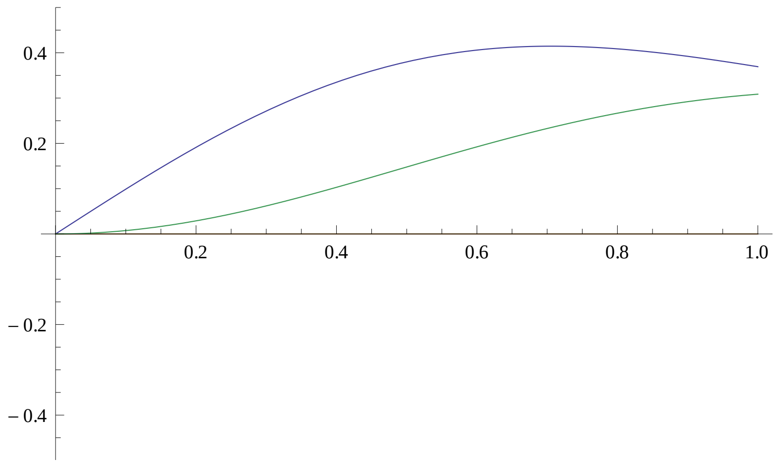
$$\partial_5\left\{\left\{\frac{1}{R},\ i\,(5-R^2)\right\},\ \left\{i\,(5-R^2),\ -\frac{2}{R}\right\}\right\}$$

```
r = 1 // N
k = U[En, 2, 10^-10, r][[2]]; Un[En, 2, k, 1]
G = {Re[#], Im[#]} &[Un[3, 2, k, x]]; Plot[G, {x, 0, r}, PlotRange → {-0.5, 0.5}]
r =.
```

```
1.
```

```
19
```

```
{-0.0989079, 0.+0.0687335 i}
```



RungeKutta von Links mit Randverhalten

```
Exit[]
```

```
U[En_, m_, g_, X_] := Module[{n = 10, U, G},
  U = Un[En, m, n, X]; G = -Un[En, m, n+1, X];
  While[Sqrt[Abs[Conjugate[U - G].(U - G)]] > g,
   n++;
   U = G; G = -Un[En, m, n+1, X];

  ];
  Print[n];
  {Un[En, m, n, X], n}]
```

```
p = 2;
```

```
f[u_, x_] :=
  {e^(-i F[x]+i G[x]) En - e^(-i F[x]+i G[x]) x^2, e^(i F[x]-i G[x]) En - i/x + (2 i m)/x - e^(i F[x]-i G[x]) x^2} /.
    F[x] → u[[1]] /. G[x] → u[[2]]; f[{F[x], G[x]}, r] // MatrixForm
```

$$\begin{pmatrix} e^{-i F[x]+i G[x]} \text{En} - e^{-i F[x]+i G[x]} r^2 \\ e^{i F[x]-i G[x]} \text{En} - \frac{i}{r} + \frac{2 i m}{r} - e^{i F[x]-i G[x]} r^2 \end{pmatrix}$$

```
n = 5000; S = 1; h = 10 / n; ra = 0.05; En = 5; m = 2;
r = 0.1; k = Log[U[En, m, 10^-25, r][[1]] / r^s] / I
kK = {{r, k}};
Do[
 k0 = h * f[k, r]; k1 = h * f[(k + k0 / 2), r + h / 2];
 k2 = h * f[(k + k1 / 2), r + h / 2]; k3 = h * f[(k + k2), r + h];
 k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r += h;
 AppendTo[kK, {r, k}], {n}];
ListPlot[Join[{ {#[[1]], Re[#[[2, 1]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], 0 * Im[#[[2, 1]]]} & /@ kK[[S ;; n]] // N}], PlotRange → All, Joined → True]
ListPlot[Join[{ {#[[1]], Re[#[[2, 2]]]} & /@ kK[[S ;; n]] // N},
  { {#[[1]], 0 * Im[#[[2, 2]]]} & /@ kK[[S ;; n]] // N}], PlotRange → All, Joined → True]

m =.; r =.;
```

11

{0.0313618 i, 1.5708+ 2.10163 i}

General::ovfl : Overflow occurred in computation. ≫

General::unfl : Underflow occurred in computation. ≫

$Aborted

Part::take : Cannot take positions 1 through 5000 in {{0.1, {0.0313618 i, 1.5708 + 2.10163 i}}, ≪9≫, ≪3501≫}. ≫

Part::partd : Part specification (1 ;; 5000)⟦2, 2⟧ is longer than depth of object. ≫

Part::pspec : Part specification {1, Re[(1 ;; 5000)⟦2, 2⟧]} is neither an integer nor a list of integers. ≫

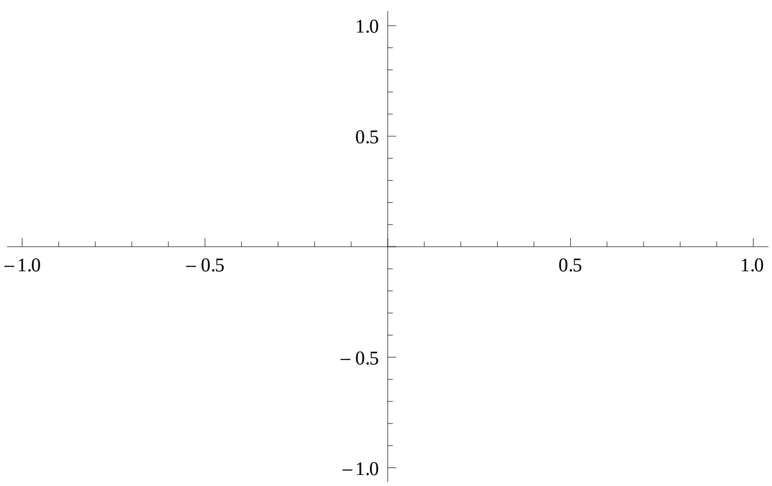
Part::partd : Part specification (1 ;; 5000)⟦2, 2⟧ is longer than depth of object. ≫

Part::pspec : Part specification {1, Re[(1 ;; 5000)⟦2, 2⟧]} is neither an integer nor a list of integers. ≫

Part::take : Cannot take positions 1 through 5000 in {{0.1, {0.0313618 i, 1.5708 + 2.10163 i}}, ≪9≫, ≪3501≫}. ≫

Part::partd : Part specification (1 ;; 5000)⟦2, 2⟧ is longer than depth of object. ≫

General::stop : Further output of Part::partd will be suppressed during this calculation. ≫

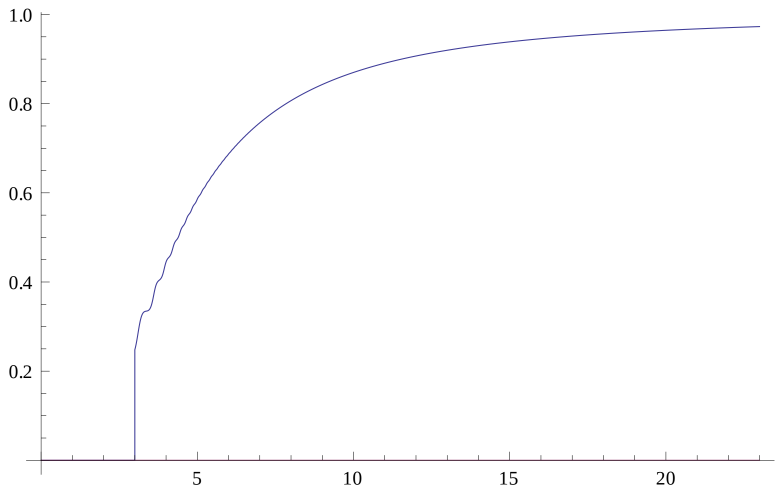


```
3
```

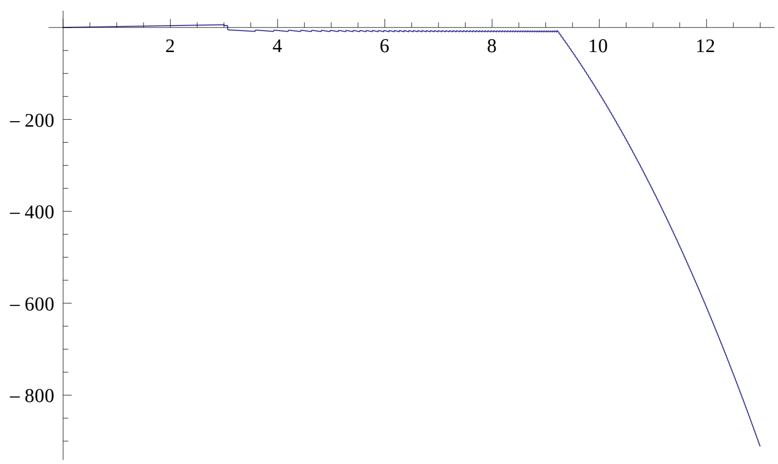
```
Sqrt[5] // N
```

```
2.23607
```

```
S = 1; n = 10000;
ListPlot[Join[{ {#[[1]], Re[#[[2, 1]] / (#[[1]]^3 / 3)]} & /@ kK[[S ;; S + n]]},
  { {#[[1]], 0 * Im[#[[2, 1]]]} & /@ kK[[S ;; S + n]]}], PlotRange → All, Joined → True]
```



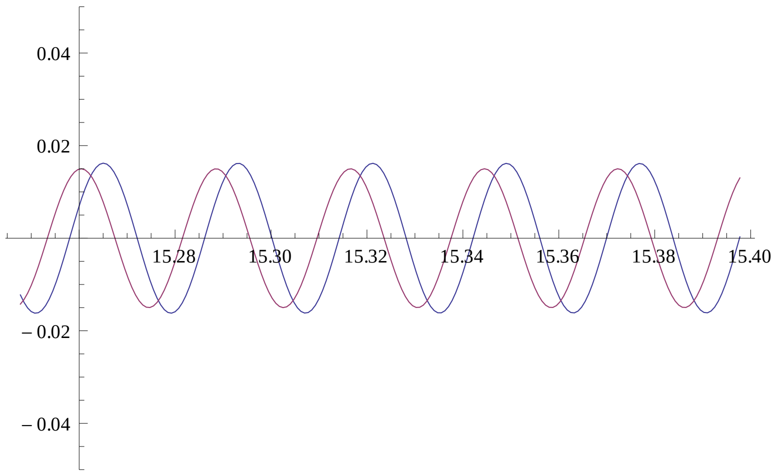

```
S = 1; n = 5000; ListPlot[
 Join[{ {#[[1]], Re[#[[2, 2]] - (#[[1]]^3 / 3 - En * #[[1]])]} & /@ kK[[S ;; S + n]]}],
 PlotRange → All, Joined → True]
```




```
En
```

```
5 + 0.2 ⅈ
```

```
S = 19000; n = 200; ListPlot[Join[{ {#[[1]], Im[#[[2, 2]]]} & /@ kK[[S ;; S + n]]},
  { {#[[1]], -0.1 * Sin[(-#^3 / 3 + 10 * #)] &[#[[1]]] * 0.15} & /@ kK[[S ;; S + n]]}],
 PlotRange → {-ra, ra}, Joined → True]
```



RungeKutta von Rechts->Nullstellengesuche

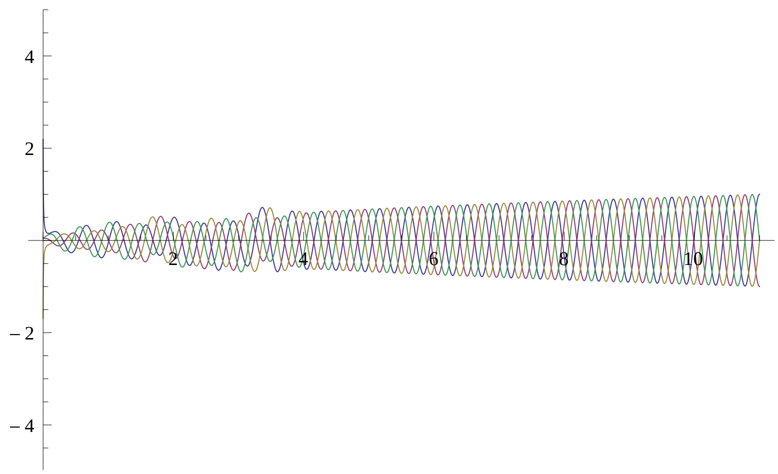
```
Exit[]
```

```
p = 2;
```

```
f[r_, En_, m_] :=
  {{(m - 1) / r, I * (En - r ^ p)}, {I * (En - r ^ p), -m / r}} - IdentityMatrix[2] * I * r ^ p;
```

```
n = 3000; En = 14 + I * 0.001; m = 2; r = 11.0; h = r / (n - 1); k = {1, -1};
kK = {{r, k}};
Do[
  k0 = h * f[r, En, m].k; k1 = h * f[r + h / 2, En, m].(k + k0 / 2);
  k2 = h * f[r + h / 2, En, m].(k + k1 / 2); k3 = h * f[r + h, En, m].(k + k2);
  k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r -= h;
  AppendTo[kK, {r, k}], {n}];
Print[kK[[n, 2]]];
ListPlot[Join[Table[ {#[[1]], Re[#[[2, i]]]} & /@ kK[[1 ;; n]] // N, {i, 2}],
  Table[ {#[[1]], Im[#[[2, i]]]} & /@ kK[[1 ;; n]] // N, {i, 2}]],
 PlotRange → {-5, 5}, Joined → True]
```

{2.19637 - 1.69195 ⅈ, 0.0535395 + 0.0697368 ⅈ}




```
d[En_, m_, x_, X_, n_] := Module[{k, k0, k1, k2, k3, k4},
  r = X; h = (X - x) / (n); k = {1, -1};
  Do[
   k0 = h * f[r, En, m].k; k1 = h * f[r + h / 2, En, m].(k + k0 / 2);
   k2 = h * f[r + h / 2, En, m].(k + k1 / 2); k3 = h * f[r + h, En, m].(k + k2);
   k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r -= h;, {n}];
  k4 = k;
  r = 0.001; h = (X - x - r) / (n); k = U[En, m, 0.001, r][[1]] * {1, -1} * ⅇ^(ⅈ r^3 / 3);

  Do[
   k0 = h * f[r, En, m].k; k1 = h * f[r + h / 2, En, m].(k + k0 / 2);
   k2 = h * f[r + h / 2, En, m].(k + k1 / 2); k3 = h * f[r + h, En, m].(k + k2);
   k += 1 / 6 * (k0 + 2 * k1 + 2 * k2 + k3); r += h;, {n}];
  k - k4
 ]

d[7, 2, 2, 11.0, 3000]
```

{-21.3966 + 38.1887 ⅈ, 8.2075 + 3.56692 ⅈ}

```
AA = Table[Abs[d[i + I * j, 2, 2.0, 11.0, 3000][[1]]], {j, 8, 20, 2}, {i, 0, 5}]
```

$\{\{2.01539\times10^{72}, 1.70761\times10^{71}, 2.23889\times10^{69}, 3.61115\times10^{68}, 4.14497\times10^{66}, 5.36746\times10^{65}\},$
$\{3.36981\times10^{79}, 8.41473\times10^{77}, 2.13402\times10^{76}, 4.93856\times10^{74}, 1.72678\times10^{73}, 4.46675\times10^{71}\},$
$\{4.80477\times10^{86}, 1.27969\times10^{85}, 3.48353\times10^{83}, 9.67405\times10^{81}, 2.79312\times10^{80}, 8.22132\times10^{78}\},$
$\{6.07865\times10^{93}, 1.78739\times10^{92}, 5.38671\times10^{90}, 1.66212\times10^{89}, 5.26181\times10^{87}, 1.70489\times10^{86}\},$
$\{6.97571\times10^{100}, 2.27062\times10^{99}, 7.57069\times10^{97}, 2.58576\times10^{96}, 9.04737\times10^{94},$
$3.24291\times10^{93}\}, \{7.27266\times10^{107}, 2.62014\times10^{106}, 9.66553\times10^{104},$
$3.65111\times10^{103}, 1.41238\times10^{102}, 5.59539\times10^{100}\}, \{6.89962\times10^{114},$
$2.75055\times10^{113}, 1.12233\times10^{112}, 4.68769\times10^{110}, 2.00434\times10^{109}, 8.7738\times10^{107}\}\}$

```
MatrixPlot[AA]
```