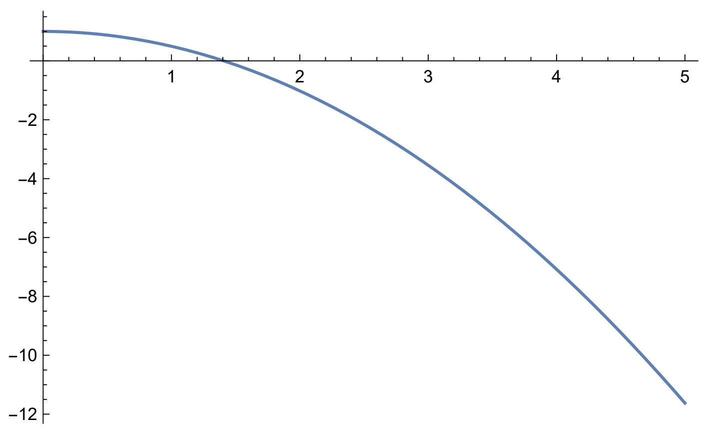
In[ ]:=

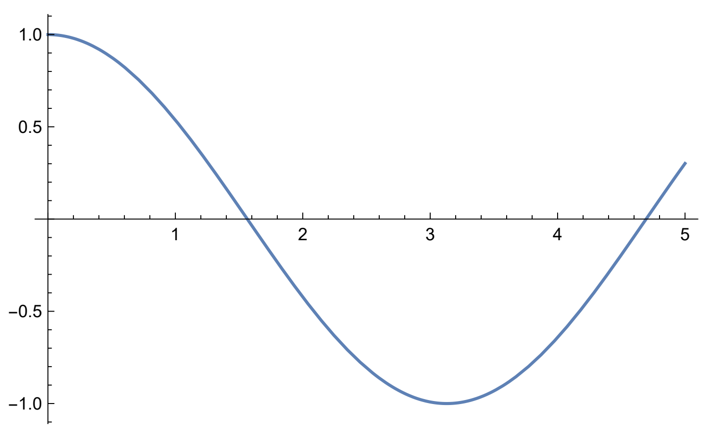
```
taska[sub_, a_, tmax_] := Module[{asymp, eqa},
  eqa = (x''[t] + ω^2 x[t] + δ b x[t]^3 == 0) /. sub;
  asymp = Evaluate[AsymptoticDSolveValue[{eqa, x[0] == a, x'[0] == 0}, x[t], {t, 0, 2}]];
  Print[asymp];
  Print[Plot[asymp, {t, 0, tmax}]];
  Print[Plot[Evaluate[
     x[t] /. NDSolve[{eqa, x[0] == a, x'[0] == 0}, x, {t, 0, 5}][[1]]], {t, 0, tmax}]]
 ]
```

In[ ]:=

```
taska[{ω → 1, δ → 0.01, b → 1}, 1, 5]
```

$1. - 0.505\, t^2$



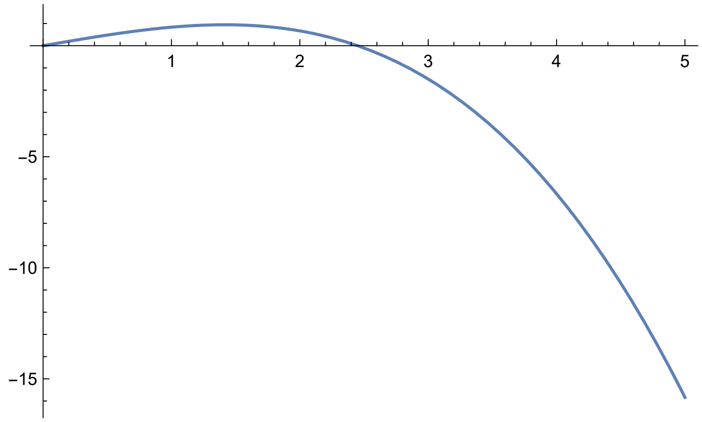


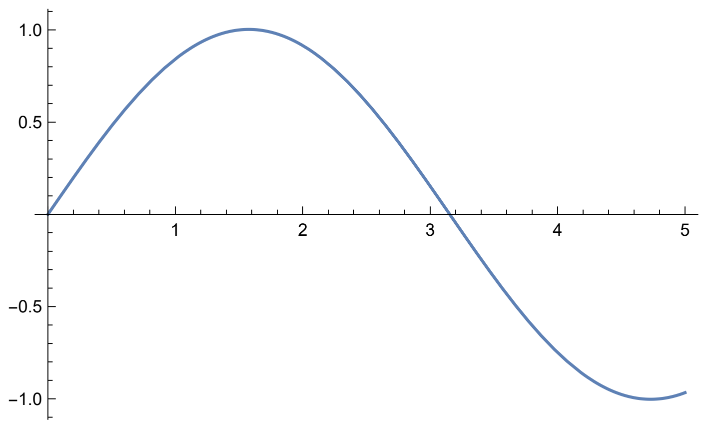
In[13]:=

```
taskb[sub_, v0_, tmax_, deg_] := Module[{asymp, eqa},
  eqa = (x''[t] + ω^2 x[t] - δ b x[t]^3 == 0) /. sub;
  asymp =
   Evaluate[AsymptoticDSolveValue[{eqa, x[0] == 0, x'[0] == v0}, x[t], {t, 0, deg}]];
  Print[asymp];
  Print[Plot[asymp, {t, 0, tmax}]];
  Print[Plot[Evaluate[
     x[t] /. NDSolve[{eqa, x[0] == 0, x'[0] == v0}, x, {t, 0, 5}][[1]]], {t, 0, tmax}]]
 ]
```

In[15]:=
```
taskb[{ω → 1, δ → 0.01, b → 1}, 1, 5, 4]
```

$t - 0.166667\,t^3$






```
taskc[sub_, tmax_, deg_] := Module[{asymp, eqa},
  eqa = {t x'[t] == x + δ y[t], t y'[t] == (2 - x[t]) y[t]} /. sub;
  asymp = Evaluate[
    AsymptoticDSolveValue[{eqa, x[0] == 0, x'[0] == v0}, {x[t], y[t]}, {t, 0, deg}]];
  Print[asymp];
  Print[Plot[asymp, {t, 0, tmax}]];
  Print[Plot[Evaluate[
      x[t] /. NDSolve[{eqa, x[0] == 0, x'[0] == v0}, , {x[t], y[t]}, {t, 0, 5}][[1]]], {t,
      0, tmax}]]
 ]
```

In[∘]:=
```
taskc[{δ → 0.01}, 5, 4]
```

Set: Tag Times in t x′[t] is Protected.

Set: Tag Times in t y′[t] is Protected.

```
AsymptoticDSolveValue[
 {{x + 0.01 y[t], (2 - x[t]) y[t]}, x[0] == 0, x′[0] == v0}, {x[t], y[t]}, {t, 0, 4}]
```

AsymptoticDSolveValue: 0.00010214285714285715` is not a valid variable.

AsymptoticDSolveValue: Approximation order specification 4.` should be a positive integer.

AsymptoticDSolveValue: 0.10214295918367347` is not a valid variable.

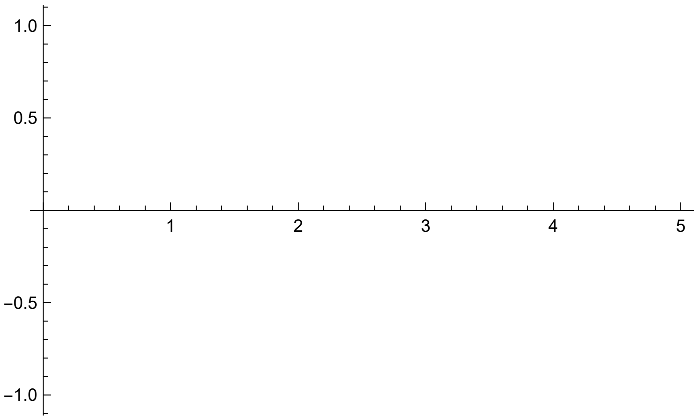
AsymptoticDSolveValue: Approximation order specification 4.` should be a positive integer.

AsymptoticDSolveValue: 0.20418377551020409` is not a valid variable.

General: Further output of AsymptoticDSolveValue::asvar will be suppressed during this calculation.

AsymptoticDSolveValue: Approximation order specification 4.` should be a positive integer.

General: Further output of AsymptoticDSolveValue::aord will be suppressed during this calculation.



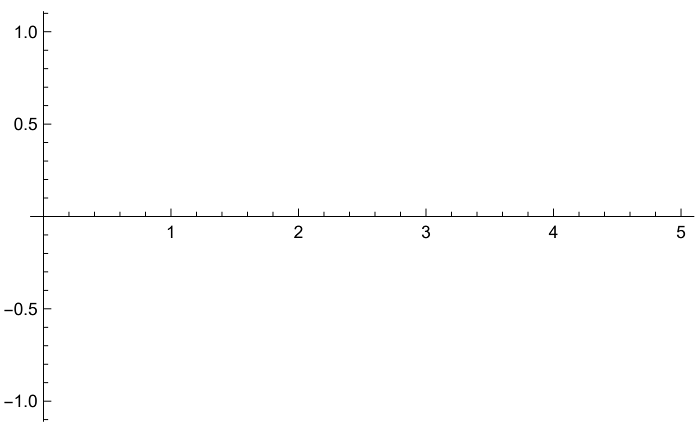
NDSolve: Equation or list of equations expected instead of x + 0.01 y[t] in the first argument {{x + 0.01 y[t], (2 – x[t]) y[t]}, x[0] == 0, x′[0] == v0}.

ReplaceAll: Elements of {{x + 0.01 y[t], (2 – x[t]) y[t]}, x[0] == 0, x′[0] == v0} are a mixture of lists and nonlists.

ReplaceAll: Elements of {{x + 0.01 y[0.000102143], (2 – x[0.000102143]) y[0.000102143]}, x[0] == 0, x′[0] == v0} are a mixture of lists and nonlists.

ReplaceAll: Elements of {{x + 0.01 y[0.000102143], (2. – 1. x[0.000102143]) y[0.000102143]}, x[0.] == 0., x′[0.] == v0} are a mixture of lists and nonlists.

General: Further output of ReplaceAll::rmix will be suppressed during this calculation.



In[5]:=

```
eqa = {t x'[t] == x[t] + δ y[t], t y'[t] == (2 - x[t]) y[t]} /. {δ → 0.01}
```

Out[5]= {t x′[t] == x[t] + 0.01 y[t], t y′[t] == (2 - x[t]) y[t]}

In[11]:=
```
Evaluate[
 AsymptoticDSolveValue[Join[eqa, {x[1] == 1, y[1] == 1 / E}], {x[t], y[t]}, {t, 0, 4}]]
```

Out[11]= $\text{AsymptoticDSolveValue}\left[\left\{t\,x'[t] == x[t] + 0.01\,y[t],\ t\,y'[t] == (2 - x[t])\,y[t],\ x[1] == 1,\ y[1] == \frac{1}{e}\right\}, \{x[t], y[t]\}, \{t, 0, 4\}\right]$