In[13]:= `DSolve[y'[x] + y[x] * Tan[x] == Sin[2 * x], y[x], x]`

Out[13]= $\{\{y[x] \to c_1 \text{Cos}[x] - 2\,\text{Cos}[x]^2\}\}$

In[14]:= `DSolve[{y'[x] + y[x] * Tan[x] == Sin[2 * x], y[0] == 0}, y, x]`

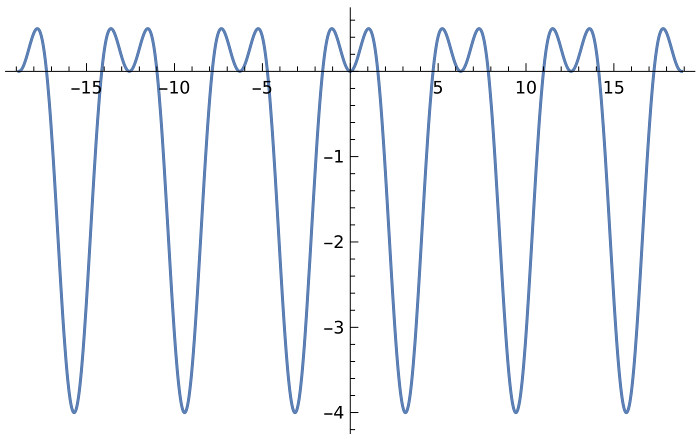
Out[14]= $\{\{y \to \text{Function}[\{x\}, -2\,(-\text{Cos}[x] + \text{Cos}[x]^2)]\}\}$

In[21]:=
```
sol = DSolve[{y'[x] + y[x] * Tan[x] == Sin[2 * x], y[0] == 0}, y, x]
y[x] /. sol[[1]]
Plot[y[x] /. sol[[1]], {x, -6 π, 6 π}]
```

Out[21]= $\{\{y \to \text{Function}[\{x\}, -2\,(-\text{Cos}[x] + \text{Cos}[x]^2)]\}\}$

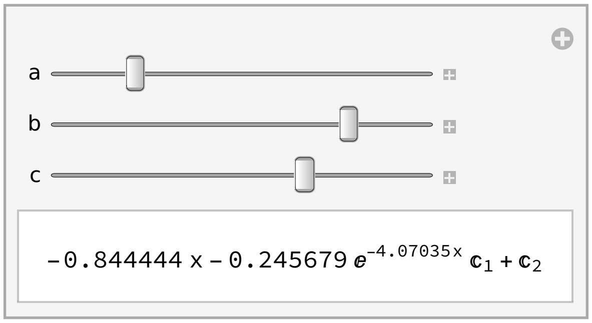
Out[22]= $-2\,(-\text{Cos}[x] + \text{Cos}[x]^2)$

Out[23]=

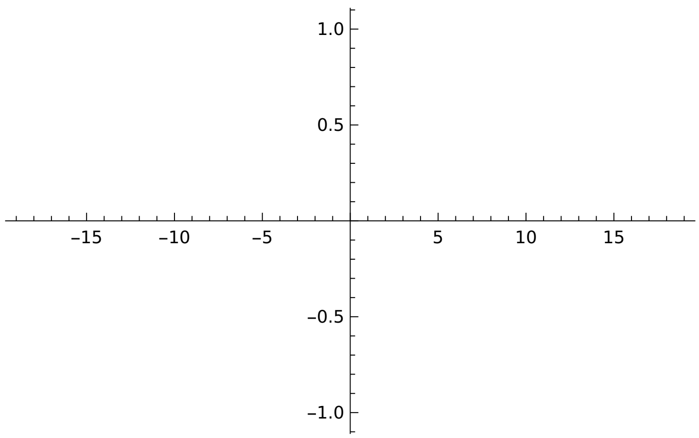


```
In[38]:= sol = Manipulate[y[x] /. First[DSolve[y''[x] + (b / a) * y'[x] + (c / a) == 0, y[x], x]],
           {a, 1, 100}, {b, 1, 100}, {c, 1, 100}]
         Plot[sol, {x, -6 π, 6 π}]
```

Out[38]=



Out[39]=




```
ndsoll = NDSolve[{θ''[t] + θ'[t] + θ + θ^3 == 10 Cos[1.5 * t], θ[0] == 0, θ'[0] == 3}, θ, {t, 0, 10}]
```

NDSolve: Equation or list of equations expected instead of True in the first argument $\{\theta + \theta^3 + \theta'[t] + \theta''[t] == 10\,\mathrm{Cos}[1.5\,t], \mathrm{True}, \mathrm{True}\}$.

Out[7]= NDSolve[$\{\theta + \theta^3 + \theta'[t] + \theta''[t] == 10\,\mathrm{Cos}[1.5\,t], \mathrm{True}, \mathrm{True}\}$, θ[t], {t, 0, 10}]

```
In[207]:= eq = x''[t] + (ω^2) * x[t] + ϵ b x[t]^3
          x[t_] = x0[t] + ϵ x1[t]
          Expand[eq]
          Collect[Expand[eq], ϵ]
          eq0 = Coefficient[Expand[eq], ϵ, 0]
          eq1 = Coefficient[Expand[eq], ϵ, 1]
          s0 = DSolve[{eq0 == 0, x0[0] == 0, x0'[0] == 0}, x0, t]
          eq1 /. s0[[1]]
          s1 = DSolve[{(eq1 /. s0[[1]]) == 0, x1[0] == a, x1'[0] == 0}, x1, t]
          x[t]
          xa[t_] = x[t] /. s0[[1]] /. s1[[1]]
          a = b = ω = 1;
          Plot[xa[t] /. ϵ → 0, {t, 0, 6 π}]
```

Out[207]=

$x0[t] + \epsilon\, x1[t] + \epsilon\, (x0[t] + \epsilon\, x1[t])^3 + x0''[t] + \epsilon\, x1''[t]$

Out[208]=

$x0[t] + \epsilon\, x1[t]$

Out[209]=

$x0[t] + \epsilon\, x0[t]^3 + \epsilon\, x1[t] + 3\, \epsilon^2\, x0[t]^2\, x1[t] + 3\, \epsilon^3\, x0[t]\, x1[t]^2 + \epsilon^4\, x1[t]^3 + x0''[t] + \epsilon\, x1''[t]$

Out[210]=

$x0[t] + 3\, \epsilon^2\, x0[t]^2\, x1[t] + 3\, \epsilon^3\, x0[t]\, x1[t]^2 + \epsilon^4\, x1[t]^3 + x0''[t] + \epsilon\, \left(x0[t]^3 + x1[t] + x1''[t]\right)$

Out[211]=

$x0[t] + x0''[t]$

Out[212]=

$x0[t]^3 + x1[t] + x1''[t]$

Out[213]=

{{x0 → Function[{t}, 0]}}

Out[214]=

$x1[t] + x1''[t]$

Out[215]=

{{x1 → Function[{t}, Cos[t]]}}

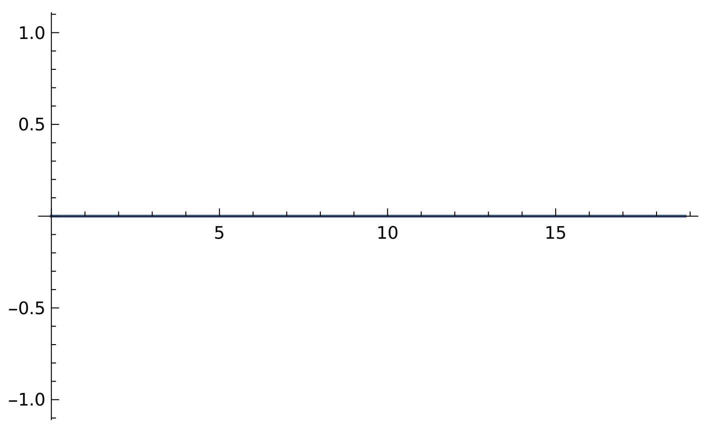
Out[216]=

$x0[t] + \epsilon\, x1[t]$

Out[217]=

ϵ Cos[t]

Out[219]=

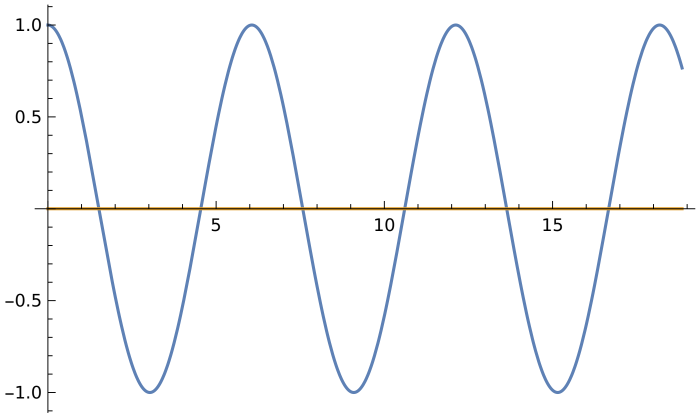


In[250]:=
```
nds = NDSolve[{X''[t] + ω^2 X[t] + 0.1 b X[t]^3 == 0, X[0] == a, X'[0] == 0}, X, {t, 0, 6 π}]
Plot[{X[t] /. nds[[1]], xa[t] /. ϵ → 0.1}, {t, 0, 6 π}]
```

Out[250]=

{{X → InterpolatingFunction[ Domain: {{0., 18.8}} Output: scalar]}}

Out[251]=



In[44]:=
```
eq = x''[t] + (ω^2) * x[t] - ϵ b (x'[t]^2) x[t]
x[t_] = x0[t] + ϵ x1[t]
Collect[Expand[eq], ϵ]
eq0 = Coefficient[Expand[eq], ϵ, 0]
eq1 = Coefficient[Expand[eq], ϵ, 1]
s0 = DSolve[{eq0 == 0, x0[0] == 0, x0'[0] == 1}, x0, t]
s1 = DSolve[{(eq1 /. s0[[1]]) == 0, x1[0] == 0, x1'[0] == 0}, x1, t]
xa[t_] = x[t] /. s0[[1]] /. s1[[1]]
a = b = ω = 1;
nds =
 NDSolve[{X''[t] + (ω^2) * X[t] - 0.1 b (X'[t]^2) X[t] == 0, X[0] == 0, X'[0] == 1}, X, {t, 0, 6 π}]
Plot[{X[t] /. nds[[1]], xa[t] /. ϵ → 0.1}, {t, 0, 6 π}]
```

Out[44]= $x0[t] + \epsilon\, x1[t] - \epsilon\,(x0[t] + \epsilon\, x1[t])\,(x0'[t] + \epsilon\, x1'[t])^2 + x0''[t] + \epsilon\, x1''[t]$

Out[45]= $x0[t] + \epsilon\, x1[t]$

Out[46]= $x0[t] - \epsilon^4\, x1[t]\, x1'[t]^2 + \epsilon^2\left(-x1[t]\, x0'[t]^2 - 2\, x0[t]\, x0'[t]\, x1'[t]\right) + \epsilon^3\left(-2\, x1[t]\, x0'[t]\, x1'[t] - x0[t]\, x1'[t]^2\right) + x0''[t] + \epsilon\left(x1[t] - x0[t]\, x0'[t]^2 + x1''[t]\right)$

Out[47]= $x0[t] + x0''[t]$

Out[48]= $x1[t] - x0[t]\, x0'[t]^2 + x1''[t]$

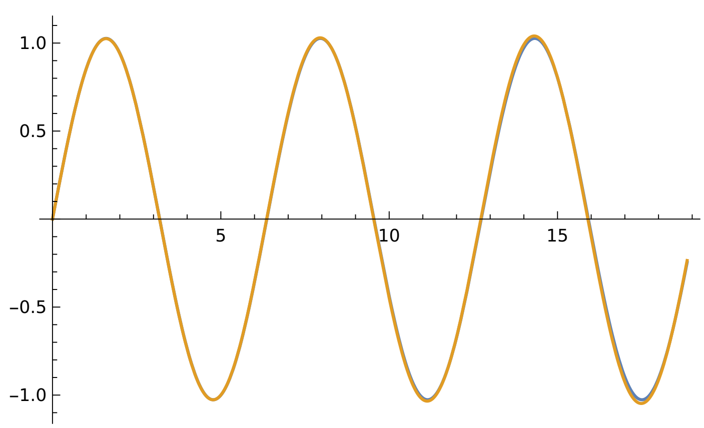
Out[49]= {{x0 → Function[{t}, Sin[t]]}}

Out[50]= $\left\{\left\{x1 \to \mathrm{Function}\left[\{t\}, \frac{1}{32}\left(-4\, t\, \mathrm{Cos}[t] + 8\, \mathrm{Sin}[t] - 8\, \mathrm{Cos}[t]^4\, \mathrm{Sin}[t] + \mathrm{Cos}[t] \times \mathrm{Sin}[4\, t]\right)\right]\right\}\right\}$

Out[51]= $\mathrm{Sin}[t] + \frac{1}{32}\,\epsilon\left(-4\, t\, \mathrm{Cos}[t] + 8\, \mathrm{Sin}[t] - 8\, \mathrm{Cos}[t]^4\, \mathrm{Sin}[t] + \mathrm{Cos}[t] \times \mathrm{Sin}[4\, t]\right)$

Out[53]= {{X → InterpolatingFunction[Domain: {{0., 18.8}} Output: scalar]}}

Out[54]=



Out[8]= $\omega^2\, x[t] + \epsilon b x[y] + x''[t]$