```
(*Solving hamilton's equation of SHO*)
(*first of all define the hamiltonian of SHO*)
H[p_, q_] := p^2 / (2 m) + m w^2 q^2 / 2;
(*p is the momentum ad q is the displacement*)
(*get the expression of hamilonian*)
Hamiltonian = H[p[t], q[t]]
```

$$\frac{p[t]^2}{2 m} + \frac{1}{2} m w^2 q[t]^2$$

```
(*defne the hmilton equations*)
Heq1 = p'[t] == -D[Hamiltonian, q[t]]
Heq2 = q'[t] == D[Hamiltonian, p[t]]
```

$$p'[t] == -m w^2 q[t]$$

$$q'[t] == \frac{p[t]}{m}$$

```
sol = DSolve[{Heq1, Heq2}, {p[t], q[t]}, t]
```

$$\left\{\left\{p[t] \to C[1] \operatorname{Cos}[t w] - m w C[2] \operatorname{Sin}[t w],\ q[t] \to C[2] \operatorname{Cos}[t w] + \frac{C[1] \operatorname{Sin}[t w]}{m w}\right\}\right\}$$

```
momentum = p[t] /. sol[[1]]
displ = q[t] /. sol[[1]]
```

$$C[1] \operatorname{Cos}[t w] - m w C[2] \operatorname{Sin}[t w]$$

$$C[2] \operatorname{Cos}[t w] + \frac{C[1] \operatorname{Sin}[t w]}{m w}$$

```
eq1 = (momentum /. t → 0) == 0
eq2 = (displ /. t -> 0) == 5
```

$$C[1] == 0$$

$$C[2] == 5$$

```
const = Solve[{eq1, eq2}, {C[1], C[2]}]
```

$$\{\{C[1] \to 0,\ C[2] \to 5\}\}$$

```
p = momentum /. const[[1]] /. {m → 2, w → 1}
x = displ /. const[[1]] /. {m → 2, w → 1}
```

$$-10 \operatorname{Sin}[t]$$

$$5 \operatorname{Cos}[t]$$

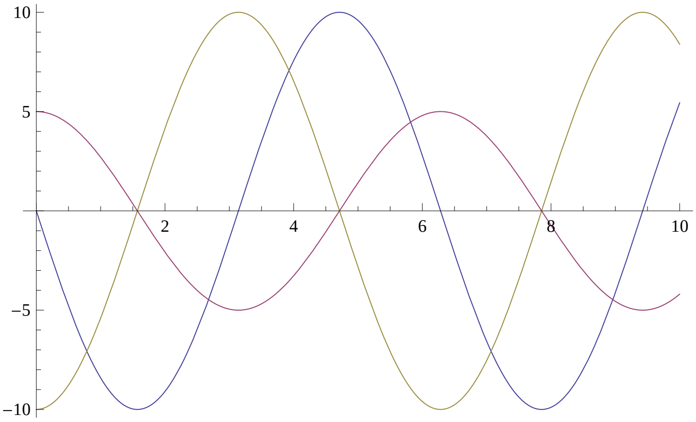
```
force = D[p, t]
```

$$-10 \operatorname{Cos}[t]$$

```
? Plot
```

Plot[f, { x, x_{min}, x_{max} }] generates a plot of f as a function of x from x_{min} to x_{max}.
Plot[{ f_1, f_2, …}, { x, x_{min}, x_{max} }] plots several functions f_i. ≫

```
Plot[{p, x, force}, {t, 0, 10}]
```




```
?ParametricPlot
```

ParametricPlot[{f_x, f_y}, {u, u_{min}, u_{max}}] generates a parametric plot of a curve with x and y coordinates f_x and f_y as a function of u.
ParametricPlot[{{f_x, f_y}, {g_x, g_y}, …}, {u, u_{min}, u_{max}}] plots several parametric curves.
ParametricPlot[{f_x, f_y}, {u, u_{min}, u_{max}}, {v, v_{min}, v_{max}}] plots a parametric region.
ParametricPlot[{{f_x, f_y}, {g_x, g_y}, …}, {u, u_{min}, u_{max}}, {v, v_{min}, v_{max}}] plots several parametric regions. ≫

```
ParametricPlot[{p, x}, {t, 0, 2*Pi}]
```