In[1]:=

```
(*Angle of when the Planks are close to be vertical approx 20.9 degrees *)
(*Calculating Delta x*)
f[t_] := a Cos[w t + ϕ] + Sqrt[L ^ 2 - (yp - a Sin[w t + ϕ]) ^ 2]
f '[t](*First derivative*)
f ''[t](*Second derivative*)
(*f[0], intial time , no time taking into account*)
deltax[t_] := f[t] - f[0]
(*Force of the Plancks*)
Fplanks[t_] := -k * deltax[t] (*where k is an arbitrary constant*)
Fplanks[t]
```

Out[2]=

$$-a\,w\,\mathrm{Sin}[t\,w+\phi]+\frac{a\,w\,\mathrm{Cos}[t\,w+\phi]\,(yp-a\,\mathrm{Sin}[t\,w+\phi])}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}$$

Out[3]=

$$-a\,w^2\,\mathrm{Cos}[t\,w+\phi]-\frac{a^2\,w^2\,\mathrm{Cos}[t\,w+\phi]^2\,(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}{\left(L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2\right)^{3/2}}-\frac{a^2\,w^2\,\mathrm{Cos}[t\,w+\phi]^2}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}-\frac{a\,w^2\,\mathrm{Sin}[t\,w+\phi]\,(yp-a\,\mathrm{Sin}[t\,w+\phi])}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}$$

Out[6]=

$$-k\left(-a\,\mathrm{Cos}[\phi]+a\,\mathrm{Cos}[t\,w+\phi]-\sqrt{L^2-(yp-a\,\mathrm{Sin}[\phi])^2}+\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)$$

In[82]:=

```
(*Calculating the force of the rod x*)

Frodx[t_] := m f''[t] + Fplanks[t]
Frodx[t] // FullSimplify

(*Caculating the total force on the rod*)
xr[t_] := a Cos[w t + ϕ]
Ftot = Frodx[t] / ((f[t] - xr[t]) / L)
Ftot[t] // FullSimplify
```

Out[8]=

$$a\,m\,w^2\left(-\mathrm{Cos}[t\,w+\phi]-\frac{a\,L^2\,\mathrm{Cos}[t\,w+\phi]^2}{\left(L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2\right)^{3/2}}+\frac{\mathrm{Sin}[t\,w+\phi]\,(-yp+a\,\mathrm{Sin}[t\,w+\phi])}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}\right)+$$
$$k\left(a\,\mathrm{Cos}[\phi]-a\,\mathrm{Cos}[t\,w+\phi]+\sqrt{L^2-(yp-a\,\mathrm{Sin}[\phi])^2}-\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)$$

Out[10]=

$$\left(L\left(m\left(-a\,w^2\,\mathrm{Cos}[t\,w+\phi]-\frac{a^2\,w^2\,\mathrm{Cos}[t\,w+\phi]^2\,(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}{\left(L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2\right)^{3/2}}-\right.\right.\right.$$
$$\left.\frac{a^2\,w^2\,\mathrm{Cos}[t\,w+\phi]^2}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}-\frac{a\,w^2\,\mathrm{Sin}[t\,w+\phi]\,(yp-a\,\mathrm{Sin}[t\,w+\phi])}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}\right)-$$
$$\left.\left.k\left(-a\,\mathrm{Cos}[\phi]+a\,\mathrm{Cos}[t\,w+\phi]-\sqrt{L^2-(yp-a\,\mathrm{Sin}[\phi])^2}+\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)\right)\right)\Big/$$
$$\left(\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)$$

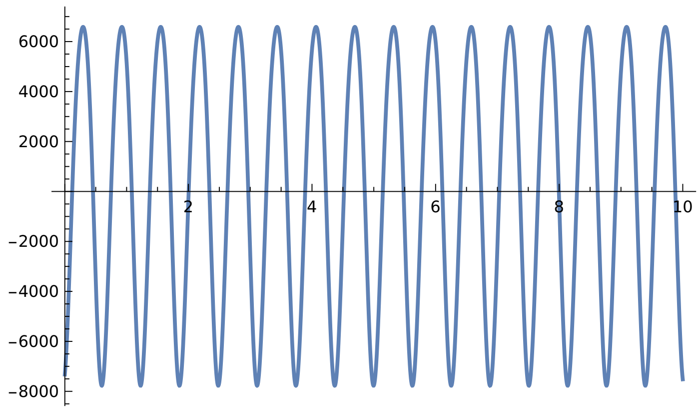
Out[11]=

$$\left(L\left(a\,m\,w^2\left(-\mathrm{Cos}[t\,w+\phi]-\frac{a\,L^2\,\mathrm{Cos}[t\,w+\phi]^2}{\left(L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2\right)^{3/2}}+\frac{\mathrm{Sin}[t\,w+\phi]\,(-yp+a\,\mathrm{Sin}[t\,w+\phi])}{\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}}\right)+\right.\right.$$
$$\left.\left.k\left(a\,\mathrm{Cos}[\phi]-a\,\mathrm{Cos}[t\,w+\phi]+\sqrt{L^2-(yp-a\,\mathrm{Sin}[\phi])^2}-\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)\right)\right)\Big/$$
$$\left(\sqrt{L^2-(yp-a\,\mathrm{Sin}[t\,w+\phi])^2}\right)[t]$$

In[88]:=

In[81]:=
```
(**w = 10
L = 10
a = 1
k = 100
yp = 1
m = 70
ϕ=21(Pi/180)**)
Plot[Ftot, {t, 0, 10}]
```

Out[81]=




```
(**Manipulate[
Plot[Ftot[t],{t,0,10}],
{L,1,20},{a,0.1,1},{k,1,100},{w,0.1,50},{yp,0,L},{m,100,1000}]**)
```