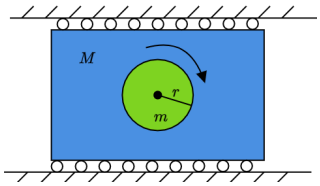


```
> restart
> with(LinearAlgebra):
  with(Physics):
  with(plots):
  with(plottools):
  with(DEtools):
  with(Typesetting):
  interface(typesetting=extended):
  interface(showassumed=0):
> T_m:=1/2*m*r^2*diff(theta(t),t)^2:
  V_m:=0:

  printf("\n");

  print(`Kinetic energy of mass m:`);
  print('T__m=1/2*I*diff(theta(t),t)^2');
  print(`where `);
  print('I=1/2*m*r^2');
  T:=simplify(T_m):
  print(`Thus:`);
  print('T__m'=T_m);

  printf("\n");

  print(`Potential energy of mass m:`);
  print('V__m'=V_m);

  printf("\n");
```

Kinetic energy of mass m:

$$T_m = \frac{1}{2}\,\mathrm{I}\,\dot{\theta}(t)^2$$

where

$$\mathrm{I} = \frac{1}{2}\,m\,r^2$$

Thus:

$$T_m = \frac{m\,r^2\,\dot{\theta}(t)^2}{2}$$

Potential energy of mass m:

$$V_m = 0$$

```
> T_M:=1/2*M*((diff(x(t),t))^2):
  V_M:=0:

  printf("\n");

  print(`Kinetic energy of mass M:`);
  print('T__M'=T_M);

  printf("\n");

  print(`Potential energy of mass M:`);
  print('V__M'=V_M);
```

Kinetic energy of mass M:

$$T_M = \frac{M\dot{x}(t)^2}{2}$$

Potential energy of mass M:

$$V_M = 0$$

```
> T:=T_m+T_M:
  V:=V_m+V_M:
  L:=T-V:
  print('L'=L);

  eq1:=simplify(<diff(L,x(t)), diff(L,theta(t))>):
  eq2:=simplify(<diff(L,diff(x(t),t)), diff(L,diff(theta(t),t))>):
  eq3:=simplify(<diff(eq2[1],t), diff(eq2[2],t)>):

  print('diff(L,x)'=eq1);
  print('diff(L,diff(x,t))'=eq2);
  print('diff(diff(L,diff(x,t)),t)'=simplify(eq3));

  printf("\n");
  print(`Thus,`);
  print('diff(diff(L,diff(x,t)),t)=diff(L,x)');
  eq4:=simplify({(eq3[1]-eq1[1]=0), (eq3[2]-eq1[2]=0)/(m*l)}):
  print(<eq4[1],eq4[2]>);
  eq5:=simplify(solve(eq4,{diff(x(t),t,t), diff(theta(t),t,t)})):
  print(<eq5[1],eq5[2]>);
```

$$L = \frac{m r^2 \dot{\theta}(t)^2}{2} + \frac{M\dot{x}(t)^2}{2}$$

$$\frac{\partial}{\partial x} L = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\frac{\partial}{\partial \frac{\partial}{\partial t} x} L = \begin{bmatrix} M\dot{x}(t) \\ m r^2 \dot{\theta}(t) \end{bmatrix}$$

$$\frac{\partial^2}{\partial\frac{\partial}{\partial t}\,x\partial t}\,L=\begin{bmatrix} M\ddot{x}(t) \\ m\,r^2\,\ddot{\theta}(t) \end{bmatrix}$$

Thus,

$$\frac{\partial^2}{\partial\frac{\partial}{\partial t}\,x\partial t}\,L=\frac{\partial}{\partial x}\,L$$

$$\begin{bmatrix} M\ddot{x}(t)=0 \\ \frac{r^2\,\ddot{\theta}(t)}{l}=0 \end{bmatrix}$$

$$\begin{bmatrix} \ddot{\theta}(t)=0 \\ \ddot{x}(t)=0 \end{bmatrix}$$

It is clear that the rotatin wheel of mass m does not cause any forces to the mass M.