

## Exercise 3 - TFY4345 Classical Mechanics

2020

### 1 Pendulum on spinning a wheel

(FIGUR)

The point of support of a simple pendulum of length  $b$  moves on a massless rim of radius  $a$ , rotating with a constant angular velocity  $\omega$ . Obtain the expression for the Cartesian components of the velocity and acceleration for the mass  $m$ . Obtain also the angular acceleration for the angle  $\theta$ , shown in the figure, by using Euler's equation.

### 2 Bead on a ring

(FIGUR)

A bead is attached to a ring with radius  $R$  where it can slide frictionless. The ring itself is attached to a vertical shaft which rotates with a constant angular velocity (let us assume that the shaft does not affect the bead motion). Obtain by using the Euler equations the equilibrium position of the bead.

### 3 Atwood's machine

(FIGURE)

Determine the Hamiltonian and Hamilton's equations of motion for a s simple Atwood's machine (one pulley), as shown in the figure. The pulley radius i  $a$  and the moment of inertia  $I$ .

### 4 Particle on a moving wedge

(FIGURE)

A particle of mass  $m$  slides down a smooth, circular wedge of mass  $M$  as shown in the figure. The wedge rests on a smooth, horizontal table with coordinate  $x$ .

(a) Find the equation of motion  $m$  and  $M$ .

(b) Find the reaction of the wedge on  $m$ .

(Note: This one is tedious, focus on the 3 others first)

(Hint: Use the method of Lagrange's undetermined multiplier. Select  $x$  and  $\theta$  as generalized coordinates.)