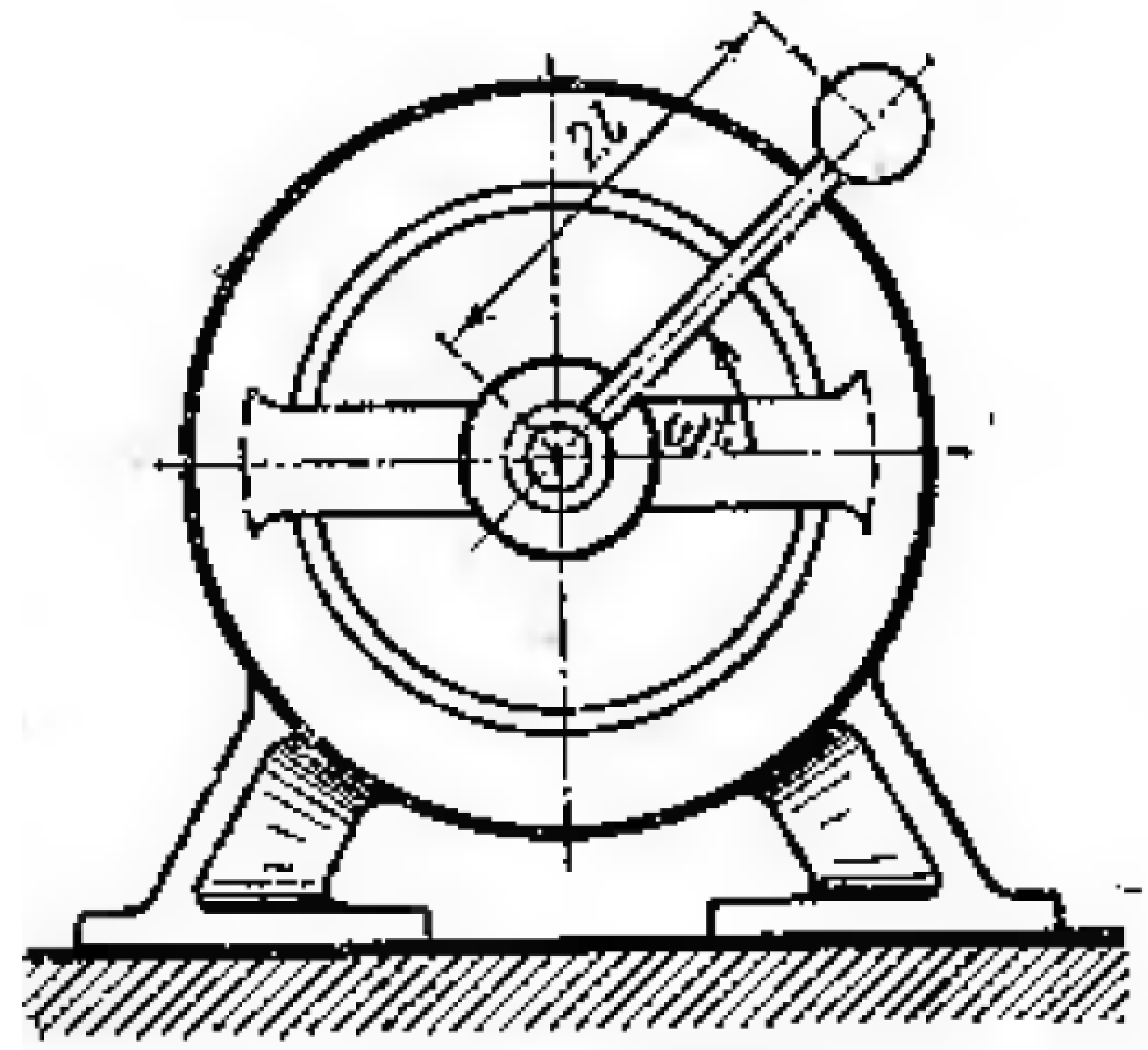
There are the motor (mass M_1), the steel shaft (mass M_2, length $2l$) and the ball (mass M_3). The angular velocity of the shaft equal to ω. The initial position of the shaft is horizontal.

You should write conditions for each body, make force analysis, and provide equations.

1. The motor is not fixed, no friction. It's needed to find a distance along the ground if the motor swing a shaft from 0 to α degree.
2. The motor is fixed. Find a reaction force among x axis.
3. The motor is not fixed, high friction. You need to find a min ω, when motor get off the ground.



Quiz 8, Task 1

Research Object:
System, consists of motor "1", shaft "2", ball "3"

Motion:
Motor "1" - translatory, shaft "2" - rotational, ball "3" - curvelinear

Conditions:

Initial	(1)	(2)	(3)
$t=0$, $x=0$, $\dot{x}=0$, $y=0$, $\dot{y}=0$	t_1 - ?, x_1 - ?, $\dot{x}_1$ - ?	t_2 - ?, x_2 - ?, $\dot{x}_2$ - ?	t_3 - ?, y_3 - ?, $\dot{y}_3$ - ?

Shifting for each body:

(1) $\alpha = \omega t$

i	f
x_1	$x_1 + \Delta x$
x_2	$x_2 + \Delta x + l\cos(\omega t)$
x_3	$x_3 + \Delta x + 2l\cos(\omega t)$

(2)

i	f
x_1	x_1
x_2	$x_2 + l\cos(\omega t)$
x_3	$x_3 + 2l\cos(\omega t)$

(3)

i	f
y_1	y_1
y_2	$y_2 + l\sin(\omega t)$
y_3	$y_3 + 2l\sin(\omega t)$

Force Analysis:
$m_1 g,\ m_2 g,\ m_3 g,\ N\quad (2)\ R_x,\quad (3)\ F_{fr}$

Forward dynamics

Solution:
(1) $m\bar{a}_c = \Sigma m\bar{g} + \bar{N} \Rightarrow x:\ m\ddot{x} = 0 \Rightarrow \Sigma m x_c^{init} = \Sigma m x_c^{final}$

(2) $m\bar{a}_c = \Sigma m\bar{g} + \bar{N} + R_x \Rightarrow x:\ \Sigma m \ddot{x} = R_x \quad (x_c^{final} - x_c^{init}) \rightarrow \dot{x}_c \rightarrow \ddot{x}_c$

Inverse dynamics

take derivative and substitute

(3) the same, but for "y" $y:\ m\ddot{y} = \cancel{\bar{N}}_0 + m_1 g + m_2 g + m_3 g$