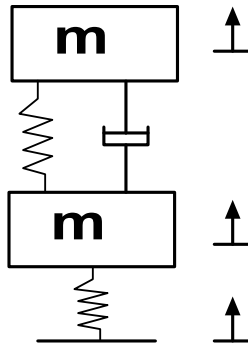




## Sheet (2)

### QUESTION (1):

A simplified translation model of an automotive suspension system, the model is shown in figure (1). The stiffness of the tire is modeled by a linear spring, the tire, axle, and moving parts by a mass ( $m_1$ ), the suspension system by a spring and viscous damper (shock absorber), and the supported vehicle components by mass ( $m_2$ ).



### QUESTION (2):

For the figure shown, drive the equation of motion.

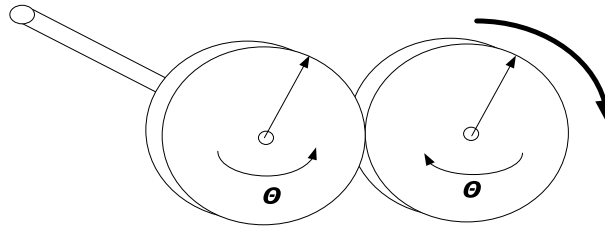


Figure (2)

### QUESTION (3):

A simplified model of a turboprop aircraft engine and propeller is shown in figure (3). The mass moment of inertia of the rotating parts of the engine is represented by  $J_e$ , the mass moment of inertia of the propeller by  $J_p$ . Develop the mathematical model for this system, and write its equation of motion.

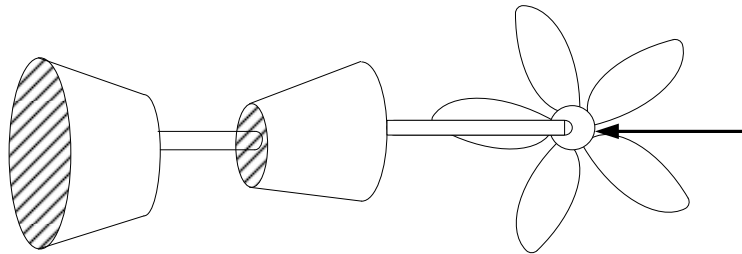


Figure (3)

**QUESTION (4):**

Find the equation of motion that governs the horizontal position of the center of the wheel.

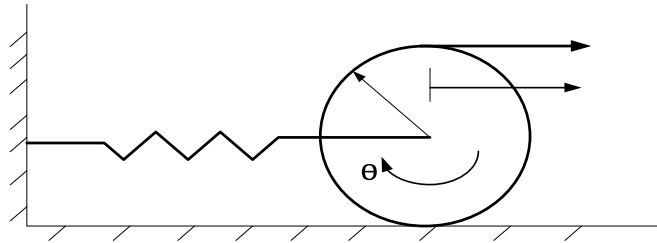
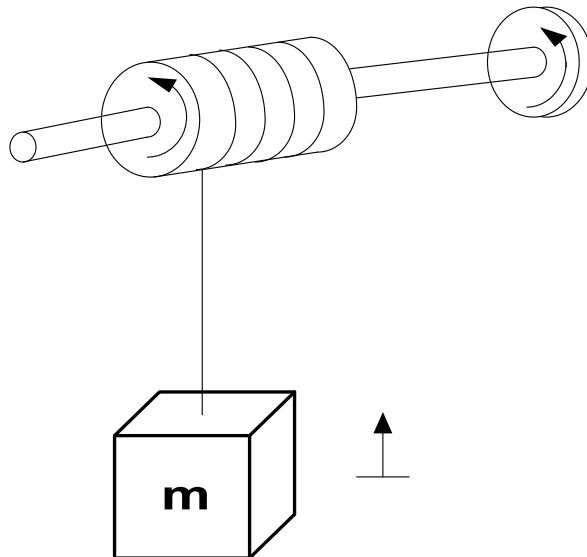


Figure (4)

**QUESTION (5):**

Find the differential equations describing the motion of the hoisting system shown in figure (5). A torque supplied by the motor raises or lowers the mass ( $m$ ). The mass is guided so that it can move only in the vertical direction, and a viscous friction device between the container and its guides is used to damp out possible oscillations.



**K**

Figure (5)