

# 淡江大學八十八學年度碩士班招生考試試題

系別：機械工程學系

科目：動態系統

本試題共 2 頁

(各題分數在括號內，總分爲 100 分)

1. A 1000kg boxcar with a velocity 1 m/s approaches an arresting system composed of a linear spring and viscous damper as shown in Figure 1.
  - a. Derive the equation of motion describing what happens after the car contacts the arresting system. (10 分)
  - b. Find the time and distance when the car comes to rest. Assume that  $k=25N/m$  and  $b=350N\ sec/m$ . (20 分)

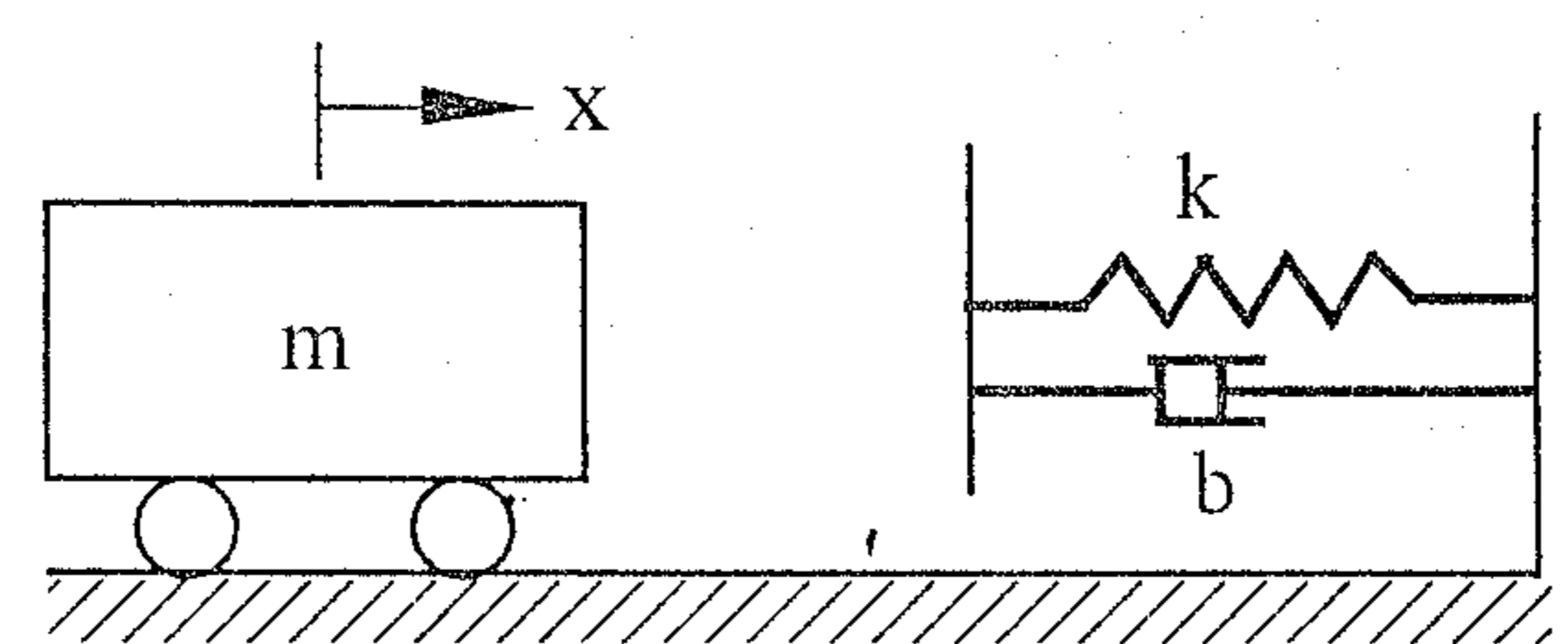


Figure 1 Boxcar

2. An ideal permanent-magnet DC motor and drive system is depicted in Figure 2. Assume that the field current is constant and the inductance is negligible. The induced voltage,  $e_m$ , in the circuit and the electromechanical force(emf),  $T_m$ , can be expressed as

$$e_m = \alpha \omega$$

$$T_m = \alpha i$$

where  $\alpha$  is torque constant. The position of the motor,  $\theta(t)$ , is feedback by an encoder. The motor has an inertia,  $J$ , and friction coefficient  $B$ .

- a. Derive the transfer function of the motor,  $\theta(s)/e_a(s)$ . (10 分)
- b. Derive the transfer function of the feedback loop,  $\theta(s)/\theta_i(s)$ . (10 分)
- c. Adjust the amplifier gain,  $K_a$ , to get a damping ratio of 0.5 for the feedback system.

Assume that  $K=0.48$ ,  $\frac{\alpha}{RJ}=150\ volt\ rad/sec^2$  and  $\left(\frac{B}{J} + \frac{\alpha^2}{JR}\right)=2.5\ sec$ . (10 分)

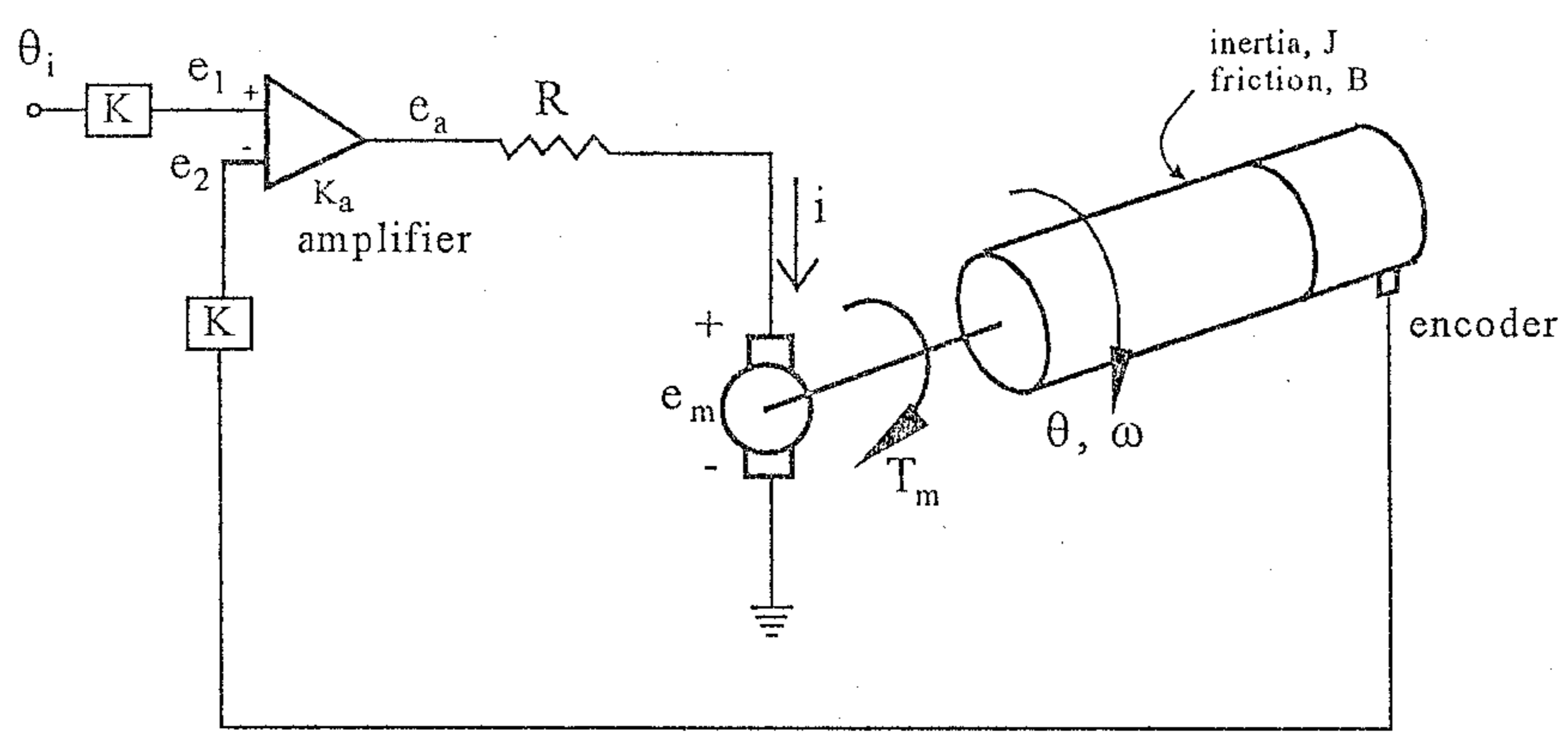


Figure 2 DC motor

本試題雙面印製

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3. The disk shown in Figure 3 rolls without slipping on a horizontal plane. Attached to the disk through a frictionless hinge is a massless pendulum of length  $L$  that carries another disk. The disk at the bottom of the pendulum cannot rotate relative to the pendulum arm. Derive the equations of motion for the system. (20 分)

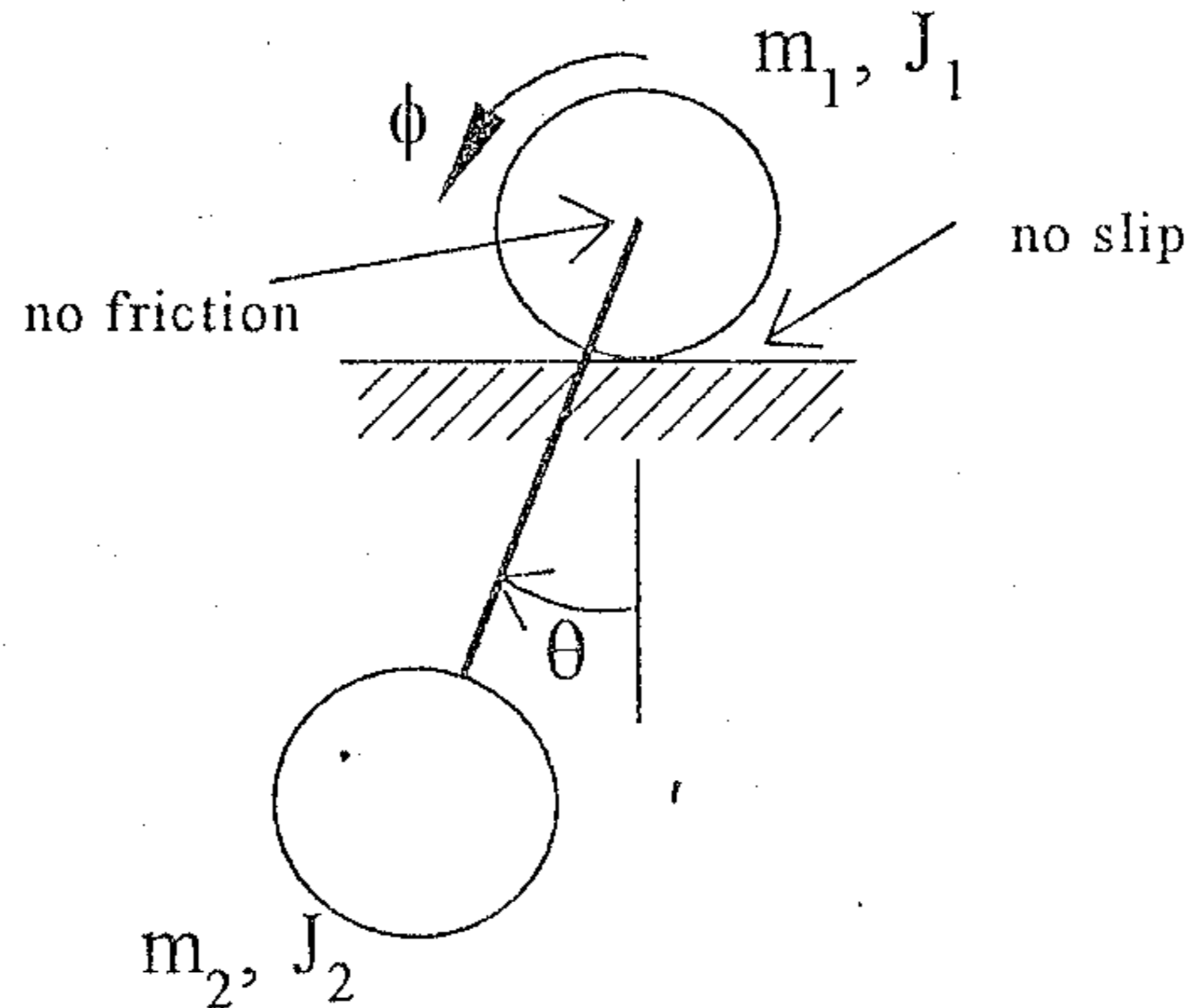


Figure 3 Rolling wheel with disk

4. Consider the RC circuit of Figure 4, which consists of the series connection of a voltage source,  $e_s(t)$ , a resistor,  $R=10\Omega$ , and a capacitor,  $C=0.1F$ .
- Derive the dynamic system equation of the circuit. (10 分)
  - Determine the time constant of the system. (5 分)
  - If the voltage source is a step input, find the time needed for the output,  $e_c(t)$ , to have error less than 5%. (5 分)

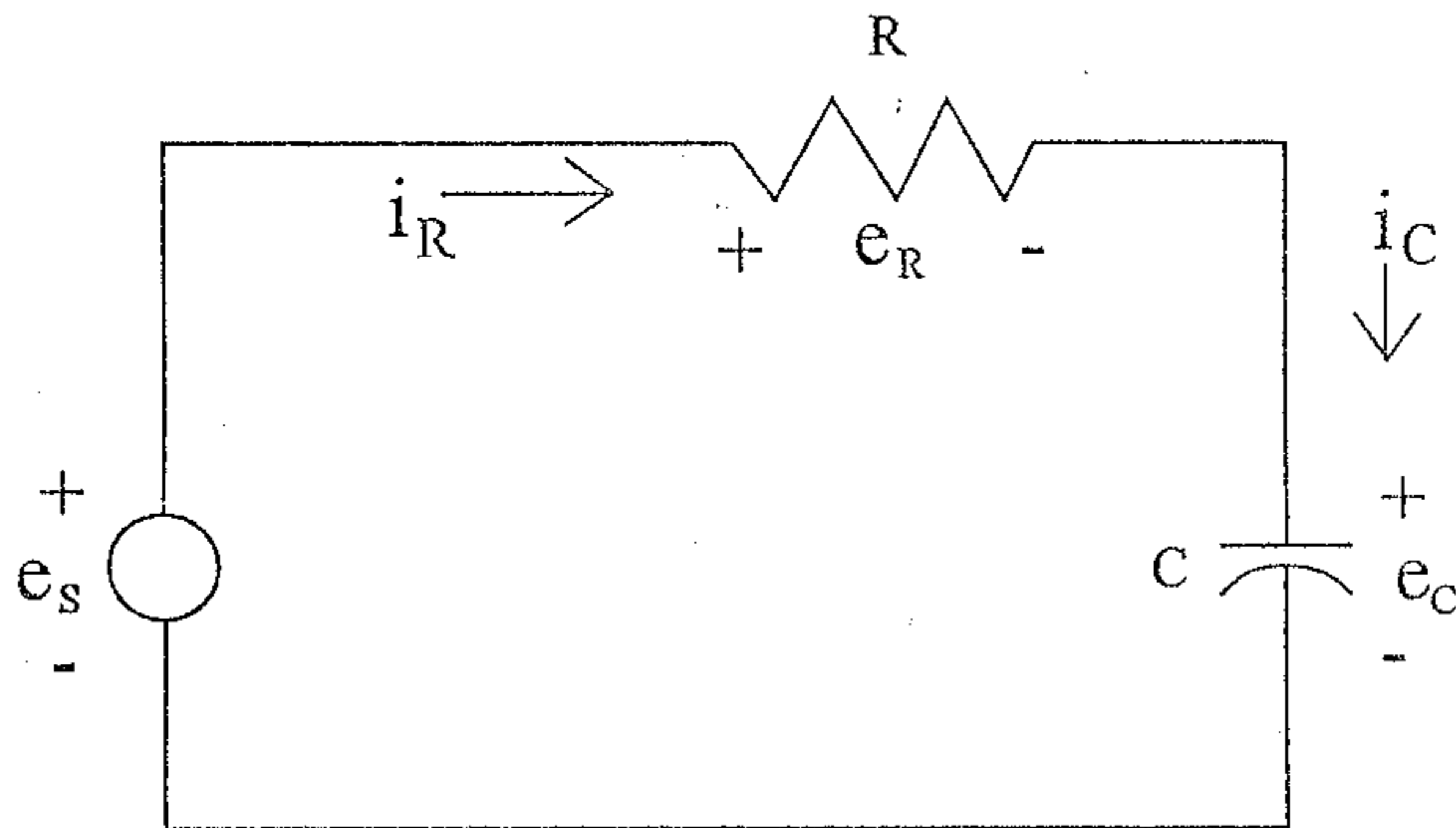


Figure 4 RC circuit