A uniform conducting disc of thickness d and radius a with mass density ρ is rotating with angular velocity ω around the conducting shaft parallel to the magnetic field $\boldsymbol{B}$. The edge of the disk and the shaft are electrically connected by a conducting stiff wire with a sliding contact at each end. The total resistance of the circuit is R.

(a) Is the current in the wire AC or DC? If the current is AC, give its angular frequency and amplitude. If it is DC, give its magnitude.

(b) What is the torque required to maintain the rotation of the disk?

(c) Now, the driving of the disk is stopped. The angular velocity of the disk decreases. Show that the angular deceleration is independent of the radius of the disk.

(d) Now, let us restore the constant rotation of the disk with angular velocity ω. In reality, the sliding contact is not frictionless, so the wire connecting the shaft and the edge of the conducting disk also rotates around the shaft with angular velocity $\omega/3$ (in the same direction as the disk). Assume that the wire can rotate without changing its shape around the shaft while maintaining good electric contact, and that the total resistance of the circuit remains R. Is the current in the wire AC or DC? If the current is AC, give its angular frequency and amplitude. If it is DC, give its magnitude.

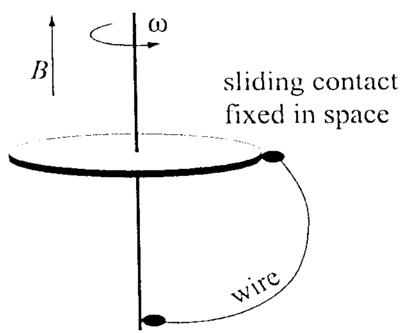

Figure for (a)-(c)

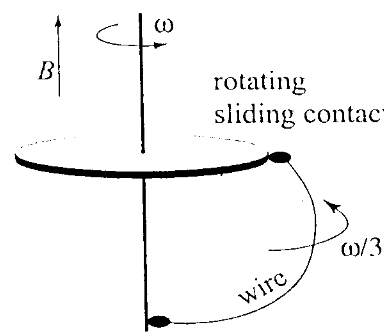

Figure for (d)