

7.20. A wheel in uniform motion about an axis passing through its centre and perpendicular to its plane is considered to be in mechanical equilibrium because no net external force or torque is required to sustain its motion. However, the particles that constitute the wheel do experience a centripetal acceleration directed towards the centre. How do you reconcile this fact with the wheel being in equilibrium? How would you set a half-wheel into uniform motion about an axis passing through the centre of mass of the wheel and perpendicular to its plane? Will you require external forces to sustain the motion?

Answer:

A wheel is a rigid elastic body with a uniform motion which is passing through its centre and is perpendicular to the plane of the wheel. Every particle of the wheel experiences a centripetal acceleration and is directed towards the axis of rotation due to elastic force. When the wheel is half, the distribution of the mass also becomes half. When the mass is half, there is no symmetry in the wheel. Therefore, the angular momentum and angular velocity does not coincide. Therefore, the external torque is required.