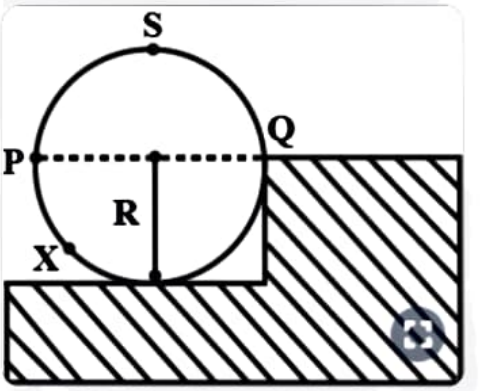
A wheel of radius R and mass M is placed at the bottom of a fixed step of height R as shown in the figure. A constant force is continuously applied on the surface of the wheel so that it just climbs the step without slipping. Consider the torque τ about an axis normal to the plane of the paper passing through the point Q. Which of the following options is/are correct?



This question has multiple correct options

A. If the force is applied tangentially at point S then $\tau \neq 0$ but the wheel never climbs the step

B. If the force is applied normal to the circumference at point P then τ is zero

C. If the force is applied normal to the circumference at point X then τ is constant

D. If the force is applied at point P tangentially then τ decreases continuously as the wheel climbs

Solution

Correct options are B) and C)

A: Torque due to mg decreases with angle whereas torque due to force is minimum at initial state.

B: Applied force passes through point Q. So, its torque is zero.

$\because \vec{r}_{PQ} \times \vec{f} = 0$. Hence τ is zero

C: Torque due to applied force at X remains constant. The perpendicular distance to the line of the force remains constant. Hence torque remains constant.

D: If the force is applied at the point P tangentially then τ remains constant.