20-R-IM-PT-2(Solution)

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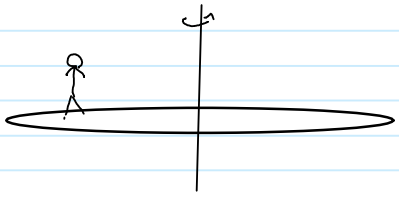
A merry-go-round is spun at to a speed of 1.5 rad/s, maintaining the speed with no forces acting on it. At this speed a child, with a mass of 23kg, directly jumps on the merry go round at a distance of 0.3 m from the centre. If the merry go round has a radius of 3m, and a mass of 50kg, what is the new speed of the merry go round. Assume the merry-go-round is a flat circle with a mass of 17kg, and the child can be treated as a point mass. Also assume that the child does not slide on the merry-go-round, and that no external torques act on it, once the child jumps on.



$I_1 \omega_1 = I_2 \omega_2 \qquad \omega_1 = 1.5 \text{ rad/s}$

$I_1 = mr^2 \cdot \frac{1}{2} \qquad m = 17\text{kg} \quad r = 3\text{m}$

$= \frac{(3)^2 \cdot 17}{2} = 76.5$

$I_2 = \left(\frac{1}{2}mr^2 + m_{child} d^2\right) \qquad m_{child} = 23\text{kg} \quad d = 1.45\text{m}$

$= \left(\frac{1}{2} \cdot 3^2 \cdot 17 + 23 \cdot 1.45^2\right) = 124.825$

$\omega_2 = \frac{I_1}{I_2} \cdot \omega_1 = \frac{76.5}{124.825} \cdot 1.5 = 0.9198 \text{ rad/s}$

The new angular speed is 0.92 rad/s