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To determine the force required to rotate the mass by 20 degrees in 250 ms, we'll break down the problem into parts:

1. **Calculate the required angular acceleration**. 2. **Determine the torque needed** to achieve this angular acceleration. 3. **Calculate the force needed** based on the given torque and distance from the pivot.

Step 1: Calculate the Required Angular Acceleration

The mass needs to rotate by 20 degrees (which is about $\theta = 0.349$ radians) in 250 ms (or 0.25 s). Assuming it starts from rest and accelerates uniformly, we can use the rotational kinematic equation:

$$\theta = \frac{1}{2}\alpha t^2$$

Solving for α (angular acceleration):

$$\alpha = \frac{2\theta}{t^2}$$

Step 2: Determine the Torque Needed

Torque (τ) is related to angular acceleration by the moment of inertia (I):

$$\tau = I\alpha$$

Since the mass can be considered as a point mass at a distance $r = 0.25m$ from the pivot, we can approximate its moment of inertia as:

$$I = mr^2$$

Step 3: Calculate the Force Needed

Torque (τ) is also related to the applied force (F) and the distance from the pivot at which it acts ($d = 0.5m$):

$$\tau = F \times d$$

From this, we can rearrange to solve for F:

$$F = \frac{\tau}{d}$$

Let's go through these steps with the values you've provided.

The required force to rotate the mass by 20 degrees in 250 ms is approximately **279.25 N**.