Solutions to selected problems

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Contents

1. Light bar problem (problem 2.7.27 from Savchenko 2008 edition)

A light bar with m1 and m2 masses ($m_1 \neq m_2$) at the ends placed on the support point (in the middle of bar). Initially it is held in this position. Then it's released. What is the force N which acts on a support point at the moment just after system is released?

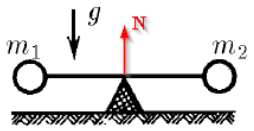

Figure 1: Light bar problem.

Solution:

Moment of inertia:

$$I = (m_1 + m_2)r^2$$

Equation of momentum:

$$(m_2 - m_1)gr = I\varepsilon = (m2 + m1)r^2\varepsilon$$

Force and acceleration $a_c = \varepsilon x$ at the center of mass:

$$F = Ma_c = (m_1 + m_2) \cdot a_c$$

Equation of forces acting:

$$F = (m_1 + m_2)g - N$$

Assume $m_2 > m_1$ and center of mass is at distance x from support point. Then:

$$x = \frac{l(m_2 - m_1)}{2(m_1 + m_2)}$$

Finally:

$$N = (m_1 + m_2)g - F = ... = \frac{4m_1m_2g}{m_1 + m_2}$$