Solutions to selected problems

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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?

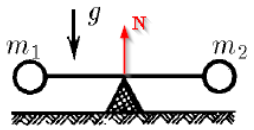

Figure 1: Light bar problem.

Solution:

Moment of inertia:

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

Equation of momentum:

$$\frac{(m_2 - m_1)gl}{2} = I\varepsilon = (m2 + m1)(\frac{l}{2})^2\varepsilon$$

Then:

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

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

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

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

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

$$F = (m_1 + m_2)\varepsilon x = \frac{(m_2 - m_1)^2 g}{m_1 + m_2}$$

Equation of forces acting:

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

Finally:

$$N = (m_1 + m_2)g - F = (m_1 + m_2)g - \frac{(m_2 - m_1)^2 g}{m_1 + m_2} = \frac{4m_1 m_2 g}{m_1 + m_2}$$

2. Problem 2

Let's figure it out