PHYS 21: Problems for Recitation 1

Due on Jan 11 2013

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Hints for Assignment 1

- For the spaceship problem (6.4), you should read Example 6.4 before starting
- For the rotating drums (6.2), does the sand exert torque as it leaves?
- For 6.5 and 6.6, example 6.1 will give you a useful equation
- For 6.13, where does the force originate?

1

There is a bridge with two supports as shown. The bridge weighs 10^5 kg. It is 20 m long. There is a truck which weighs 10^3 kg is 5 m from the left support. What is the weight supported by the right pillar?

We can use the left pillar as the pivot. There is a torque generated by the truck.

$$\begin{aligned}(M_b + m_t)g =& N_a + N_b \\ 0 =& \sum \tau_a \\ =& N_b(20m) - m_t g(5m) - M_b g(10m) \\ N_b =& \frac{1}{4} m_t g + \frac{1}{2} M_b g \\ =& \frac{1}{4} 9.8 \times 10^3 + \frac{1}{2} 9.8 \times 10^5 \\ =& 4.92450 \times 10^5 N\end{aligned}$$

We could also examine the torque about the centre of mass of the bridge:

$$\begin{aligned}0 =& \sum \tau_{cm} \\ =& 10^3 g(5m) + N_b(10m) - N_a(10m) \\ =& 10^3 g(5m) + N_b(10m) + N_b(10m) - (10^3 + 10^5)g(10m) \\ =& -10^3 g(5m) + 2N_b(10m) - 10^5 g(10m) \\ \Rightarrow N_b =& \frac{g}{4} 10^3 + \frac{g}{2} 10^5 \\ =& 4.92450 \times 10^5 N\end{aligned}$$

To find the force at the left piling, we could :

$$\begin{aligned}(M_b + m_t)g =& N_a + N_b \\ N_a =& -\frac{g}{4} 10^3 - \frac{g}{2} 10^5 + (10^5 + 10^3)g \\ =& \frac{3g}{4} 10^3 + \frac{g}{2} 10^5 \\ =& 4.97350 \times 10^5\end{aligned}$$