PHYS 21: Problems for Recitation 1
Due on Jan 11 2013

Prof. Oh

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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.

\[
(M_b + m_t)g = N_a + N_b
\]

\[
0 = \sum \tau_a = N_b(20m) - m_tg(5m) - M_bg(10m)
\]

\[
N_b = \frac{1}{4} m_tg + \frac{1}{2} M_bg
\]

\[
= \frac{1}{4} \times 9.8 \times 10^3 + \frac{1}{2} \times 9.8 \times 10^5
\]

\[
= 4.92450 \times 10^5 \text{ N}
\]

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

\[
0 = \sum \tau_{cm} = 10^3g(5m) + N_b(10m) - N_a(10m)
\]

\[
= 10^3g(5m) + N_b(10m) + N_b(10m) - (10^3 + 10^5)g(10m)
\]

\[
= - 10^3g(5m) + 2N_b(10m) - 10^5g(10m)
\]

\[
\Rightarrow N_b = \frac{g}{4} \times 10^3 + \frac{g}{2} \times 10^5
\]

\[
= 4.92450 \times 10^5 \text{ N}
\]

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

\[
(M_b + m_t)g = N_a + N_b
\]

\[
N_a = - \frac{g}{4} \times 10^3 - \frac{g}{2} \times 10^5 + (10^5 + 10^3)g
\]

\[
= \frac{3g}{4} \times 10^3 + \frac{g}{2} \times 10^5
\]

\[
= 4.97350 \times 10^5 \text{ N}
\]