

Quiz 13: Chapter 17

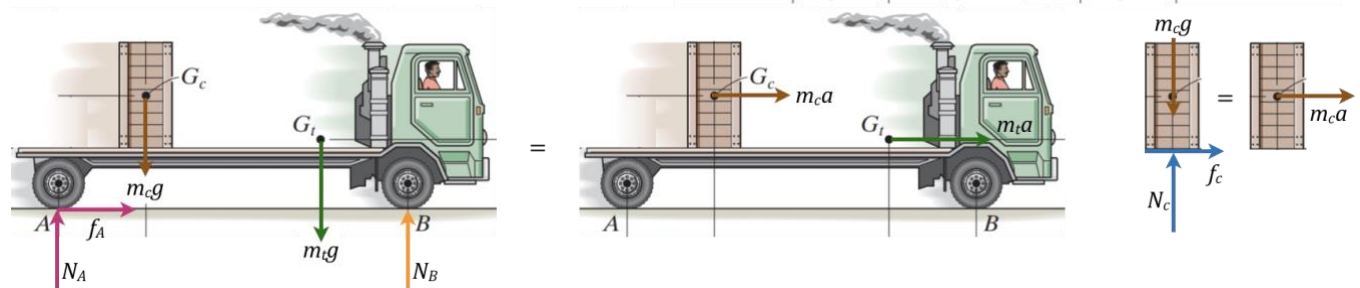
Due: Tuesday 07 March 2023

Examine the solved problem below. There are **four errors** in the solution below. Your task is to locate and identify any mistakes, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth **4 points**, and the re-calculated results are worth **4 points** as well. You must save your work in pdf format and submit via the **Quiz 13 Assignment** in the **Chapter 17** in the **Quizzes** folder of the **Online Classroom** in Blackboard. Please do not use any other file format than pdf.

The truck has a mass $m_t = 18,000\text{kg}$ and center of gravity at G_t . It carries the crate ($m_c = 1800\text{kg}$), which has a center of gravity at G_c . Determine the normal forces on each of its four tires if it accelerates at $a = 0.20\frac{\text{m}}{\text{s}^2}$. Also calculate the frictional force acting between the crate and the truck f_c , and between each of the rear tires and the road f_A . Assume that power is delivered only to the rear tires and that the front tires are free to roll. Neglect the mass of the tires. The crate does not slip or tip on the truck.

A) Construct the free body diagram for the truck + crate:



B) Write the Newton #2 equations of motion for the system:

$$\sum F_x = f_A = m_t a$$

$$\sum F_y = 4(N_A + N_B) - m_t g = 0$$

$$\sum M_A = 2N_B r_B - (m_t g) r_t - (m_c g) r_c = (m_t a) r_t + (m_c a) r_c$$

$$2N_B(6.0\text{m}) = [(18,000\text{kg})\sqrt{(4.50\text{m})^2 + (1.20\text{m})^2} + (1800\text{kg})\sqrt{(1.50\text{m})^2 + (1.95\text{m})^2}](9.8\frac{\text{m}}{\text{s}^2} + 0.20\frac{\text{m}}{\text{s}^2})$$

$$N_B = 73,549\text{N} = 73.5\text{kN}$$

$$N_A = 44,100\text{N} - N_B = 44,100\text{N} - 73,549\text{N} = -29.4\text{kN}$$

$$f_A = (18,000\text{kg})\left(0.20\frac{\text{m}}{\text{s}^2}\right) = 3600\text{N} = 3.60\text{kN}$$

$$N_A + N_B = \frac{1}{4}(18,000\text{kg})\left(9.8\frac{\text{m}}{\text{s}^2}\right) = 44,100\text{N} = 44.1\text{kN}$$

$$2N_B r_B = m_t(g + a)\sqrt{x_t^2 + y_t^2} + m_c(g + a)\sqrt{x_c^2 + y_c^2}$$

C) Find the force on each tire.

$$N_f = N_B = 73.5\text{kN}$$

$$N_r = N_A = 29.4\text{kN}$$

D) Isolate the crate.

See free body diagram above.

E) Calculate the frictional force f_c on the crate:

$$\sum F_x = f_c = m_c a = (1800\text{kg})\left(0.20\frac{\text{m}}{\text{s}^2}\right) = 360\text{N} = 0.360\text{kN}$$

$$\sum F_y = N_c - m_c g = 0$$

$$N_c = m_c g = (1800\text{kg})\left(9.8\frac{\text{m}}{\text{s}^2}\right) = 17640\text{N} = 17.6\text{kN}$$