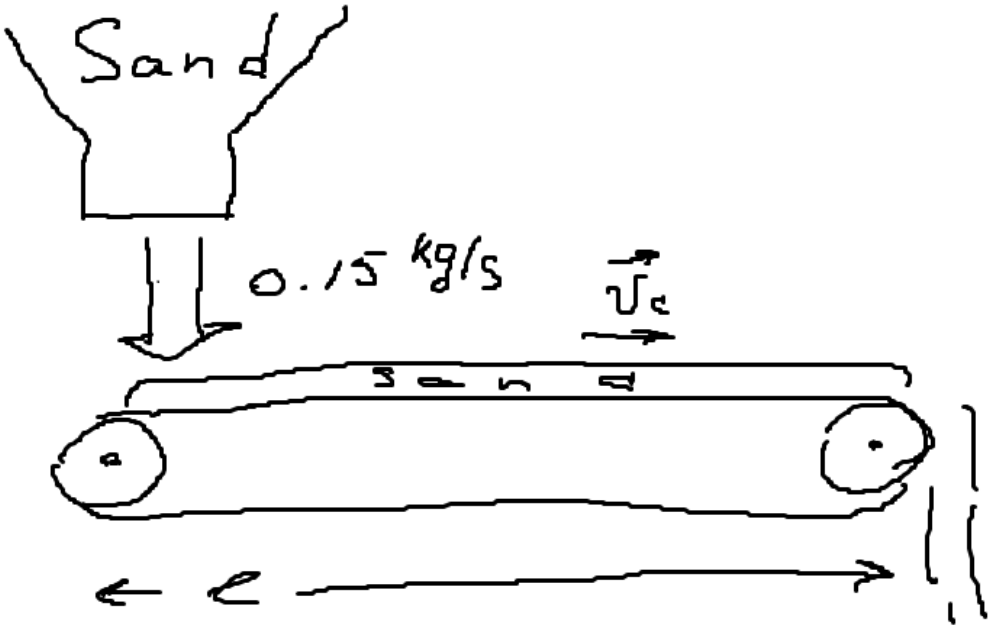
1. Sand falls at the rate of 0.15kg/s on a conveyor belt moving horizontally at a constant speed of 2 m/s , calculate i) the extra force necessary to maintain this speed ii) the rate at which work is done by this force, iii) the change in kinetic energy per second of the sand on the belt. Account for the difference between answer to (ii) to (iii)



Solution

Let $l-$ Length of conveyor belt, $\gamma = 0.15\ kg/s$ –conveyor's productivity,

$v_c - 2\ m/s -$ conveyor's belt speed.

Let's define the mass of sand on a conveyor. Calculate the time in which the sand will run from the beginning to the end conveyor

$$l = v_c t \to t = \frac{l}{v_c} \to m_s = \gamma t = \frac{l}{v_c}\gamma$$

Suppose that the conveyor belt has no weight. Then, to move the entire mass of sand evenly on the assembly line requires strength

$$F_{extra} = m_s g = \frac{l}{v_c}\gamma g$$

Work done this force -> $A = F_{extra} l = \frac{l^2}{v_c}\gamma g$

The change in kinetic energy per second of the sand on the belt is Zero

Answers:

i. $F_{extra} = \frac{l}{v_c}\gamma g$

ii. $A = \frac{l^2}{v_c}\gamma g$

iii. 0