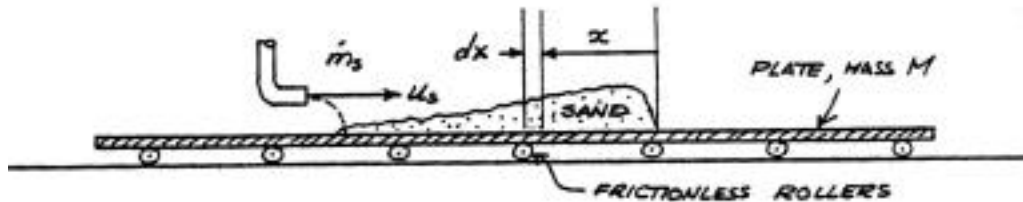


Problem 5.14

Sand thrown onto rolling plate



A steel plate of mass M is supported by frictionless rollers. At $t < 0$ the plate is moving at speed V_0 to the right. Beginning at $t = 0$, sand is dumped onto the plate from above at a mass flow rate \dot{m}_s and with horizontal velocity u_s , as shown. The plate begins to move to the right. For times small enough that the plate still has not moved away from under the sand downspout, find

(a) the plate velocity $V(t)$, and

ANSWER

(b) the sand mass distribution on the plate, expressed in terms of a mass distribution $f(x)$ such that $f(x)dx$ represents the mass of sand deposited between x and $x+dx$, where x is measured back from the point which was under the spout at $t=0$. $f(x)$ is the mass deposited on the plate per unit length the *mass distribution function* and has the units kg/m.

Make the working approximations that the time for the sand to fall from the spout to the plate is negligible, and that the sand is moist and sticks to the plate where it lands. The density of the deposited sand (grains, voids, and all) is ρ_s .

HINT

ANSWER

(c) Sketch $V(t)$ and $f(x)$.

ANSWER