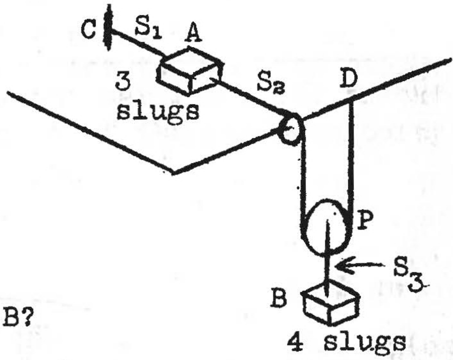
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

QUIZ #2 | PHYSICS 8.01 | OCTOBER 27, 1961

PLEASE PUT YOUR NAME AND YOUR RECITATION INSTRUCTOR'S NAME AT THE TOP OF YOUR PAPER.

1. Body A of mass 3 slugs rests on a horizontal, frictionless table, as shown. The body is held in equilibrium by two strings: S_1, which is attached to the table at C, and string S_2, which passes over a fixed pulley at the edge of the table, around pulley P (which can move), and is fastened to the table at D. Body B of mass 4 slugs hangs from pulley P by a string S_3, as shown. Assume all pulleys to be frictionless and of negligible mass; the strings have negligible mass also.



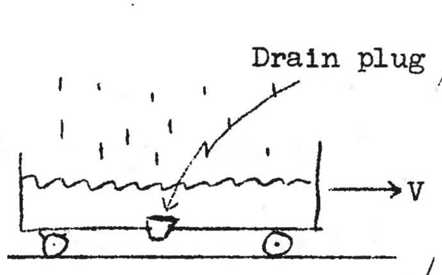
10%. (a) Isolate and indicate the forces on the masses and the pulley P. (Ignore the vertical forces on the 3-slug mass.)

10%. (b) Calculate the tensions in the strings, S_1, S_2, and S_3.

20%. (c) String S_1 is cut. Now what are the accelerations of body A and Body B?

(Suggestion: Solve algebraically in terms of M_A and M_B and check your answer for limiting cases.)

2. An open car of mass M grams moves without friction on a horizontal track with a constant velocity V. At time t=0 it starts to rain, and the car begins to fill with water at a steady rate of b grams per second. Assume that the rain falls vertically.



Mass of empty car = M

15%. (a) What time-average force must be applied to the car in order to maintain its constant velocity V? (Assume many raindrops fall on the car during your averaging time.)

15%. (b) At time $t=t_1$ the force is removed but the steady rain continues. Find an expression for the car's velocity as a function of time.

10%. (c) At time $t=t_2$ the rain stops and the car's velocity is noted to be V_2. A drain-hole in the bottom of the car is now opened. What is the velocity of the car when the water is completely drained? Explain your answer.

20%. An MIT Faculty Resident, sitting in his dormitory room, notices that a water bomb takes 1/4 second to fall past his window. The window is 9 feet high. If he assumes that the bomb was released from rest, how far above the top of his window was the bomb released?

$$g = 32 \text{ ft/sec}^2$$