

Physics - Unit V Challenge Problem

No matter how bad your day is going, here's proof that things could be A LOT worse. This is a bricklayer's accident report that was printed in the newsletter of the English equivalent of the Workers' Compensation Board. So here, thanks to John Sedgwick, is this Bricklayer's report.

Dear Sir;

I am writing in response to your request for additional information in Block #3 of the accident reporting form. I put "Poor Planning" as the cause of my accident. You asked for a fuller explanation and I trust the following details will be sufficient. I am a bricklayer by trade. On the day of the accident, I was working alone on the roof of a new six-story building. When I completed my work, I found I had some bricks left over which when weighed later were found to weigh 240 lbs. Rather than carry the bricks down by hand, I decided to lower them in a barrel by using a pulley which was attached to the side of the building at the sixth floor. Securing the rope at ground level, I went up to the roof, swung the barrel out and loaded the bricks into it. Then I went down and untied the rope, holding it tightly to insure a slow descent of the 240 lbs of bricks. You will note on the accident reporting form that my weight is 135 lbs.

Due to my surprise at being jerked off the ground so suddenly, I lost my presence of mind and forgot to let go of the rope. Needless to say, I proceeded at a rapid rate up the side of the building. **(Q1)** In the vicinity of the third floor, I met the barrel which was now proceeding downward at an equally impressive speed. **(Q2)** This explains the fractured skull, minor abrasions and the broken collarbone, as listed in Section 3, accident reporting form.

Slowed only slightly, I continued my rapid ascent, not stopping until the fingers of my right hand were two knuckles deep into the pulley which I mentioned in Paragraph 2 of this correspondence. Fortunately by this time I had regained my presence of mind and was able to hold tightly to the rope, in spite of the excruciating pain I was now beginning to experience.

At approximately the same time, however, the barrel of bricks hit the ground-and the bottom fell out of the barrel. Now devoid of the weight of the bricks, the barrel weighed approximately 50 lbs. I refer you again to my weight. As you might imagine, I began a rapid descent down the side of the building. **(Q3)** In the vicinity of the third floor, I met the barrel coming up. **(Q4)** This accounts for the two fractured ankles, broken tooth and severe lacerations of my legs and lower body.

Here my luck began to change slightly. The encounter with the barrel seemed to slow me enough to lessen my injuries when I fell into the pile of bricks and fortunately only three vertebrae were cracked. I am sorry to report, however, as I lay there on the pile of bricks, in pain, unable to move and watching the empty barrel six stories above me, I again lost my composure and presence of mind and let go of the rope. **(Q5, 6, 7)**

In order to do these problems, you need to know that $1 \text{ lb} \approx 4.5 \text{ N}$. Convert the weights involved to newtons. Assume that the 6-floor building is 20 meters high.

1. Draw a force diagram detailing the forces acting on the man and on the barrel of bricks (290 lbs). Determine the acceleration of the *system*.
2. How fast was the barrel traveling when it struck the man 1/2 way up the building? What was the barrel's velocity relative to the man?
3. Draw a new force diagram for the barrel and man after the bricks have fallen out. Determine the new acceleration of the system.
4. How fast was the barrel traveling when it struck the man a 2nd time? What was its velocity relative to the man?
5. Once the man let go of the rope, assume that the barrel was essentially in free fall. (Assume negligible air resistance). How long did it take the barrel to reach the ground?
6. How fast was it going when it hit the man?
7. How fast would it have been going if it had been full of bricks (290 lbs, not 50 lbs)? Explain your answer.