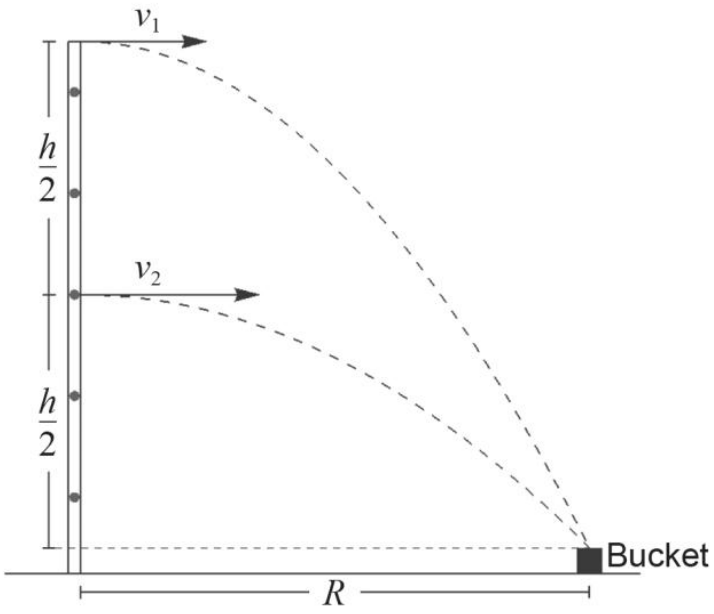
Question 3 **(7 marks)**



A window cleaner on a vertical ladder is at a height h from the ground. He throws a used sponge into a bucket on the ground at a distance R from the base of the ladder. He throws it horizontally at a velocity v_1. When he is halfway down the ladder, he has to throw the sponge at a different velocity v_2 in order for it to land in the bucket. He still throws the sponge horizontally.

Express v_2 in terms of v_1. Assume there is no air resistance and the sponge lands in the middle of the bucket. Show all working.