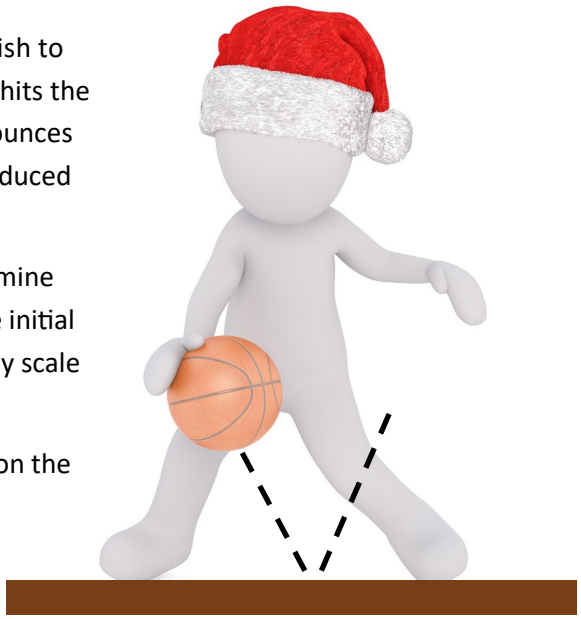
Individual Quizbit 7

PH201, Fall 2022

You are encouraged to discuss these questions with others, but those conversations need to be only in words. Please do not write down steps for others, draw pictures, show math steps, or consult online resources. Any work shown here should be your own thoughts and not copied from any source. You will be graded on the clarity of how well you communicate your steps and reasoning, not on absolute correctness. Hand write your solutions (paper or tablet) and turn your work into Gradescope.



Problem Statement | A 625 gram basketball bounces off the ground and we wish to find the impulse imparted on the ball by the ground during the collision. The ball hits the ground with a speed of 12.5 m/s, at angle of 35° with respect to the vertical. It bounces back at the same angle with respect to the vertical, but the speed of the ball is reduced by 20%.

(a) Draw a physical representation of the vector operation required to determine the impulse imparted on the ball. It should include representations of the initial moment, final momentum, and change in momentum. Be sure to carefully scale each vector relative to each other.

(b) Determine both the x and y components of the impulse vector imparted on the ball. Use that to find the magnitude of the impulse on the ball.

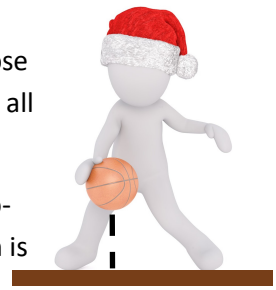
(c) In words describe how the ground imparts an impulse on the ball and the consequences of that impulse.

(d) What would Newton's 3rd law mean about the impulse imparted on the ground by the ball? Explain what this does to the ground?

Group Quizbit 7

PH201, Fall 2022

You will be working with your group to create a single solution for these questions. You are encouraged to think about the questions beforehand, and discussing with your classmates is encouraged, but do not bring a solution to your group's working session. You are working to develop a shared solution, with the input and problem solving skills of all your group members. You will be graded on both the clarity of how well you communicate your steps and reasoning, and on absolute correctness.



Problem Statement | Consider the basketball that bounced off the ground in the Individual Quizbit 7 question. We wish to determine the recoil speed of the Earth after it's collision with the basketball. Choose a reference frame where the Earth is initially stationary before the basketball hits it. Ignore the affects of all other objects besides the basketball and the Earth.

(a) To simplify the situation, assume the ball is bounced straight up and down. Use a conservation of momentum analysis to determine the recoil speed of the Earth after this collision. The mass of the Earth is 5.97×10^{24} kg.

(b) Sometimes it is hard to grasp very small or very large numbers. To make sense of the speed you found in part (a), determine the time, in years, it would take the Earth to move a distance of 1.00×10^{-10} m at this speed. This is on the order of the distance between atoms, and about the point where making smaller measurements of distance becomes exceedingly difficult.

(c) The recoil speed of the Earth found in part (a) is very small. Even with that the case, there are billions of collisions with the Earth per second, most much larger than this basketball example (think walking). Why is it that these small impulses, added up over many occurrences and over much time, don't eventually fly the Earth out of orbit? Should we be worried about these continuous bombardment of impulses on the Earth? Explain using words, diagrams, math, graphs, or any other representation that supports your answer.