

Answer to Question #70079, Physics / Mechanics | Relativity

Question:

Anthony carelessly rolls his toy car off a 61.0-cm-high table. The car strikes the floor at a horizontal distance of 95.0 cm from the edge of the table. What was the angle of the car's velocity with respect to the floor just before the impact?

Solution:

After leaving the table the car starts to fall down due to gravity (original vertical component of speed is 0, as the car is moving on the table) so the vertical movement can be described with

$$h = \frac{gt^2}{2}$$

The time it will be falling then can be calculated as

$$t = \sqrt{\frac{2h}{g}}$$

And the vertical component of the final speed will be

$$v_y = gt = g\sqrt{2h/g}$$

The horizontal component of the speed can be calculated as

$$v_x = \frac{l}{t} = \frac{l}{\sqrt{2h/g}}$$

Then the tangent of the angle of the car velocity with respect to the floor surface can be calculated as

$$\tan(a) = \frac{v_y}{v_x} = \frac{g\sqrt{2h/g}}{\frac{l}{\sqrt{2h/g}}} = \frac{2h}{l}$$

And the respective angle can be calculated as

$$a = \arctan\left(\frac{2h}{l}\right) = \arctan\left(2 * \frac{0.61}{0.95}\right) = 52.1^\circ$$