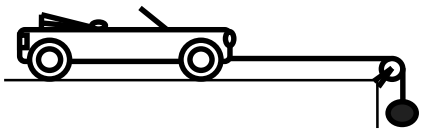
Answer on Question #57329, Physics / Mechanics | Relativity

Two lovers are parked 10.0m from the edge of a cliff in a car (m=1000kg, including the two occupants). A jealous suitor ties a rope to the car's bumper and a 50kg rock to the other end of the rope. He then lowers the rock over the edge of the cliff, and the car, which is in neutral, accelerates towards the edge. Determine the acceleration of the car towards the edge and how long do the lovers have to apply the brakes before they go over the edge.

Solution:



We will assuming that: the rock is lowered at constant speed; the surface is level; and there is no friction.

Then, the tension in the rope equals the weight of the rock, so

$$T = mg$$

$$T = (50\ kg)\ \cdot (9.8 m/s^2) = 490\ N$$

This force is the tension in the rope and the force that pulls on the car, so we have

$$F\ =\ ma$$

the acceleration is

$$a = \frac{F}{m} = \frac{490\ N}{1000\ kg}\ =\ 0.49\ m/s^2$$

If you are initially at rest and accelerate at 0.49 m/s^2,

$$d = \frac{1}{2}at^2$$

it will take a time given by

$$t = \sqrt{\frac{2d}{a}}$$

to travel d = 10 m

$$t = \sqrt{\frac{2 \cdot 10}{0.49}} = 6.4\ s$$

which is the time they have to react.

Answer: $a = 0.49\ m/s^2; t = 6.4\ s.$