

SCIE 001 MATHEMATICS ASSIGNMENT 7 (Due 10:00 am Nov. 27, 2013)

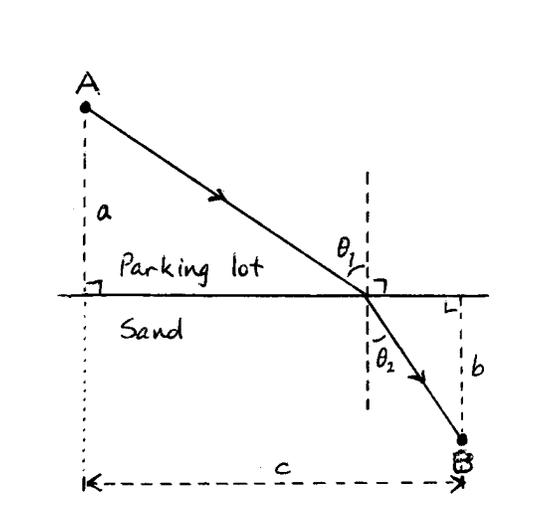
There are two parts to this assignment. The first part is on WeBWorK and is due by 10:00 am on Wed. Nov. 27. The second part consists of the questions on this page. This assignment is due by 10:00 am on Wed. Nov. 27. For these questions, you are expected to provide full solutions with complete arguments and justifications. You will be graded on the correctness, clarity and elegance of your solutions. Your answers must be typeset or very neatly written. They must be stapled, with your name and student number at the top of each page.

1. You are at point A in a hot parking lot and very thirsty. The parking lot has a straight edge and beyond the edge there is sand. In the sand at point B there is a cooler containing an ample supply of your favourite beverage. Suppose you can run at speed v_1 in the parking lot and at speed v_2 in the sand, and want to reach the cooler as soon as possible.

(a) Show that the travel time has a critical number when

$$\frac{\sin \theta_1}{v_1} = \frac{\sin \theta_2}{v_2},$$

where θ_1 , θ_2 are the angles shown in the figure, measured from the perpendicular to the parking lot-sand interface. *Hint:* Since the travel time depends on speed and distance, express the travel time using the distances a , b , c shown.



- (b) Justify that the travel time attains its absolute minimum value at this critical number.
2. A streetlight is on top of a vertical pole 8 m high. A ball is dropped from a helicopter and falls vertically, landing 3 m away from the base of the streetlight pole. When the ball is below the level of the streetlight, the light casts a shadow of the ball on the ground. When the ball is 4 m above the ground, it is falling at a rate of $20 \text{ m}\cdot\text{s}^{-1}$.
 - (a) How fast is the shadow moving along the ground when the ball is 4 m above the ground?
 - (b) When the ball is 4 m above the ground, how fast is the distance between the ball and its shadow changing?