College Physics Homework 1

March 11, 2022

, Due: March 18 2022

This is an individual assignment; you must solve it by yourself.

Problem 1

A vector has components $A_x = 5.0$, $A_y = -3.0$, $A_z = 1.0$. What is the magnitude of this vector? What is the angle between this vector and the x axis? The y axis? The z axis?

Problem 2

The refraction of light can be understood by purely kinematical considerations. We need to assume that light takes the shortest (timewise) path between two points (Fermat's principle of least time.) Referring to the Fig 1, let the speed of light in medium 1 be v_1 and in medium 2, v_2. Calculate the time it takes light to go from point A to point B as a function of variable x. Minimize with respect to x.
Given that

$$v_1 = c/n_1, \quad and \quad v_2 = c/n_2 \tag{1}$$

where n's are known as indices of refraction, prove Snell's law of refraction.
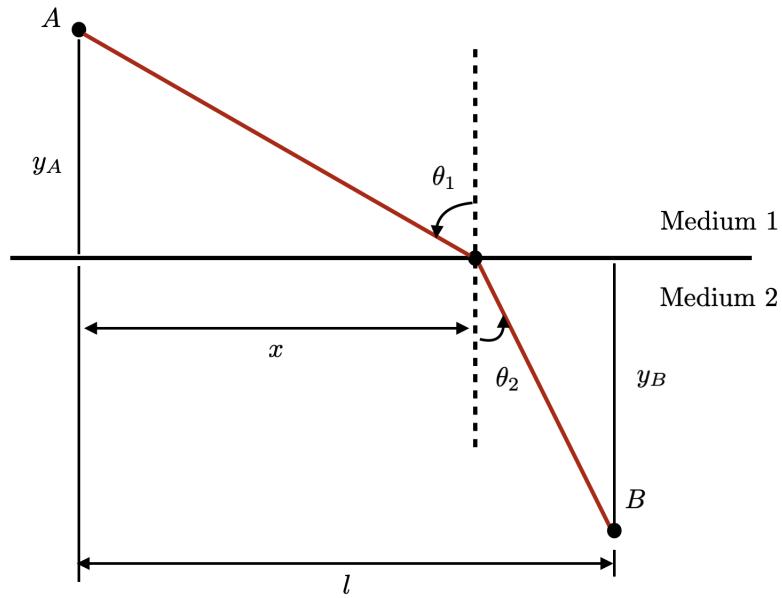
$$n_1 \sin \theta_1 = n_2 \sin \theta_2. \tag{2}$$

Figure 1: Figure for problem 2

Problem 3

Suppose you throw a stone straight up with an initial speed of 15.0 m/s.

i) If you throw a second stone straight up 1.00s after the first, with what speed must you throw the second stone if it is to hit the first at a height of 11.0m? (There are two answers. Are both plausible?)

ii) If you throw the second stone 1.30 s after the first, with what speed must you throw the second stone if it is to hit the first at a height of 11.0 m?

Problem 4

A perfectly elastic ball is thrown to a wall and bounces back over the head of the thrower (Fig 2). It is thrown height a above the ground and distance c from the wall, and has $v_{0x} = v_{0y} = v$. How far behind the thrower does the ball hit the ground ?

Problem 5

An airplane, whose air speed is 580 km/h is supposed to fly in a straight path 38 North of East. But steady 72 km/h wind is blowing from the north. In what direction should the plane head?
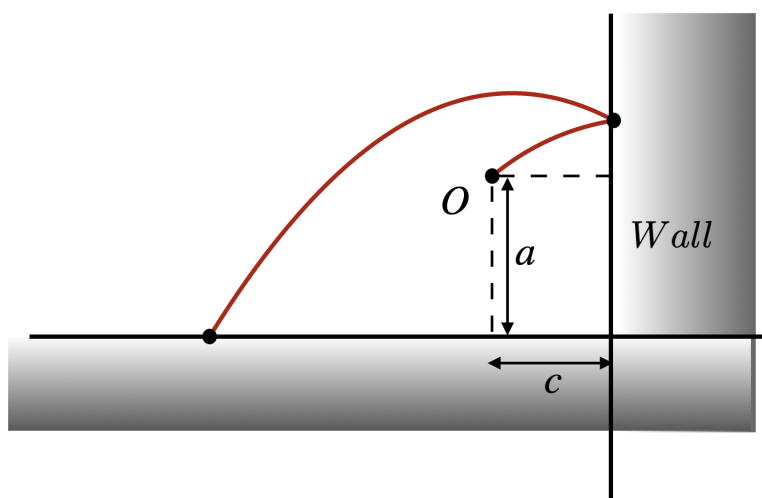
Figure 2: Projectile motion for problem 4