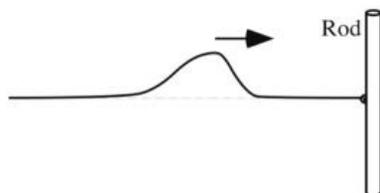


AP Physics 2 – Waves and Refraction

E1-QRT14: WAVE PULSE ON HORIZONTAL SPRING WITH FIXED END—REFLECTION SHAPE

A long spring is firmly connected to a stationary metal rod at one end. A student holding the other end moves her hand rapidly up and down to create a pulse with the shape shown in the figure. The pulse moves along the taut spring toward the rod.



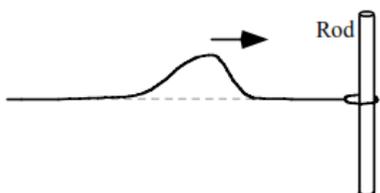
In the space below, draw what the pulse on the spring looks like after it has completely reflected from the wall and is moving to the left.



Explain your reasoning.

E1-QRT15: WAVE PULSE ON HORIZONTAL SPRING WITH FREE END—REFLECTION SHAPE

A long spring is connected to a loop that passes around a stationary metal rod at one end. The loop is free to move vertically without friction along the rod. A student holding the other end moves her hand rapidly up and down to create a pulse with the shape shown in the figure. The pulse moves along the taut spring toward the rod.



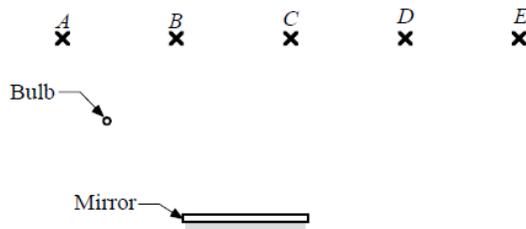
In the space below, draw what the pulse on the spring looks like after it has completely reflected from the wall and is moving to the left.



Explain your reasoning.

E2-SCT03: PLANE MIRROR II—OBSERVER LOCATION

A small light bulb is placed near a plane mirror. The locations of five observers are marked, labeled A–E as shown. Three students are discussing which observers will see an image of the bulb:



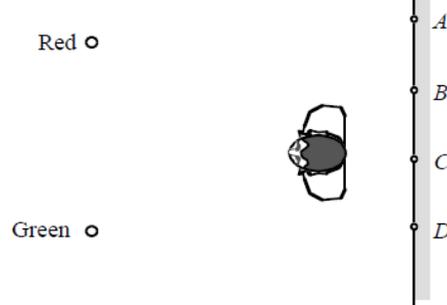
- Ashley: “None of them will see an image. The bulb isn’t in front of the mirror, so no image is formed.”
- Briar: “Even though the bulb isn’t in front of the mirror, rays from the bulb still hit the mirror and bounce off. They bounce off in the direction of observers D and E, so these two will see the image.”
- Capria: “The image is in the mirror. As long as you are in front of the mirror you will see it. Observer C will see the image, but the rest of the observers aren’t in front of the mirror.”

With which, if any, of these students do you agree?
 Ashley _____ Briar _____ Capria _____ None of them _____

Explain your reasoning.

E2-SCT04: SHADOWS ON A WALL—COLOR

A student stands in front of a white wall in a room that is dark except for the light from two small light bulbs, one red and one green. In the top-view at right, four locations on the wall are labeled A–D. Three students are discussing the color of the wall at the labeled points:



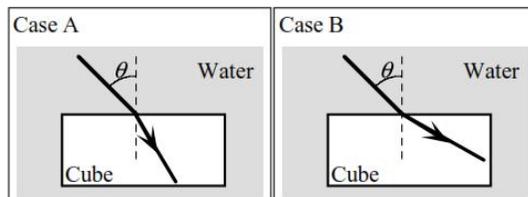
- Anuradha: “No light from either bulb will reach point C, so I think that point is going to be black or very dark. The wall there will have no color.”
- Brandon: “The wall at point A will get light from both bulbs. The color of the wall there will be a mix of red and green light—sort of yellow.”
- Carlos: “Point B will get light from the red bulb but not from the green one, so it will be red. The opposite happens at point D: Light reaches it from the green bulb but not the red one, so it will appear green.”

With which, if any, of these students do you agree?
 Anuradha _____ Brandon _____ Carlos _____ None of them _____

Explain your reasoning.

E2-CT07: LIGHT RAYS BENT AT A SURFACE—INDEX OF REFRACTION

In both cases shown, a light ray traveling in water bends at the surface of a cube. The cases are identical except that the cube in Case A is made of a different material than the cube in Case B.



Is the index of refraction of the cube (i) greater in Case A, (ii) greater in Case B, or (iii) the same in both cases?

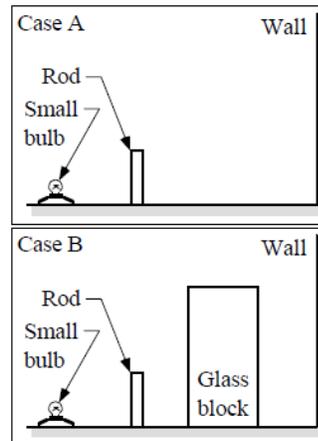
Explain your reasoning.

E2-CT06: LIGHT FROM A SMALL BULB—HEIGHT OF SHADOW

In both cases shown, a small light bulb illuminates a wall. A shadow is created on the wall of a rod placed between the wall and the bulb. The two cases are identical except that in Case B there is a glass block between the rod and the wall.

(a) Is the height of the shadow of the rod on the wall (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases*? _____

Explain your reasoning.

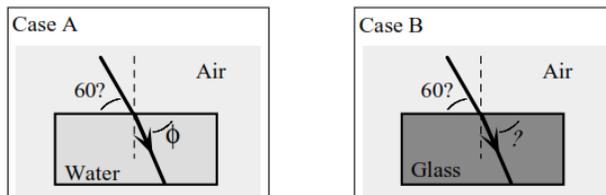


(b) If the entire arrangement from Case B—bulb, rod, glass block, and wall—were submerged in water, would the height of the shadow on the wall (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.

E2-CT09: BENDING OF LASER BEAM IN AIR—ANGLE BENT

A laser beam traveling in air enters water at an angle of 60° with respect to the surface and is bent in water to an angle of ϕ from the surface as shown in Case A. (Note that the drawings may or may not be accurately portraying the situation.)



If the water is replaced by glass, is the angle with respect to the surface that the laser beam is bent (i) *greater than*, (ii) *smaller than*, or (iii) *equal to* ϕ ? _____

Explain your reasoning.

E2-CT11: LASER LIGHT PULSE TRAVELING THROUGH SLAB—TIME

It has been noted that red light bends less than blue light in glass when it enters the glass at an angle.

Is the time that it takes for a pulse of red light to pass perpendicularly through a slab of glass surrounded by air (i) *greater than*, (ii) *less than*, or (iii) *equal to* the time for a blue light pulse? _____

Explain your reasoning.

