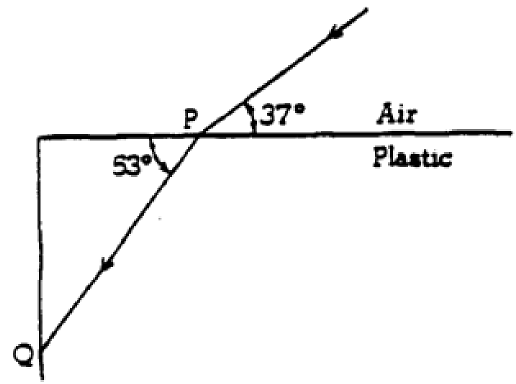
2024 AP Physics 2 Exam FR

Name________________________ Hr__

A light ray enters a block of plastic and travels along the path shown.

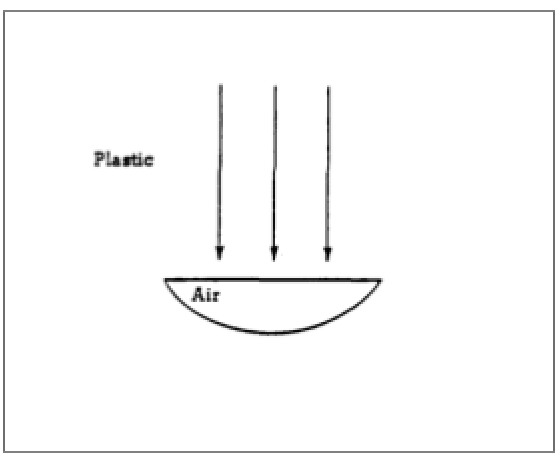


a. By considering the behavior of the ray at point P, determine the speed of light in the plastic.

B. Determine what will happen to the light ray when it reaches point Q, <u>use the diagram</u> to illustrate your conclusion.

Explain your reasoning for the path you drew

C. There is an air bubble in the plastic block that happens to be shaped like a plano-convex lens as shown below. Sketch what happens to parallel rays of light that strike this air bubble.



Explain your reasoning.

2024 AP Physics 2 Exam FR

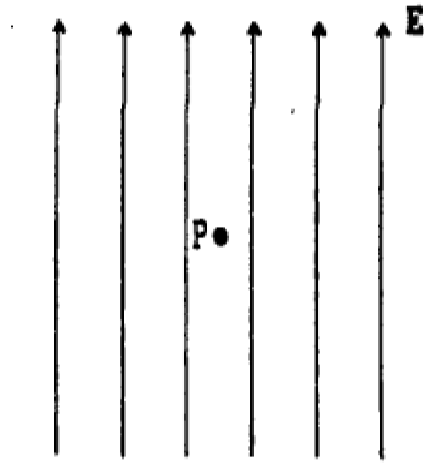
Name________________________ Hr__

Determine the magnitude and direction of the force on a proton in each of the following situations. Describe qualitatively the path followed by the proton in each situation and sketch the path on each diagram. Neglect gravity.

a. The proton is released from rest at the point P in an electric field E having intensity 10^4 newtons per coulomb and directed up in the plane of the page as shown below.

the force:

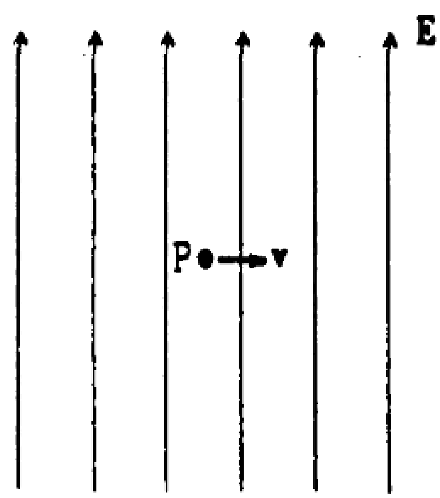
the path:



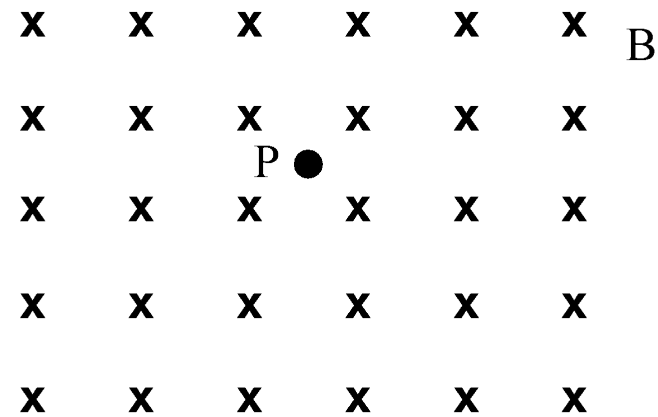
b. In the same electric field as in part (a), the proton at point P has velocity $v = 10^5$ meters per second directed to the right as shown below.

the force:

the path:



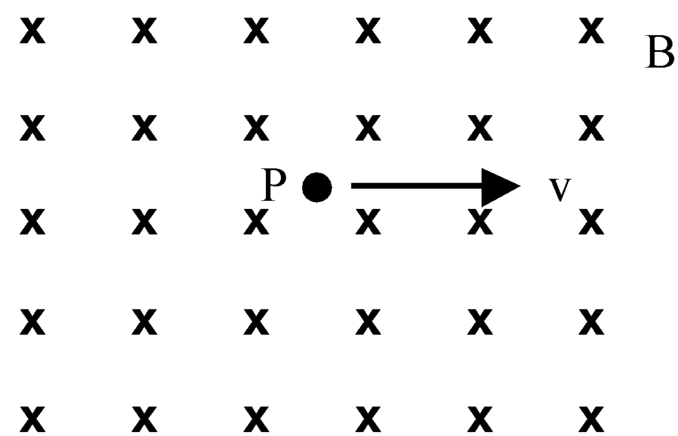
c. The proton is released from rest at point P in a magnetic field B having intensity 10^{1} tesla and directed into the page as shown below.



the force:

the path:

d. In the same magnetic field as in part (c), the proton at point P has velocity $v = 10^{5}$ meters per second directed to the right as shown below.



the force:

the path:

1979 B-6

(a) 5 points

From Snell's law, one has

$$\frac{\sin i}{\sin r} = \frac{v_i}{v_r}$$ 2 points

$\angle i = 53°$, $\angle r = 37°$ 1 point

$v_i = c$ 1 point

$v_r = (\sin 37°/\sin 53°)c$

$\quad = (3/4)c$ 1 point

or alternate solution involving index of refraction.

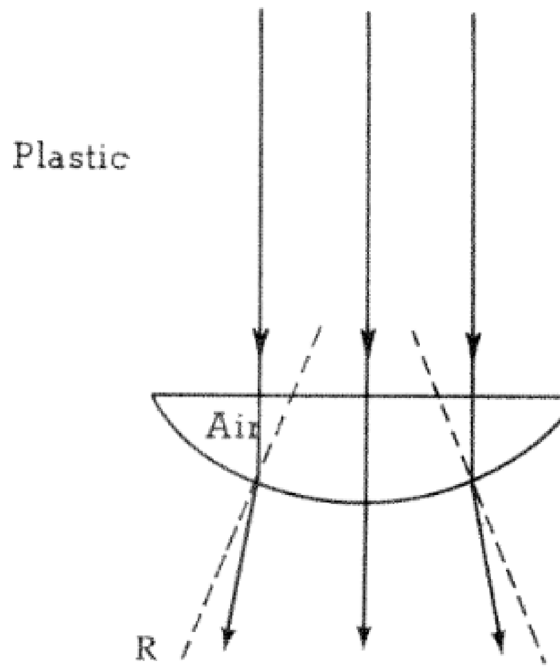
(b) 5 points

Again applying Snell's law one has

$$\sin r = \left[\frac{c}{(3/4)c}\right] \sin 53° = 16/15$$ 1 point

Since $\sin r > 1$, there is no refracted ray. 2 points

(c) 5 points



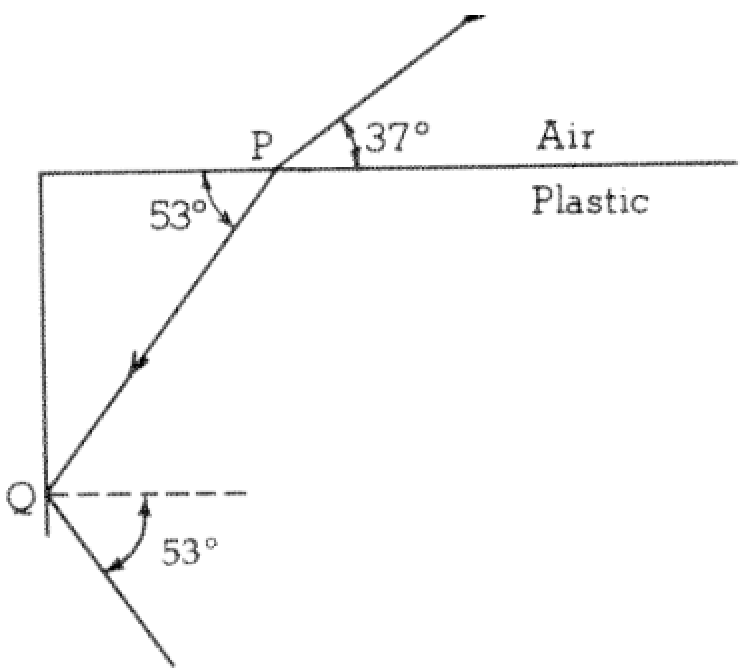
Correct drawing

3 points

2 points

Total 15 points

The rays diverge because medium II is more dense than medium I (or some equivalent statement).



Correct drawing

2 points

(a) 3 points

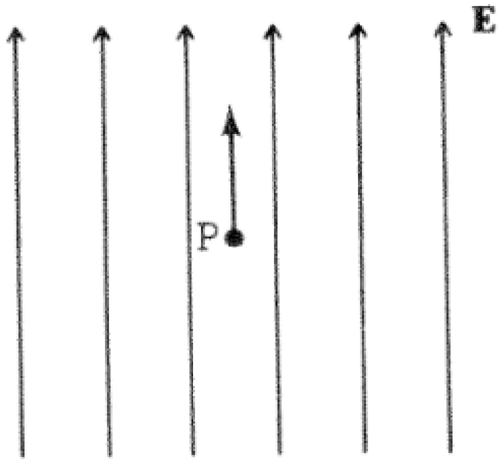
$F = q_pE$

$= (1.6 \times 10^{-19}C)(10^4 N/C) = 1.6 \times 10^{-15}$ N

(Numerical solution not required)

The force is directed up in the plane of the paper. 1 point

1 point

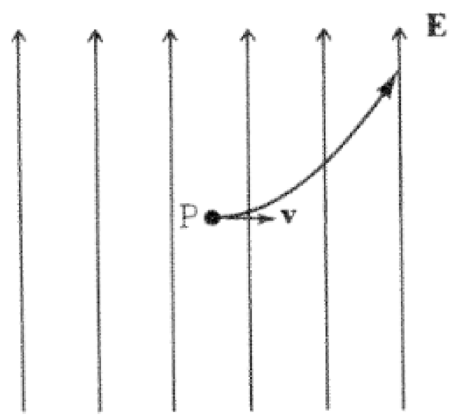


It moves along a straight line with constant linear acceleration. 1 point

(b) 5 points

$F = q_pE$ 1 point

The force is directed up in the plane of the paper. 1 point



2 points

It moves along a parabolic path as shown. 1 point

or

The proton experiences a uniform linear acceleration up and uniform velocity to the right.

(c) 3 points

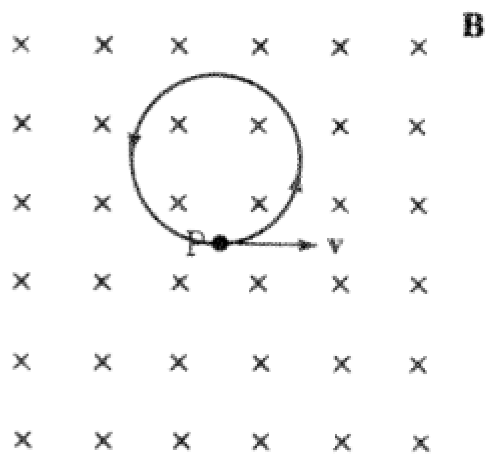
The force is zero. 2 points

The proton remains at rest. 1 point

(d) 4 points

$F = q_p v B$

The force is initially directed up in the plane of the paper.



As the proton first moves to the right, it is also deflected up. As it moves, the force will be constant in magnitude and perpendicular to the velocity. Thus it will move in a circle.

(Full credit was given for stating that the path is a circle and indicating counterclockwise motion.)