

2019 AP[®] PHYSICS 2 FREE-RESPONSE QUESTIONS

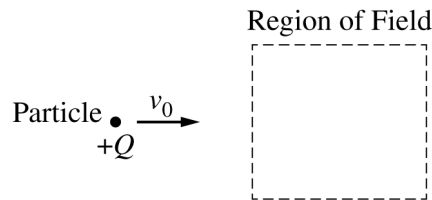
PHYSICS 2

Section II

Time—1 hour and 30 minutes

4 Questions

Directions: Questions 1 and 4 are short free-response questions that require about 20 minutes each to answer and are worth 10 points each. Questions 2 and 3 are long free-response questions that require about 25 minutes each to answer and are worth 12 points each. Show your work for each part in the space provided after that part.

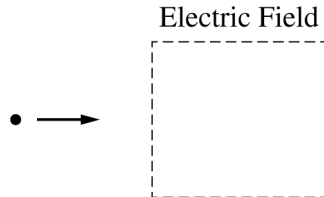


1. (10 points, suggested time 20 minutes)

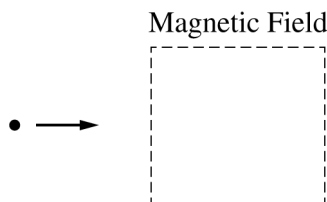
The figure above shows a particle with positive charge $+Q$ traveling with a constant speed v_0 to the right and in the plane of the page. The particle is approaching a region, shown by the dashed box, that contains a constant uniform field. The effects of gravity are negligible.

(a)

- i. On the figure below, draw a possible path of the particle in the region if the region contains only an electric field directed toward the bottom of the page.

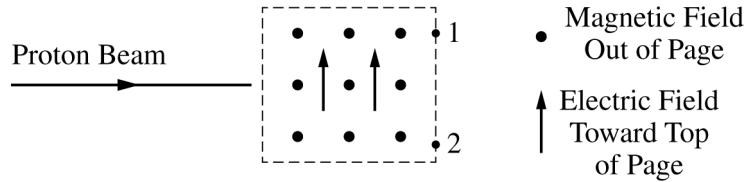


- ii. On the figure below, draw a possible path of the particle in the region if the region contains only a magnetic field directed out of the page.



- iii. For which of the previous situations is the motion more similar to that of a projectile in only a gravitational field near Earth's surface, and why?

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- (b) Another region of space contains an electric field directed toward the top of the page and a magnetic field directed out of the page. Both fields are constant and uniform. A horizontal beam of protons with a variety of speeds enters the region, as shown above. Protons exit the region at a variety of locations, including points 1 and 2 shown on the figure. In a coherent, paragraph-length response, explain why some protons exit the region at point 1 and others exit at point 2. Use physics principles to explain your reasoning.