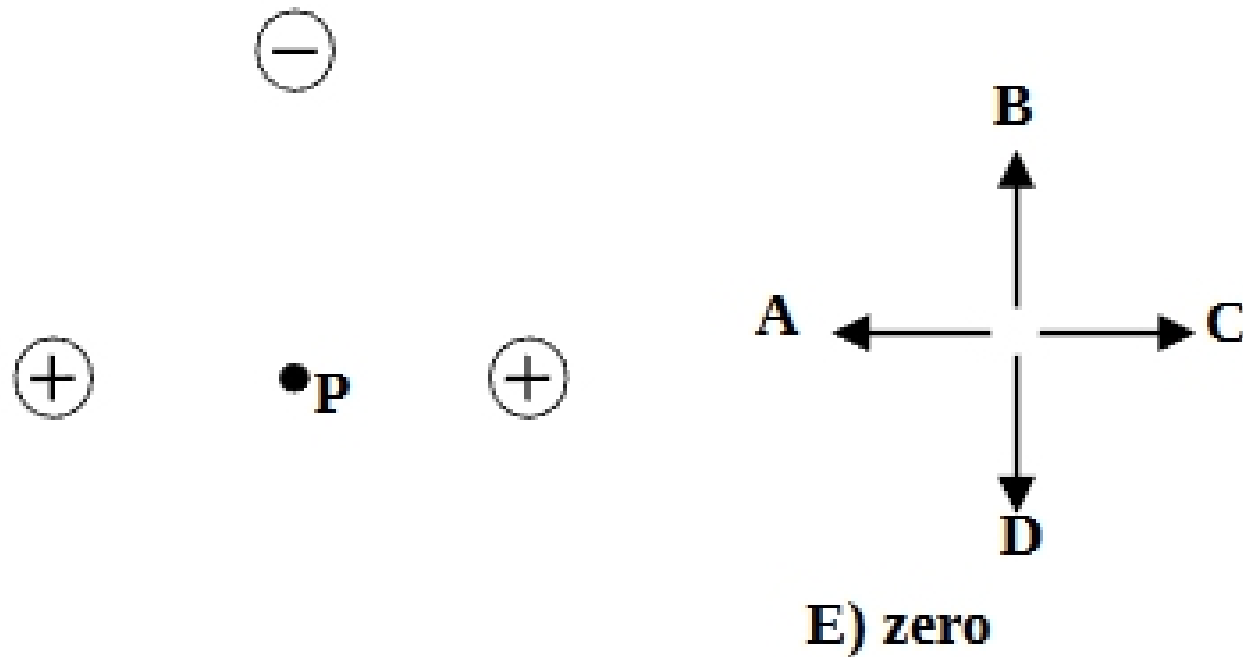
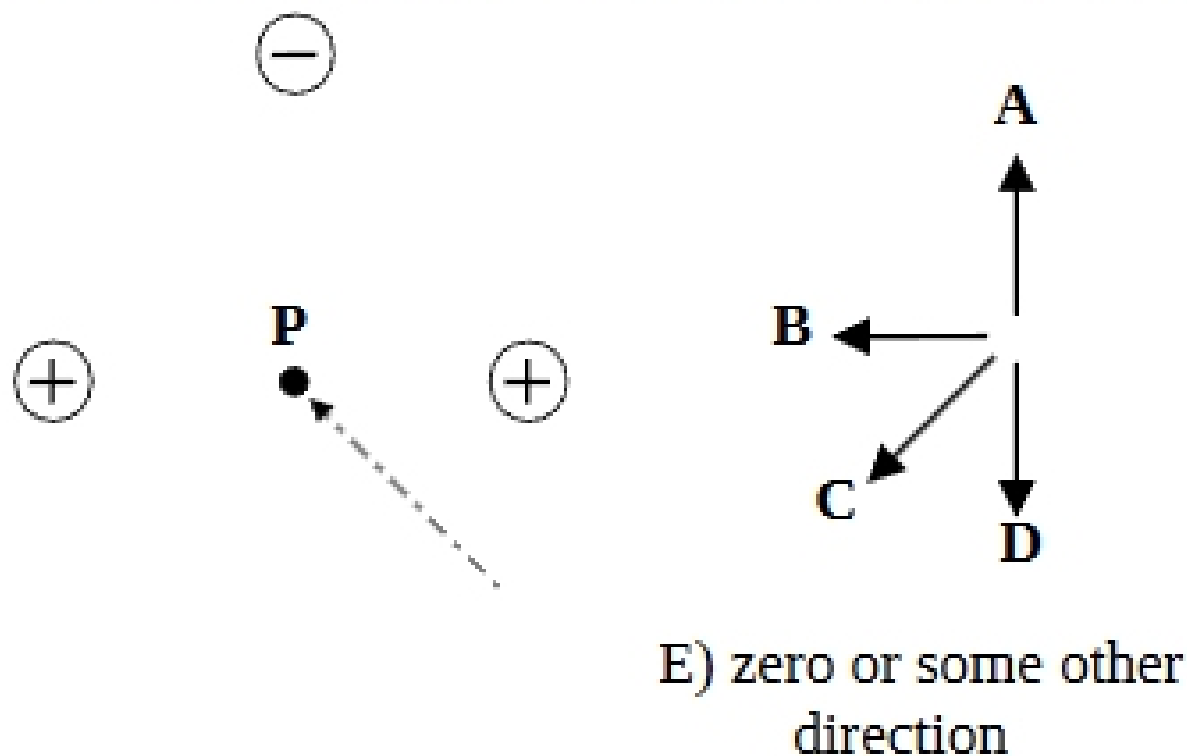


CT16-8 Three charges of equal magnitude are arranged as shown. What is the direction of the Electric field at point P?



An electron is fired into the region of the three charges from the lower right as shown. What is the direction of the acceleration of the electron when it is at point P?



Answers:

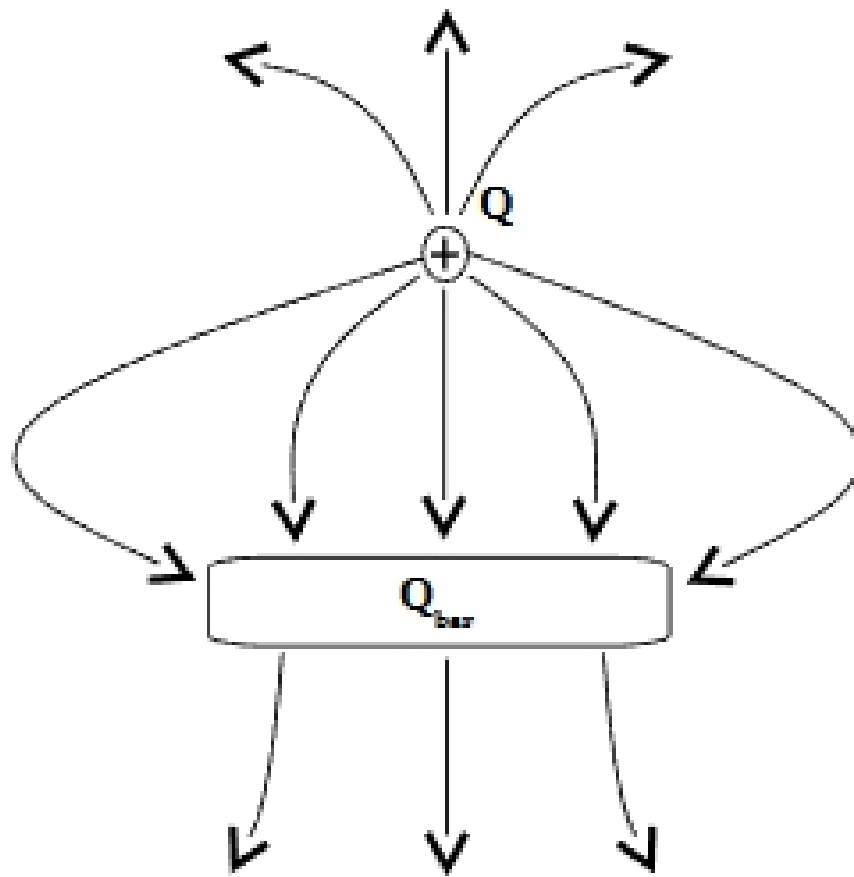
First question: The E-field points upward toward the (-) charge. The E-fields due to the two (+) charges cancel at point P.

Second question: The direction of the acceleration of the electron is downward away from the (-) charge. The acceleration is related to the net force and the E-field by

$$\mathbf{a} = \mathbf{F}/m = (1/m) q \mathbf{E} = -(e/m)\mathbf{E}.$$

(The charge of an electron is $q = -e$). So at point P, where the direction of the E-field is straight up [toward the (-) charge], the direction of the force on an electron at point P is straight down, away from the (-) charge. The direction of the acceleration has nothing to do with the direction of the velocity.

CT16-9 A positive point charge is near a bar of metal. The electric field in the vicinity of the point charge and the bar are shown by the field lines in the figure.



From the figure, what can you say about the net charge on the bar?

- A) $Q_{\text{bar}} = 0$ B) $Q_{\text{bar}} > 0$ (the bar has a net positive charge)
- C) $Q_{\text{bar}} < 0$ (net negative charge)
- D) Not enough information in the figure to answer the question.

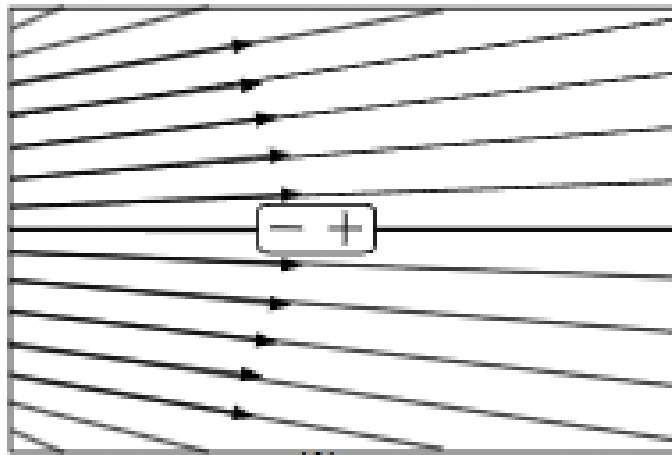
From the figure, what can you say about the magnitude of the charge on the bar $|Q_{\text{bar}}|$, compared to the magnitude of the charge Q of the positive point charge?

- A) $|Q_{\text{bar}}| > Q$ B) $|Q_{\text{bar}}| = Q$ C) $|Q_{\text{bar}}| < Q$
-

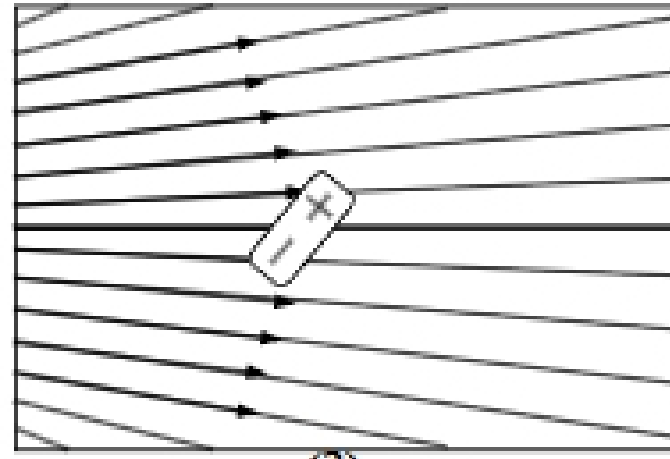
Answers: $Q_{\text{bar}} < 0$ (the bar has a net negative charge). In a field line diagram, a line exits from a certain amount of (+) charge and a line ends on the same amount of (-) charge. There are 5 lines entering the bar (5 units of negative charge) and only three lines exiting (3 units of positive charges). So the net charge on the bar is $(-5 \text{ units} + 3 \text{ units} = -2 \text{ units})$. The physical situation here is a metal bar with a net negative charge near a positive point charge.

Answer: $|Q_{\text{bar}}| < Q$. In the diagram, there are 8 field lines exiting the charge Q . So the charge of Q is +8 units of charge. As explained above, the net charge on the bar is (-5 units + 3 units = -2 units). The net charge on the bar is -2 units.

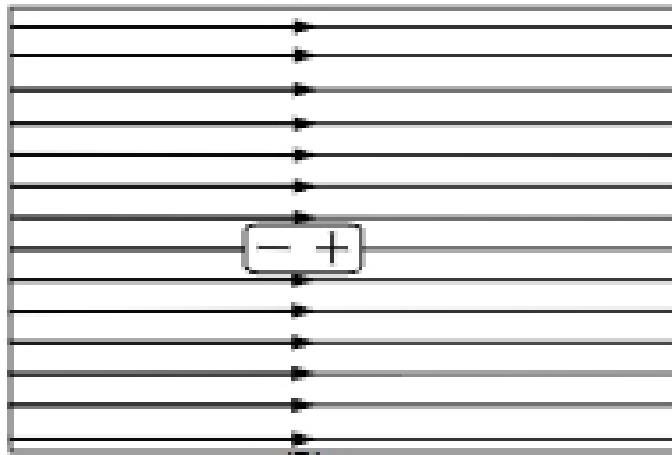
CT16-10 A dipole is placed in an external field as shown. In which situation(s) is the net force on the dipole zero?



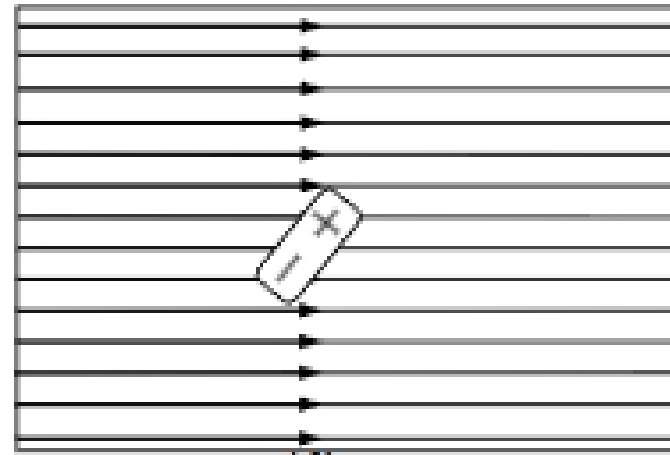
(1)



(2)



(3)



(4)

A) (1) only

B) (2) only

C) (1) and (2)

D) (3) and (4)

E) (2) and (4)

Answer: D) (3) and (4)

When the field is uniform [situations (3) and (4)] the net force is zero (but the torque might be non-zero). When the field is non-uniform [situations (1) and (2)], the net force on the dipole is non-zero
