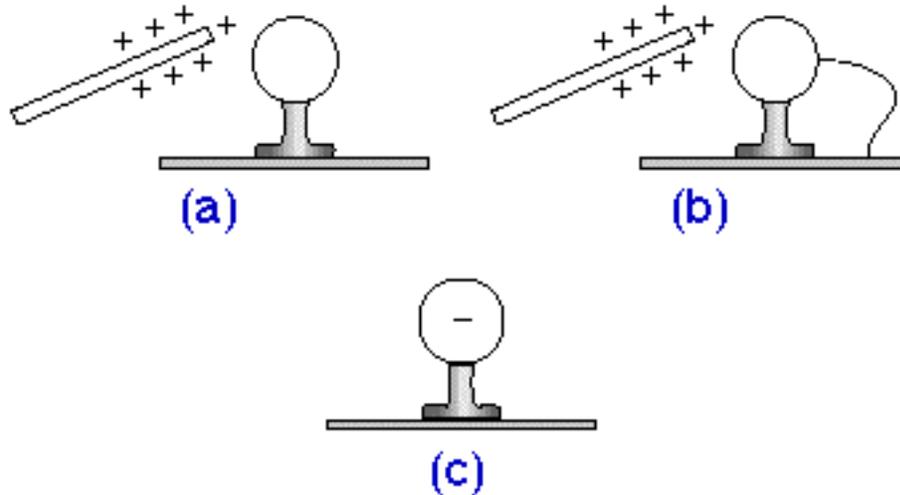


CPS lesson
Electric Field
ANSWER KEY

1. A positively charged rod is brought near a conducting sphere on an insulated base. The opposite side of the sphere is briefly grounded. If the rod is now withdrawn, the sphere is left with a negative charge because:



- A. Negative charges moved up the ground connection onto the sphere.
- B. Positive charges moved off the sphere down the ground connection.
- * C. This experiment cannot distinguish between cases A and B.

2. Three pithballs are suspended from light threads. Pithballs 1 and 2 repel each other, as do balls 2 and 3. One can conclude that:

- A. balls 1 and 3 carry charges of opposite sign
- B. balls 1 and 3 carry charges of the same sign, while ball 2 has the opposite charge
- * C. all three balls have charges of the same sign
- D. one of the balls is uncharged
- E. more experiments are needed to determine the signs of the charges

3. Three pithballs are suspended from light threads. Pithballs 1 and 2 attract each other, while balls 2 and 3 repel each other. One can conclude that:

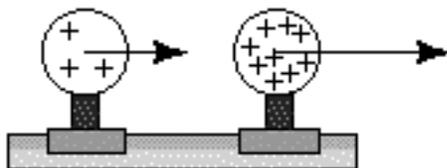
- A. balls 1 and 3 carry charges of opposite sign
- B. balls 1 and 3 carry charges of the same sign, while ball 2 has the opposite charge
- C. all three balls have charges of the same sign
- D. one of the balls is uncharged
- * E. more experiments are needed to determine the signs of the charges

4. A hydrogen atom consists of an electron orbiting a proton. In its ground state, the electrical force is about 10^{39} times stronger than the gravitational force between these two particles. By changing the distance between the proton and electron, can we find a separation at which the electric and gravitational forces are equal to each other?

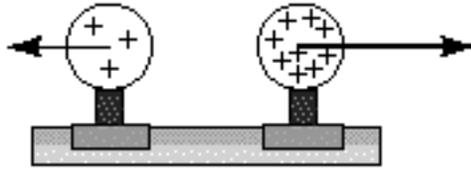
- A. Yes, by moving the particles far apart.
- B. Yes, by moving the particles close together.
- * C. No, not at any distance.

5. The right sphere has 3 times the charge of the left sphere. Which correctly shows the direction and magnitude of the electric forces?

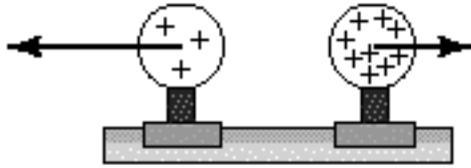
A.



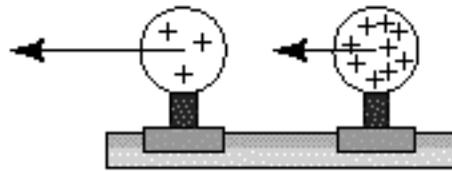
B.



C.

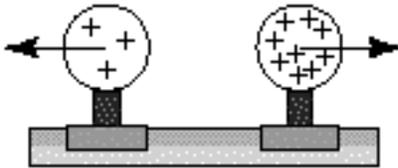


D.



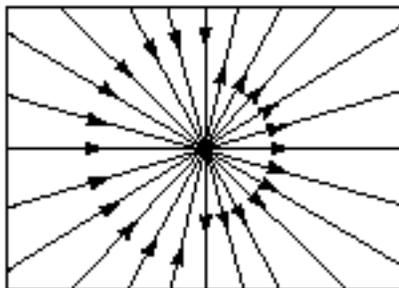
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E.

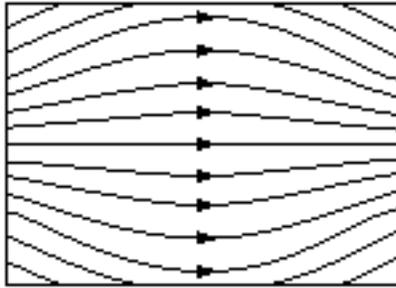


6. With no charge in the box, which is a possible E field pattern?

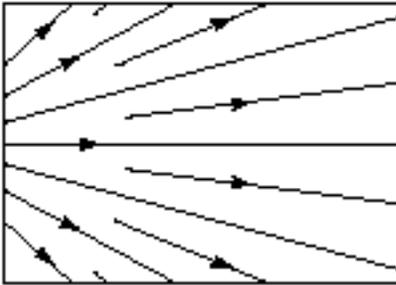
A.



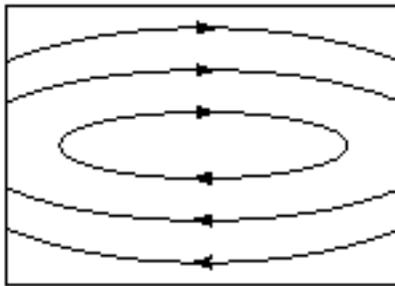
* B.



C.

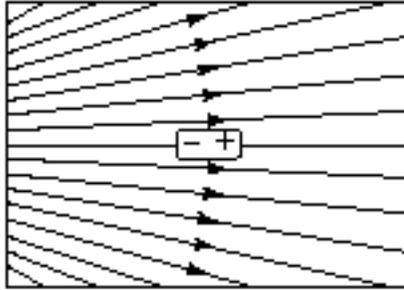


D.

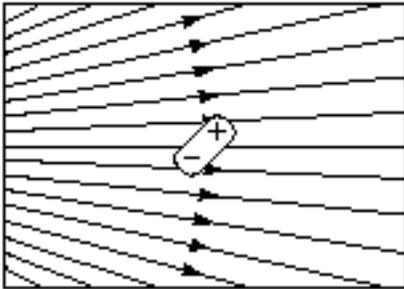


7. The figures show an electric dipole in an E field.
In which case is there zero net force on the dipole?

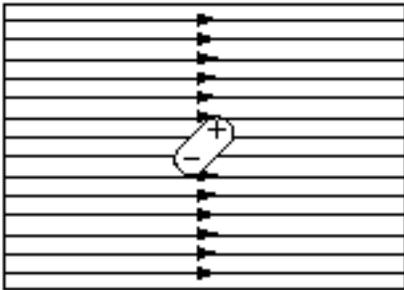
A.



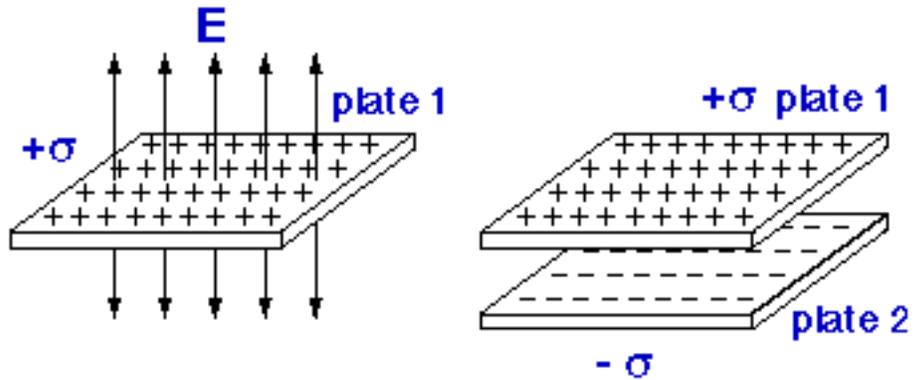
B.



* C.



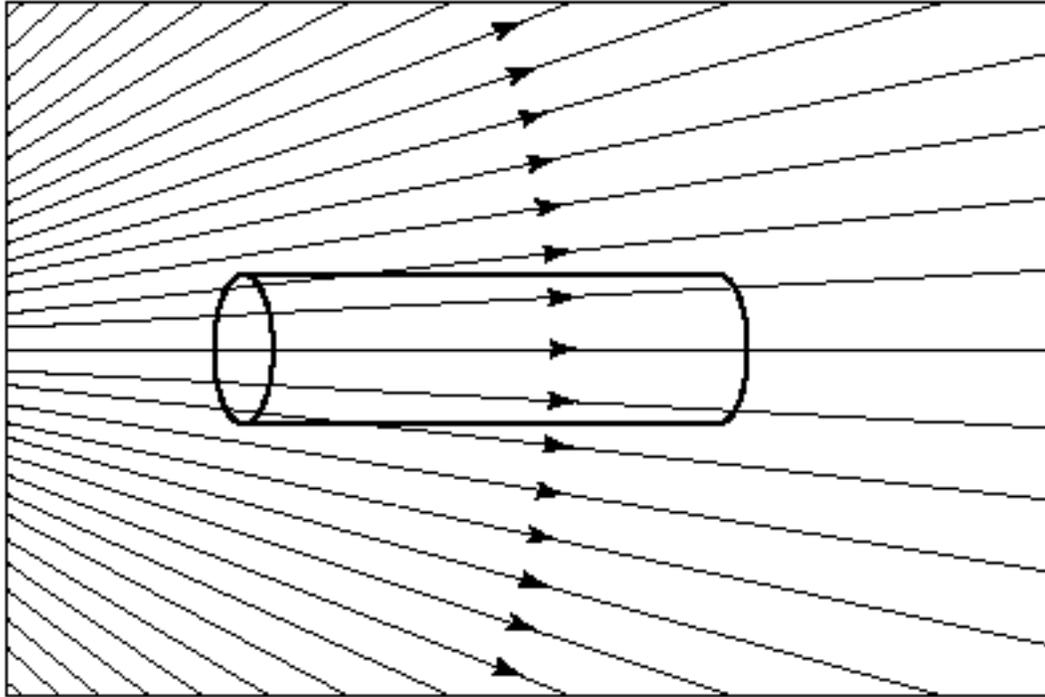
8. The charge per unit area is s , giving the indicated E field for a single plate.
 What is the electric field for a pair of parallel plates of equal and opposite surface charge density?



- * A. s/ϵ_0 between the plates; zero outside
- B. s/ϵ_0 between the plates; $s/2\epsilon_0$ outside
- C. zero both between and outside the plates
- D. $s/2\epsilon_0$ both between and outside the plates

9. A cylindrical insulator is placed in an external electric field.

The net electric flux through the surface of the cylinder is:



- A. positive
- B. negative
- * C. zero

10.
Which of the following is false?

- A. Electric force decreases with the inverse of the square of the distance between two point charges.
- B. The electric force between an electron and a proton is vastly stronger than the gravitational force between them.
- * C. The electric force between two electrons is not equal to the electric force between two protons at the same separation.
- D. Electrical forces can be either attractive or repulsive.

11.

A material that allows electric charges to flow through it is called:

- A. an insulator
- * B. a conductor
- C. a capacitor
- D. an inductor

12.

If the electric charge on each of two stationary particles is doubled, the electric force between them will:

- A. double
- * B. quadruple
- C. remain the same

13.

In any chemical or nuclear reaction between particles, the electric charge before the reaction equals that after the reaction because charge is:

- A. quantized
- * B. conserved
- C. induced

14.

Which statement is false?

- A. Electric fields superpose vectorially.
- B. The tangent to an electric field line gives the direction of E at that point.
- C. The density of field lines is proportional to the strength of E at that point.
- * D. Negative charges are source of field lines, while positive charges are sinks.

15.
An electric dipole at an angle in a uniform external E field experiences:

- A. only a net external force
- * B. only a torque
- C. both a net external force and a torque
- D. neither a net external force nor a torque

16.
In electrostatics, Gauss' law is equivalent to Coulomb's law.

- * A. TRUE
- B. FALSE

17.
Which of the following are true for a conductor in electrostatic equilibrium?

- A. The electric field inside the conductor is zero.
- B. Any net charge on the conductor resides on its surface.

surface. C. The electric field just outside the conductor is perpendicular to the

D. Exactly two of these statements are true.

* E. All three of them are true.

18.

Why does the electric field on the axis of a uniformly charged disk point in the direction of the axis?

A. There is no charge at the center of the disk.

B. The electric field is everywhere perpendicular to the disk.

* C. The radial field on the axis is canceled by the cylindrical symmetry.

19.

Electrostatic field lines:

infinity A. start at positive charges, and can only end at negative charges or

B. may cross each other, but only far away from any charges

C. around a charge, number in proportion to the magnitude of the charge

* D. more than one statement is true

E. none of these statements are true

20.

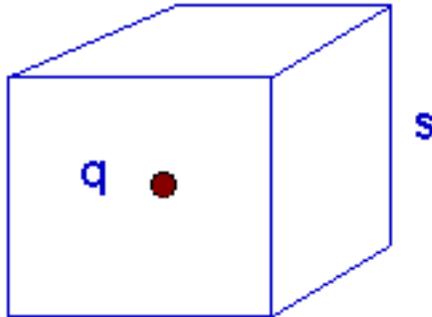
The number of electric field lines from a dipole that reach infinity is proportional to:

A. the magnitude of the charge on either pole

B. the magnitude of the dipole moment

* C. zero

21. A charge q is at the center of a cube of side s . The electric flux through a side of the cube is:



A. s^2E where E is the field at the center of the face

B. q/ϵ_0

* C. $q/6\epsilon_0$

D. zero

22.

Which of the following Gaussian surfaces cannot be used to solve for the E field due to the specified charge distribution?

A. sphere centered on a point

B. sphere concentric with a smaller sphere

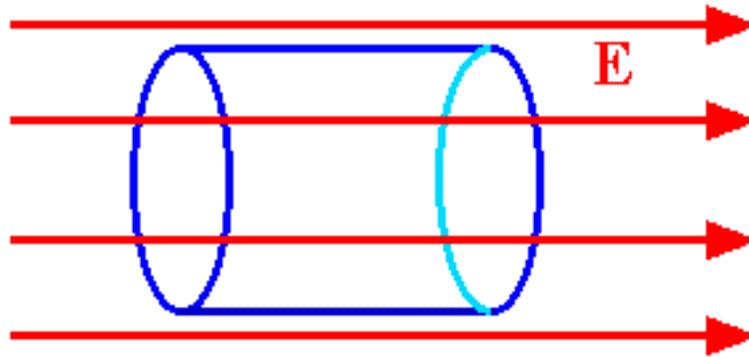
* C. cube centered on a point

D. cylinder coaxial with a line

E. cube cut in half by a plane

23. A uniform electric field passes through a cylinder.

What is the net electric flux through the two ends of the cylinder?



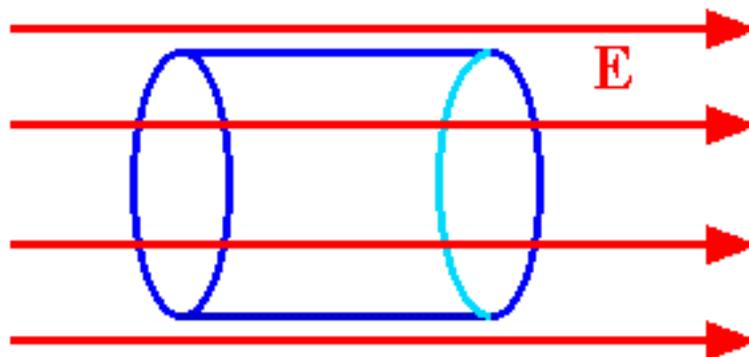
A. positive

* B. zero

C. negative

24. A uniform electric field passes through a cylinder.

What is the net electric flux through the sides of the cylinder?

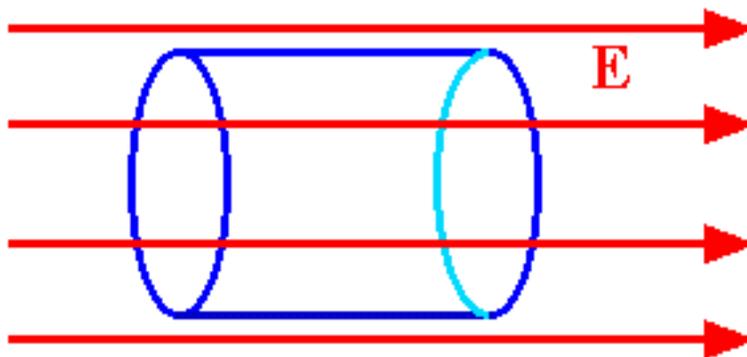


A. positive

* B. zero

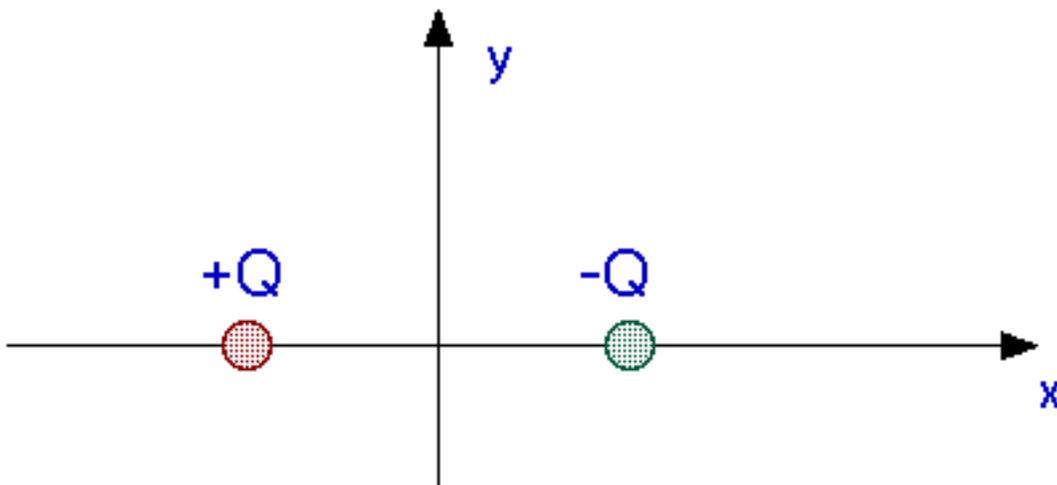
C. negative

25. A uniform electric field passes through a cylinder.
What is the net electric flux through the left end of the cylinder?



- A. positive
- B. zero
- * C. negative

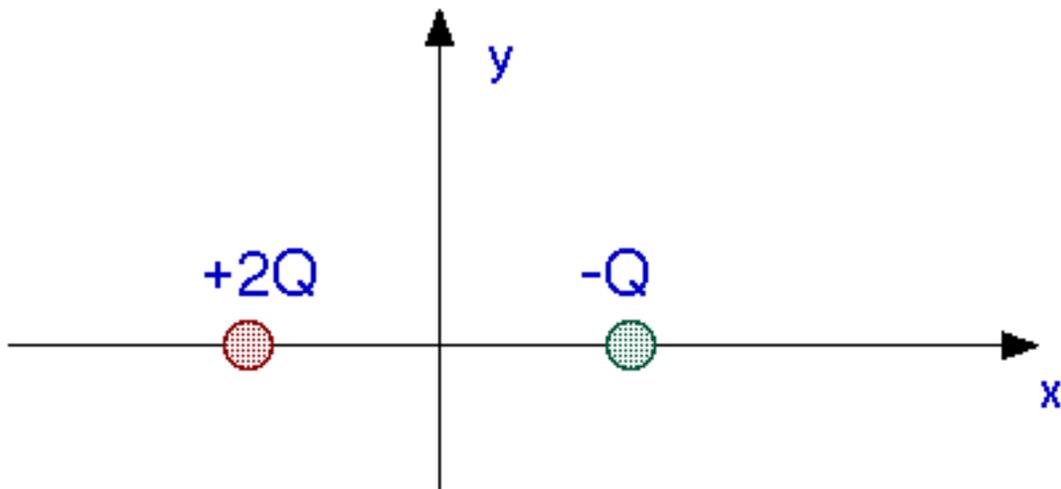
26.
For what finite values on the x-axis is the electric field zero?



- A. to the left of $+Q$
- B. between $+Q$ and
- Q
- C. to the right of $-Q$
- * D. nowhere

27.

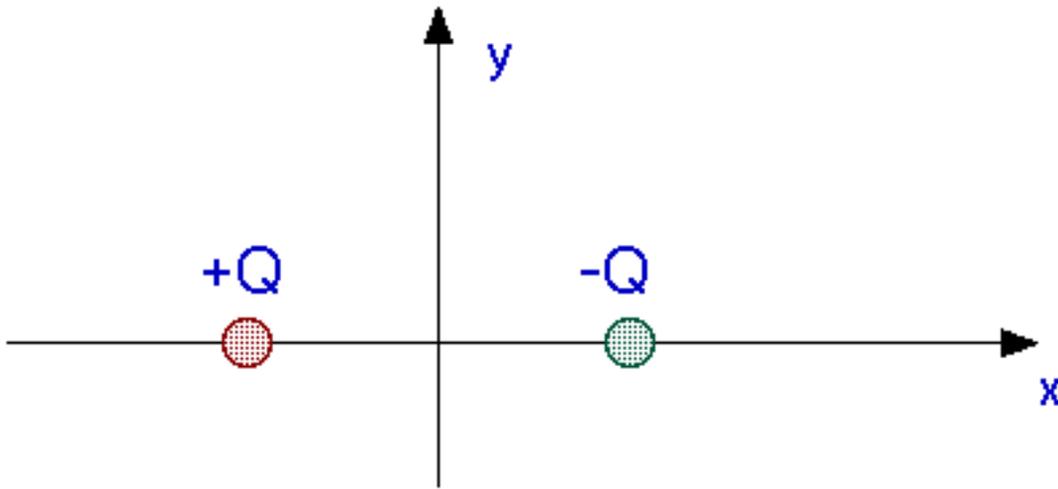
For what finite values on the x-axis is the electric field zero?



- A. to the left of $+2Q$
- B. between $+2Q$ and
- Q
- * C. to the right of $-Q$
- D. nowhere

28.

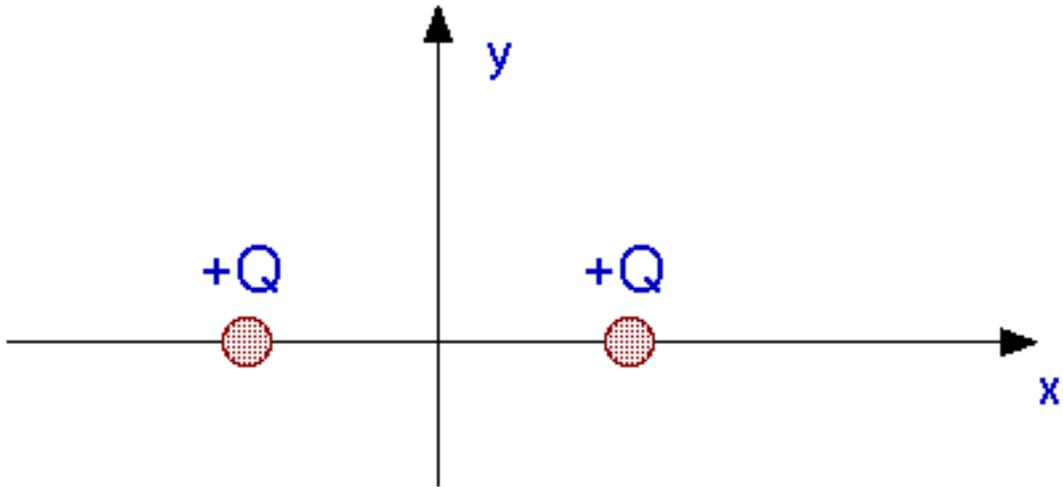
For what finite values on the y-axis is the electric field zero?



- A. positive y
- B. negative y
- C. at the origin
- * D. nowhere

29.

For what finite values on the y-axis is the electric field zero?



- A. positive y
- B. negative y
- * C. at the origin
- D. nowhere

30.

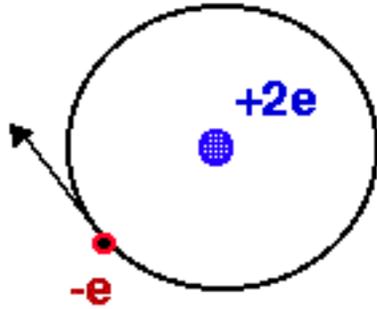
A positive charge is brought near an uncharged conductor. The conductor is then grounded for an instant while the charge is nearby. If the charge is now taken away, the conductor will:

- A. be positively charged
- * B. be negatively charged
- C. remain uncharged

31.

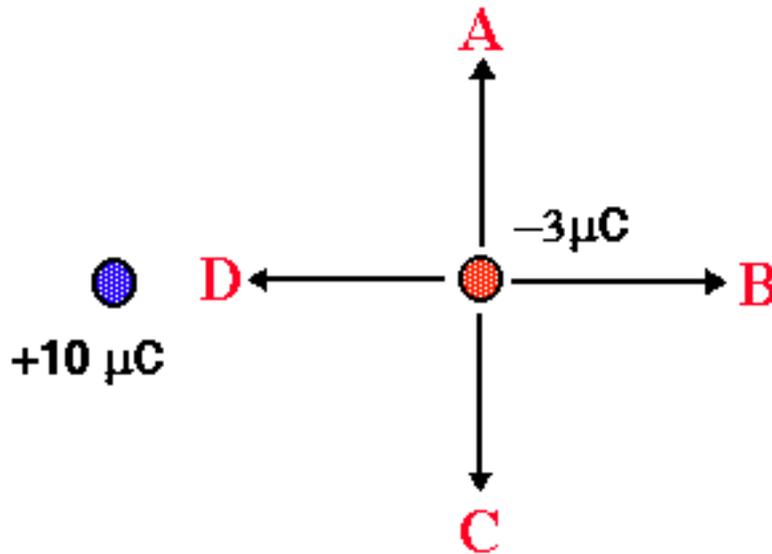
An electron orbits a helium nucleus.

Which statement is true?



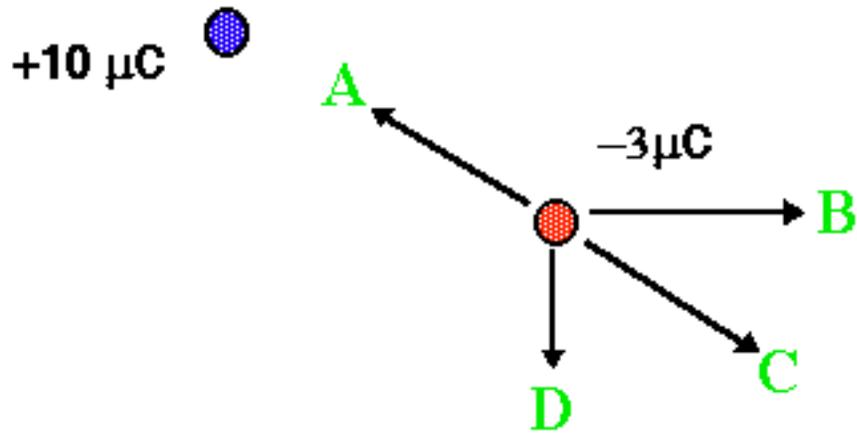
- A. The electron exerts a larger force on the nucleus than the nucleus exerts on the electron.
- B. The electron exerts a smaller force on the nucleus.
- * C. The two forces are equal in magnitude.

32. Which represents the direction of the force on the $-3 \mu\text{C}$ charge?



- A.
- B.
- C.
- * D.

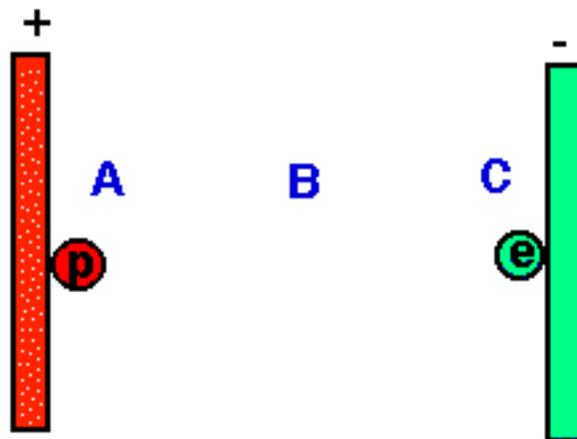
33. Which represents the electric field due to the $+10 \text{ mC}$ charge?



- A.
- B.
- * C.
- D.

34. A proton and an electron start from rest near charged parallel plates and accelerate toward the opposite plate.

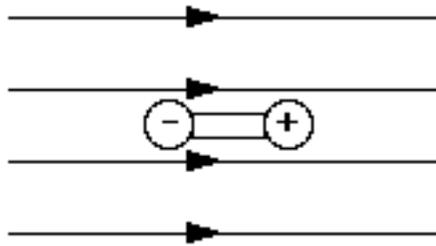
At what point do they cross each other?



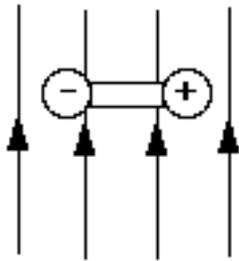
- * A.
- B.
- C.

35. In which case is there a net force on the dipole in the E field?

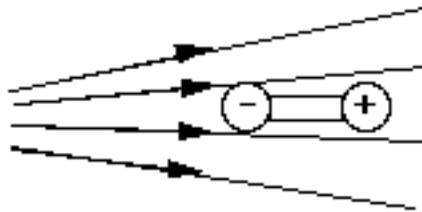
A.



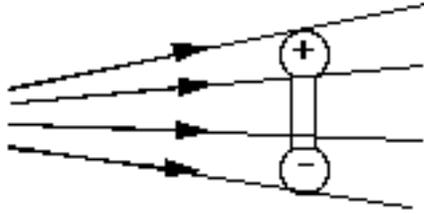
B.



* C.



D.



Neglect the slight y-force!

36.

Which of the following statements is false?

- A. Charge is a scalar quantity.
- B. There are two types of charges.
- C. Charge in bulk matter is quantized in units of e .
- D. Charge is not created in batteries.
- * E. All of these statements are true.

37. The net flux through a closed surface is zero.

Which of the following statements MUST be true?

- A. The electric field is zero everywhere on the surface.
- * B. The number of field lines entering the surface equals the number exiting it.
- C. There are no point charges inside the surface.
- D. All of these statements must be true.
- E. Any of these statements can be false.