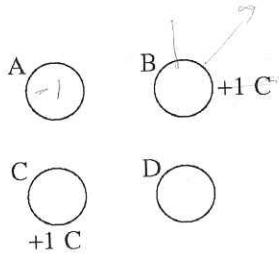


Four charges—A, B, C, and D— are at the corners of a square. Charges A and D, on opposite corners, have equal charge, whereas both B and C have a charge of 1.0 C. If the force on B is zero, what is the charge on A?

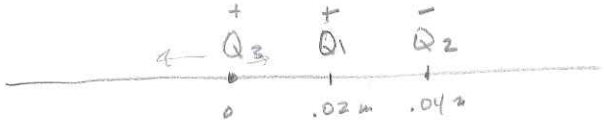
a. –1.0 C b. –0.20 C c. –0.35 C d. –0.71 C

29. b Two charges are located on the positive x-axis of a coordinate system. Charge $q_1 = 2.00 \times 10^{-9}$C, and it is 0.02 m from the origin. Charge $q_2 = -3.00 \times 10^{-9}$C, and it is 0.04 m from the origin. What is the electric force exerted by these two charges on a third charge, $q_3 = 5.00 \times 10^{-9}$, located at the origin?

a. 2.2×10^{-4} N b. 1.4×10^{-4} N c. 3.1×10^{-4} N d. 8.4×10^{-4} N

$F_{1\to3} = k\frac{(2\times10^{-9}C)(5\times10^{-9})}{(.02m)^2} = 2.75\times10^{-4}N$ Left

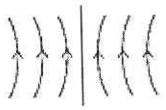
$F_{2\to3} = k\frac{(3\times10^{-9})(5\times10^{-9})}{(.04m)^2} = 8.43\times10^{-5}N$ Right



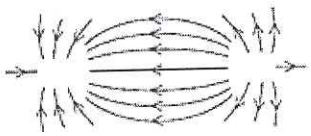
30. Which **one** of the field patterns below could be produced by two point charges?

A.

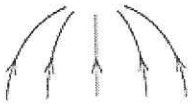
B.



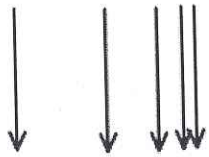
C.



D.



31. The distribution of electric field lines in a certain region of space varies as shown in the figure.

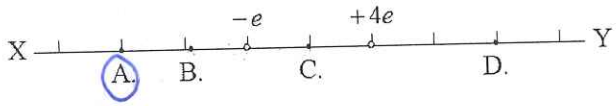


The magnitude of the electric field in this region

A. increases to the right.
B. decreases to the right.
C. increases in the downward direction.
D. decreases in the downward direction.

32. Two charges of $-e$ and $+4e$ are fixed at the positions shown below. At which position along the line XY is the electric field due to these charges equal to zero?

$E = \frac{kQ}{r^2}$



33. The diagram below shows two stationary point charges $+2Q$ and $-Q$.

At which point is the electric field strength greatest?

A. A (B. B) C. C D. D

34. A point charge of 25 μC experiences a force of 1.0×10^{-4} N. Calculate the electric field strength producing this force.

$E = \frac{F}{q} = \frac{1.0 \times 10^{-4} N}{25 \times 10^{-6} C} = 4.0 \frac{N}{C}$ in same direction of the force

35. Calculate the electric field strength 1.5 cm from a point charge of 1.00×10^2 pC in a vacuum.

$E = \frac{kq}{r^2} = \frac{(8.99 \times 10^9)(1.00 \times 10^{-12})}{(.015 m)^2} = 40.0 \frac{N}{C}$

37. If an object is given a positive charge, does its mass increase, decrease, or stay the same? Explain.

e⁻ are moved off of object

38. If an object is given a negative charge, does its mass increase, decrease, or stay the same? Explain.

e⁻ transferred onto object

39. Explain why a comb that has been rubbed through your hair attracts small bits of paper, even though the paper is uncharged.

40. Small bits of paper are attracted to an electrically charged comb, but as soon as they touch the comb they are strongly repel led. Explain this behavior.

Bits of paper become polarized. The side closest to comb have opposite charge ⇒ attracted

41. Explain what happens when you vigorously rub your wool socks on a carpeted floor, touch a metal doorknob, and get a shock.

Socks (and person) lose e⁻ to the carpet
e⁻ are transferred to doorknob (shock!)

42. A charged rod is brought near a suspended object, which is repelled by the rod. Can we conclude that the suspended object is charged? Explain.

YES. Polarization of rod would cause an attraction
Repulsion means that rod and object have same charge.

52. What is the difference between an insulator and a conductor? Which would you guess copper is? Wood? Distilled water?

53. A 2-C charge experiences a force of 20 N when put at a certain location in space. The electric field at that location is

$$E = \frac{F}{q} = \frac{20N}{2C} = 10\frac{N}{C}$$

54. The electric field in a certain region of space is 40 N/C. What is the force on a 10-C charge placed in that region?

$$F = Eq = 40\frac{N}{C} \cdot 10C = 400\,N$$

55. The electrical force on a 2-C charge is 60 N. What is the value of the electric field at the location of the charge?

$$E = \frac{F}{q} = \frac{60N}{2C} = 30\frac{N}{C}$$

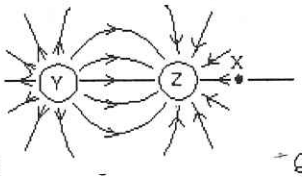
56. 10,000 electrons are removed from a neutral plastic ball. What is its charge?

$$10{,}000\,e^- \times \frac{1.60\times10^{-19}C}{e} = 1.60\times10^{-15}C$$

57. What is the magnitude of the force of an electron in an electric field of 300 N/C?

$$F = Eq = \left(300\frac{N}{C}\right)(1.60\times10^{-19}C) = 4.8\times10^{-17}N$$

58. The diagram shows the electric field lines in a region of space containing two small charged spheres (Y and Z). Then:



a. Y is negative and Z is positive
b. the magnitude of the electric field is the same everywhere
c. the electric field is strongest midway between Y and Z
d. a small negatively charged body placed at X would be pushed to the right
e. Y and Z must have the same sign

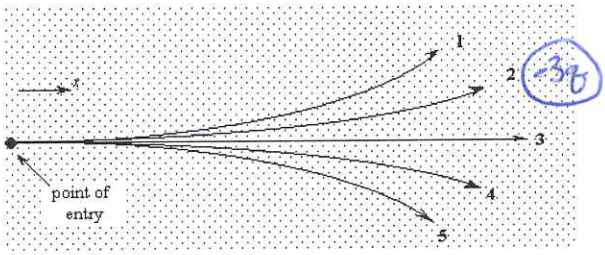
59. The diagram shows a positive charge Q and a negative charge $-Q$ with the
The electric field at point P on the perpendicular bisector of the line joining them is:

a. ↑ b. ↓ c. → d. ← e. zero

60. An electron traveling north enters a region where the electric field is uniform and points north. The electron:

a. speeds up
b. slows down
c. veers east
d. veers west
e. continues with the same speed in the same direction

61. Five particles are shot from the left into a region that



contains a uniform electric field. The numbered lines show the paths taken by the five particles.
A negatively charged particle with a charge -3*Q* follows path **2** while it moves through this field.

Which path would be followed by a helium atom (an electrically neutral particle)?
A) path 5 B) path 2 C) path 3 D) path 1 E) path 4

In which direction does the electric field point?
A) toward the left of the page
B) toward the right of the page
C) out of the page, toward the reader
D) toward the bottom of the page
E) toward the top of the page

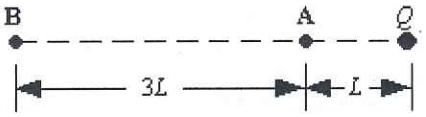
Which path would be followed by a charge +6Q?
a. path 5 b. path 2 c. path 1 d. path 4 e. path 3

62. An isolated point charge produces an electric field with magnitude *E* at a point 2 m away from the charge. A point at which the field magnitude is *E*/4 is:
a. 1 m away from the charge
b. 0.5 m away from the charge
c. 2 m away from the charge
d. 4 m away from the charge
e. 8 m away from the charge

$E = \frac{kq}{r^2}$

63. An isolated point charge produces an electric field with magnitude *E* at a point 2 m away. At a point 1 m from the charge the magnitude of the field is:
a. *E*
b. 2*E*
c. 4*E*
d. *E*/2
e. *E*/4

64. In the figure, point **A** is a distance *L* away from a point charge *Q*. Point **B** is a distance 4*L* away from *Q*. What is the ratio of the electric field at **B** to that at **A**, *E***B**/*E***A**?



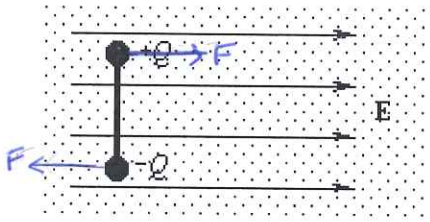
$E_A = \frac{kQ}{L^2}$ $E_B = \frac{kQ}{(4L)^2}$ $\frac{1}{16}$

a. 1/9
b. 1/3
c. This cannot be determined since neither the value of *Q* nor the length *L* is specified.
d. ¼
e. 1/16

65. What is the magnitude and direction of the electric force on a –1.2 μC charge at a point where the electric field is 2500 N/C and is directed along the +*y* axis.
a. 0.0030 N, +*y* direction
b. 0.15 N, +*y* direction
c. 0.15 N, –*y* direction
d. 4.3 N, +*x* direction
e. 0.0030 N, –*y* direction

$E = \frac{F}{q}$ = $F = qE = (1.2\times10^{-6}\,C)(2500\,\frac{N}{C}) = .003\,N$

66. A electric dipole is released from rest in a uniform electric field with the orientation shown. Which entry in the table bel ow correctly describes the rotation and the net force on the dipole?



	rotation	*net force*
a.	clockwise	non-zero
b.	zero	zero
c.	counterclockwise	non-zero
d.	counterclockwise	zero
e.	clockwise	zero

67. At which point (or points) is the electric field zero N/C for the two point charges shown on the *x* axis?

$E_1 = \frac{kQ}{r}$ $E_2 = \frac{k4q}{r^2}$

a. The electric field is zero somewhere on the *x* axis to the right of the $-2q$ charge.
b. The electric field is zero somewhere on the *x* axis between the two charges, but this point is nearer to the $-2q$ charge.
c. The electric field is never zero in the vicinity of these charges.
d. The electric field is zero at two points along the *x* axis; one such point is to the right of the $-2q$ charge and the other is to the left of the $+4q$ charge.
e. The electric field is zero somewhere on the *x* axis to the left of the $+4q$ charge.

68. Two point charges, $q1$ and $q2$, are placed a distance *r* apart. The electric field is zero at a point P between the charges on the line segment connecting them. We conclude that:
a. $q1$ and $q2$ must have the same magnitude and sign
b. P must be midway between $q1$ and $q2$
c. $q1$ and $q2$ must have the same sign but may have different magnitudes
d. $q1$ and $q2$ must have equal magnitudes and opposite signs
e. $q1$ and $q2$ must have opposite signs and may have different magnitudes

POTENTIAL PROBLEMS 1

1. A uniform electric field with a magnitude of 500 N/C is directed parallel to the positive *x*-axis. If the potential at $x = 5$ m is 2500 V, what is the potential at $x = 2$ m? Solutions, detailed in my notes.

   a. 1000 V c. 4000 V

   b. 2000 V d. 4500 V

2. A small, positively charged object near a positively charged sphere is moved closer to the sphere. The electric potential energy of the small object

   a. increases. b. decreases. c. stays the same.