Questions

Chapter 24
Electric Potential

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24-3 Electric Potential
m2-062

Calculate the ratio of the speed of a proton to that of an electron, both accelerated through the same potential difference.

A)0.240
B)0.023
C)0.353
D)0.560
E)1.00

Answer B

24-3 Electric Potential
m2-061

An electron starts from rest at a point 10 cm from a positively charged conducting plate, with a surface charge density $\sigma = +1 \times 10^{-9}$ C/m^2. The electron is attracted to the plate until it collides with the plate. With what speed will the electron collide with plate?

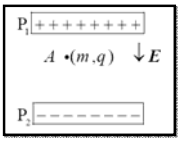
A) 2.7×10^6 m/s
B) 1.4×10^6 m/s
C) 7.1×10^5 m/s
D) 1.0×10^6 m/s
E) 2.0×10^6 m/s

Answer E

24-3 Electric Potential
m2-061

A particle, of mass and charge q, is placed at rest at point A in a uniform electric field E, as shown in the figure. If the particle is released, then the kinetic energy it attains after moving a distance y is:

A) ½ qEy
B) ½ mq$E$y
C) ½ m(qEy)^2
D) qE^2y
E) qEy



Answer E

24-3 Electric Potential
m2-042

Two oppositely charged parallel plates, 0.02 m apart, produce a uniform electric field between the plates. The potential energy U(J) of an electron in the field varies with displacement x(m) from one of the plates as shown in figure 5. What is the magnitude of the force on the electron?

A)1.5 x10^{-15} N.
B)3.0 x10^{-18} N.
C)6.0 x10^{-20} N.
D)7.5 x10^{-15} N.
E)zero.

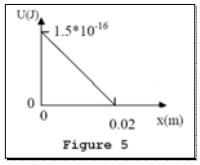


Figure 5

Answer D

24-3 Electric Potential
m2-042

Figure 6 shows three points X, Y and Z forming an equilateral triangle of side S in a uniform electric field of strength E. A unit positive test charge is moved from X to Y, then from Y to Z, and from Z back to X. Which one of the following correctly gives the work done by an external agent in moving the charge along the various parts of the path?

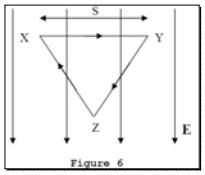


Figure 6

A) 0, -E x S x Sin(60 degrees) , + E x S x Sin(60 degrees).
B) 0, -E x S x Cos(60 degrees) , + E x S x Cos(60 degrees).
C) E x S, -E x S x Sin(60 degrees) , + E x S x Cos(60 degrees).
D) 0, -E x S x Cos(60 degrees) , + E x S x Sin(60 degrees).
E) -E x S, -E x S x tan(60 degrees) , + E x S x Sin(60 degrees).

Answer A

24-3 Electric Potential
m2-041

An electron is shot directly toward the center of a large metal plate that has excess negative charge with surface charge density 2.0 x10^{-6} C/m^2. If the initial kinetic energy of the electron is 1.6 x10^{-13}J and if the electron is to stop(owing to electrostatic repulsion from the plate) just as it reaches the plate, how far from the plate must it be shot?

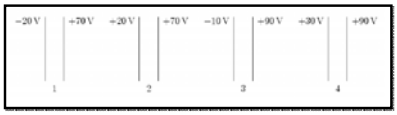
A)1.2 m.
B)4.4 m.
C)3.4 m.
D) 8.0 m.
E)22 m.

Answer B

24-4 Equipotential surfaces
m2-061

The diagram shows four pairs of, identical, large parallel conducting plates. The value of the electric potential is given for each plate. Rank the pairs according to the magnitude of the electric field between the plates, least to greatest.

A) 2, 4, 1, 3
B) 1, 2, 3, 4
C) 4, 3, 2, 1
D) 2, 3, 1, 4
E) 3, 2, 4, 1



Answer A

24-4 Equipotential surfaces
m2-041

In figure 3, two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of -6.0 V. What potential should be applied to the upper plate to create an electric field of strength 4000 V/m UPWARDS in the space between the plates?

A)10 V.
B)22 V.
C)-10 V.
D)-22 V.
E)-16 V.

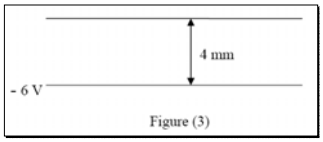


Figure (3)

Answer D

24-6 Potential Due to a Point Charge
m2-062

A particle having a charge of q = 8.0x10^{-8} C is fixed at point D. Another particle of mass 10 g and charge of 5.0 × 10^{-9} C starts from rest at point A and moves in a straight line to the right, as shown in figure (4). The speed of the particle when it reaches point B is: [Assume V = 0 at infinity.]

A) 0.08 m/s
B) 0.02 m/s
C) 0.2 m/s
D) 1.2 m/s
E) 0.04 m/s

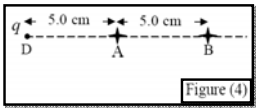


Figure (4)

Answer A

24-5 Potential Due to a Point Charge
m2-061

A point charge of 5.0 × 10^{-9} C is transferred, by an external agent, from infinity to the surface of a ball of radius 5.0 cm. If the ball has the charge density 5.0 × 10^{-4} C/m^2, then the amount of work done, by the external agent, in the process is: [Assume V = 0 at infinity.]

A) 3.0×10^{-3} J
B) 1.4×10^{-2} J
C) 7.1×10^{-5} J
D) 8.4×10^{-3} J
E) 7.0×10^{2} J

Answer B

24-6 Potential Due to a Point Charge
m2-041

In figure 4, the point charge Q1 causes an electric potential of 60 V and an electric field strength of 30 V/m at P, and the point charge Q2, separately, causes an electric potential of 120 V and electric field strength of 40 V/m at P. Which of the following gives possible values of potential and field strength at P due to the joint action of Q1 and Q2?

A)180 V, 50 V/m.
B)180 V, 70 V/m.
C)135 V, 50 V/m.
D)-600 V, 10 V/m.
E)135 V, 70 V/m.

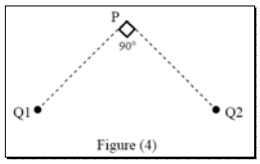


Figure (4)

Answer A

24-10 Calculating the field from the potential
m2-042

Over a certain region of space, the electric potential is give by:

$$V(x,y) = x^2 + y^2 + 2xy.$$

Find the angle that the electric field vector makes with Z-axis at the point P(1,2,0)

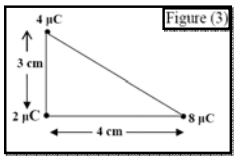
A)0 degrees.
B)45 degrees.
C)60 degrees.
D)75 degrees.
E)90 degrees.

Answer E

24-11 Electric Potential Energy of a System of Point Charges
m2-062

Figure (3) shows three charges located at the corners of a triangle. How much energy would be needed to remove the 4 μC charge to infinity? [Assume V = 0 at infinity.]

A) 3.4 J
B) 8.2 J
C) zero
D) 1.4 J
E) 5.6 J



Answer B

24-11 Electric Potential Energy of a System of Point Charges
m2-062

Three concentric spherical shells A, B and C, of radii a, b and c (a<b<c), have charges q, -q and q respectively. The potential of C is:

A)$V_C = k\,[(q/a)-(q/b)+(q/c)]$
B)$V_C = k\,[(q/a)+(q/b)-(q/c)]$
C)$V_C = k\,[(q/a)+(q/b)+(q/c)]$
D)$V_C = k\,[-(q/a)+(q/b)+(q/c)]$
E)$V_C = k\,q/c$

Answer E

24-11 Electric Potential Energy of a System of Point Charges
m2-042

A point charge Q, at the center of a circle, is surrounded by six charges each of magnitude q at a distance r as shown in figure 4. How much work is done by an external agent to remove the charge Q from the center to infinity? [Consider the electrostatic potential at infinity = 0]

A)k x 6 x q/r^2.
B) k x 6 x Q x q/r^2.
C)k x 6 x q/r.
D)zero.
E)k x 3 x Q x q/r.

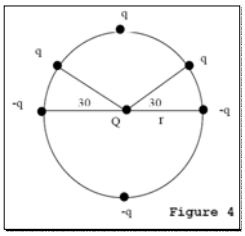


Figure 4

Answer D

24-11 Electric Potential Energy of a System of Point Charges
m2-042

Two protons, P, are fixed 6.0 m apart, as shown in figure 7. An electron, e, is released from point A. Find its speed at point O, midway between the protons.

A)11.6 m/s.
B)24.0 m/s.
C)121 m/s.
D)2.4 m/s.
E)0.1 m/s.

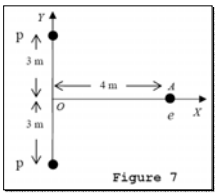


Figure 7

Answer A

24-11 Electric Potential Energy of a System of Point Charges
m2-041

In the xy plane, a charge q1 = 3.0 micro-C located at (3.0 cm, 0.0) and another charge q2 = -4.0 micro-C located at (0.0 cm, 4.0 cm). How much work must be done, by an external agent, to bring these charges to their fixed positions starting from infinite separation. [Consider V = 0 at infinity]

A)-2.2 J.
B)2.2 J.
C)-3.5 J.
D)3.5 J.
E)1.5 J.

Answer A

24-11 Electric Potential Energy of a System of Point Charges
m2-041

It is required 1.0 mJ of work to move two identical positive charges +q from infinite separation so that they are separated by a distance a. How much work is required to move four identical positive charges +q from infinite separation so that they are arranged at the corner of a square with edge length a? [Consider V = 0 at infinity]

A)3.5 mJ.
B)2.0 mJ.
C)5.4 mJ.
D)4.0 mJ.
E)6.5 mJ.

Answer C

24-12 Potential of a Charged Isolated Conductor
m2-062

Two charged spherical conductors having radii 4.0 cm and 6.0 cm are connected by a long conducting wire. A total charge of 20 μC is placed on this combination of two spheres. Find the charges on each sphere (smaller first).

A) 14 μC & 6.0 μC
B) 4.0 μC & 16 μC
C) 8.0 μC & 12 μC
D) 7.0 μC & 13 μC
E) 5.0 μC & 15 μC

Answer C

24-12 Potential of a Charged Isolated Conductor
m2-061

A 5-cm radius conducting sphere has a surface charge density of 2×10^{-6} C/m^2 on its surface. The electric potential, at r = 2.5 cm from the center of the sphere is: [Assume V = 0 at infinity.]

A) 3.6×10^5 V
B) 2.2×10^4 V
C) 0.5×10^4 V
D) 1.1×10^4 V
E) 7.2×10^6 V

Answer D

24-12 Potential of a Charged Isolated Conductor
m2-042

Which of the following statements are CORRECT:

(1) The electric flux through a Gaussian surface depends on the shape of the surface.

(2) The electric flux through a closed surface depends on the net charge enclosed by the surface.

(3) The electric field inside a uniformly charged solid conducting sphere in electrostatic equilibrium is zero.

(4) The electric potential inside a uniformly charged solid conducting sphere in electrostatic equilibrium is zero.

A) 2 and 3 only.
B) 1 and 2 only.
C) 1, 2, 3, and 4.
D) 3 and 4 only.
E) 4 only.

Answer A

24-12 Potential of a Charged Isolated Conductor
m2-041

If an isolated metal sphere of radius r = 10 cm has a net charge of 4.0 micro-C. What is the potential on the surface of the sphere? [Consider V = 0 at infinity]

A)-4.2 x10^6 V.
B)3.6 x10^6 V.
C)4.2 x10^5 V.
D) 3.6 x10^5 V.
E)zero.

Answer D