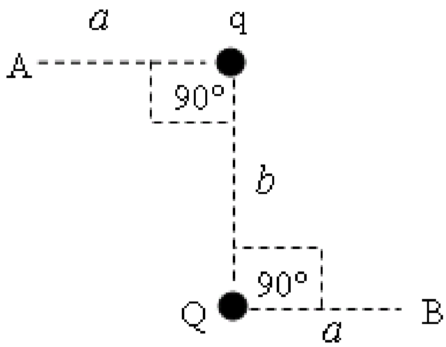
Old-Exams-Ch. 24

T081

Q10. Points A (2.0 m, 3.0 m) and B (5.0 m, 7.0 m) are located in a region where the electric field is uniform and is given by $\vec{E} = \left(4.0\hat{i} + 3.0\hat{j}\right)$ N/C. What is potential difference ($V_A - V_B$)? (Ans: 24 V)

Q11. Eight isolated identical spherical raindrops are each at a potential of 100 V at the surface, relative to the potential at infinity. They are combined together to make one spherical raindrop whose potential at the surface is: (Ans: 400 V)

Q12. Point charges q and Q are placed as shown in Fig. 4. If q = +2.0 nC and Q = –2.0 nC, a = 3.0 m, and b = 4.0 m, what is the electric potential difference (V_A-V_B)? (Ans: 4.8 V)

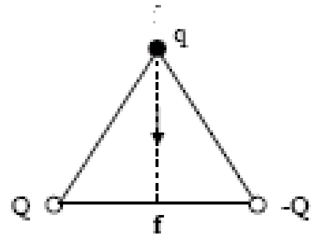


Q13.Two identical and isolated 8.0 μC point charges are positioned on the x-axis, one is at x = +1.0 m and the other is at x = – 1.0 m. They are released from rest simultaneously. What is the kinetic energy of either of the charges after it has moved 2.0 m along the x axis? (Ans: 96 mJ)

Q14. A conducting sphere 1 with radius R has a positive charge Q. Another conducting sphere 2 with radius 2 R is far from sphere 1 and initially uncharged. After the separated spheres are connected with a thin conducting wire the two spheres end up with charges q_1 and q_2. Which of the following statements is correct? (Ans: both spheres are at same) potential.

T072

Q9. In the figure 1, two particles with charges Q and −Q are fixed at the vertices of an equilateral triangle with sides of length a. The work required to move a particle with charge q from point **i** to point **f** is: (Ans: 0)



Q10. Over a certain region of space, the electric potential is give by: $V(x,y) = x^2+y^2+2xy$ where V is in volts and x and y are in meters. Find the magnitude of the electric field at the point P (1.0 , 2.0). (Ans: 8.5 N/C)

Q11. In the figure 2 , two conducting spheres, one having twice the diameter of the other, are separated by a distance large compared to their diameters. Initially, the smaller sphere (1) has charge q and the larger sphere (2) is uncharged. If the spheres are then connected by a long thin conducting wire: (Ans: 1 and 2 have the same potential)

Q12. A charge q1 = −5.0 μC and a charge q2 = 6.0μC are located at (8.0 cm, 0.0) and (0.0 cm, 6.0 cm) respectively in the xy plane. How much work was done, by an external agent, to bring these charges to their final positions starting from infinite separation.[Consider V = 0 at infinity] (Ans: – 2.7 J)

Q13. A particle, with mass = 9.0×10^{-9} kg and charge = +8 nC , has a kinetic energy of 36 μJ at point A and moves to point B where the potential is 3.0×10^{3} V greater than that at point A. What is the particle's kinetic energy at point B? (Ans: 12 μJ)

T071:

Q10. What is the external work required to bring four 3.0×10^{-9} C positive point charges from infinity and place them at the corner of a square of side 0.12 m (Ans: +3.7 μJ)

Q11. A point charge $q1 = +2.4\ \mu C$ is held stationary at the origin. A second point charge $q2 = -4.3\ \mu C$ moves from $x1 = 0.15$ m, $y1 = 0$ to a point $x2 = 0.25$ m, $y2 = 0.25$ m. How much is work done by the electric force on q2? (Ans: 0.36 J)

Q12. An electron is accelerated from a speed of 3×10^6 m/s to 8×10^6 m/s. Calculate the potential through which electron has to pass to gain this acceleration? (Ans: 157 V)

Q13. The electric potential in a certain region is described by $V(x,y,z) = 2xy - 4x^2 + 6y$. Find the magnitude of the net electric field at $x = -1$ and $y = 1$? (Ans: 11 N/C)

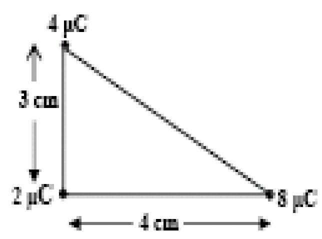
Q14. A conducting sphere with a radius of 10 cm, has a surface charge density of $4 \times 10^{-6}\ C/m^2$. The electric potential, at $r = 5$ cm from the center of the sphere is (assume V= 0 at infinity): (Ans: 4.5×10^4 V)

T062:

Q8. Calculate the ratio of the speed of a proton to that of an electron, both accelerated through the same potential difference. (Ans: 0.023)

Q10. 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). (8 μC and 12 μC)

Figure (3)



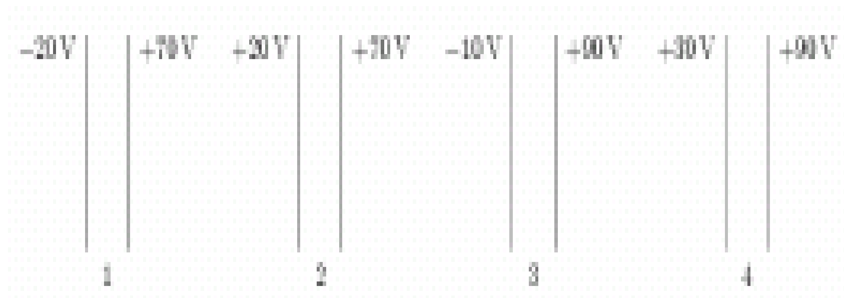
Q11. Figure 3 shows three charges located at the corners of a triangle. How much energy would be needed to remove the 4 μC charge to infinity? [Assume V = 0 at infinity.] (8.2J)

Q12. 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: Vc=kq/c:

T061:

Q10. 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.] (Ans: 1.1×10^4 V)

Q11. The diagram in Fig. 1 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.
(Ans: 2,4, 1, 3)



Q12. 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? (Ans: 2.0×10^6 m/s)

Q13. 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.] (Ans: 1.4×10^{-2} J)

T052

Q2. A particle with a charge of 5.5×10^{-8} C is fixed at the origin. How much work is done by external agent to move a charge of -2.3×10^{-8} C from point A to point B shown in figure 6. (Ans: 6.0×10^{-5} J)

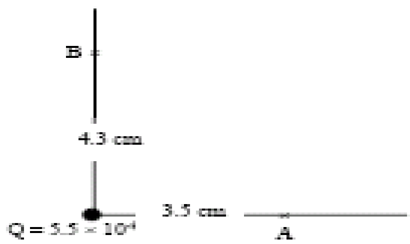


FIGURE 6

Q11. Two conducting spheres, one having twice the diameter of the other, are separated by a distance large compared to their diameters. The smaller sphere has charge q and the larger sphere is uncharged. If the spheres are connected by a long thin conducting wire: (Ans: 1 and 2 have the same potential)

Q13. Two electrons are initially far away. Each electron is moving toward the other one with a speed of 500 m/s. Find the closest distance they can get to each other. (Ans: 1.01 mm)

Q16. In a certain region of the xy plane, the electric potential is given by $V(x,y) = 2xy - 3x^2 + 5y$, where At which point is the electric field equal to zero? (Ans: –2.5, –7.5)

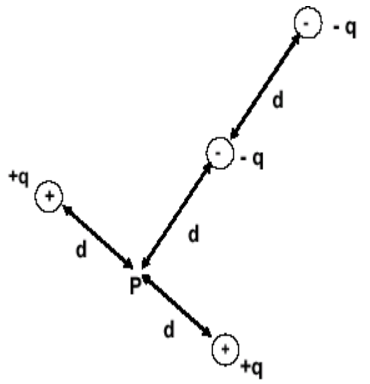
Q18. A charged solid conducting sphere has a radius = 20 cm and a potential of 400V. Calculate the electric field 40 cm from the center of the sphere, (Ans: 500 V/m)

<u>T051</u>:

Q10. A proton moves in a uniform electric field of 2.5×10^{7} N/C from point **A** to point **B** by traveling a distance of 1.5 m. Find the work done and the potential difference between point a and b.(Ans: 6×10^{-12} J; 3.75×10^{7} V.)

Q11. The electric potential at point in an XY plane is given by $V = 3X^2 - 4Y^2$ what are the magnitude and direction of the electric field at a point (4m, 2m) ? (Ans: E = 29 N/C and 146 counterclockwise from + x-axix.)

Q12. What is the net potential at point **P** due to four point charges arranged in the configuration as shown in the Figure 1. Here q = 36 nC, d = 0.5 m.) (Ans: Vp = 324 V.)



T042:

Q11. 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? (Ans: 7.5×10^{-15} N.).

Q12. 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] (Ans: zero.)

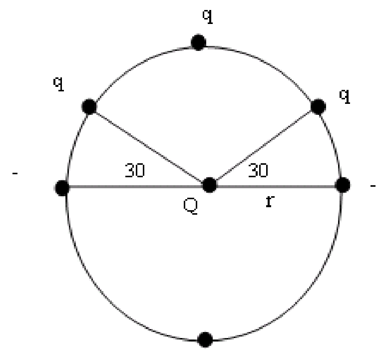


Figure 4

Q13. 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.
(Ans: 11.6 m/s.)

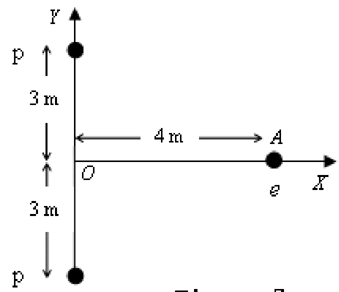


Figure 7

Q14. 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? (Ans: 0, $-ES\sin(60^0)$, $+ ES\sin(60^0)$)

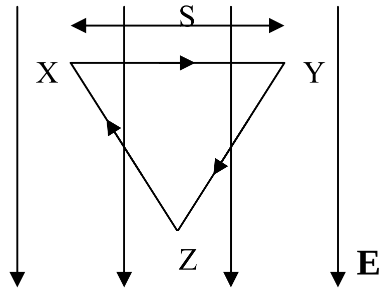


Figure 6

Q15. 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(1.0,2.0,0.0) (Ans: 90 degrees.)

T041

Q1. 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? (Ans: –22 V.)

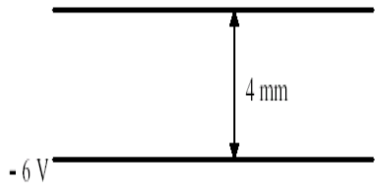


Figure (3)

Q2. 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 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? (Ans: 180 V, 50 V/m).

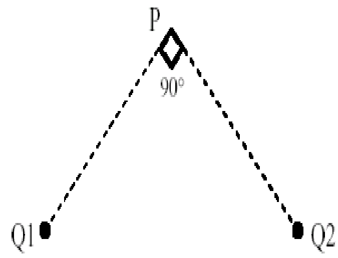


Figure (4)

Q3. In the xy plane, a charge q1 = 3.0 μC located at (3.0 cm, 0.0) and another charge q2 = –4.0 μC 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] (Ans: –2.2 J)

Q4. 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] (Ans: $3.6\text{x}10^5$ V.)

Q5. 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] (Ans: 5.4 mJ)