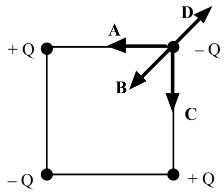
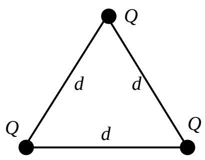
PHYS102 – Chapters 21+22 (Instructor: Dr. Al–Shukri)

Q1. Four point charges, each of the same magnitude, with varying signs are arranged at the corners of a square as shown in the **Figure**. Which of the arrows labeled **A**, **B**, **C**, and **D** gives the correct direction of the net force that acts on the charge at the upper right corner?



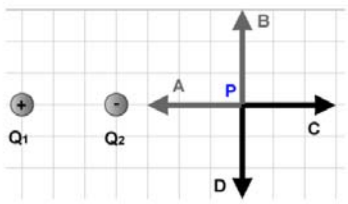
a. B b. A c. C d. D
e. The net force on that charge is zero

Q2. Three identical point charges, Q, are placed at the corners of an equilateral triangle as shown in the **Figure**. The length of each side of the triangle is d. Determine the magnitude and direction of the total electrostatic force on the charge at the top of the triangle.



a. $\frac{kQ^2\sqrt{3}}{d^2}$**, upward** b. $\frac{2kQ^2}{d^2}$, downward
c. $\frac{kQ^2\sqrt{3}}{d^2}$, downward d. $\frac{2kQ^2}{d^2}$, upward
e. Zero

Q3. Two charges Q_1 and Q_2 of equal magnitudes and opposite signs are positioned as shown in the **Figure**. Which of the shown arrows represents correctly the direction of the electric field at point P?



a. A b. B c. C d. D
e. The electric field is zero.

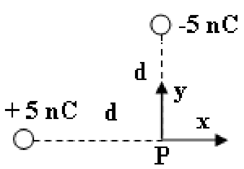
Q4. A uniform electric field has a magnitude of 2.0×10^4 N/C and points to the right. An electron is released from rest in this electric field. How far will the electron travel in two nanoseconds after its release?

a. 7.0 mm to the left b. 7.0 mm to the right
c. 14 mm to the left d. 3.5 mm to the left
e. 3.5 mm to the right

Q5. Four equal negative point charges are located at the corners of a square centered at the origin, their positions in the xy plane are (1, 1), (-1, 1), (-1, -1), (1, -1). The direction of the electric field at (1, 0) is:

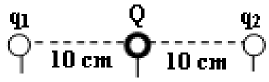
a. along the − x axis b. along the + x axis
c. along the + y axis d. along the − y axis
e. along the + z axis

Q6. Two charges are arranged as shown in the **Figure**. If d = 7.2 cm, what is the resultant electric field at point P?



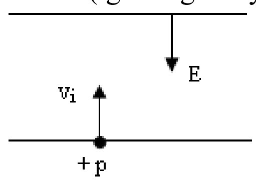
a. 1.23×10^4 N/C making an angle of 45° with + x-axis
b. 1.23×10^4 N/C making an angle of 135° with + x-axis.
c. 1.23×10^4 N/C making an angle of 225° with + x-axis.
d. 1.23×10^4 N/C making an angle of 315° with + x-axis.
e. 1.23×10^4 N/C making an angle of 0° with + x-axis.

Q7. In the **Figure**, charge Q = −3.7 nC. For what value of charge q_1 will charge q_2 be in static equilibrium?



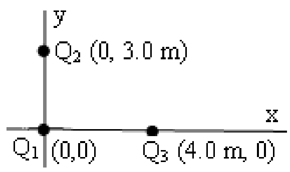
a. 15 nC b. 7.4 nC c. 10.7 nC d. 30 n e. 20 nC

Q8. In the **Figure** below, a uniform electric field E = −18 j N/C exists between two plates that are 4 cm apart. A proton is fired from the lower plate with a velocity 8×10^3 j m/s. Find the distance from that plate at which the instantaneous velocity of the proton is zero.(ignore gravity)



a. 1.9 cm b. 2.0 cm
c. 3.3 cm d. 2.5 cm
e. 4.0 cm

Q9. Three point charges Q_1, Q_2 = 20 μC and Q_3 = 50 μC are located as shown in the **Figure**. If the net force on Q_3 is in the direction of the negative y-axis, find the charge of Q_1.

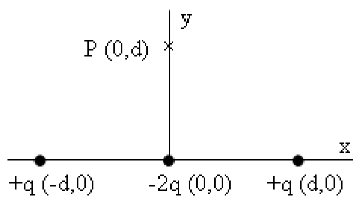


a. −10 μC b. +10 μC
c. 0 d. −7.7 μC
e. +7.7 μC

Q10. The distance between two identical conductor spheres is 0.50 m. Initially, one sphere has a charge of –8.0 μC and the other sphere has a charge of +2.0 μC. If the spheres are connected with a very thin conducting wire, what will be the electrostatic force on each sphere?

a. 0.32 N, repulsive. b. 0.32 N, attractive.
c. 0. d. 0.58 N, repulsive.
e. 0.58 N, attractive.

Q11. For the arrangement of charges shown in the **Figure**, what is the electric field at the point P? q = 1.0 μC and d = 50 cm.



a. − 47 kV/m ĵ b. + 4.7 kV/m ĵ. c. Zero.
d. − 72 kV/m ĵ. e. + 72 kV/m ĵ.

Q12. An electron is released from rest in a region of uniform electric field. The electron travels 4.0 cm in 20×10^{-9} s. What is the magnitude of the electric field?

a. 1.1 kN/C. b. 2.1 kN/C. c. 0.80 kN/C.
d. 2.0 kN/C. e. 8.0 kN/C.

Q13. Particle 1 with charge q_1, and particle 2 with charge q_2 are on the x axis, with particle 1 at x = 4.0 cm and particle 2 at x = −2.0 cm. Find the relationship between q_1 and q_2 so that the net force on a third particle of charge q located at the origin, be zero,

a. $q_2 = q_1 / 4$ b. $q_2 = 4\,q_1$ c. $q_2 = -2\,q_1$
d. $q_2 = -4\,q_1$ e. $q_2 = -q_1 / 4$

Q14. A particle with charge 2.0 μC is placed at the origin, an identical particle, with the same charge, is placed 2.0 cm from the origin on the positive x axis, and a third identical particle, with the same charge, is placed 2.0 cm from the origin on the positive y axis. The magnitude of the force on the particle at the origin is:

a. 1.3×10^2 N b. zero N c. 6.4×10^3 N
d. 1.8×10^2 N e. 3.6×10^2 N

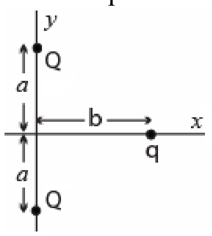
Q15. Two identical charges each of charge Q are positioned at points A (5.0 m, 0.0 m) and B(-5.0 m, 0.0 m) to produce a net electric field of $\vec{E} = \left(-10\hat{j}\right)$ N/C at point C (0.0 m, 5.0 m). Find the value of Q.

a. −39 nC b. +39 nC c. +70 nC
d. −70 nC e. −80 nC

Q16. The dipole moment of a dipole in a 300-N/C electric field is initially perpendicular to the field, but it rotates so that it becomes in the same direction as the field. If the electric dipole moment has a magnitude of 2.0 x 10^{-9} C.m, the work done by the field is:

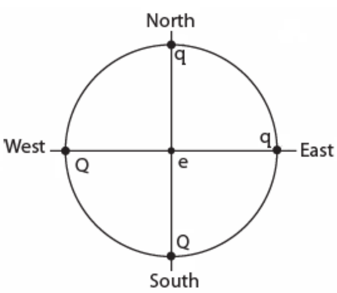
a. $+6.0\times10^{-7}$ J b. -6.0×10^{-7} J c. 0
d. -12×10^{-7} J e. $+12\times10^{-7}$ J

Q17. In the **Figure**, Q = 60 μC, q = 20 μC, a = 3.0 m, and b = 4.0 m. Calculate the total electric force on q due to the other 2 charges.



a. 0.69 $\hat{i}$ (N) b. 1.12 $\hat{j}$ (N)
c. $-0.34\hat{i}$ (N) d. $-0.69\hat{i}$ (N)
e. $0.34\hat{i}$ (N)

Q18. In the **Figure**, four positive charges are placed on the circumference of a circle of diameter 2.0 m and fixed at their positions. If an electron is placed at the center of the circle, then the electron will [Take Q = 60 μC, q = 20 μC].

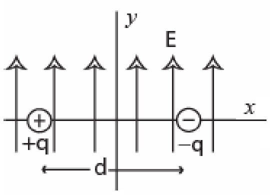


a. move South West. b. move North East.
c. move toward the West. d. move toward the South.
e. stay at the center.

Q19. A proton enters a region of uniform electric field $\vec{E}$ = 80 $\hat{j}$ N/C with an initial velocity $\vec{v}$ = $20\hat{i}$ (km/s). What is the speed of the proton 2.0 μs after entering this region?

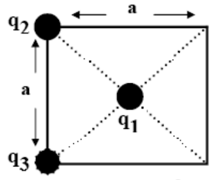
a. 25 km/s b. 15 km/s c. 42 km/s d. 35 km/s e. 4.7 km/s

Q20. An electric dipole consists of two opposite charges, each of magnitude 5.00×10^{-19} C, separated by a distance d = 1.00×10^{-9} m. The dipole is placed in a uniform electric field of strength 2.45×10^5 N/C. Calculate the torque exerted on the dipole when the dipole moment is perpendicular to the electric field as shown in the **Figure**.



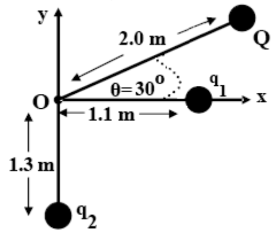
a. 1.23×10^{-22} N.m. into the page.
b. 5.20×10^{-19} N.m. out of the page.
c. 2.00×10^{-22} N.m. into the page.
d. 2.00×10^{-22} N.m. out of the page.
e. 5.20×10^{-19} N.m. into the page.

Q21. As shown in the **Figure**, a point charge q_1 = +**Q** is placed at the center of a square, and a second point charge q_2 = −**Q** is placed at the upper-left corner. It is observed that an electrostatic force of 2.0 N acts on the positive charge at the center. What is the magnitude of the force that acts on the center charge if a third charge q_3 = −**Q** is placed at the lower-left corner as shown?



a. 2.8 N b. 2.0 N
c. 4.0 N d. 5.3 N
e. 0.0 N

Q22. A point charge Q = 500 nC and two unknown point charges , q_1 and q_2 , are placed as shown in the **Figure**. The net electric field at the origin O , due to charges Q, q_1 and q_2, is equal to zero. The charges q_1 and q_2, respectively, are:



a. +131 nC, −106 nC b. +210 nC, −206 nC
c. −210 nC, + 106 nC d. +270 nC, −301 nC
e. −100 nC , + 100nC

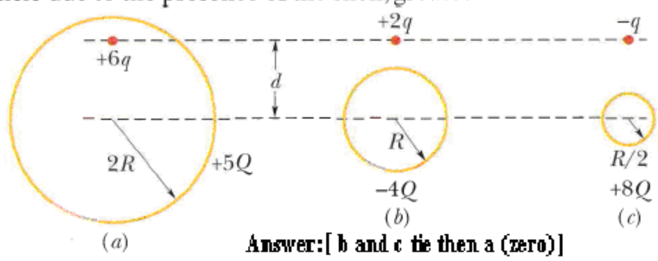
Q23. A particle (m = 20 mg, q = −5.0 μC) moves in a uniform electric field **E** = (60 N/C) **i**. At t = 0, the particle has a velocity **v** = (30 m/s) **i**. Determine the velocity of the particle at t = 4.0 s.

a. (−30 m/s) i b. (−50 m/s) **i** c. (5.0 m/s) **i**
d. (15 m/s) **i** e. (−15 m/s) **i**

Q24. An electric dipole of dipole moment **p** = (5.0×10^{-10} C.m) **i** is placed in an electric field **E** = (2.0×10^6 **i** + 2.0×10^6 **j**) N/C**.** What is magnitude of the maximum torque experienced by the dipole?

a. 1.00×10^{-3} N.m b. 1.40×10^{-3} N.m
c. 2.80×10^{-3} N.m d. 2.00×10^{-3} N.m
e. 3.00×10^{-3} N.m

Q25 The Figure shows three situations involving a charged particle and a uniformly charged spherical shell. The charges are given, and the radii of the shells are indicated. Rank the situations according to the magnitude of the force on the particle due to the presence of the shell, greatest first.



Answer:[b and c tie then a (zero)]