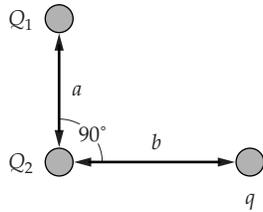


Name: \_\_\_\_\_

1. Three point charges are positioned on the  $x$  axis. If the charges and corresponding positions are  $+32 \mu\text{C}$  at  $x = 0$ ,  $+20 \mu\text{C}$  at  $x = 40 \text{ cm}$ , and  $-60 \mu\text{C}$  at  $x = 60 \text{ cm}$ , what is the magnitude of the electrostatic force on the  $+32\text{-}\mu\text{C}$  charge?

- a. 84 N
- b. 12 N
- c. 36 N
- d. 50 N
- e. 48 N

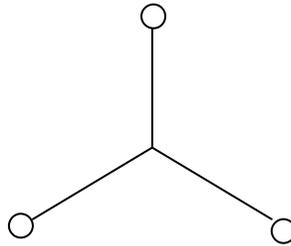
2. If  $a = 3.0 \text{ mm}$ ,  $b = 4.0 \text{ mm}$ ,  $Q_1 = 60 \text{ nC}$ ,  $Q_2 = 80 \text{ nC}$ , and  $q = 24 \text{ nC}$  in the figure, what is the magnitude of the total electric force on  $q$ ?



- a. 2.7 N
- b. 1.9 N
- c. 2.3 N
- d. 1.5 N
- e. 0.52 N

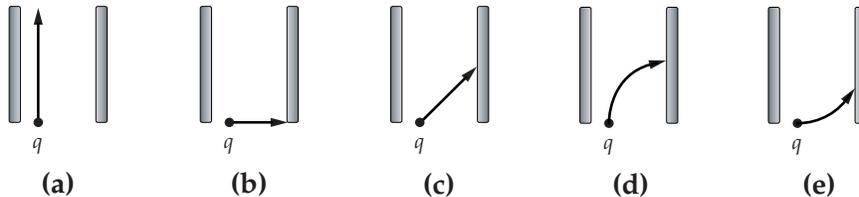
3. Three  $2.50 \mu\text{C}$  charges are placed on tiny conducting spheres at the ends of  $1.00 \text{ m}$ -long strings that are connected at  $120^\circ$  angles as shown below. The magnitude, in N, of the force on the knot at the center is

- a. 0.
- b.  $3.75 \times 10^{-2}$ .
- c.  $5.63 \times 10^{-2}$ .
- d.  $6.50 \times 10^{-2}$ .
- e.  $7.50 \times 10^{-2}$ .

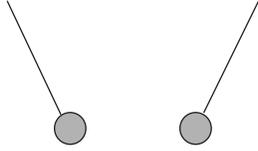


4. Two tiny metal spheres are fixed to the ends of a non-conducting string of length  $\ell$ . Equal charges,  $+q$ , are placed on the metal spheres. Randall says that the force on the string has magnitude  $\frac{1}{2\pi\epsilon_0} \frac{q^2}{\ell^2}$ . Tilden says that the tension in the string has magnitude  $\frac{1}{2\pi\epsilon_0} \frac{q^2}{\ell^2}$ . Which one, if either, is correct?
- Randall, because both charges exert forces on the string, but the tension is  $\frac{1}{4\pi\epsilon_0} \frac{q^2}{\ell^2}$ .
  - Tilden, because both charges exert forces on the string, but the net force is  $\frac{1}{4\pi\epsilon_0} \frac{q^2}{\ell^2}$ .
  - Both are correct, because both charges exert forces on the string.
  - Neither is correct, because both the tension and the force have magnitude  $\frac{1}{4\pi\epsilon_0} \frac{q^2}{\ell^2}$ .
  - Neither is correct, because the tension is  $\frac{1}{4\pi\epsilon_0} \frac{q^2}{\ell^2}$ , but the net force is 0.

5. A positively charged particle is moving in the  $+y$ -direction when it enters a region with a uniform electric field pointing in the  $+x$ -direction. Which of the diagrams below shows its path while it is in the region where the electric field exists. The region with the field is the region between the plates bounding each figure. The field lines always point to the right. The  $x$ -direction is to the right; the  $y$ -direction is up.



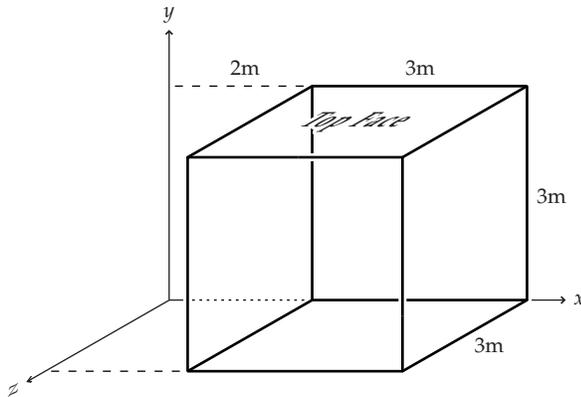
6. Two identical pith balls supported by insulating threads hang side by side and close together, as shown below.



One is positively charged; the other is neutral. We can conclude that

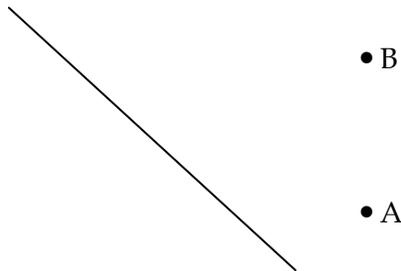
- all field lines leaving the positively charged pith ball end on the neutral pith ball.
  - some of the field lines leaving the positively charged pith ball end on the neutral pith ball.
  - none of the field lines leaving the positively charged pith ball end on the neutral pith ball.
  - positive charge is transferred along the field lines until both balls have equal charges.
  - positive charge is transferred along the field lines until both balls hang along vertical lines.
7. The velocity of a particle ( $m = 10 \text{ mg}$ ,  $q = -4.0 \mu\text{C}$ ) at  $t = 0$  is  $20 \text{ m/s}$  in the positive  $x$  direction. If the particle moves in a uniform electric field of  $20 \text{ N/C}$  in the positive  $x$  direction, what is the particle's speed at  $t = 5.0 \text{ s}$ ?
- $60 \text{ m/s}$
  - $20 \text{ m/s}$
  - $45 \text{ m/s}$
  - $40 \text{ m/s}$
  - $70 \text{ m/s}$
8. A uniform linear charge density of  $4.0 \text{ nC/m}$  is distributed along the entire  $x$  axis. Consider a spherical (radius =  $5.0 \text{ cm}$ ) surface centered on the origin. Determine the electric flux through this surface.
- $68 \text{ N} \cdot \text{m}^2/\text{C}$
  - $62 \text{ N} \cdot \text{m}^2/\text{C}$
  - $45 \text{ N} \cdot \text{m}^2/\text{C}$
  - $79 \text{ N} \cdot \text{m}^2/\text{C}$
  - $23 \text{ N} \cdot \text{m}^2/\text{C}$

9. The electric field in the region of space shown is given by  $E = (8\mathbf{i} + 2y\mathbf{j})$  N/C where  $y$  is in m. What is the magnitude of the electric flux through the top face of the cube shown?



- a.  $90 \text{ N} \cdot \text{m}^2/\text{C}$   
 b.  $6.0 \text{ N} \cdot \text{m}^2/\text{C}$   
 c.  $12 \text{ N} \cdot \text{m}^2/\text{C}$   
 d.  $54 \text{ N} \cdot \text{m}^2/\text{C}$   
 e.  $126 \text{ N} \cdot \text{m}^2/\text{C}$
10. Charge of a uniform density ( $8.0 \text{ nC}/\text{m}^2$ ) is distributed over the entire  $xy$  plane. A charge of uniform density ( $5.0 \text{ nC}/\text{m}^2$ ) is distributed over the parallel plane defined by  $z = 2.0 \text{ m}$ . Determine the magnitude of the electric field for any point with  $z = 1.0 \text{ m}$ .
- a.  $0.45 \text{ kN}/\text{C}$   
 b.  $0.17 \text{ kN}/\text{C}$   
 c.  $0.28 \text{ kN}/\text{C}$   
 d.  $0.73 \text{ kN}/\text{C}$   
 e.  $0.62 \text{ kN}/\text{C}$
11. An uncharged spherical conducting shell surrounds a charge  $-q$  at the center of the shell. Then charge  $+3q$  is placed on the outside of the shell. When static equilibrium is reached, the charges on the inner and outer surfaces of the shell are respectively
- a.  $+q, -q$ .  
 b.  $-q, +q$ .  
 c.  $+q, +2q$ .  
 d.  $+2q, +q$ .  
 e.  $+3q, 0$ .

12. A charged particle ( $q = -8.0 \text{ mC}$ ), which moves in a region where the only force acting on the particle is an electric force, is released from rest at point A. At point B the kinetic energy of the particle is equal to 4.8 J. What is the electric potential difference  $V_B - V_A$ ?
- 0.60 kV
  - +0.60 kV
  - +0.80 kV
  - 0.80 kV
  - +0.48 kV
13. An electron ( $m = 9.1 \times 10^{-31} \text{ kg}$ ,  $q = -1.6 \times 10^{-19} \text{ C}$ ) starts from rest at point A and has a speed of  $5.0 \times 10^6 \text{ m/s}$  at point B. Only electric forces act on it during this motion. Determine the electric potential difference  $V_A - V_B$ .
- 71 V
  - +71 V
  - 26 V
  - +26 V
  - 140 V
14. An infinite plane of charge with  $\sigma = +5.55 \frac{\mu\text{C}}{\text{m}^2}$  is tilted at a  $45^\circ$  angle to the vertical direction as shown below. The potential difference,  $V_B - V_A$ , in volts, between points A and B, a 4.50 m distance apart, is



- 7.06.
- 9.98.
- 14.11.
- +7.06.
- +9.98.

15. A nonconducting sphere of radius 10 cm is charged uniformly with a density of  $100 \text{ nC/m}^3$ . What is the magnitude of the potential difference between the center and a point 4.0 cm away?
- a. 12 V
  - b. 6.8 V
  - c. 3.0 V
  - d. 4.7 V
  - e. 2.2 V