

PHYS 1004  
INTRODUCTORY  
ELECTROMAGNETISM  
AND WAVE MOTION  
Term Test # 1

Name \_\_\_\_\_

Student Number \_\_\_\_\_

Monday, January 21, 2013, 8:30-11:30

Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- *Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.*
  - **DO NOT CIRCLE YOUR ANSWERS ON THIS SHEET** as it will not be graded. *Fill in the corresponding answers, as well as your name, student number and section on the scantron sheet provided which is to be submitted.*
  - *Both problems are weighted equally.*
1. Two circular disks spaced 0.80 mm apart form a parallel-plate capacitor. Transferring  $6.0 \times 10^9$  electrons from one disk to the other causes the electric field strength to be  $1.0 \times 10^5$  N/C. What are the diameters of the disks?
- a) 7.4 cm
  - b) 5.2 cm
  - c) 1.9 cm
  - d) 3.7 cm

2. Two 1.0-cm-diameter insulating spheres have a 5.0 cm space between them. One sphere is charged to +20 nC, the other to -30 nC. What is the electric field strength at the midpoint between the two spheres?

a)  $E = 1.4 \times 10^5 \text{ N/C}$

b)  $E = 5.0 \times 10^5 \text{ N/C}$

c)  $E = 1.0 \times 10^5 \text{ N/C}$

d)  $E = 7.2 \times 10^5 \text{ N/C}$

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Monday, January 21, 2013, 11:30-14:30

Tutorial Section (if not this one): \_\_\_\_\_

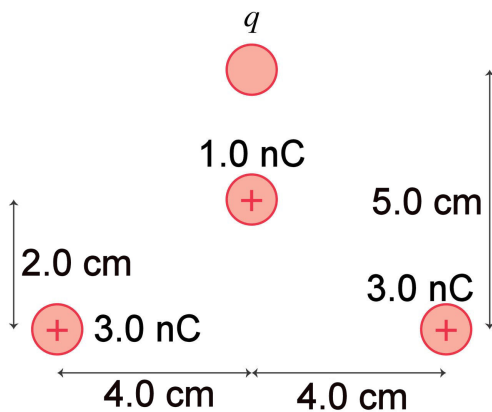
Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
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- Both problems are weighted equally.

1. The net force on the 1.0 nC charge in the FIGURE is zero. What is  $q$ ?



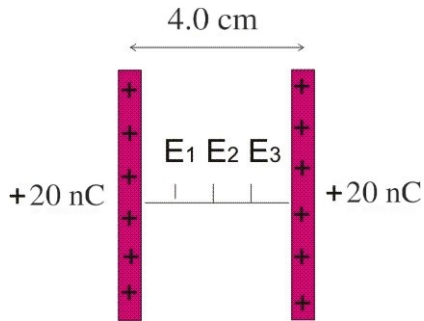
a)  $q = +1.2 \text{ nC}$

b)  $q = -0.60 \text{ nC}$

c)  $q = +2.7 \text{ nC}$

d)  $q = -2.4 \text{ nC}$

2. Two 10-cm-long thin glass rods uniformly charged to +20 nC are placed vertically side by side, 4.0 cm apart, as shown in the figure below. What are the electric field strengths  $E_1$ ,  $E_2$  and  $E_3$  at distances 1.0 cm, 2.0 cm, and 3.0 cm, respectively, to the right of the rod on the left along the line ( $x$ -axis) connecting the midpoints of the two rods?



- a)  $E_1 = E_2 = E_3 = 2.5 \times 10^5 \text{ N/C}$   
b)  $E_1 = 3.5 \times 10^5 \text{ N/C}$ ,  $E_2 = 1.7 \times 10^5 \text{ N/C}$ ,  $E_3 = 1.0 \times 10^5 \text{ N/C}$   
**c)  $E_1 = E_3 = 2.5 \times 10^5 \text{ N/C}$ ,  $E_2 = 0$**   
d)  $E_1 = E_3 = 1.3 \times 10^5 \text{ N/C}$ ,  $E_2 = 0$

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Name \_\_\_\_\_

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Monday, January 21, 2013, 14:30-17:30

Tutorial Section (if not this one): \_\_\_\_\_

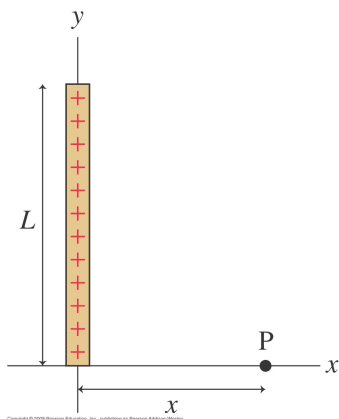
Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

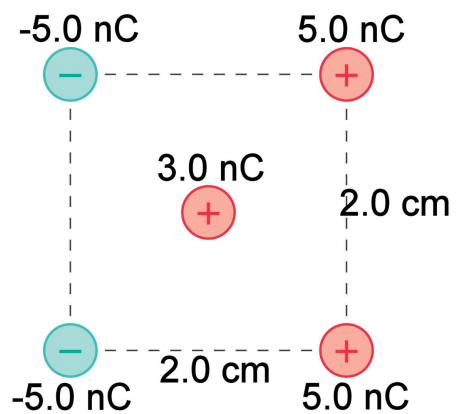
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- Both problems are weighted equally.

1. The figure below shows a thin rod of length  $L$  with total charge  $Q$ . Which of the following expressions describe the electric field  $\vec{E}$  at point P?



- a)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0 x^2} \hat{i}$
- b)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0} \left[ \frac{1}{x\sqrt{x^2+L^2}} \hat{i} - \frac{1}{L\sqrt{x^2+L^2}} \hat{j} \right]$
- c)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0} \left[ \frac{1}{x\sqrt{x^2+L^2}} \hat{i} - \frac{1}{Lx} \left( 1 - \frac{x}{\sqrt{x^2+L^2}} \right) \hat{j} \right]$
- d)  $\vec{E}(\text{P}) = \frac{Q}{2\pi\epsilon_0} \frac{1}{x\sqrt{x^2+L^2}} \hat{i}$

2. What is the force  $\vec{F}$  on the 3.0 nC charge in the middle of the FIGURE due to the four other charges? Give your answer in component form.



- a)  $\vec{F} = +4.8 \times 10^{-4} \hat{j} \text{ N}$   
b)  $\vec{F} = -4.8 \times 10^{-4} \hat{i} \text{ N}$   
c)  $\vec{F} = -1.9 \times 10^{-3} \hat{i} \text{ N}$   
d)  $\vec{F} = +1.9 \times 10^{-3} \hat{i} \text{ N}$

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Name \_\_\_\_\_

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Monday, January 21, 2013, 18:00-21:00

Tutorial Section (if not this one): \_\_\_\_\_

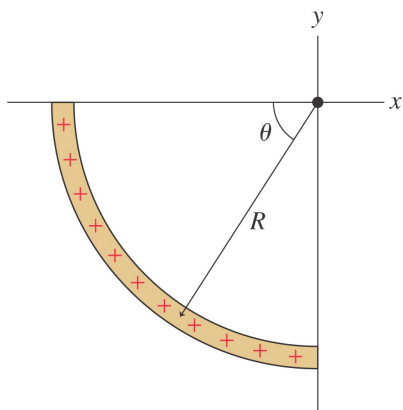
Duration: 30 minutes

Allowed aids: Calculator, Ruler

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- *Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.*
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  - *Both problems are weighted equally.*
1. Two 10-cm-diameter charged disks face each other, 40 cm apart. The left disk is charged to  $-20$  nC and the right disk is charged to  $+20$  nC. What are the electric field  $\vec{E}$  at the midpoint between the two disks, and the force  $\vec{F}$  on a  $-2.0$  nC charge placed at the midpoint between the two disks?
- a)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, left}), \vec{F} = (1.7 \times 10^{-5} \text{ N, left})$
  - b)  $\vec{E} = (7.6 \times 10^4 \text{ N/C, left}), \vec{F} = (7.6 \times 10^{-5} \text{ N, right})$
  - c)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, left}), \vec{F} = (1.7 \times 10^{-5} \text{ N, right})$
  - d)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, right}), \vec{F} = (1.7 \times 10^{-5} \text{ N, left})$

2. A plastic rod with linear charge density  $\lambda$  is bent into the quarter circle shown in the figure below. Which of the following expressions describe the electric field  $\vec{E}_{net}$ , at the origin?



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a)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{R} (\hat{i} + \hat{j})$

b)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{4R} (\hat{i} + \hat{j})$

c)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{R} \hat{i}$

d)  $\vec{E}_{net} = 0$

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Name \_\_\_\_\_

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Tuesday, January 22, 2013, 8:30-11:30

Tutorial Section (if not this one): \_\_\_\_\_

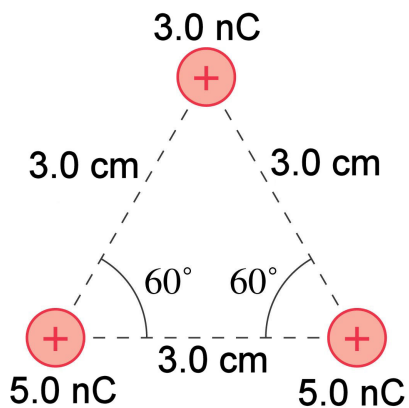
Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- *Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.*
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  - *Both problems are weighted equally.*
1. The permanent electric dipole moment of the water molecule ( $\text{H}_2\text{O}$ ) is  $6.2 \times 10^{-30}$  C m. What is the maximum possible torque on a water molecule in a  $2.0 \times 10^8$  N/C electric field?
- a)  $1.2 \times 10^{-21}$  N m
  - b)  $3.1 \times 10^{-21}$  N m
  - c)  $8.8 \times 10^{-22}$  N m
  - d)  $2.2 \times 10^{-21}$  N m

2. What is the force  $\vec{F}$  on the 3.0 nC charge in the FIGURE? Give your answer as a magnitude and a direction.



- a)  $\vec{F}_{total} = 2.6 \times 10^{-4}$  N upwards (+y axis).
- b)  $\vec{F}_{total} = 1.5 \times 10^{-4}$  N upwards (+y axis).
- c)  $\vec{F}_{total} = 1.3 \times 10^{-4}$  N at an angle of 60° ccw from the positive  $x$ -axis.
- d)  $\vec{F}_{total} = 1.3 \times 10^{-4}$  N at an angle of 120° ccw from the positive  $x$ -axis.

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Tuesday, January 22, 2013, 11:30-14:30

Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- *Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.*
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1. You have a lightweight spring whose unstretched length is 4.0 cm. First, you attach one end of the spring to the ceiling and hang a 5.0 g mass from it. This stretches the spring to a length of 6.5 cm. You then attach two small plastic beads to the opposite ends of the spring, lay the spring on a frictionless table, and give each plastic bead the same charge. This stretches the spring to a length of 5 cm. What is the magnitude of the charge (in nC) on each bead?
- a)  $Q = 46 \text{ nC}$
  - b)  $Q = 37 \text{ nC}$
  - c)  $Q = 130 \text{ nC}$
  - d)  $Q = 74 \text{ nC}$

2. Two circular disks spaced 0.80 mm apart form a parallel-plate capacitor. Transferring  $6.0 \times 10^9$  electrons from one disk to the other causes the electric field strength to be  $1.0 \times 10^5$  N/C. What are the diameters of the disks?
- a) 7.4 cm
  - b) 5.2 cm
  - c) 1.9 cm
  - d) 3.7 cm

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Tuesday, January 22, 2013, 14:30-17:30

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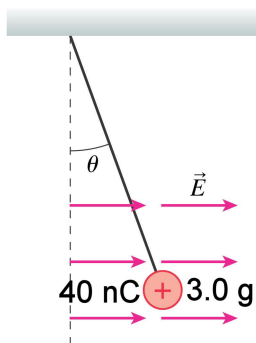
Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

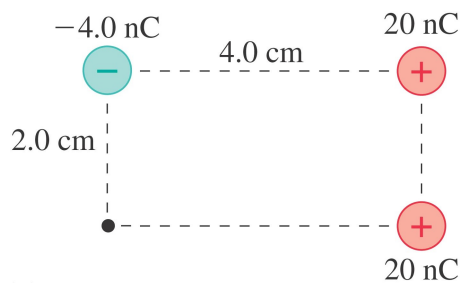
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1. An electric field  $\vec{E} = 350,000 \hat{i}$  N/C causes the point charge in the FIGURE to hang at an angle. What is  $\theta$ ?



- a)  $\theta = 64^\circ$   
b)  $\theta = 25^\circ$   
c)  $\theta = 78^\circ$   
d)  $\theta = 45^\circ$

2. What are the strength and direction of the electric field, in component form, at the position indicated by the dot in the figure below?



a)  $\vec{E} = (-1.1 \hat{i} + 0.90 \hat{j}) \times 10^5 \text{ N/C}$

b)  $\vec{E} = (-1.9 \hat{i} + 0.50 \hat{j}) \times 10^5 \text{ N/C}$

c)  $\vec{E} = (-8.0 \hat{i} + 4.0 \hat{j}) \times 10^4 \text{ N/C}$

d)  $\vec{E} = (-1.9 \hat{i} - 1.3 \hat{j}) \times 10^5 \text{ N/C}$

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Tuesday, January 22, 2013, 18:00-21:00

Tutorial Section (if not this one): \_\_\_\_\_

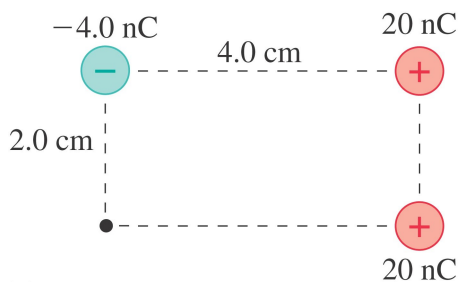
Duration: 30 minutes

Allowed aids: Calculator, Ruler

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- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
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1. What are the strength and direction of the electric field, in component form, at the position indicated by the dot in the figure below?



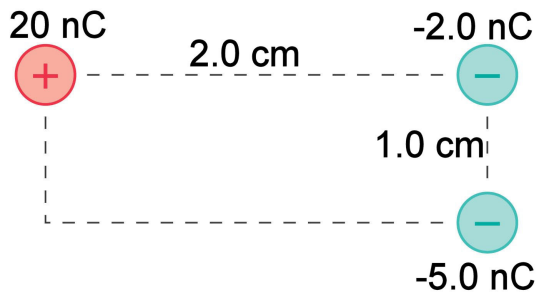
a)  $\vec{E} = (-1.1 \hat{i} + 0.90 \hat{j}) \times 10^5 \text{ N/C}$

b)  $\vec{E} = (-1.9 \hat{i} + 0.50 \hat{j}) \times 10^5 \text{ N/C}$

c)  $\vec{E} = (-8.0 \hat{i} + 4.0 \hat{j}) \times 10^4 \text{ N/C}$

d)  $\vec{E} = (-1.9 \hat{i} - 1.3 \hat{j}) \times 10^5 \text{ N/C}$

2. What is the force  $\vec{F}$  on the  $-5\text{ nC}$  charge in the FIGURE? Give your answer as a magnitude and an angle measured cw or ccw (specify which) from the  $+x$ -axis.



- a)  $F = 1.6 \times 10^{-3}\text{ N}$  at an angle of  $3^\circ$  ccw from the  $+x$ -axis.
- b)  $F = 1.6 \times 10^{-3}\text{ N}$  at an angle of  $183^\circ$  ccw from the  $+x$ -axis.
- c)  $F = 2.3 \times 10^{-3}\text{ N}$  at an angle of  $137^\circ$  ccw from the  $+x$ -axis.
- d)  $F = 2.3 \times 10^{-3}\text{ N}$  at an angle of  $43^\circ$  cw from the  $+x$ -axis.

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Wednesday, January 23, 2013, 8:30-11:30

Tutorial Section (if not this one): \_\_\_\_\_

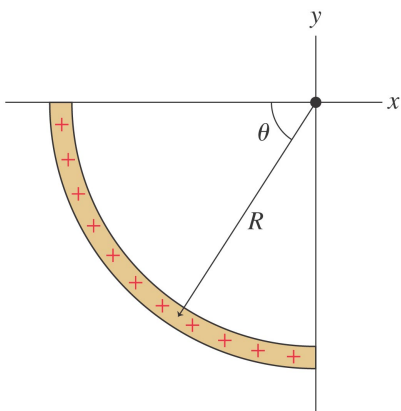
Duration: 30 minutes

Allowed aids: Calculator, Ruler

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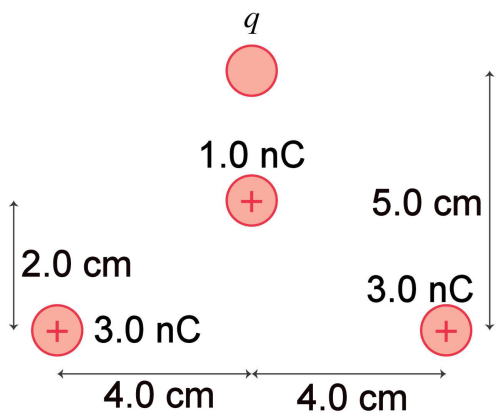
1. A plastic rod with linear charge density  $\lambda$  is bent into the quarter circle shown in the figure below. Which of the following expressions describe the electric field  $\vec{E}_{net}$ , at the origin?



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- a)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{R} (\hat{i} + \hat{j})$
- b)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{4R} (\hat{i} + \hat{j})$
- c)  $\vec{E}_{net} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{R} \hat{i}$
- d)  $\vec{E}_{net} = 0$

2. The net force on the 1.0 nC charge in the FIGURE is zero. What is  $q$ ?



- a)  $q = +1.2 \text{ nC}$   
b)  $q = -0.60 \text{ nC}$   
c)  $q = +2.7 \text{ nC}$   
d)  $q = -2.4 \text{ nC}$

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Wednesday, January 23, 2013, 14:30-17:30

Tutorial Section (if not this one): \_\_\_\_\_

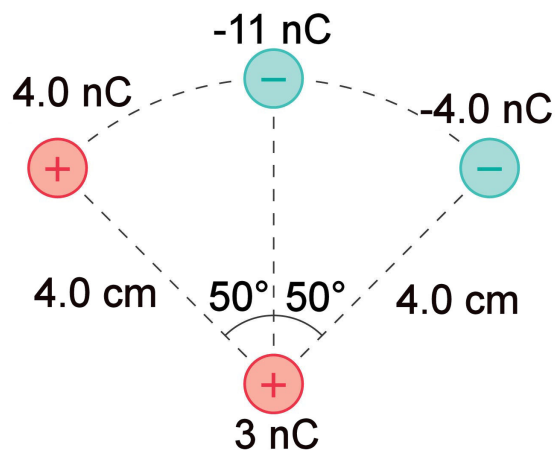
Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

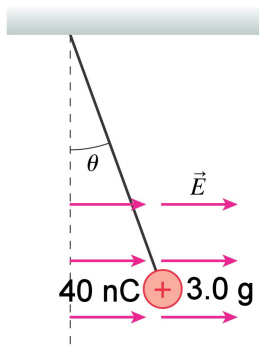
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- Both problems are weighted equally.

1. What is the force  $\vec{F}$  on the 3.0 nC charge at the bottom in the FIGURE? Give your answer in component form.



- a)  $\vec{F} = (0.87 \hat{i} - 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- b)  $\vec{F} = (0.87 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- c)  $\vec{F} = (0.52 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- d)  $\vec{F} = (1.0 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$

2. An electric field  $\vec{E} = 350,000 \hat{i}$  N/C causes the point charge in the FIGURE to hang at an angle. What is  $\theta$ ?



- a)  $\theta = 64^\circ$   
b)  $\theta = 25^\circ$   
c)  $\theta = 78^\circ$   
d)  $\theta = 45^\circ$

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Wednesday, January 23, 2013, 18:00-21:00

Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
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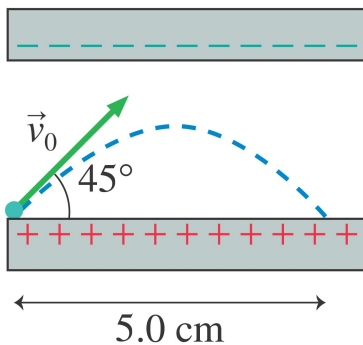
1. An electron is launched at a  $45^\circ$  angle and a speed of  $v_0 = 2.0 \times 10^6$  m/s from the positive plate of the parallel-plate capacitor shown in the figure below. The electron lands 5.0 cm away. What is the electric field strength inside the capacitor and what is the smallest possible spacing between the plates?

*Hint: For projectile motion under the force of gravity (represented here by the acceleration due to gravity,  $g$ ):*

$$\text{Range} = |v_0| \cos \theta \times 2 |v_0| \sin \theta / g$$

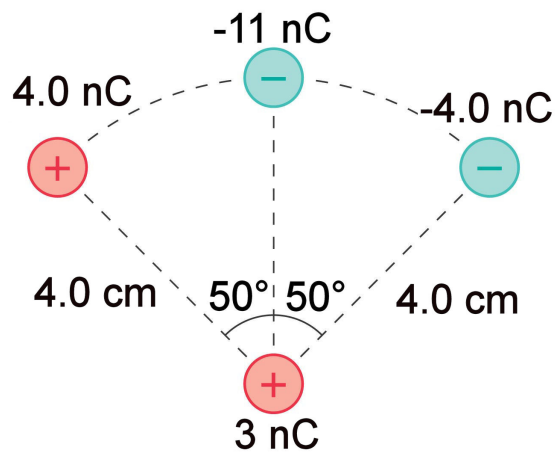
$$\text{Height} = (\text{vertical velocity})^2 / 2g = (|v_0| \sin \theta)^2 / 2g$$

*Note to change to the electrostatic calculation, replace  $g$  with the acceleration due to an electric field  $E$  acting on an object with mass  $m$  and electric charge  $e$ .*



- a)  $E = 3600$  N/C,  $d_{min} = 1.0$  cm
- b)  $E = 910$  N/C,  $d_{min} = 2.4$  cm
- c)  $E = 230$  N/C,  $d_{min} = 2.4$  cm
- d)  $E = 460$  N/C,  $d_{min} = 1.2$  cm

2. What is the force  $\vec{F}$  on the 3.0 nC charge at the bottom in the FIGURE? Give your answer in component form.



- a)  $\vec{F} = (0.87 \hat{i} - 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- b)  $\vec{F} = (0.87 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- c)  $\vec{F} = (0.52 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$
- d)  $\vec{F} = (1.0 \hat{i} + 1.8 \hat{j}) \times 10^{-4} \text{ N}$

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Name \_\_\_\_\_

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Thursday, January 24, 2013, 8:30-11:30

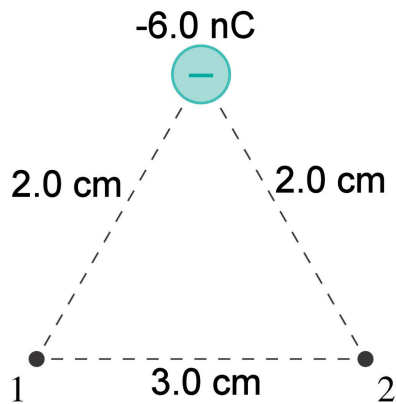
Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

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  - Both problems are weighted equally.
1. What are the electric fields at points 1 and 2 in the FIGURE? Give your answer as a magnitude and direction.



- a)  $E_1 = 1.3 \times 10^5$  N/C at  $41^\circ$  ccw from the positive  $x$ -axis  
 $E_2 = 1.3 \times 10^5$  N/C at  $139^\circ$  ccw from the positive  $x$ -axis
- b)  $E_1 = 1.3 \times 10^5$  N/C at  $221^\circ$  ccw from the positive  $x$ -axis  
 $E_2 = 1.3 \times 10^5$  N/C at  $319^\circ$  ccw from the positive  $x$ -axis
- c)  $E_1 = 6.0 \times 10^4$  N/C at  $41^\circ$  ccw from the positive  $x$ -axis  
 $E_2 = 6.0 \times 10^4$  N/C at  $139^\circ$  ccw from the positive  $x$ -axis
- d)  $E_1 = 3.1 \times 10^5$  N/C downward (in the negative  $y$ -direction)  
 $E_2 = 3.1 \times 10^5$  N/C downward (in the negative  $y$ -direction)

2. The permanent electric dipole moment of the water molecule ( $\text{H}_2\text{O}$ ) is  $6.2 \times 10^{-30}$  C m. What is the maximum possible torque on a water molecule in a  $2.0 \times 10^8$  N/C electric field?

a)  $1.2 \times 10^{-21}$  N m

b)  $3.1 \times 10^{-21}$  N m

c)  $8.8 \times 10^{-22}$  N m

d)  $2.2 \times 10^{-21}$  N m

PHYS 1004  
INTRODUCTORY  
ELECTROMAGNETISM  
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Term Test # 1

Name \_\_\_\_\_

Student Number \_\_\_\_\_

Thursday, January 24, 2013, 11:30-14:30

Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- *Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.*
  - **DO NOT CIRCLE YOUR ANSWERS ON THIS SHEET** as it will not be graded. *Fill in the corresponding answers, as well as your name, student number and section on the scantron sheet provided which is to be submitted.*
  - *Both problems are weighted equally.*
1. Two positive point charges  $q$  and  $25q$  are at  $x = 0$  and  $x = 2L$ , respectively, and free to move. A third charge is placed so that the entire three-charge system is in static equilibrium. What are the charge (magnitude and sign) and  $x$ -coordinate of the third point charge?
- a)  $Q_{new} = -\frac{25}{4}q, x = \frac{L}{3}$
  - b)  $Q_{new} = +\frac{25}{36}q, x = \frac{L}{3}$
  - c)  $Q_{new} = -\frac{25}{36}q, x = \frac{L}{3}$
  - d)  $Q_{new} = -\frac{25}{36}q, x = -\frac{L}{2}$

2. Two 10-cm-diameter charged disks face each other, 40 cm apart. The left disk is charged to  $-20$  nC and the right disk is charged to  $+20$  nC. What are the electric field  $\vec{E}$  at the midpoint between the two disks, and the force  $\vec{F}$  on a  $-2.0$  nC charge placed at the midpoint between the two disks?

a)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, left}), \vec{F} = (1.7 \times 10^{-5} \text{ N, left})$

b)  $\vec{E} = (7.6 \times 10^4 \text{ N/C, left}), \vec{F} = (7.6 \times 10^{-5} \text{ N, right})$

c)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, left}), \vec{F} = (1.7 \times 10^{-5} \text{ N, right})$

d)  $\vec{E} = (8.6 \times 10^3 \text{ N/C, right}), \vec{F} = (1.7 \times 10^{-5} \text{ N, left})$

PHYS 1004  
INTRODUCTORY  
ELECTROMAGNETISM  
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Term Test # 1

Name \_\_\_\_\_

Student Number \_\_\_\_\_

Thursday, January 24, 2013, 14:30-17:30

Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

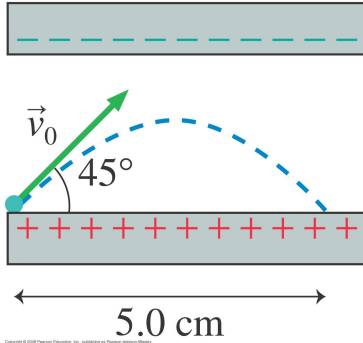
- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
  - **DO NOT CIRCLE YOUR ANSWERS ON THIS SHEET** as it will not be graded. Fill in the corresponding answers, as well as your name, student number and section on the scantron sheet provided which is to be submitted.
  - Both problems are weighted equally.
1. Two 20-cm-diameter charged rings face each other, 40 cm apart. The left ring is charged to  $-10$  nC and the right ring is charged to  $+10$  nC. What are the electric field  $\vec{E}$  at the midpoint between the two rings, and the force  $\vec{F}$  on a  $-4.0$  nC charge placed at the midpoint between the two rings?
- a)  $\vec{E} = (2.6 \times 10^4 \text{ N/C, left}), \vec{F} = (2.6 \times 10^{-5} \text{ N, right})$
  - b)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, right}), \vec{F} = (1.3 \times 10^{-5} \text{ N, left})$
  - c)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, left}), \vec{F} = (1.3 \times 10^{-5} \text{ N, left})$
  - d)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, left}), \vec{F} = (1.3 \times 10^{-5} \text{ N, right})$

2. An electron is launched at a  $45^\circ$  angle and a speed of  $v_0 = 2.0 \times 10^6$  m/s from the positive plate of the parallel-plate capacitor shown in the figure below. The electron lands 5.0 cm away. What is the electric field strength inside the capacitor and what is the smallest possible spacing between the plates?

*Hint: For projectile motion under the force of gravity (represented here by the acceleration due to gravity,  $g$ ):*

$$\text{Range} = |v_0| \cos \theta \times 2 |v_0| \sin \theta / g$$
$$\text{Height} = (\text{vertical velocity})^2 / 2g = (|v_0| \sin \theta)^2 / 2g$$

*Note to change to the electrostatic calculation, replace  $g$  with the acceleration due to an electric field  $E$  acting on an object with mass  $m$  and electric charge  $e$ .*



- a)  $E = 3600$  N/C,  $d_{min} = 1.0$  cm
- b)  $E = 910$  N/C,  $d_{min} = 2.4$  cm
- c)  $E = 230$  N/C,  $d_{min} = 2.4$  cm
- d)  $E = 460$  N/C,  $d_{min} = 1.2$  cm

PHYS 1004  
INTRODUCTORY  
ELECTROMAGNETISM  
AND WAVE MOTION  
Term Test # 1

Name \_\_\_\_\_

Student Number \_\_\_\_\_

Friday, January 25, 2013, 8:30-11:30

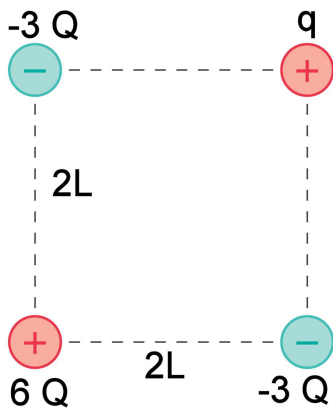
Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

Reference material provided on separate sheet

- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
  - **DO NOT CIRCLE YOUR ANSWERS ON THIS SHEET** as it will not be graded. Fill in the corresponding answers, as well as your name, student number and section on the scantron sheet provided which is to be submitted.
  - Both problems are weighted equally.
1. The FIGURE shows four charges at the corners of a square of side  $2L$ . What is the magnitude of the net force on  $q$ ?



- a)  $F_{net} = \frac{3kQq}{4L^2}$
- b)  $F_{net} = \frac{3kQq}{4L^2} (\sqrt{2} - 1)$
- c)  $F_{net} = \frac{3\sqrt{2}kQq}{4L^2}$
- d)  $F_{net} = 0$

2. Two 20-cm-diameter charged rings face each other, 40 cm apart. The left ring is charged to  $-10$  nC and the right ring is charged to  $+10$  nC. What are the electric field  $\vec{E}$  at the midpoint between the two rings, and the force  $\vec{F}$  on a  $-4.0$  nC charge placed at the midpoint between the two rings?

a)  $\vec{E} = (2.6 \times 10^4 \text{ N/C, left}), \vec{F} = (2.6 \times 10^{-5} \text{ N, right})$

b)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, right}), \vec{F} = (1.3 \times 10^{-5} \text{ N, left})$

c)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, left}), \vec{F} = (1.3 \times 10^{-5} \text{ N, left})$

d)  $\vec{E} = (3.2 \times 10^3 \text{ N/C, left}), \vec{F} = (1.3 \times 10^{-5} \text{ N, right})$

PHYS 1004  
INTRODUCTORY  
ELECTROMAGNETISM  
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Term Test # 1

Name \_\_\_\_\_

Student Number \_\_\_\_\_

Friday, January 25, 2013, 14:30-17:30

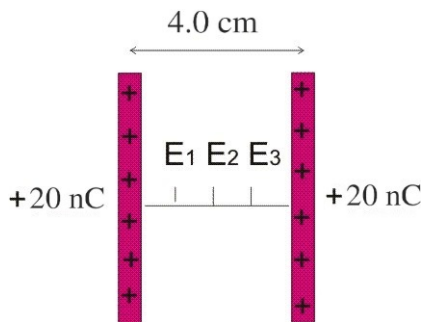
Tutorial Section (if not this one): \_\_\_\_\_

Duration: 30 minutes

Allowed aids: Calculator, Ruler

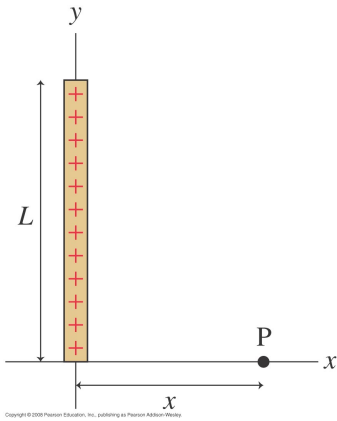
Reference material provided on separate sheet

- Complete both problems which have been selected from and based on those twenty problems assigned in the tutorials.
  - **DO NOT CIRCLE YOUR ANSWERS ON THIS SHEET** as it will not be graded. Fill in the corresponding answers, as well as your name, student number and section on the scantron sheet provided which is to be submitted.
  - Both problems are weighted equally.
1. Two 10-cm-long thin glass rods uniformly charged to +20 nC are placed vertically side by side, 4.0 cm apart, as shown in the figure below. What are the electric field strengths  $E_1$ ,  $E_2$  and  $E_3$  at distances 1.0 cm, 2.0 cm, and 3.0 cm, respectively, to the right of the rod on the left along the line ( $x$ -axis) connecting the midpoints of the two rods?



- a)  $E_1 = E_2 = E_3 = 2.5 \times 10^5 \text{ N/C}$
- b)  $E_1 = 3.5 \times 10^5 \text{ N/C}$ ,  $E_2 = 1.7 \times 10^5 \text{ N/C}$ ,  $E_3 = 1.0 \times 10^5 \text{ N/C}$
- c)  $E_1 = E_3 = 2.5 \times 10^5 \text{ N/C}$ ,  $E_2 = 0$**
- d)  $E_1 = E_3 = 1.3 \times 10^5 \text{ N/C}$ ,  $E_2 = 0$

2. The figure below shows a thin rod of length  $L$  with total charge  $Q$ . Which of the following expressions describe the electric field  $\vec{E}$  at point P?



- a)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0 x^2} \hat{i}$
- b)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0} \left[ \frac{1}{x\sqrt{x^2+L^2}} \hat{i} - \frac{1}{L\sqrt{x^2+L^2}} \hat{j} \right]$
- c)  $\vec{E}(\text{P}) = \frac{Q}{4\pi\epsilon_0} \left[ \frac{1}{x\sqrt{x^2+L^2}} \hat{i} - \frac{1}{Lx} \left( 1 - \frac{x}{\sqrt{x^2+L^2}} \right) \hat{j} \right]$
- d)  $\vec{E}(\text{P}) = \frac{Q}{2\pi\epsilon_0} \frac{1}{x\sqrt{x^2+L^2}} \hat{i}$