**Physics 121 Common Exam 1, Fall 2013**

**A**

**Name (Print):** _____ **4 Digit ID:**_____ **Section:** _____

**Honors Code Pledge:** For ethical and fairness reasons all students are pledged to comply with the provisions of the NJIT Academic Honor Code. You must answer the exam questions entirely by yourself. **Turn off all cell phones, pagers, or other communication devices.** Use only your own calculator.

**Instructions:**

- First, write your name and section number on **both** the Scantron card and this exam sheet.
- Use the formula sheet (last exam booklet page) and no other materials.
- Budget your time to about 4.4 minutes/question. (75 minutes/18 questions). The questions are all worth the same. You may skip a question that you find hard, since the professors drop 2 wrong answers: 16 correct answers will earn a score of 100%.
- **Show how your work on this set of exam sheets.** Use the backs of pages if necessary. The professors may decline to give credit to answers that show no appropriate work, assuming that no work indicates no understanding.
- Answer each question on the Scantron card using #2 pencil. Also circle your answers on question papers.
- Do not hesitate to ask for clarification of any exam question, if needed, from your proctor or Professor.

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**1.** The cross (vector) product $\vec{A}\times\vec{B}$ of two vectors **A** = 3**i** + 0**j** − 5**k** and **B** = 4**i** + 0**j** + 0**k** is:

A) 40 j
B) -20 j
C) 3
D) 0
E) -21k

$(0-(-5)(0))\hat{i} + ((-5)(4) - (3)(0))\hat{j} + ((3)(0) - (0)(4))$

$-20\hat{j}$

**2.** If vector **A** = 3**i** + 4**j** +5**k** and **B** = 5**i** - 4**j** -3**k** what is the angle between them??

A) 109°
B) 63°
C) -63°
D) 71°
E) 0

$\vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta$

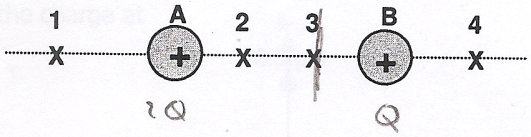
$3\cdot5 + 4\cdot(-4) + (5)(-3)$

$15 - 16 - 15 = -16$

$\theta = \cos^{-1}\left(\frac{A\cdot B}{|A||B|}\right)$

$\sqrt{(3)^2+(4)^2+(5)^2}$ $\sqrt{5^2+(-4)^2+(-3)^2}$

**3.** Object A has a positive charge of +2Q Coulombs. Object B has a positive charge of +Q coulombs. At which of the points labeled 1, 2, 3, or 4 could a test charge remain at rest?




A) The answer depends on the test charge, which is not given
B) 1.
C) 2.
D) 3.
E) 4.

**8.** Two equal and opposite charges are located on the horizontal axis, as shown in the figure. The direction of the electric field at point P in the plane midway between the charges is:

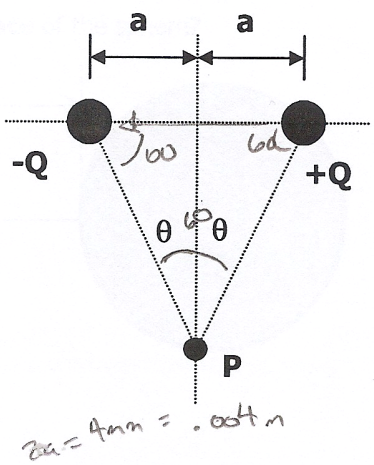
A) The electric field is zero at point P.

B) ↑

C) ↓

D) ←

E) →



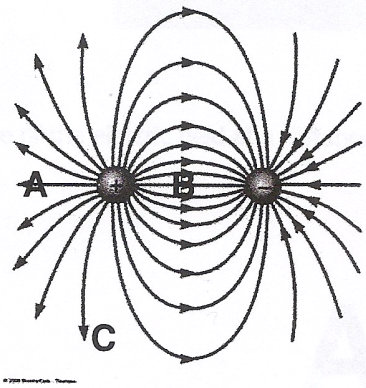

**9.** For the charge configuration of the previous problem, the angle θ = 30 degrees, a = 2 mm (i.e., the two charges and point P form an equilateral triangle with side 4 mm), and the value of Q is 8 μC. Calculate (approximately) the magnitude of the electric field at point P,

A) The electric field is zero at point P.
B) $9.0 \times 10^9$ N/C
C) $1.2 \times 10^6$ N/C
D) $9 \times 10^3$ N/C
E) $4.5 \times 10^9$ N/C

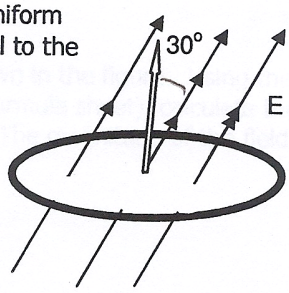
**A**

**10.** The sketch at right represents field strength near a pair of charges. Which choice below lists the field magnitudes at points A, B, C in decreasing order?

A) A, B, C
B) A, C, B
C) C, B, A
D) B, A, C
E) C, A, B



**15.** The circular surface shown in the sketch has a radius of 10 cm. It is immersed in a uniform electric field with magnitude 100N/C. The field lines make a 30° angle with the vector normal to the surface, as shown in the sketch. What is the electric flux through the surface in $N.m^2/C$?

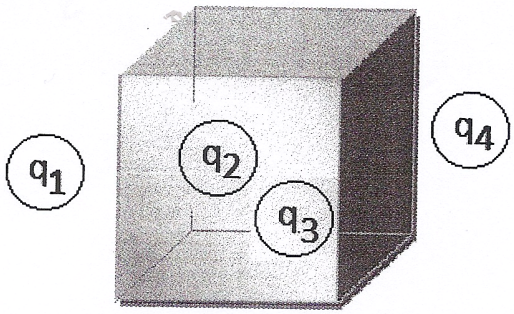



A) $7.1 \times 10^{-3}$ B) -15.08 C) 2.72 D) 15.08 E) 10.7

$E \cdot A \cdot \cos\theta$ $100 \cdot (\pi(.1)^2)\cos(30)$

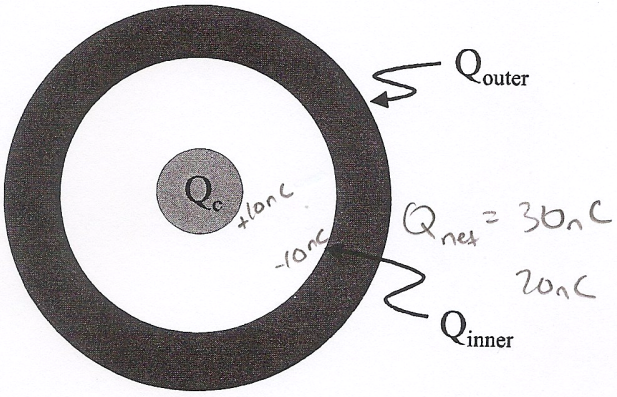
**16.** Consider several point charges as shown in the figure below, having the following values: $q_1 = 2$ nC and $q_4 = -5$nC outside the cube, and $q_2 = -2$ nC and $q_3 = 4$ nC inside the cube. What is the electric flux through the surface of the cube shown in the figure?

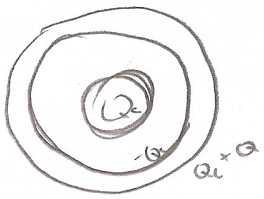
A) 226 $N \cdot m^2/C$
B) 113 $N \cdot m^2/C$
C) 791 $N \cdot m^2/C$
D) -339 $N \cdot m^2/C$
E) None of the other answers are correct




**17.** An **insulating** sphere with a total positive charge $Q_c$ is placed at the geometric center of the cavity within a **conducting** spherical shell as shown in the figure. The shell has a total net charge of Q = 30 nC. The INNER surface of the conducting shell has a measured total charge of $Q_{inner}$ = -10 nC. How much charge resides on the outer surface of the shell and what must be the value of $Q_c$?

A. $Q_{outer}$ = 0 C. $Q_c$ = -30 nC
B. $Q_{outer}$ = + 40 nC. $Q_c$ = +10 nC
C. $Q_{outer}$ = +10 nC. $Q_c$ = +10 nC
D. $Q_{outer}$ = -40 nC. $Q_c$ = -10 nC
E. none of the above




30 + Qc

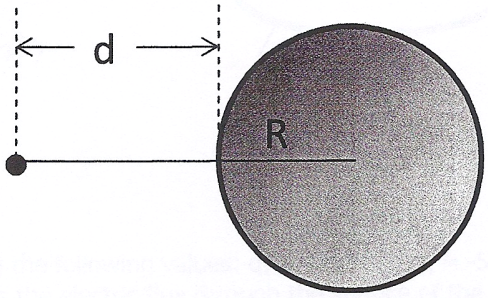
A

Use the sketches at right for the following two problems. A perfectly spherical shell has a net positive charge of Q = 10.0 μC on it. Its radius R is 1.0 m. The charge is uniformly distributed over the surface of the sphere.

**11.** What is the magnitude of the electric field at a distance d = 1.0 m from the **surface** of the sphere?

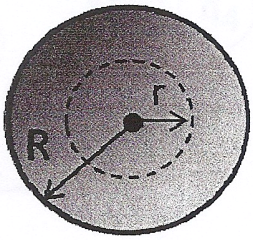
A) $6.0 \times 10^9$ N/C
B) $2.25 \times 10^4$ N/C
C) $2.0 \times 10^9$ N/C
D) $1.13 \times 10^4$ N/C
E) 0.0 N/C

$\sigma = \frac{Q}{SA}$




**12.** For the same sphere as above, find the magnitude of the electric field at a point that is a distance r = 0.50 m from the **center** of the sphere.

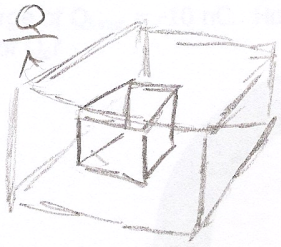
A) $9.0 \times 10^{13}$ N/C
B) $4.8 \times 10^{10}$ N/C
C) $3.6 \times 10^{10}$ N/C
D) $1.13 \times 10^4$ N/C
E) 0.0 N/C

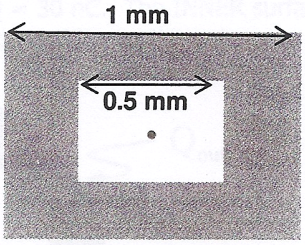



**13.** A hollow conducting cube has a net positive charge of Q = 20.0 μC on it. The outer and inner dimensions of the cube are shown in the sketch at right. Find the magnitude of the electric field at a point that is a distance r = 0.25 mm from the **center** of the cavity.

A) $9 \times 10^9$ N/C
B) 900 N/C
C) 90,000 N/C
D) 90 N/C
E) 0.0 N/C

$\sigma = \frac{Q}{A}$






**14.** For the same cube as in the previous question, find the approximate magnitude of the electric field at a distance of 1.0 m from the center of the conducting cube.

A) 0.0 N/C
B) $9 \times 10^9$ N/C
C) 1800 N/C
D) 180 N/C
E) 180,000 N/C

**A**

**4.** A charge of -5μC and a charge of -10μC are located at a distance .30 m from each other. The force between them is (approximately):

A) 1.5 N, repulsion
B) 22.5 N, repulsion
C) 5.0 N, repulsion
D) 1.5 N, attraction
E) 0. 45 N, attraction

$F = \frac{q_1 q_2 k}{r^2}$

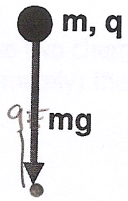
**A**

**5.** A small conducting ball has a mass of $5.0 \times 10^{-2}$ kg and a negative charge of -300 μC. What electric field and direction are needed to exactly balance the weight of the ball? ($g = 9.8$ m/s$^2$)?

A) 0.49 N/C down
B) 1,000 N/C up
C) 1630 N/C down
D) 9800 N/C up
E) $1.96 \times 10^3$ N/C down

$mg = .49$

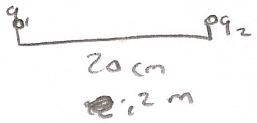
$.49 = qE$




.01kg

**6.** A particle whose mass is 10.0 grams and whose charge is 10 nC is released from rest when it is 20 cm from a second particle of charge 10 nC. Find the magnitude of the particle's initial acceleration.

A) $2.25 \times 10^{-3}$ m/s$^2$
B) 0.011 m/s$^2$
C) 0.015 m/s$^2$
D) 15 m/s$^2$
E) 0.23 m/s$^2$




-.3μC

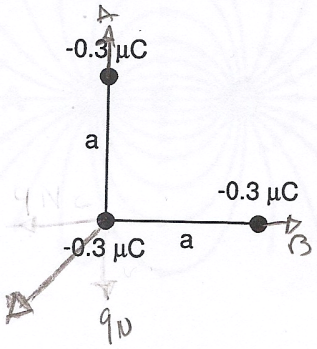
**7.** A negative 0.3-μC charge is placed at the origin (lower left in the sketch). An identical charge is placed a distance a = 0.03 m from the origin on the x axis, and a third identical charge is placed 0.03 m from the origin on the y axis. The magnitude and direction (relative to the positive x-axis) of the force on the charge at the origin are:

A) 1.3 N, 45°
B) 3.9 N, 225°
C) 3.9 N, 90°
D) 2.0 N, 45°
E) 1.3 N, -135°

$F = \frac{q_1 q_2 k}{r^2}$

$F_{Ac} = \frac{k(.3\mu C)(.3\mu C)}{(.03\ m)^2}$

$= 90$



**18.** Consider a thin rod of total length **L** with uniform charge per unit length λ on it as shown in the figure. Using the integral formula for the total electric field due to a continuous charge distribution (see formula sheet), calculate the total electric field a distance **D** from the right edge of the rod (as shown in the figure). The magnitude of the field is given by:

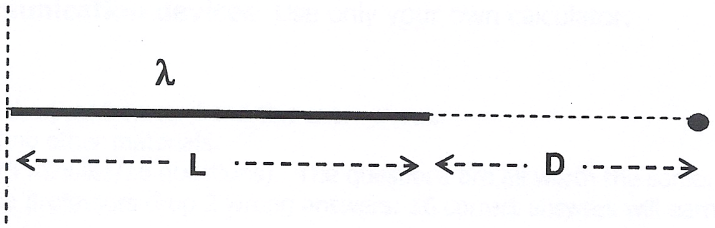
A) None of the answers below

B) $E = \dfrac{1}{4\pi\varepsilon_o}\dfrac{\lambda L}{D(D+L)}$

C) $E = \dfrac{1}{2\pi\varepsilon_o}\dfrac{\lambda}{D}$

D) $E = \dfrac{1}{2\pi\varepsilon_o}\dfrac{\lambda}{L}$

E) $E = \dfrac{1}{4\pi\varepsilon_o}\lambda \ln\left(\dfrac{D+L}{D}\right)$




$\lambda = \frac{Q}{L}$ $\quad \lambda L = Q$

$\frac{1}{2\pi\varepsilon_o}$

**A**