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by prof. M. Jones 26 Oct 2015

Name_____ PUID (10 digits)_____

Calculator Used:_____Model No.: _____

PHYSICS 219
Exam I
TIME LIMIT: 60 minutes
February 16, 2015

Use the following values for constants in this test; other values may give results in slight disagreement with listed answers.

charge on electron = -1.602×10^{-19} C

mass of electron = 9.11×10^{-31} kg

$k = 9.0 \times 10^{9}$ N m^2/C^2

$\varepsilon_o = 8.85 \times 10^{-12}$ $C^2/(N \bullet m^2)$

$\pi = 3.14 \ldots$

The use of cell phones, pagers, or computers during the exam is forbidden. Headphones of any type are not allowed. Check these items at the front of the room **before** the exam begins.

This test has **18 questions all with equal weight**. Each correct answer is worth **5.55 points**. All questions have equal weight. There will be no partial credit assigned. You should have an **ORANGE** Op-scan sheet with this exam.

Use soft pencils to fill in answer sheets. Be sure to enter name and ID number both in writing and in dot code on the answer sheet. The answer on the op-scan sheet is your ``official'' answer.

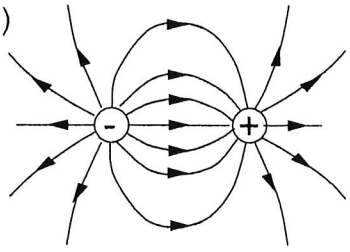
Cheating on this exam, no matter how minor, will lead to an immediate F in the course and possible dismissal from the University. To answer some questions on this test, some algebra and computational work is required. Consistently providing answers to questions without indicating how you arrived at the answer (i.e., without showing any work) is strongly discouraged since 'answers without work' are one indicator you have copied from another student's Op-scan sheet.

1. A dielectric material with a dielectric constant of 5 fits snugly between the plates of a parallel plate capacitor. The area of the plates is 0.25 m^2 and the plates have a separation of 0.001 m. What is the capacitance of the dielectric-filled capacitor?

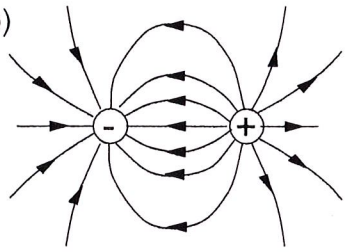
a) 1.1×10^{-8} F
b) 4.4×10^{-10} F
c) 9.0×10^{-9} F
d) 2.2×10^{-9} F
e) none of the above

2. A positive and negative point charge of equal but opposite polarity are positioned in a plane as shown. Which diagram best describes the electric fields in the vicinity of these two charges?

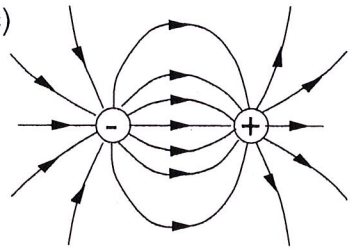
a)



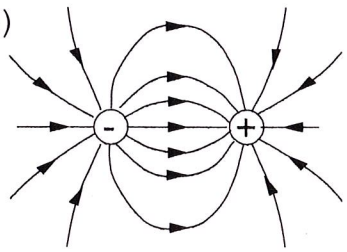
b)



c)



d)

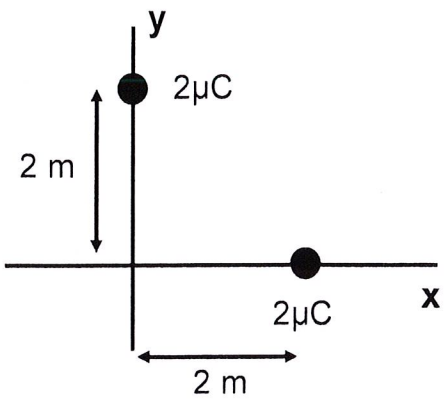


3. To charge a 1 F capacitor with 2 C requires a potential difference of

a) 2 V
b) 0.2 V
c) 5 V
d) 0.5 V
e) need more information

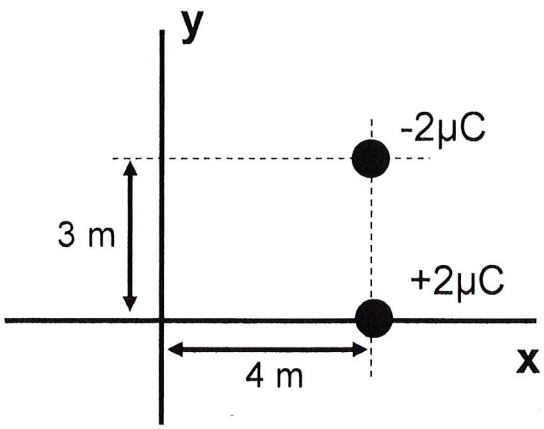
4. Two point charges are located as shown in the figure to the right. What is the magnitude of the electric field at the origin?

a) 9000 N/C
b) 4500 N/C
c) 6360 N/C
d) 18,000 N/C
e) none of the above



5. Two point charges are located as shown in the figure to the right. What is the electrostatic potential at the coordinate origin?

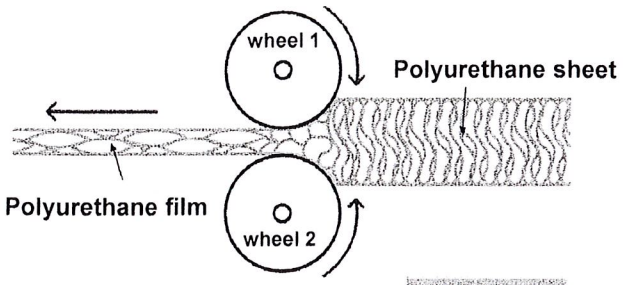
a) 0 V
b) 8100 V
c) -1494 V
d) 900 V
e) none of the above



6. If 500 J of work is required to move a 40 C of charge from one point to another, the potential difference between these two points is

a) 12.5 V
b) 20,000 V
c) 0.08 V
d) answer depends on the path through which the charge is moved
e) none of the above

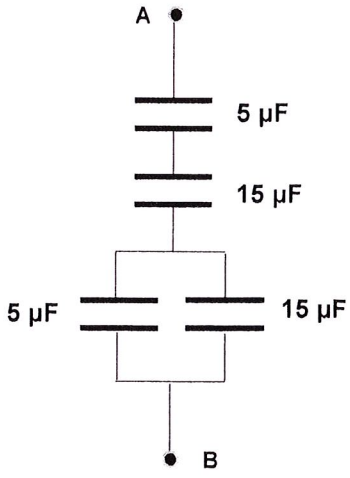
7. A thick polyurethane sheet must be compressed to form a thin polyurethane film as indicated in the diagram. The compression is accomplished by two rotating wheels. Your job is to minimize frictional charging. A quick check with the stockroom indicates only wheels made from nylon, glass, copper and aluminum are readily available. Which wheels would you recommend for use?



Human body
Glass
Mica
Nylon
Wool
Silk
Aluminum
Polyester
Paper
Cotton
Steel
Copper
Rubber
Polyurethane
Polypropylene
Vinyl chloride
Silicon
Fluororesin

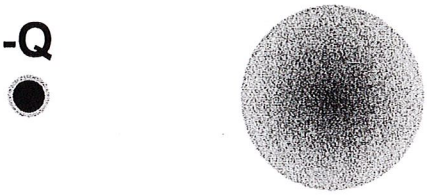
a) the nylon wheels
b) the glass wheels
c) the copper wheels
d) the aluminum wheels

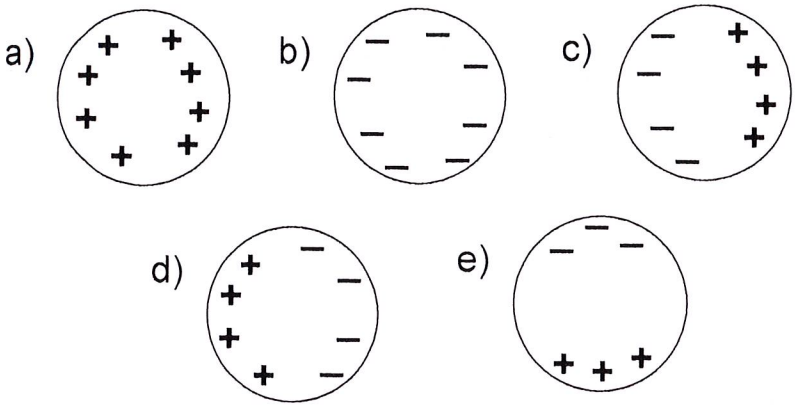
8. Four capacitors are arranged as shown in the diagram. What is the equivalent capacitance between points A and B?



a) 40.0 μF
b) 23.7 μF
c) 1.88 μF
d) 3.16 μF
e) none of the above

9. An electrically neutral metallic sphere is placed near a positive point charge -Q as shown schematically in the figure to the right. The two objects are located in free space, far from any other objects. Which picture below most accurately describes the charge distribution on the metallic sphere?

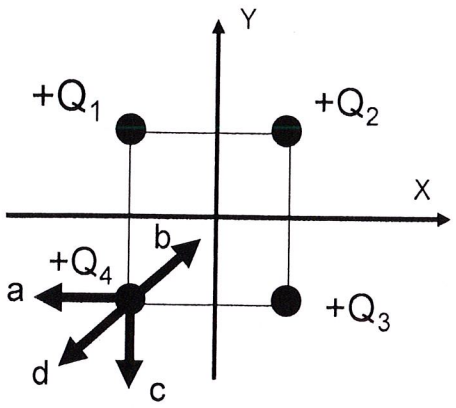




10. In some initial configuration, the electrostatic force that two identical charges exert on each other is measured to be a repulsive force of 15.0 N. If the distance between the charges is increased by 5 times its original value, what electrostatic force will then be acting between each charge?

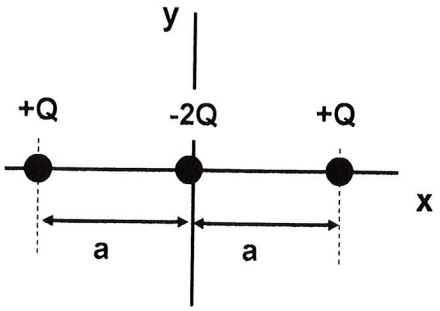
a) 375 N, repulsive
b) 15.0 N, attractive
c) 0.60 N, repulsive
d) 3.0 N, repulsive
e) none of the above

11. Four <u>identical</u> positive point charges are stuck to the corners of a square as shown to the right. If the charge Q_4 is suddenly released, in what direction will it initially move?



a) in the direction marked by the arrow a
b) in the direction marked by the arrow b
c) in the direction marked by the arrow c
d) in the direction marked by the arrow d
e) Q_4 will not move since no net force is acting on it

12. Three charges are moved from infinity and positioned as shown in the diagram. Assuming the potential energy of the charges is zero when they are infinitely far apart, what is the electrostatic potential energy stored in this arrangement of charges?



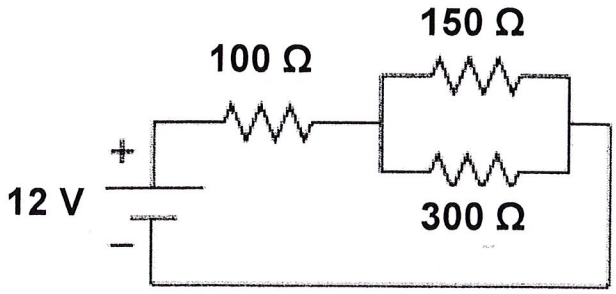
a) $-3.5kQ^2/a^2$
b) $3.5kQ^2/a^2$
c) $-3.5kQ^2/a$
d) $-4kQ^2/a$
e) none of the statements are correct

13. If a uniform electric field of magnitude 150 N/C points in the +x direction in free space, what is the distance between equipotential surfaces having a potential difference of 10 V?

a) 5.0×10^{-2} m
b) 6.7×10^{-2} m
c) 1.3×10^{-2} m
d) 40 m
e) none of the above

14. What is the voltage across the 100 Ω resistor?

a) 2.18 V
b) 3 V
c) 6 V
d) 12 V
e) none of the above

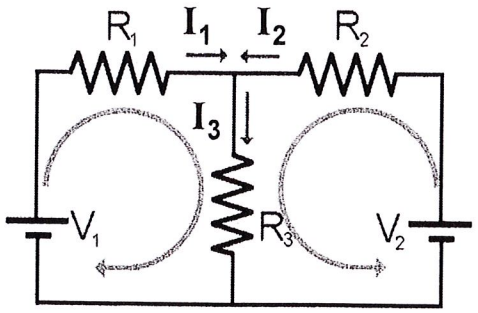


15. In the circuit above, what is the power dissipated in the 100 Ω resistor?

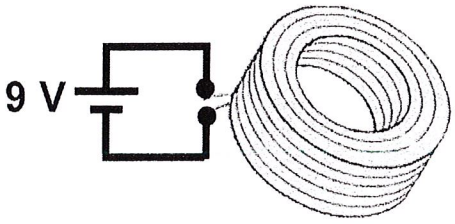
a) 0.36 W
b) 6 W
c) 37 W
d) 0.97 W
e) none of the above

16. In the circuit to the right, the correct application of Kirchhoff's junction rule would require that

a) $I_1 - I_2 = I_3$
b) $I_1 + I_2 = -I_3$
c) $-I_1 - I_3 = I_2$
d) $I_1 + I_2 = I_3$
e) none of the above

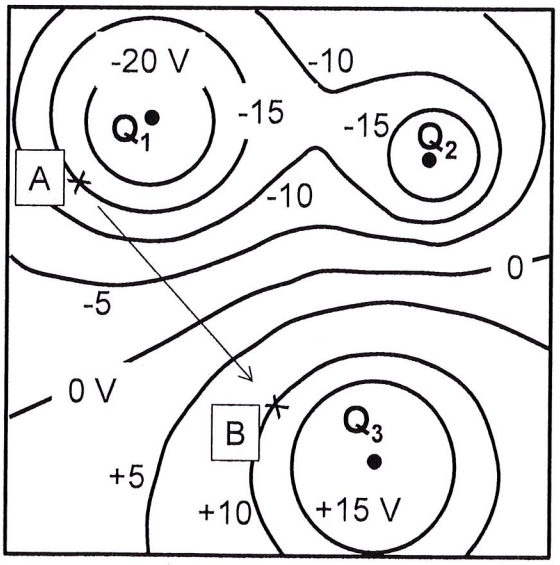


17. A 9 V battery is connected to a coil of wire as shown. The wire coil is made from a material which has a resistivity of 1.5×10^{-6} Ωm. The length of the wire used to wrap the coil is 50 m and the wire has a diameter of 0.1 mm. What is the total charge the battery must provide in 10 seconds?



a) 5.9×10^{15} electrons
b) 2.4×10^{16} electrons
c) 5.9×10^{16} electrons
d) 2.4×10^{17} electrons
e) can't tell, need more information

18. The equipotential lines in a region of space are mapped as shown in the diagram. How much work must you perform to move a charge of +1 nC from point A to point B? (no sign required)



a) no work is required
b) 25×10^{-9} J
c) 15×10^{-9} J
d) 10×10^{-9} J
e) none of the above

END OF TEST!
THIS TEST HAS 18 QUESTIONS

When turning in your exam,
make sure your opscan answer sheet is

NOT

inserted into (or between) the test questions!

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Physics 219
Important Formulas: TEST I

$$\left|\vec{F}\right| = k\frac{|q_1||q_2|}{r^2} \qquad \vec{F} = q_o\vec{E} \qquad \left|\vec{E}\right| = k\frac{|Q|}{r^2}$$

$$PE_E = k\frac{q_1 q_2}{r} \qquad V = \frac{PE_E}{q_{test}} \qquad V = k\frac{Q}{r} \qquad \Delta V = \frac{\Delta PE_E}{q_o}$$

$$\Delta PE_E + W = 0$$

$$E_x = -\frac{\Delta V}{\Delta x} \qquad E_y = -\frac{\Delta V}{\Delta y} \qquad E_z = -\frac{\Delta V}{\Delta z}$$

$$C = \frac{q}{\Delta V} \qquad C = \frac{\varepsilon_o A}{d} \qquad C_\kappa = \kappa C \qquad PE_e = \frac{q^2}{2C} \qquad \Delta V = |E|\,d$$

$$C_{equiv} = C_1 + C_2 + \ldots \qquad \frac{1}{C_{equiv}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$$

$$I = \frac{\Delta q}{\Delta t} \qquad R = \rho\frac{L}{A} \qquad V = IR \qquad P = IV = I^2R = \frac{V^2}{R}$$

$$\mathcal{E} - IR = 0$$

$$R_{equiv} = R_1 + R_2 + \ldots \qquad \frac{1}{R_{equiv}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$\sum_{in} I = \sum_{out} I \qquad \sum_{loop} \Delta V = 0$$