Instructor(s): *P. Kumar*

PHYSICS DEPARTMENT

PHY 2049   Exam 1   June 12, 2013

Name (print, last first): _____   Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.
(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number)**.
Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your
answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the
test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or <u>blue</u> or <u>black ink</u>.** Do not
make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you
believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

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1. An atom is charge neutral. A positively charged ion is made by removing a number of electrons from the atom. The
electrons are then transferred to another neutral atom which will now be negatively charged and experience an attractive
force from the other positive ion. When two such ions are separated by a distance of 6.2×10^{-10}m, the electrostatic
force each exerts on the other is 2.4×10^{-9}N. How many electrons were moved?

(1) 2   (2) 3   (3) 1   (4) 4   (5) 5

2. What is the magnitude (in pC) of a point charge whose electric field 50 cm away has a magnitude of 2V/m?

(1) 55.6   (2) 111   (3) 27.8   (4) 18.5   (5) None of these

3. What is the net electric potential (in mV) at the origin due to the circular arc
of charge $Q_1 = +7.21$ pC and the two particles of charges $Q_2 = 4.00Q_1$ and
$Q_3 = -2.00Q_1$? The arc's center of curvature is at the origin and its radius
is $R = 2.00$ m; the angle indicated is $\theta = 20.0°$. The potential is taken to be
zero at infinity.

(1) 32.5
(2) 162
(3) 227
(4) 16.2
(5) none of these
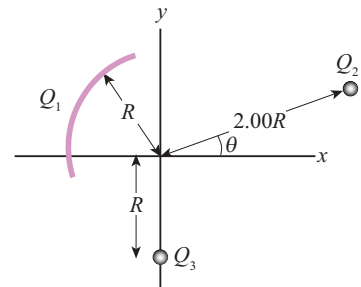
4. The capacitances of the four capacitors shown are given in terms of a certain
quantity C. In ratio to C, what is the equivalent capacitance between points
A and B? (*Hint:* First imagine that a battery is connected between those two
points; then reduce the circuit to an equivalent capacitance.)
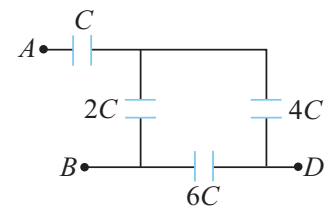
(1) 0.82   (2) 0.41   (3) 13   (4) 0.63   (5) none of these

5. In the above problem, now consider a battery connected between points A and D. What fraction of the charge is stored
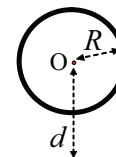on the 4C capacitor? Express your answer as a ratio to the charge stored on the C capacitor.

(1) 0.73   (2) 1.0   (3) 0.52   (4) 4.0   (5) none of these

6. Two charges, $q_1 = -1$C and $q_2 = -4$C, are placed along the x-axis a distance L apart with charge q_1 at the origin and q_2 at $x = L$. A third charge, $q_3 = +4/9$C, is also placed along the x-axis such that there is no net Coulomb force on any of the charges. What is the position of this charge along the x axis in units of L i.e., what is x/L?

(1) $\dfrac{1}{3}$ (2) $\dfrac{1}{2}$ (3) 1   (4) 2   (5) 3

7. A uniformly charged thin non-conducting shell (hollow sphere) of radius R with the total positive charge Q is placed at a distance d away from an infinite non-conducting sheet carrying a uniformly distributed positive charge with a density σ. The distance d is measured from shell's center (point O). What is the magnitude of the total electric field at the center of the shell?

(1) $\dfrac{\sigma}{2\epsilon_0}$ (2) $\dfrac{Q}{4\pi\epsilon_0 R^2} + \dfrac{\sigma}{2\epsilon_0}$ (3) $\dfrac{Q}{4\pi\epsilon_0 R^2} + \dfrac{\sigma}{\epsilon_0}$ (4) $\dfrac{Q}{4\pi\epsilon_0 R^2}$ (5) $\dfrac{Q}{4\pi\epsilon_0 R} + \dfrac{\sigma}{\epsilon_0}$

8. A non-uniform electric field given by $E = (5.5\hat{i} - 2.1\hat{j} + (4.6z^2 - 3)\hat{k})$N/C pierces a cube with sides 3 m, as shown in the figure. The cube has its rear corner at the origin. What is the total charge inside the cube?

(1) $+3.3$ nC
(2) -3.3 nC
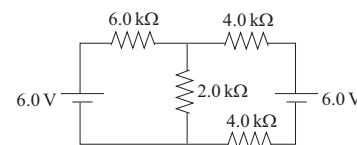(3) $+1.5$ nC
(4) -1.5 nC
(5) none of these
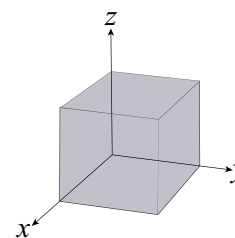
9. In the circuit shown, all capacitors are 4.0μF and the power supply is 12V. The charge (in μC) on the capacitor labeled q is:

(1) 19.2
(2) 29
(3) 39
(4) 7
(5) none of these
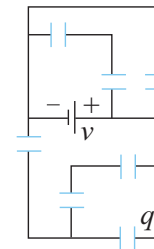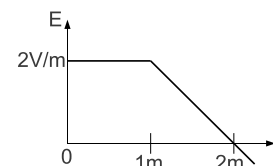

10. In the multi-loop circuit shown, the current through the 2.0kΩ resistor is (in mA),

(1) 1.20   (2) 0.4   (3) 2.4   (4) 0.80   (5) 0.23

11. The electric field as a function of position in one dimension is shown in the figure. If the electrical potential at $x = 0$ m is 5 V, what is the electrical potential (in Volts) at $x = 2$ m?


(1) 2   (2) 1   (3) 4   (4) 3   (5) none of these

12. A 60 pF capacitor is charged to a potential difference of 60 V, and the charging battery is disconnected. The capacitor is then connected in parallel with a second (initially uncharged) capacitor. If the potential difference across the first capacitor drops to 48 V, what is the capacitance of this second capacitor?

(1) 15 pF   (2) 20 pF   (3) 10 pF   (4) 35 pF   (5) none of these

13. You have a piece of wire with the total resistance R. You interconnect the two wire ends to make a five sided loop and measure the resistance between points A and B as shown in the figure. Approximately, what is this resistance in terms of R?
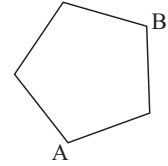
(1) 0.24 (2) 0.16 (3) 0.5 (4) 0.67 (5) 0.80

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 5