Exam Total
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PHYS 2135 Exam I
September 18, 2018

Name: _____

For questions 1-5, select the best answer. For problems 6-9, solutions must begin with an Official Starting Equation, when appropriate. Work must be shown to receive credit. Calculators are not allowed.

(8) _____ 1. A Gaussian sphere of radius *R* is centered on a positive charge *Q*. If the radius of the sphere is doubled the net electric flux through the Gaussian surface is …

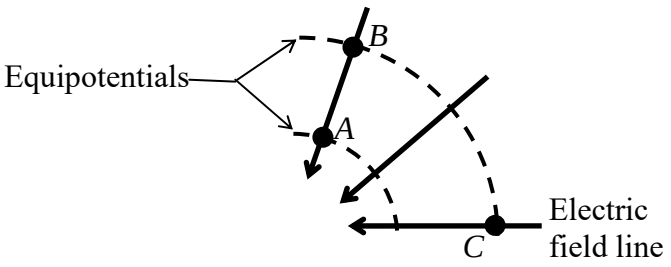
[A] doubled
[B] halved
[C] unchanged
[D] reduced by a factor of four

(8) _____ 2. You are given three charged insulating spheres. Spheres 1 and 2 are found to attract each other. Spheres 2 and 3 are found to repel each other. Which of the following can you conclude?

[A] Spheres 1 and 3 carry charges of equal sign
[B] Spheres 1 and 3 carry charges of opposite sign
[C] All three spheres carry charges of the same sign
[D] Spheres 1 and 3 will repel each other

(8) _____ 3. The figure shows the electric field lines and equipotentials in a certain region of space. Which of the following is true?

[A] $V_A > V_B$ and $V_B = V_C$
[B] $V_B > V_A$ and $V_B = V_C$
[C] $V_C > V_B$ and $V_A = V_B$
[D] $V_A = V_B = V_C$



(8) _____ 4. The capacitance of a parallel-plate capacitor can be increased …

[A] by increasing charge on each plate.
[B] by increasing the area of each plate.
[C] by increasing spacing between the plates.
[D] by increasing the potential difference across the plates.

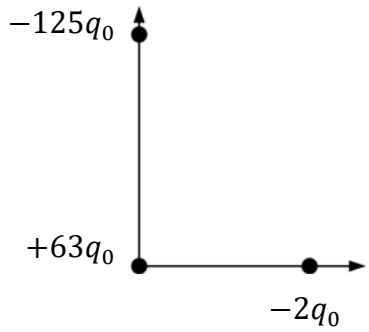
(8) _____ 5. What do the San Diego Chargers have in common with PHYS 2135 students?

[A] Great Potential [B] Field Lines
[C] Formulas for Success [D] More Points

/40

6. There is a positive charge $+63q_0$ at the origin and a negative charge $-125q_0$ located at (x,y) = (0, 4*a*). Start with an OSE and express your answers in terms of *k*, q_0, *m* and the given quantities. For vectors, express your answers in unit vector notation.

(15) (a) What is the electric field at (x,y) = (3*a*, 0) due to the $+63q_0$ charge?



(15) (b) What is the electric field at (x,y) = (3*a*, 0) due to the $-125q_0$ charge?

(5) (c) A particle with a negative charge $-2q_0$ and mass *m* is placed at (3*a*, 0). What is the net force on this particle?

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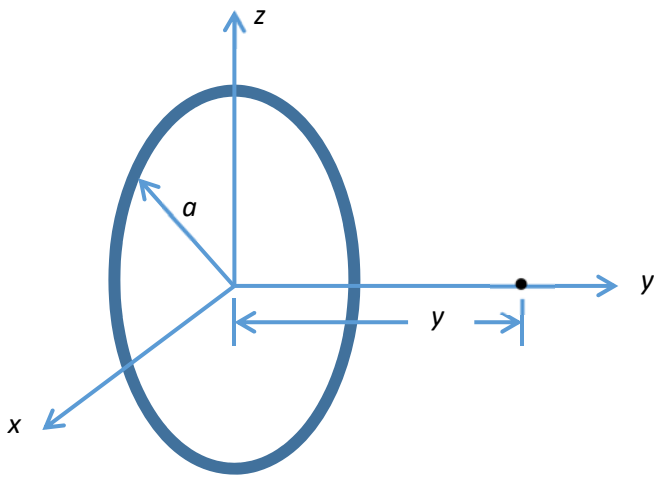
7. An insulating ring of radius *a* has a net charge $+Q$ uniformly distributed along the ring. The ring lies in the x-z plane with the origin of the coordinate system at the center of the ring. The *y*-axis is perpendicular to the ring and is on a line through the center of the ring.



(10) (a) Determine the linear charge density λ on the ring.

(15) (b) Set up and evaluate an integral to determine the electric potential as a function of *y* along the *y*-axis.

(15) (c) A particle of mass *m* and charge $-q_0$ is placed at $y = 2a$ and released from rest. Determine the speed of the particle as it passes through the center of the ring.

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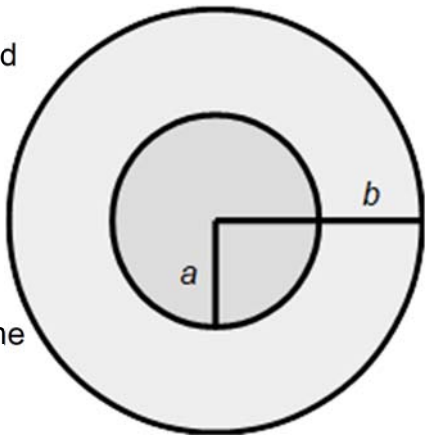
8. A solid **insulating** plastic sphere of radius *a* carries a total net negative charge -*Q* uniformly distributed throughout its interior. The insulating sphere is coated with a **conducting** metallic layer in the form of a spherical shell with inner radius *a* and outer radius *b*. The conducting layer carries a net charge of +*Q*.

(5) (a) Compute the volume charge density ρ in the plastic sphere in terms of variables introduced above.



(10) (b) Apply Gauss's law to find the magnitude of the electric field *E(r)* in the region $r < a$.

(10) (c) Find the electric field at points in the region $b > r > a$. Justify your answer.

(10) (d) Find the charge density on the inner surface of the spherical shell.

(5) (e) Find the electric field at points in the region $r > b$.

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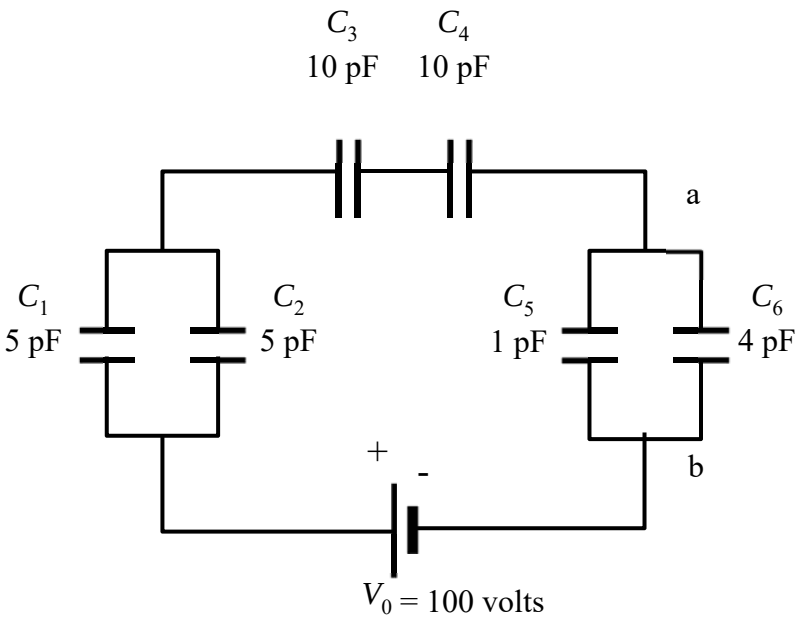
9. Consider the given circuit.

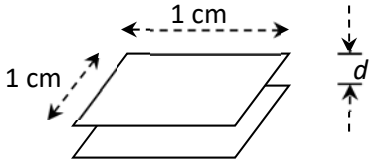


(10) (a) Calculate the equivalent capacitance of the entire circuit.
(Note: 1 pF = 10^{-12} F)

(10) (b) Find the charge Q_3 on capacitor C_3.

(10) (c) Find the voltage V_1 across capacitor C_1.

(10) (d) Capacitor C_5 is a parallel plate capacitor, with the dimensions indicated. Determine the spacing d between the plates of this capacitor (a numerical answer is required.)



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