BRAC University
MNS Department
Principles of Physics - II

Makeup Mid-term Examination | **Spring Semester 2013**
Course: PHY 112 | **March 29, 2013**
Total Marks: 40 | **10:00am - 11:00am**

Instructions: Read it first carefully

- **DO NOT** make any rough work on the question paper. Do it on the last page of your answer script.
- Answer all questions in both Part-I and Part-II. Answer the MCQ part **on the question paper**, NOT on the answer script.
- **Write your name and ID#** on the second page. Also you must use your own calculator if needed.
- You **must return the question paper** along with your answer script.
- You may use $e = 1.6 \times 10^{-19}\,\mathrm{C}$ and $\epsilon_0 = 8.85 \times 10^{-12}\,\mathrm{C^2/N \cdot m^2}$.

Part-I: Problem solving. Marks are as indicated.

1. Two particles $q_1 = +8q$ and $q_2 = -2q$ are fixed on x-axis at $x_1 = 0\,m$ and $x_2 = 0.1\,m$
   (a) (6 marks) At what point (other than infinitely far away) can a proton be placed so that it is in equilibrium?
   (b) (2 marks) Draw the necessary forces lines that acts on the proton.
   (c) (2 marks) Is the equilibrium stable or unstable?
2. A cube has edge length of $1.4\,m$ and is oriented in a region of uniform electric field, Find the net flux through the cube if the electric field, in newtons per coulomb is given by
   (a) (5 marks) $6\hat{i}$ and
   (b) (5 marks) $-3\hat{i} + 2\hat{j}$

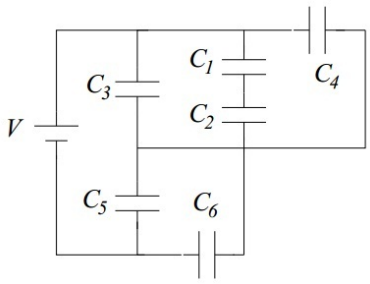

Figure 1: Multiple capacitor

3. Six capacitors, $C_1 = C_2 = 20\,\mu F$ and $C_3 = C_4 = C_5 = C_6 = 10\,\mu F$ form a circuit as shown in figure-1, and it is connected to a voltage source of 10 V.
   (a) (5 marks) Find the equivalent capacitance of the circuit.
   (b) (3 marks) What is the charge stored in C_2?
   (c) (2 marks) What is the potential difference across C_1?

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Part-II: Multiple choice questions. Choose only the correct answer. Marks: ____/10

4. (a) If a charged particle is located inside a shell of uniform charge, there is _____ on the particle from the shell.
A. a electrostatic force **B.** no electrostatic force **C.** an electromagnetic force **D.** None of these.

(a) _____

(b) An electron and a proton are held fixed at a distance on the positive x and negative y axes respectively. What is the direction of the net electric field at the origin?
A. first quadrant. **B.** second quadrant **C.** third quadrant **D.** fourth quadrant.

(b) _____

(c) An isolated charged particle produces an electric filed with magnitude E at a distance $1\,m$ away. What will be the magnitude of the field at a point $2\,m$ away?
A. $2E$. **B.** $4E$. **C.** $\frac{E}{2}$. **D.** $\frac{E}{4}$.

(c) _____

(d) Object A has a charge of $+2\mu C$, and object B has a charge of $+6\mu C$. Which statement is true about the electric forces on the objects?
A. $\vec{F}_{AB} = -3\vec{F}_{BA}$ **B.** $\vec{F}_{AB} = -\vec{F}_{BA}$ **C.** $3\vec{F}_{AB} = -\vec{F}_{BA}$ **D.** $\vec{F}_{AB} = \vec{F}_{BA}$

(d) _____

(e) An object with negative charge is placed in a region of space where the electric field is directed vertically upward. What is the direction of the electric force exerted on this charge?
A. up **B.** down **C.** there is no force **D.** the force can be in any direction

(e) _____

(f) A particle with charge q is located inside a cubical gaussian surface. No other charges are nearby. If the particle is at the centre of the cube, what is the flux through each on of the faces of the cube?
A. 0. **B.** $q/2\epsilon_0$. **C.** $q/6\epsilon_0$. **D.** $q/8\epsilon_0$. **E.** depends on the size of the cube.

(f) _____

(g) An electron in the atmosphere is moved upward through a displacement $\vec{d}$ by an electrostatic force $\vec{F}$ due to an electric field $\vec{E}$ as shown in figure-2. Which of the following statement is true about the potential energy and work done by the electrostatic force respectively?
A. increases, positive **B.** decreases, negative. **C.** decreases, positive. **D.** increases, negative

(g) _____

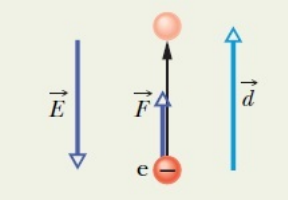

Figure 2: work done by the electron

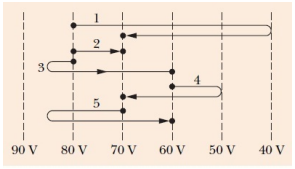

Figure 3: Movement of a test charge

(h) In figure-3 an electron is moving between the equipotential surfaces in five different paths? What is the direction of the electric field?
A. up **B.** down **C.** left **D.** right

(h) _____

(i) A parallel plate capacitor can store E amount of energy when it is connected to a 10 V battery. How much energy will it store if it is connected to a 20 V battery?
A. $2E$. **B.** $4E$. **C.** $\frac{E}{2}$. **D.** $\frac{E}{4}$.

(i) _____