Advanced Electrodynamics

Course: PYL111

Minor-1

Time: 1 hr

Marks: 20

Read before you start:

1. *No need to show any systematic calculations in your answer sheet.*
2. ***You have to only tick the right option(s) in the question paper itself*** *and you must submit it at the end of the examination alongside of the rough work that you have done in the answer-sheet.* ***If any calculations/rough works is done in the question paper, it will lead to cancelation of the paper.***
3. *There is* ***negative marking*** *for each wrong answer, which is 1/4th of the marks assigned to the respective questions.*

Part-1

Answer ALL questions: 10x1=10

1. To eliminate electric field interference, electronic devices are enclosed in
A. wooden box B. metal box C. plastic box D. any box

2. System international unit of electric flux is
A. NM^2C^{-1} B. NM^2C C. NM^1C^{-1} D. M^2C^{-1}

3. Lines of force between two plates are directed from
A. negative to negative B. positive to positive C. negative to positive
D. positive to negative

4. If charge particle 2e falls at potential difference of 6 V, then energy required to fall will be
A. 19 J B. 19.2 J C. 19×10^{-19} J D. 19.2×10^{-19} J

5. Two potentials V_1 and V_2 satisfy Laplace's equation within a closed volume and assume the same values on its surface. Then
A. $V_1=V_2$ B. $V_1 - V_2 \neq 0$ C. V_1 may or may not be equal to V_2 D. none of these

6. The function $P_n(x)$ is even if n is: (A)
A. even B. odd C. zero only D. none of these

7. A point charge q is held at a distance 2a from the centre of an isolated, uncharged, conducting sphere of radius a. The potential of the sphere is:
A. zero B. $q/4\pi\varepsilon_0 a$ C. $q/2\pi\varepsilon_0 a$ D. $q/8\pi\varepsilon_0 a$

8. Two conducting planes are inclined at an angle of 30^0 to each other. A point charge is placed between them. The number of image charges required to evaluate the potential is: (blank)
A. 12 B. 13 C. 11 D. 9

9. Which of the following statement is true for electrical image?
A. It's always equal and opposite to the real charge
B. It may be real or virtual
C. It's always virtual
D. It's always equal in magnitude to the real charge

[illegible]. Two equal charges +q are placed a distance d apart in front of an infinite earthed conducting plane such that each charge is at a distance d/2 from the plane. Magnitude of force on each charge is:

A. [illegible] B. $5q^2/2\pi\varepsilon_0 d^2$ C. $3q^2/2\pi\varepsilon_0 d^2$ D. $11q^2/12\pi\varepsilon_0 d^2$

Part-2

Answer ALL questions:

1. Two similar point charges are kept separated by a distance 2d in air. Now an earthed conducting sphere of radius R is placed midway between them. Assuming d >> R, if the introduction of the sphere just neutralizes the repulsive force existing between the point charges, the approximate value of R needs to be:

A. d/6 B. d/9 C. d/24 D. d/32 E. d/8 F. d/64 G. d/14
H. d/2 I. d/3

2. Consider a spherical shell of radius a with a surface charge distribution $\sigma(\theta) = \sigma_0 Cos\theta$, where σ_0 is a constant and θ is the polar angle. The potential at any inside and outside point are: 3

A. $V_{inside} = (\sigma_0/3\varepsilon_0) rCos\theta$ and $V_{outside} = (\sigma_0 a^3/3\varepsilon_0)(Cos\theta/r^2)$
B. $V_{inside} = (\sigma_0/4\varepsilon_0)(r^2 Cos\theta/a)$ and $V_{outside} = (2\sigma_0 a^3/3\varepsilon_0)(Sin\theta/r^2)$
C. $V_{inside} = (3\sigma_0/4\varepsilon_0)(r^3 Cos\theta/a)$ and $V_{outside} = (4\sigma_0 a^3/\varepsilon_0)(Sin\theta/r^3)$
D. $V_{inside} = (3\sigma_0/4\varepsilon_0)(11r^2 Cos\theta/a^2)$ and $V_{outside} = (21\sigma_0 a^3/\varepsilon_0)(33Sin\theta/r^2)$
E. $V_{inside} = (3\sigma_0/\varepsilon_0)(11rCos\theta/a^2)$ and $V_{outside} = (21\sigma_0 a^5/\varepsilon_0)(2Cos\theta/r^3)$
F. $V_{inside} = (2\sigma_0/\varepsilon_0)(rCos\theta/a^4)$ and $V_{outside} = (9\sigma_0 a^5/\varepsilon_0)(1/2)(Cosec\theta/r^3)$
G. $V_{inside} = (4\sigma_0/3\varepsilon_0)(rSin\theta/a^3)$ and $V_{outside} = (7\sigma_0 a^5/5\varepsilon_0)(1/2)(Sec\theta/r^3)$
H. $V_{inside} = (\sigma_0/\varepsilon_0)(rCosec\theta/a)$ and $V_{outside} = (\sigma_0 a^5/\varepsilon_0)(1/2)(Tan\theta/r^3)$
I. $V_{inside} = (\sigma_0/\varepsilon_0)(rCosec\theta/a^3)$ and $V_{outside} = (\sigma_0 a^5/\varepsilon_0)(1/2)(Cot\theta/r^3)$

3. A charge density $\sigma = ASin5\theta$ is glued over the surface of an infinite cylinder of radius R, where A is a constant. The potential at any inside and outside points are: 4

A. $V_{inside} = (Ar^5 Sin5\theta/10\varepsilon_0 R^5)$ and $V_{outside} = (AR^5 Sin5\theta/10\varepsilon_0 r^5)$
B. $V_{inside} = (A^5 r^5 Sin5\theta/5\varepsilon_0 R^5)$ and $V_{outside} = (R^5 Sin5\theta/A^5 10\varepsilon_0 r^5)$
C. $V_{inside} = (ArSin\theta/\varepsilon_0 R)$ and $V_{outside} = (RSin\theta/A\varepsilon_0 r)$
D. $V_{inside} = (Ar^2 Sin5\theta/10\varepsilon_0 R^6)$ and $V_{outside} = (AR^5 Sin5\theta/10\varepsilon_0 r^6)$
E. $V_{inside} = (Ar^5 Sin5\theta/10\varepsilon_0 R^4)$ and $V_{outside} = (AR^6 Sin5\theta/10\varepsilon_0 r^5)$
F. $V_{inside} = (Ar^5 Sin5\theta/25\varepsilon_0 R^4)$ and $V_{outside} = (AR^5 Sin5\theta/25\varepsilon_0 r^5)$
G. $V_{inside} = (Ar^5 Sin5\theta/8\varepsilon_0 R^5)$ and $V_{outside} = (AR^5 Sin5\theta/8\varepsilon_0 r^5)$
H. $V_{inside} = (Ar^5 Sin5\theta/10\varepsilon_0 R^5)$ and $V_{outside} = (AR^6 Sin5\theta/10\varepsilon_0 r^5)$
I. $V_{inside} = (Ar^5 Sin5\theta/5\varepsilon_0 R^4)$ and $V_{outside} = (AR^6 Sin5\theta/5\varepsilon_0 r^5)$

19+1 = 20

Expected Mark = 19