Second Year
Fields and Wave Propagation ELC 2050
Fall 2020

Quiz 1

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Model Answer

Total number of points in this Exam is 8 points.

Choose the right answer: (Each requirement worths 1 point)

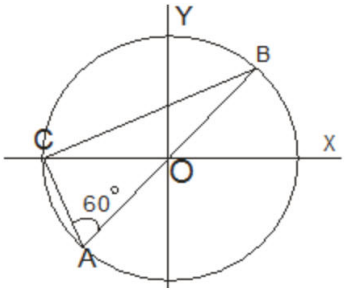
1. Consider a system of three charges q/3, q/3 and –2q/3 placed at points A, B and C respectively as shown in the figure. Take O to be the centre of the circle of radius R and angle CAB = 60º, which is the true statement from the following?

(a) The electric field at point O is $q/8\pi\varepsilon_0 R^2$

(b) The magnitude of the force between the charges at C and B is $q^2/54\pi\varepsilon_0 R^2$

(c) The potential energy of the system is zero

(d) The potential at point O is $q/12\pi\varepsilon_0 R$



The electric field at O is due to the negative charge at C only since the equal positive charges situated at A and B will produce equal and opposite fields at O (and they will mutually cancel). The field at O is therefore negative and the option (a) is obviously wrong. Option (c) also is obviously wrong.
The magnitude of the force (F) between the charges at C and B is given by
Thus,

$$F = \frac{1}{4\pi\epsilon_0}\frac{(2q/3)(q/3)}{(2R\sin 60)^2}$$

or

$$F = \frac{q^2}{54\pi\epsilon_0 R^2}$$

Hence (b) is correct

2. As per Gauss law $\oint_{S_c} \underline{E}\cdot\underline{ds} = \frac{1}{\varepsilon_o}\sum_{\substack{\text{enclosed}\\ \text{by } S_c}} Q$

Which of the following is true about this?

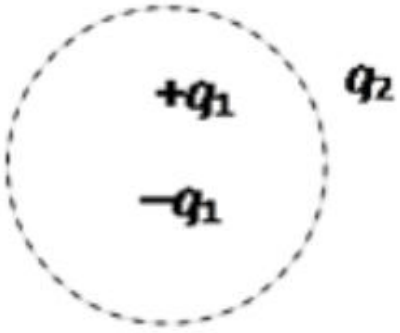
(a) This is valid for symmetrical surface only

(b) E is the electric field to the charge inside the surface

(c) Electric flux on the closed surface due to outside charge is always zero

(d) none of the above

3. Consider the charge configuration and spherical Gaussian surface as shown in the figure. When calculating the electric field intensity over the spherical surface, the electric field will be due to



(a) q_2

(b) Only the positive charges

(c) All the charges

(d) $-q_1$ and $+q_1$

Answer is (c)
The electric field is due to all charges present whether inside or outside the given surface.

4. A metallic shell having inner radius R_1 and outer radii R_2 has a point charge Q kept inside the cavity. Electric field in the region $R_1 < r < R_2$ where r is the distance from the centre is given by

(a) depends on the value of r

(b) Zero

(c) Constant and nonzero everywhere

(d) None of the above

Electric field inside the conductor is zero as electron move in such a way in the conductor so as to nullify any electric field produced by the charge
So answer is b

5. The electric potential at a point (x,y) in (x-y) plane is given by V=−xy. The total Electric Field intensity at a distance r from origin varies as

(a) r^2

(b) r

(c) 1/r

(d) $1/r^2$

$$V = -xy$$
Now
$$E_x = -\frac{\partial V}{\partial x} = y$$
$$E_y = -\frac{\partial V}{\partial y} = x$$
So
$$E = \sqrt{x^2 + y^2} = \sqrt{r^2} = r$$
So answer is (b)

6. The electrostatic potential on the surface of a charged conducting sphere is 200V. Two statments are made in this regard:
S1 : At any point inside the sphere, electric intensity is zero.
S2 : At any point inside the sphere, the electrostatic potential is 200V.
Which of the following is a correct statement?

(a) S1 is true but S2 is false.

(b) Both S1 & S2 are false.

(c) S1 is true, S2 is also true and S1 is the cause of S2.

(d) S1 is true, S2 is also true but the statements are independant.

7. Electric potential at any point x, y, z in the space is given $V=4x^2-3x$
Find the electric field at any point (x, y, z)

(a) (8x - 3) i

(b) -(8x - 3) i

(c) -8x i

(d) 8x i

$V = 4x^2 - 3x$
$E_x = \partial V/\partial x = 8x - 3$
$E_y = \partial V/\partial y = 0$
$E_z = \partial V/\partial z = 0$
So, $E = -(8x - 3)\mathbf{i}$
Hence (b) is correct

8. Electric potential at any point x, y, z in the space is given $V=4x^2-3x$
Equipotential surface in the region are

(a) planes parallel to X-Y plane

(b) planes parallel to Y-Z plane

(c) planes parallel to X-Z plane

(d) none of the above