PRACTICE MCQs

CLASS 12 PHYSICS (TERM - I)

ELECTRIC CHARGES AND FIELDS

BY

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learning simplified

Question 1:
The substances that offer high resistance to the passage of electricity through them are called as _____.
(a) Electric charges
(b) Insulators
(c) Conductors
(d) None of the above

Answer: (b) insulators
The non-metals like glass, porcelain, plastic, nylon, wood offer high resistance to the passage of electricity through them. They are called insulators.

Question 2:
_____ of electric charge means that the total charge of the body is always an integral multiple of basic quantum of a charge e.
(a) Additivity
(b) Conservation
(c) Quantization
(d) None of the above

Answer: (c) Quantization
Experimentally it is established that all free charges are integral multiples of a basic unit of charge denoted by e. Thus, charge q on a body is always given by q = ne where n is any integer, positive or negative.

Question 3:
If two-point charges q_1, q_2 are separated by a distance r in vacuum, the magnitude of the force (F) between them is given by:
(a) $F = k|q_1q_2|/(r)$
(b) $F= k\ |q_1+q_2|/(r)$
(c) $F= k|q_1q_2|/(r^2)$
(d) $F= k\ (q_1q_2)/(r^2)$

Answer: (c) F = k $\frac{|q_1q_2|}{r^2}$
The force between two-point charges varies inversely as the square of the distance between the charges and is directly proportional to the product of the magnitude of the two charges and acts along the line joining the two charges.

Question 4:
"Force on any charge due to a number of other charges is the vector sum of all the forces on that charge due to the other charges, taken one at a time. The individual forces are unaffected due to the presence of other charges." What is this known as?
(a) Coulomb's law
(b) Principle of superposition
(c) Quantization
(d) Electrostatic force

Answer: (b) Principle of superposition
The principle of superposition says that in a system of charges q_1 , q_2 , ..., q_n , the force on q_1 due to q_2 is the same as given by Coulomb's law, i.e., it is unaffected by the presence of the other charges q_3 , q_4 , ..., q_n. The total force F_1 on the charge q_1, due to all other charges, is then given by the vector sum of the forces F_{12}, F_{13}, ..., F_{1n}

Question 5:
Electric field is produced by which charge?
(a) Point charge
(b) Test charge
(c) Source charge
(d) Field charge

Answer: (c) source charge
The electric field due to a charge Q at a point in space is defined as the force that a unit positive charge q would experience if placed at that point. The charge Q, which is producing the electric field, is called a source charge and the charge q, which tests the effect of a source charge, is called a test charge.

Question 6:
If an electric dipole is kept in a uniform electric field, then resultant electric force on it is :
(a) always zero
(b) never zero
(c) depend upon capacity of dipole
(d) None

Answer: (a) always zero

Force on +q is qE and force on charge −q is −qE. Therefore, the total force will be sum of these two forces, and it will result in zero.

Question 7:
When a charged body comes in contact with the earth, all the excess charge on the body disappears by causing a momentary current to pass to the ground through the connecting conductor (such as human body). What the process of sharing the charges with earth known as?
(a) Quantization
(b) Polarity of charges
(c) Grounding or earthing
(d) None of the above

Answer: (c) Grounding or earthing
Earthing provides a safety measure for electrical circuits and appliances. A thick metal plate is buried deep into the earth and thick wires are drawn from this plate; these are used in buildings for the purpose of earthing near the mains supply. The electric wiring in our houses has three wires: live, neutral and earth.

Question 8:
Which of the following is not a basic property of electric charges?
(i) If a system contains n charges q_1, q_2, q_3, …, q_n, then the total charge of the system is $q_1 + q_2 + q_3 + … + q_n$
(ii) The total charge of the isolated system is always conserved
(iii) All free charges are integral multiples of a basic unit of charge denoted by e
(iv) Whenever there is transfer electrons from one body to the other, new charges are either created or destroyed
(a) (i), (ii), (iii)
(b) (iv)
(c) (i) and (iv)
(d) (ii) and (iv)

Answer: (b) (iv)
When bodies are charged by rubbing, there is transfer of electrons from one body to the other; no new charges are either created or destroyed. When the two bodies are rubbed, what one body gains in charge the other body loses. Within an isolated system consisting of many charged bodies, due to interactions among the bodies, charges may get redistributed but it is found that the total charge of the isolated system is always conserved.

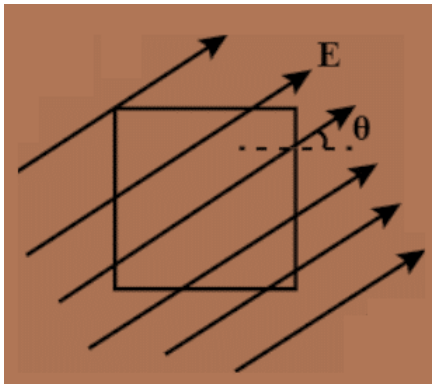
Question 9:
When a pair of equal and opposite point charges q and –q separated by a distance 2a.What is this termed as?
(a) Electric flux
(b) Electric field
(c) Electric dipole
(d) None of the above

Answer: (c) Electric dipole
An electric dipole is a pair of equal and opposite point charges q and –q, separated by a distance 2a. The line connecting the two charges defines a direction in space. By convention, the direction from –q to q is said to be the direction of the dipole. The mid-point of locations of –q and q is called the centre of the dipole.

Question 10:
How many electrons will be lost by an object if it attains +1 C of charge?
(a) 6.25×10^{18}
(b) 16.23×10^{10}
(c) -6.25×10^{17}
(d) -1

Answer: (a) 6.25×10^{18}
6.25×10^{18} electrons are in 1C of charge.
Using Q=ne
where Q = charge
n = number of electrons
e = charge on one electron
So, n=(Q/e)
$=(1C)/(1.6 \times 10^{-19})$
$=0.625 \times 10^{19}$
$=6.25 \times 10^{18}$

Question 11:
A square surface of side L meter in the plane of the paper is placed in a uniform electric field E(volt/m) acting along the same plane at an angle with the horizontal side of the square as shown in figure. The electric flux linked to the surface, in units of volt−m, is



(a) EL^2
(b) $EL^2/2\varepsilon_0$
(c) $EL^2/2$
(d) zero

Answer: (d) zero
As the electric field lines are parallel to the surface, so there will not be any field lines crossing the surface. Hence, the electric flux through the surface is 0.

Question 12:
"The total electric flux through a closed surface is zero if no charge is enclosed by the surface" this result of electrostatics is called as _____.
(a) Coulomb's law
(b) Parallelogram law
(c) Gauss's law
(d) Law of superposition

Answer: (c) Gauss's law
Electric flux through a closed surface $S = q/\varepsilon_0$ where q = total charge enclosed by S. The law implies that the total electric flux through a closed surface is zero if no charge is enclosed by the surface.

Question 13:
State which of the following statements are true
Statement i: The term q on the right side of Gauss's law i.e. $S = q/\varepsilon_0$, includes the sum of all charges enclosed by the surface. The charges may be located anywhere inside the surface.
Statement ii: Gauss's law is based on the inverse square dependence on distance contained in the Coulomb's law. Any violation of Gauss's law will indicate departure from the inverse square law.

(a) Both the statements are true
(b) Both the statements are false
(c) Only statement I is true
(d) Only statement ii is true

Answer: (a) Both the statements are true

Question 14:
The SI unit of permittivity of free space ε_0 is _____.
(a) $C^2\ N^{-1}m^{-2}$
(b) $C\ N^{-2}m^{-2}$
(c) $C^2\ N^{-1}m^{-1}$
(d) CNm

Answer: (a) $C^2N^{-1}m^{-2}$
$\varepsilon_0 = (1/\mu_0 C_2)$ where ε_0 is permittivity of free space.
μ_0=magnetic constant
And C is the speed of light

Question 15:
Which of the following is a scalar quantity?
(a) electric flux
(b) electric dipole moment
(c) gravitational force
(d) torque

Answer: (a) electric flux
Electric flux is a dot product of two vectors, electric field and area vector and hence it is a scalar.

Question 16:
Which of the following statements is not true about Gauss's law?
(a) Gauss's law is true for any closed surface.
(b) The term q on the right side of Gauss's law includes the sum of all charges enclosed by the surface.
(c) Gauss's law is not much useful in calculating electrostatic field when the system has some symmetry.

(d) Gauss's law is based on the inverse square dependence on distance contained in the coulomb's law

Answer: (c) Gauss's law is not much useful in calculating electrostatic field when the system has some symmetry.

Gauss's law is useful in calculating of electrostatic field when the system has some symmetry. This is achieved by the choice of a suitable Gaussian surface.

Question 17:

Two charges of equal magnitudes kept at a distance r exert a force F on each other. If the charges are halved and distance between them is doubled, then the new force acting on each charge is

(a) (F/8)
(b) (F/4)
(c) 4F
(d) (F/16)

Answer. (d) (F/16)

From Coulomb's law the force between two points charges q_1 and q_2, separated by a distance r is given by

$F= (1/4\pi\varepsilon_0) (q_1q_2)/(r^2)$

As $q_1=q_2=q$

Therefore, $F= (1/4\pi\varepsilon_0) (q^2)/(r^2)$ (1)

In second case when $q_1=q_2=(q/2)$ and $r'=2r$

Then, $F' = (1/4\pi\varepsilon_0) (q/2)^2/(2r)^2$

$= (1/4) (q^2/16r^2)$ (2)

Dividing (2) by (1) we get,

$(F'/F) = (q^2/16r^2) x(r^2/q^2)$

$= (1/16)$

$F'=(F/16)$

Question 18:

What will a dipole experienceswhen placed in a uniform electric field?

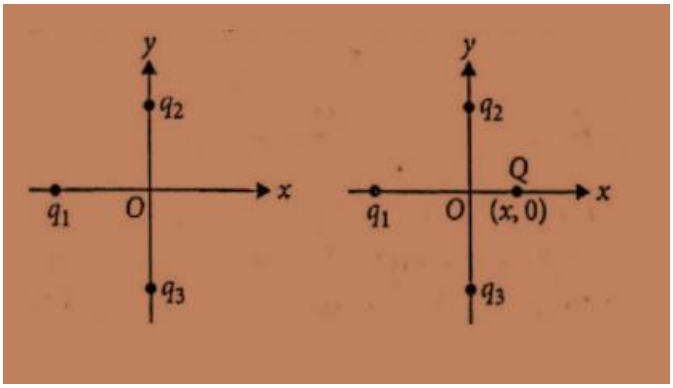
(a) Torque
(b) Net force
(c) Both net force and torque
(d) None of the above

Answer: (a) Torque

Consider a permanent dipole of dipole moment p in a uniform external field E. There is a force qE on q and a force –qE on –q. The net force on the dipole is zero, since E is uniform. However, the charges are separated, so the forces act at different points, resulting in a torque on the dipole. When the net force is zero, the torque (couple) is independent of the origin. Its magnitude equals the magnitude of each force multiplied by the arm of the couple (perpendicular distance between the two antiparallel forces). Magnitude of torque = q E × 2 a sinθ = 2 q a E sinθ

Question 19:

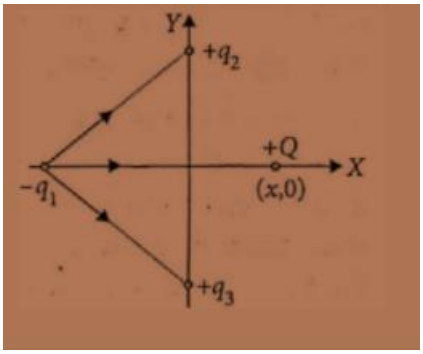
In Fig. (i) two positive charges q_2 and q_3 fixed along the y-axis, exert a net electric force in the +x direction on a charge q_1 fixed along the x-axis. If a positive charge Q is added at (x, 0) in figure (ii), the force on q_1 is



(a) shall increase along the positive x-axis.
(b) shall decrease along the positive x-axis.
(c) shall point along the negative x-axis.
(d) shall increase but the direction changes because of the intersection of Q with q_2 and q_3.

Answer. (a) shall increase along the positive x-axis.

As positive charge q_2, q_3 exert a net force in +X direction on the charge q1 fixed along the X-axis, the X-axis, the charge q_1 is negative as shown in figure. Obviously, due to addition of positive charge Q at (x,0), the force on −q shall increase along the positive X-axis.



Assertion Reason Based Questions

In the following questions from 20 to 22 a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are true and the reason is the correct explanation of assertion.
(b) Both assertion and reason are true but the reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

Question 20:
Assertion: In a non-uniform electric field, electric dipole experiences both net force and torque.
Reason: Consider a permanent dipole of dipole moment p in a non-uniform external field E. The net force on the dipole is not zero, since E is non-uniform. The charges are separated, so the forces act at different points, resulting in a torque on the dipole.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Question 21:
Assertion: A Gaussian surface can pass through a continuous charge distribution but cannot pass through a discrete charge.
Reason: The electric field due to a system of discrete charges is not well defined at the location of any charge.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Question 22:
Assertion: Violation of Gauss's law will indicate departure from the Coulomb's inverse square law.
Reason: Gauss's law is based on the inverse square dependence on distance contained in the Coulomb's law. Hence if Gauss's law is not satisfied then the Coulomb's law also doesn't hold good.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Case Study Based Questions

Question 23:
The experience of seeing a spark or hearing a crackle when we take off our synthetic clothes or sweater, particularly in dry weather. This is almost inevitable with ladies' garments like a polyester saree. Another common example of electric discharge is the lightning in the sky during thunderstorms. We also experience a sensation of an electric shock either while opening the door of a car or holding the iron bar of a bus after sliding from our seat. The reason for these experiences is discharge of electric charges through our body, which were accumulated due to rubbing of insulating surfaces. This is due to generation of static electricity.

1) Static means _____.
(a) Anything that doesn't move
(b) Sudden movement
(c) Discharge of electric charges
(d) None of the above

2) _____ deals with the study of forces, fields and potentials arising from Static charges.
(a) Electrodynamics

(b) Electric field
(c) Electrical analysis
(d) Electrostatics

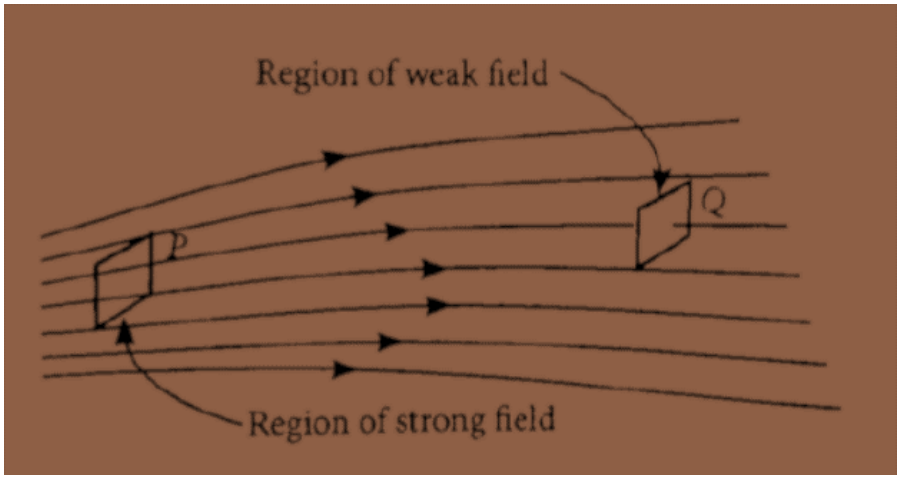
3) When the glass rod is rubbed with silk, they are attracted to each other because, ___
(a) Glass rod is positively charged and silk is negatively charged
(b) Glass rod is negatively charged and silk is positively charged
(c) Frictional force
(d) Both (a) and (b)

4) Unlike charges ____ each other.
(a) Repel
(b) Attract
(c) Both attract and repel
(d) Charge

5) When an object possesses no charge, it is said to be _____.
(a) Electrified
(b) Charged
(c) Electrically neutral
(d) Electrostatically neutral

Answer:
1) (a) Anything that doesn't move
2) (d) Electro statistics
3) (a) Glass rod is positively charged and silk is negatively charged.
4) (b) Attract
5) (d) Electrically neutral

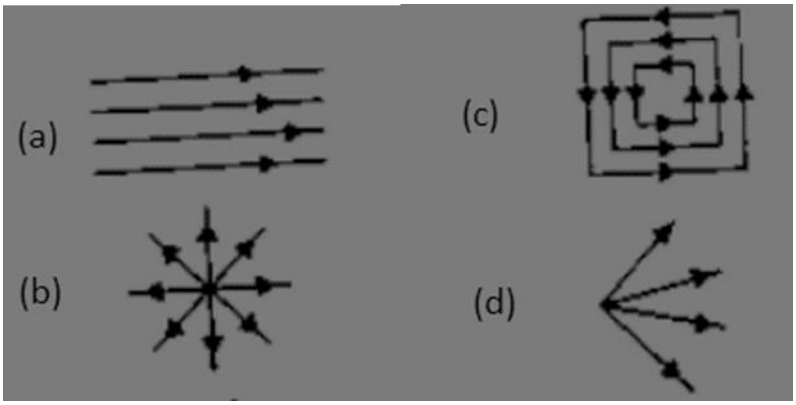
Question 24:
Electric field strength is proportional to the density of lines of force i.e., electric field strength at a point is proportional to the number of lines of force cutting a unit area element placed normal to the field at that point. As illustrated in given figure, the electric field at P is stronger than at Q.



1) Electric lines of force about a positive point charge are
(a) radially outwards
(b) circular clockwise
(c) radially inwards
(d) parallel straight lines

2) Which of the following is false for electric lines of force?
(a) They always start from positive charge and terminate on negative charges.
(b) They are always perpendicular to the surface of a charged conductor.
(c) They always form closed loops.
(d) They are parallel and equally spaced in a region of uniform electric field.

3) Which one of the following patterns of electric line of force is not possible in field due to stationary charges?

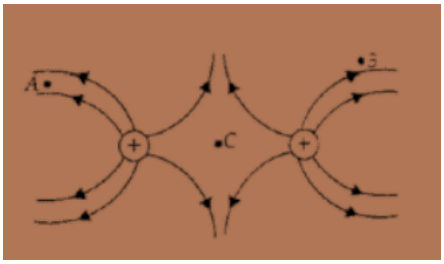


4) Electric field lines are curved
(a) in the field of a single positive or negative charge
(b) in the field of two equal and opposite charges.

(c) in the field of two like charges.
(d) both (b) and (c)

5) The figure below shows the electric field lines due to two positive charges. The magnitudes E_A, E_B and E_C of the electric fields at point A, B and C respectively are related as

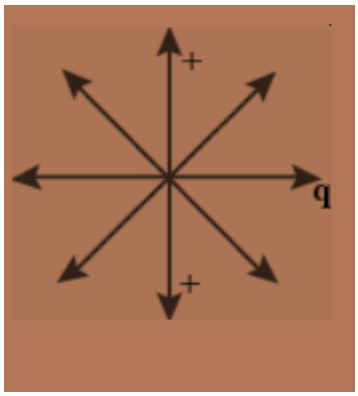
(a) $E_A > E_B > E_C$
(b) $E_B > E_A > E_C$
(c) $E_A = E_B > E_C$
(d) $E_A > E_B = E_C$



Answer:

1) (a) radially outwards

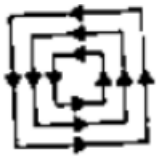
Electric lines of force about a positive point charge are always radially outwards.



2) (c) They always form closed loops.

Electric lines of force do not form any closedloops.

3)

(c) 

Electric field lines can't be closed.

4) (d) both (b) and (c)

5) (c) $E_A = E_B > E_C$

No. of electric field lines crossing is proportional to the magnitude of charge. At point "C" there is no electric field line crossing therefore, charge is 0 at that point.

Question 25:

For electrostatics, the concept of electric field is convenient, but not really necessary.Electric field is an elegant way of characterizing the electrical environment of a system ofcharges. Electric field at a point in the space around a system of charges tells you the forcea unit positive test charge would experience if placed at that point (without disturbing thesystem). Electric field is a characteristic of the system of charges and is independent of thetest charge that you place at a point to determine the field. The term field in physicsgenerally refers to a quantity that is defined at every point in space and may vary frompoint to point. Electric field is a vector field, since force is a vector quantity.

1) Which of the following statement is correct? The electric field at a point is
(a) always continuous.
(b) continuous if there is a charge at that point.
(c) discontinuous only if there is a negative charge at that point.
(d) discontinuous if there is a charge at that point.

2) The force per unit charge is known as
(a) electric flux
(b) electric field
(c) electric potential
(d) electric current

3) The SI unit of electric field is
(a) CN^{-1}
(b) N-m
(c) NC^{-1}
(d) N/C^2

4) The magnitude of electric field intensity E is such that, an electron placed in itwould experience an electrical force equal to its weight is given by
(a) mge
(b) mg/e
(c) e/mg
(d) e^2g/m^2

5) At a particular point, Electric field depends upon
(a) Source charge Q only
(b) Test Charge q_0 only.
(c) Both q and q_0
(d) Neither Q nor q_0

Answer:

1) (b) continuous if there is a charge at that point.

Electric field at a point is continuous if there is no charge at that point.

2) (b) electric field

The force per unit charge (E = F/q) is called the electric field. So option (a) is correct.
The electric charge flowing per unit time is called current.
The electric field per unit area is called electric flux.
The electrostatic potential energy per unit charge is called electric potential.

3) (c) NC^{-1}

E=(F/q)
Hence, SI unit of electric field intensity is N/C= NC^{-1}

4) (b) (mg/e)

Force on electron
|F| =qE = eE =mg
E=(mg/e)

5) (a) Source charge Q only

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