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QUESTION PAPER FOR CBT JULY 2023-24

CLASS :-XII
SUBJECT:-PHYSICS

TOPIC :-
ELECTROSTATICS

CASE STUDY – I

Electric Charges and Field**s**

Read the following article and answer four questions follows

The total number of electric field lines passing through a given area in a unit time isdefined as the electric flux.

If plane is normal to the flow of the electric field, the total flux is given as Φ=EA

When the same plane is tilted at an angle, the projected area is given as **A cosθ** and the total flux through this surface is given as **Φ=EA cos θ**

Where **E** is the magnitude of the electric field.

A is area of the surface through which the electric flux is to be calculated. **θ** is the angle made by the plane and the axis parallel to the direction of flow of the electric field.
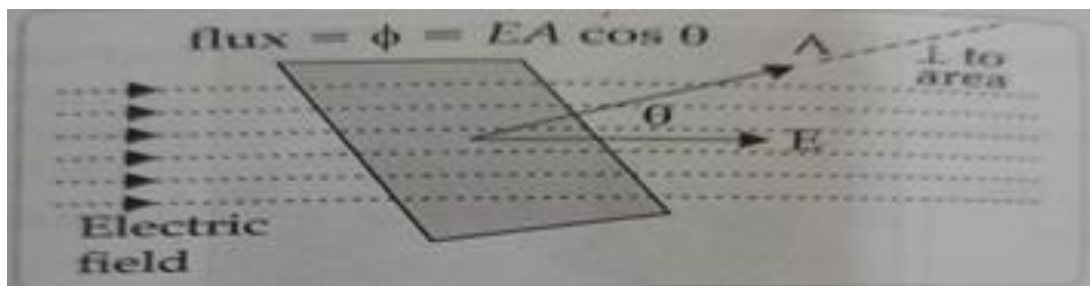
1.   1.if a unit positive charge is kept in the air, then what is the total flux comingout of unit charge is

   (a) q/ε_0

   (b) $1/\varepsilon_0$

   (c) zero

   (d) q/ε_0

   Ans - b
   Feedback – flux = q/ε_0 (Gauss's law)
   For unit charge , flux = $1/\varepsilon_0$

2.   Q2 when is the flux through a surface taken as positive   1 point

○ (a) When the flux lines are directed outward

○ (b) when the flux lines are directed inward

○ (c) when no charge is there

○ (d) when charge is negative.

Ans - a

Feedback - As per convention it is positive when the flux lines are directed outward

Q3 A plane surface is rotated in a uniform electric field. During its rotationwhen is the flux of the electric field through the surface is maximum.

○ (a) when surface is parallel to field lines

○ (b) when surface is anti parallel to field lines

○ (c) when surface is perpendicular to field lines

○ (d) when area vector is inclined at an angle 45' to field lines.

Ans - c

Feedback - when surface is perpendicular, maximum flux is associated with surface.

Q4 What is the value of electric flux on a plane of area 1 square meter onwhich an electric field of 3 Volt/m crosses with an angle of 30⁰

○ (a) 1Vm

○ (b) 2Vm

○ (c) 3Vm

○ (d) 1.5Vm

Ans - d

Feedback - electric field making angle with surface = 30 degree
Therefore electric field making an angle with area vector = 90 – 30 = 60 degree
Flux = EAcosθ = 3*1*cos60⁰ = 3*1*(1/2) = 1.5 Vm

CASE STUDY – II

Electrostatic Potential and Capacitance
Read the following article and answer four questions follows

An arrangement of two conductors separated by an insulating medium can be used to store electric charge and electric energy. Such a system is called a capacitor. The more charge a capacitor can store, the greater is its capacitance. Usually, a capacitor consists of two conductors having equal and opposite charge +Q and -Q. Hence, there is a potential difference V between them. By the capacitance of a capacitor, we mean the ratioof the charge Q to the potential difference V. By the charge on a capacitor we mean only the charge Q on the positive plate. Total charge of the capacitor is zero. The capacitance of a capacitor is a constant and depends on geometric factors, such as the shapes, sizes and relative positions of the two conductors, and the nature of the medium between them.The unit of capacitance is farad (F), but the more convenient

units are µF and pF. A commonly used capacitor consists of two long strips or metal foils, separated by two long strips of dielectrics, rolled up into a small cylinder. Common dielectric materials are plastics (such as polyesters and polycarbonates) and aluminum oxide. Capacitors are widely used in radio, television, computer, and other electric circuits.
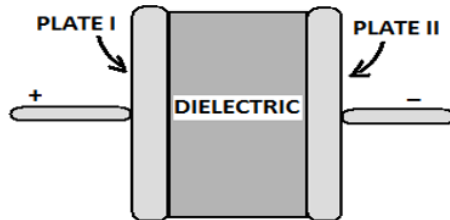
Q5. A parallel plate capacitor is charged. If the plates are pulled apart   1 point

( ) (a) the capacitance increases

( ) (b) the potential difference increases(c)the

( ) total charge increases

( ) (d) the charge & potential difference remains the same

Ans - b

(d) Feedback - C = ε0*A/d

if plates are pulled apart , d increases and hence C decreases.
From formula C = q/V   we can conclude that as C decreases so V increases.

Q6. Three capacitors of 2 , 3 & 6 µF are connected in series to a 10 V source. 1 point
The charge on the 3 µF capacitor is

( ) (a) 5µC

( ) (b) 10µC

( ) (c) 12µC

( ) (d) 15µC

Ans - b

Feedback - Net capacitance , 1/C = (1/C1) + (1/C2) + (1/C3)
1/C = (½)+(1/3)+(1/6)   this gives C= 1 **µF**

So charge on each capacitor is =   Q=CV = 1*10 = 10 µC

Q7. A parallel plate capacitor is made of two dielectric blocks in series. One of the   1 point
blocks has thickness d1 and dielectric constant K1 and the other has thickness d2 and dielectric constant K2 as shown in figure. This arrangementcan be thought as a dielectric slab of thickness d (= d1 + d2) and effective dielectric constant K. Then K is
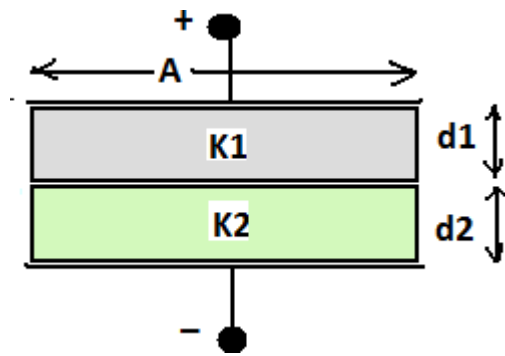
(a) (K1d1+K2d2)/(d1+d2)

(b)$K1d1+K2d2/K1+K2$

(c)$K1K2(d1+d2)/K2d1+K1d2$

(d)$2K1K2/K1+K2$

Ans - c

Feedback - Capacitance with dielectric is given by $C = \dfrac{\varepsilon_0 A}{\dfrac{d1}{K1}+\dfrac{d2}{K2}}$

Capacitance of a capacitor of effective dielectric constant K is $C = \dfrac{\varepsilon_0 A}{\dfrac{d}{K}}$

comparing the equation we get $K = \dfrac{k1k2(d1+d2)}{k2d1+k1d2}$

Q8. In the circuit shown in figure initially key K1 is closed and keys K2 is open. Then K1 is opened and K2 is closed (order is important). [Take Q1′ and Q2′ as charges on C1 and C2 and V1 and V2 as voltage respectively. Then which of the options are correct:

(A) charge on C1 gets redistributed such that V1 = V2

(B) charge on C1 gets redistributed such that Q1′ = Q2

(C) charge on C1 gets redistributed such that C1V1 + C2V2 = C1 E

(D) charge on C1 gets redistributed such that Q1′ + Q2′ = Q
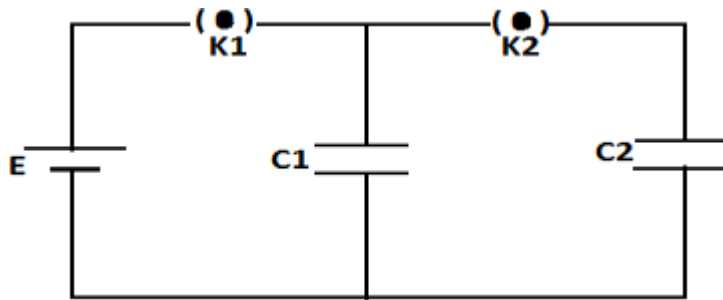
○ (a) Option (A) & (B)

○ (b) Option (A),(B) & (C)

○ (c) Option (A) & (C)

○ (d) Option (A) & (D)

Ans – d

Feedback - When K1 is closed only capacitor C1 is charged.
When K1 open and K2 closed, charge gets redistributed in C1 and C2.
Charge stored on C1 = QV (when K1 closed)
When K2 closed, charge redistributed until both capacitor come to equal potential.
so V1=V2
And total charge is given by Q1'+Q2'=Q

ASSERTION – REASON QUESTIONS

Directions: These questions consist of two statements, each printed as Assertion and Reason.

While answering these questions, you are required to choose any one of the following four responses.

Q9. Assertion : A parallel plate capacitor is connected across battery through a key. A dielectric slab of dielectric constant K is introduced betweenthe plates. The energy which is stored becomes K times.

Reason : The surface density of charge on the plate remains constant or unchanged.

   ( ) (a) Both Assertion and Reason are correct and the Reason is a correct explanationof the Assertion.

   ( ) (b) Both Assertion and Reason are correct but Reason is not a correct explanationof the Assertion.

   ( ) (c) Assertion is correct, Reason is incorrect

   ( ) (d) Both Assertion and Reason are incorrect.

Ans – c
Feedback - Assertion is correct but reason is false.

Q10. Assertion: Two equipotential surfaces cannot intersect each other.   1 point

Reason: Two equipotential surfaces are parallel to each other.

   ( ) (a) Both Assertion and Reason are correct and the Reason is a correct explanationof the Assertion.

   ( ) (b) Both Assertion and Reason are correct but Reason is not a correct explanationof the Assertion.

   ( ) (c) Assertion is correct, Reason is incorrect

   ( ) (d) Both Assertion and Reason are incorrect.

Ans - b
Feedback - Both assertion and reason are correct but it is not correct explaination.

Answer Key July Month CBT Physics XII

Q No	Answer
1	b
2	a
3	c
4	d
5	b
6	b
7	c
8	d
9	c
10	b

Feedback:
1. Average score in this test is 6.32/10
2. Question 5 and 6 are scored by most of the students,
3. Question 10 is scored by least No of students.
4. Median marks scored by students is 6