Physics 2nd - Chpt 2nd

1. Coulomb's formula for free space, F?

Hints: ϵ₀ = Vacuum permittivity, q = Coulomb, d = distance (m)

A. F = (1/4πϵ₀) × (q₁q₂/d²) (ans.)

B. F = (1/2πϵ₀) × (q₁q₂/d²)

C. F = ϵ₀q₁q₂/d²

D. F = q1q2 /2ϵ₀d2

Ans: F = (1/4πϵ₀) × (q₁q₂/d²)

Prove:

We know, F = C × (q₁q₂ / d²) ------ (i)

When the SI unit measures the force in Newtons (N), the distance in meters (m) and the charge in coulombs (C), the value of the constant C, proportional to Coulomb's formula, is found for vacuum,

C =9 × 10⁹ N m² C⁻²

In the SI method this proportional constant is written,

C = 1 / 4πϵ₀

Although this solvent may seem seemingly complex, it is expressed in this way because it simplifies the form of other important formulas and equations of electromagnetic knowledge.

So, C

= 1 / 4πϵ₀ = 9 × 10⁹ N m² C⁻²

Here ϵ₀ is a constant number which is called permittivity of free space. If its measured value is,

ϵ₀ = 8.854 x 10⁻¹² C² N⁻¹ m⁻²

So the form of Coulomb's formula (from Eq. i) for space is,

F = 1 / 4πϵ₀ × (q₁q₂/d²)

2. Coloumb's formula, F?

Hints: ϵ₀ = Permittivity of free space, q = Coulomb, d = distance (m)

A. F = (1/4πϵ₀) × (q₁q₂/d²) (ans.)

B. F = (1/2πϵ₀) × (q₁q₂/d²)

C. F = q1q2 /2ϵ₀d2

D. F = ϵ₀q₁q₂/d²

Ans: F = (1/4πϵ₀) × (q₁q₂/d²)

Prove:

We know, F = (1/4πϵ₀) × (q₁q₂/d²) ----- (i)

So, Fₘ = (1/4πϵ₀) × (q₁q₂/d²) ----(ii)

Suppose, F = force between two charges in a vacuum.

Fₘ = force between any two charges at the same distance through either.

K = The electrical mean of the medium.

So, K = F / Fₘ ------- (iii)

The electric mean is the ratio of two similar numbers, so there is no unit. The electric mean of glass is 7, which means that the force acting on the glass at any distance between the two charges acts 7 times the force between the two charges at the same distance in space. From (i) and (ii) equations F and F, (iii) we get,

K = ϵ / ϵ₀ -----(iv)

From this equation, it is seen that the ratio of the permeability of a medium to the permeability of a space is the electric mean or ultraviolet constant. This is also called relative permeability. That is, relative permeability,

ϵᵣ= ϵ / ϵ₀ ------(v)

From equation (iv) we get, ϵ = ϵ₀K

Now obtained from the equation (ii) or (iii),

F = (1/4πϵ₀) × (q₁q₂/d²)

3. Formula of the force acting on a charge, F?

Hints: q = Charge, E = Electric field, F = force acting on a charge

A. F = qE (ans.)

B. F =

C. F =

D. F = - qE

Ans: F = qE

Prove: We know, E = F / q

So, F = qE

4. Formula of Electric field, E?

Hints: E = Electric field, ϵ₀ = Vacuum permittivity, q = charge, r = distance between charges, K = Electric mean

A. E = (1/4πϵ₀K) × (q/r²) (ans.)

B. E = (1/4πϵ₀K) × (q2/r2)

C. E = (1/16πϵ₀2K) × (q2/r²)

D. E = (4πϵ₀K) × (q/r²)

Ans: E = (1/4πϵ₀K) × (q/r²)

Prove:

Suppose, a small charge at point P + q₀. When placed (Figure). Now force the triad on the q₀ charge, F = (1/4πϵ₀K) × (qq₀/r²) --------(i)

But the force of electricity is the force on a single positive charge.

So the electric field strength of point P,

E = F / q₀

(i) From the equation we get the value of F,

E = (1/4πϵ₀K) × (qq₀/r²q₀)

or, E = (1/4πϵ₀K) × (q/r²)

5. Formula of Electric field, E?

Hints: E = Electric field, ϵ₀ = Vacuum permittivity, q = charge, r = distance between charges

A. E = (1/4πϵ₀) × (q/r²) (ans.)

B. E = (4πϵ₀) × (q/r²)

C. E = (1/16πϵ₀2) × (q2/r²)

D. E = (1/4πϵ₀) × (q/r²)

Ans: E = (1/4πϵ₀) × (q/r²)

Prove:

Suppose, a small charge at point P + q₀ when placed (Figure). Now force the triad on the q₀ charge, F = 1 / 4πϵ₀K × (qq₀/r²) --------(i)

But the force of electricity is the force on a single positive charge.

So the electric field strength of point P,

E = F / q₀

(i) From the equation we get the value of F,

E = (1/4πϵ₀K) × (qq₀/r²q₀)

or, E = (1/4πϵ₀K) × (q/r²)

+q When the charge is placed through a vacuum or air, the value of the electric medium K is taken to be 1. In that case, electricity will prevail,

E = (1/4πϵ₀) × (q/r²)

6. Formula of Electric field, E?

Hints: E = Electric field, σ = Infusion concentration, ϵ = Vacuum permittivity

A. E = (ans.)

B. E = σ × ϵ

C. E =

D. E =

Ans: E =

Prove:

Suppose a sphere K is located through an angle with an electric medium. If +Q amount of charge is evenly distributed on the surface of an isolated galactic conductor, that charge can be considered as a point charge placed at the center of that galactic conductor. If the radius of a galvanic conductor is r then the force of electric field on its surface,

E = 1 / 4πϵ₀K × (Q/r²)------(i)

The amount of charge per unit area of ​​a conductor injured at an angle is called its charge density σ. Since the surface area of ​​the conductor is A = 4πr². So the charge density on its surface,

σ = Q / A = Q / 4πr² -----(ii)

From equation (i) and (ii) we get,

E = σ / ϵ₀K------(iii)

But we know that the permeability of any medium is ϵ if ϵ = ϵ₀K; So the equation (iii) can be written,

E = σ / ϵ

7. Formula of W? [From B to A]

Hints: q = charge, Vᴀ = Potential of A point, Vʙ = Potential of B point

A. W = q (VA – VB) (ans.)

B. W = q (VB – VA)

C. W =

D. W = qVB × qVA

Ans: W = q (VA - VB) (ans.)

Prove:

If the voltages of the two points A and B in the electric field at the angle are Vᴀ & Vʙ and, voltage is able to move every single positive charge from point B to point A then Work (W) = Vᴀ - Vʙ

Thus, it manages to move a single positive charge from point B to point A.

So, W = q (Vᴀ - Vʙ)

VB – VA

8. Formula of W? [From A to B]

Hints: q = charge, Vᴀ = Potential of A point, Vʙ = Potential of B point

A. W = q (VB – VA) (ans.)

B. W = q (VA – VB)

C. W = qVA × qVB

D. W =

Ans: W = q (Vʙ - Vᴀ) (ans.)

Prove:

If the voltages of the two points B and A in the electric field at the angle are Vʙ & Vᴀ and, voltage is able to move every single positive charge from point A to point B then Work (W) = Vʙ - Vᴀ

Thus, it manages to move a single positive charge from point A to point B.

So, W = q (Vʙ - Vᴀ)

9. Formula of V? [Electric field]

Hints: V = Potential, ϵ₀ = Vacuum permittivity, q = charge, r = radius

A. V = (1/4πϵ₀) × (q/r) (ans.)

B. V = (1/4πϵ₀) × (q/r2)

C. V = (1/4πϵ₀) × (q2 – r2)

D. V = (1/4πϵ₀) × (qr)

Ans: V = (1/4πϵ₀) × (q/r)

Prove:

We know, E = (1/4πϵ₀K) × (q/r²)

dV = Force on a single positive charge × the component of the movement towards the ball

= E × dr cos 180° [Since the force E and the shift dr are opposite to each other, their inclusion angle is 180]

So, dV = - Edr

or, dV = - (1/4πϵ₀K) × (q/r²) dr

By adding we get,

∫₀ⱽ = - ∫ʳ∞ (1/4πϵ₀K) × (q/r²) dr

= - (q/4πϵ₀K) ∫ʳ∞ dr/r²

[V]ⱽ₀ = - (q/4πϵ₀K) × [-1/r]ʳ∞

Or, V - 0 = - (q/4πϵ₀K) × [-1/r + 1/∞]

Or, V = (1/4πϵ₀K) × q/r

If, K = 1 [If the medium is air or empty]

Then,

V = (1/4πϵ₀) × (q/r)

10. Formula of p?

Hint: p = electric dipole moment, q = charge, l = distance between two opposite charges

A. p = q × 2l C m (ans.)

B. p = q × 2l N m

C. p = C m

D. p = Cm-1

Ans: p = q × 2l C m

B. p = q × l m

C. p = q × 2l N m

D. p = 2l / q C m

Prove:

The distance between two equal and opposite point charges -q and +q is 2I. The straight line passing through the positive and negative charges of an electric bipolar at an angle is called the axis of that electric bipolar. The strength of an electric bipolar is measured by its electric dipole moment.

Electric bipolar illusion: An electric bipolar is the product of a charge at any point on an electric bipolar and the distance between them.

So, p = q × 2l

11. Formula of E? (figure)

Hints: E = Intensity of Energy, p = point, r = radius

A. E = 1/4πϵ₀K × 2p/r3 (ans.)

B. E = 1/4πϵ₀K × 2p3/r

C. E = 1/4πϵ₀K × 2p3/r3

D. E =

Ans: E = 1/4πϵ₀K × 2p/r3

Prove:

Suppose an electromagnet is formed by combining two point charges -q and + q at a distance of 2I (Fig.). Suppose that the charges -q and + q are located at points A and B, respectively, through two K-medium electrodes. This electric current has to be determined from the midpoint O of the bipolar to the point P at a distance r on its axis.

Now, for the charge of point A -q, the force at point P is,

E₁ = (1/4**π**ϵ₀K) × -q/(r+l)2

Or E1 = (1/4**π**ϵ₀K) × q/(r+l)2  [along PC]

Again, for the q charge of point B, the force at point P,

E1 = (1/4**π**ϵ₀K) × q/(r-l)2  [along PD]

Whereas, E1 and E2 act in opposite directions along the same straight line and E1> E2, so the predominance at point P will be E,

E = E1 – E2, will be towards E2 along with PD

Therefore, E = (1/4**π**ϵ₀K) × q/(r-l)2  - (1/4**π**ϵ₀K) × q/(r+l)2

= q/4**π**ϵ₀K [1/(r-l)2 – 1/(r+1)2]

= q/4**π**ϵ₀K [ {(r+1)2 – (r-1)2} / r2 – l2)2]

= q/4**π**ϵ₀K × 4rl/(r2 – l2)2  , [along with PD]

Special field: If the point P is far away from the bipolar (r >> l) then l2 can be ignored as compared to r2. In that case,

E = 1/4**π**ϵ₀K × 2pr/r4

or, E = 1/4**π**ϵ₀K × 2p/r3

If the medium is zero or air, K = 1, so

E = 1/4**π**ϵ₀K × 2p/r3

12. Formula of V? (figure)

Hints: V = Electric Potential, p = point, r = radius

A. V = (1/4πϵ₀) × (p/r²) (ans.)

B. V = (1/4πϵ₀) × (p2/r²)

C. V = (1/4πϵ₀) × (p/r3)

D. V = (1/4πϵ₀) × (p3/r3)

Ans: V = (1/4πϵ₀) × (p/r²)

Prove:

Suppose an electromagnet is formed by the combination of two point charges -q and +q at a distance of 2I. (Figure) Suppose that the charges q and +q are located at the points A and B, respectively, through two K-medium electrodes. It is necessary to determine the electric potential at the point P at a distance r from the midpoint O of the bipolar on its axis. Now the voltage at point P for the charge of point A -q,

V1 = - (1/4πϵ₀K) × q/(r+l)  
Again, the voltage at point P for the charge q of point B,

V2  = (1/4πϵ₀K) × q/(r+l)

Now if the potential of point P is V,

V = V1 + V2  = - (1/4πϵ₀K) × q/(r+l) + (1/4πϵ₀K) × q/(r+l)

= q/4πϵ₀K [ 1/(r-l) - 1/(r+l) ]

= q/4πϵ₀K [ r+l-r+l/r2 – l2 ]

= (1/4πϵ₀K) × 2ql/(r2 – l2)

Thus, 2ql = p

V = (1/4πϵ₀K) × p/(r2 – l2)

Special field: If the point P is far away from the bipolar (r >> l) then l2 can be ignored as compared to r2. In that case,

V = (1/4πϵ₀K) × (p/r2)

If the medium is zero or air, K = 1, so

V = (1/4πϵ₀) × (p/r2)

13. Formula of E? (figure)

Hints: ϵ₀ = Permittivity of free space, r = radius, E = Intensity of Electric field, p = point

A. E = (1/4πϵ₀) × (p/r³) (ans.)

B. E = (1/4πϵ₀) × (p3/r³)

C. E = (1/4πϵ₀) × (p/r)

D. E = (1/4πϵ₀) × (p2/r2)

Ans: E = (1/4πϵ₀) × (p/r³)

Prove:

Suppose an electric bipolar is formed by the combination of two point charges –q and + q at a distance of 2I. Suppose that the charges -q and + q are located at the points A and B, respectively, through two K-electric mediums. This electric current has to be determined at the point P at a distance r on its axis from the midpoint O of the bipolar.

Now the predominance at point P for the charge -q of point A

E₁ = (1/4πϵ₀K) × (-q/r²+l²)

Or, E₁ = (1/4πϵ₀K) (q/r²+l²), Along with PC

Again, for the charge of point B, the force at point P is,

E₂ = (1/4πϵ₀K) × q/(r²+l²), Along with PD

Now, the electricity of the point will be E₁ and E₂

Suppose, ∠PAB = ∠PBA = θ

Thus, the angle of E₁ and E₂ in Point, the angle of E₁ and E₂,

So, ∠DPC = ∠PAB + ∠PBA = θ + θ = 2θ

So, the electricity of the pond, according to the vector,

E = √(E₁²+E₂²+2E₁E₂cos2θ)

Since the value of E₁ and E₂ is equal,

E₁ = E₂ = (1/4πϵ₀K) × q/(r²+l²)

So, E = √(2E₁²+2E₁²cos2θ)

= √2 E₁√(1+cos2θ)

= √2 E₁√2cos²θ)

= 2 E1 cosθ

From figure, cosθ= l/√(r²+l²)

So, E = 2 × (1/4πϵ₀K) × q/r²+l²) × l/√(r²+l²)

Or, E = (1/4πϵ₀K) × 2lq/(r²+l²)³/²

Direction: Since, the value of E₁ and E₂ is equal, so it will be included in the angle of E, E₁ and E₂. So, the E, produces theta angle with E₁. Now ∠DPR = ∠PBA = θ. Similar angles on ∠DPB of the same land. So PR, BA's parallel. Therefore, the bipolar will be on the basis of electrolyte. The symmetry of symmetry of the axis is to the negotiable charge from the positive charge. Special field: If the point P is far away from the bipolar (i.e. if r >> I) then I² can be ignored as compared to r². In that case,

E = (1/4πϵ₀K) × (p/r³)

If space or air is K = 1, so

E = (1/4πϵ₀) × (p/r³)

14. Formula of V?

Hints: V = ϵ₀ = Permittivity of free space, r = radius, p = point

A. V = (1/4πϵ₀) × (p cosθ/r2) (ans.)

B. V = (1/4πϵ₀) × (p cosθ/r)

C. V = (1/4πϵ₀) × (p cosθ/r3)

D. V = (1/4πϵ₀) × (p3 cos3θ/r3)

Ans: V = (1/4πϵ₀) × (p cosθ/r2)

Prove:

Here, the voltage at point P for the charge of point A –q,

V1 = - (1/4πϵ₀) × (q/r1)

And voltage at point P for the charge q of point B,

V2 = (1/4πϵ₀) × (q/r2)

Therefore, the total voltage at point P,

V = V1 + V2 = - (1/4πϵ₀) × (q/r1) + (1/4πϵ₀) × (q/r2)

= q/4πϵ₀K [ 1/r2 – 1/r1 ]

= q/4πϵ₀K [ (r1 - r2)/r1r2]

Now ∠ANB is about 90 °. Also ∠PAB can be supposed.

Therefore, V = (q/4πϵ₀K) × (2lcos θ/r2)

If the medium is zero or air, K = 1, so

V = (1/4πϵ₀) × (p cosθ/r2)

15. Formula of C?

Hints: C = Charge capacity, Q = Charge, V = Conductor voltage

A. C = Q/V (ans.)

B. C = V/Q

C. C = QK/V

D. C = QV

Ans: C = Q/V

Prove:

If V is required to increase the voltage of a conductor, then Q / V is required to increase the voltage in a single quantity. So the charge capacity,

C=Q/V

16. Formula of C?

Hints: C = Charge capacity, r = radius, ϵ₀ = Permittivity of free space

Ans: C = 4πϵ₀r

Prove:

We know,

C=q/V

The voltage on the surface of the sphere is the potential of the sphere,

V = (1/4πϵ₀K) × (q/r)

Putting this value of potential in the above equation of capacitance we get, C = 4πϵ₀Kr

If the sphere is located in the air or in space K = 1, So, C = 4πϵ₀r

17. Formula of C?

Hints: C = Charge capacity, A = The area of ​​each leaf of the container, d = The distance between the two leaves, ϵ = The permeability of the medium between the two leaves , ϵ0 = The permeability of the medium between the two leaves in free space

A. C = (ans.)

B. C = ϵ0KAd

C. C =

D. C =

Ans: C = ϵ0KA/d

Prove:

We know,

C = Q/V----(i), E = σ/ϵ-----(ii)

or, E = Q/ϵA

but, V = Ed

or, V = Qd/ϵA by putting the value in (i),

C = Q ϵA/Qd

Therefore, C = ϵ A/d

Since, K = ϵ/ ϵ0 or, ϵ = ϵ0K

Therefore, C = ϵ0KA/d

18. Formula of equivalent capacity in class connection?

Hints: Cs = Equivalent capacity in class connection, Q = Charge, V = Potential difference n = normal number

A. 1/Cs = 1/C1 + 1/C2 + 1/C3 + ……..+ 1/Cn (ans.)

B. Cs = C1 + C2 +C3  ……..+ Cn

C. 1/Cs = 1/C1 + 1/C2 + 1/C3 + ……..+ 1/C

D. Cs = 1/C1 + 1/C2 + 1/C3 + ……..+ 1/Cn

Ans: 1/Cs = 1/C1 + 1/C2 + 1/C3 + ……..+ 1/Cn

Prove:

19. Formula of U’?

Hints: U’ = Stored energy of charge (in volume), ϵ = The permeability of the medium between the two leaves

A. U’ = ½ϵ E2 (ans.)

B. U’ = ½ϵE

C. U’ = ½UϵE2

D. U’ = ½ϵU

Ans: U’ = ½ ϵE2

Prove:

Stored energy, U’ = Total energy stored, U / The size of the space between the holder sheets

or, U’ = U/Ad = (½ CV2) / Ad = (½ C (Ed)2) / Ad [Fact, V = Ed]

or, U’ = [½(ϵ A/d) × (Ed2) ] / Ad [Fact, C = ϵ A/d]

So, U’ = ½ ϵ E2

20. Formula of ϵr ?

Hints: ϵr = K = Dielectric constant, C = Dielectric full container capacity , C0 = Dielectric zero capacitance

A. ϵr = (ans.)

B. ϵr = C × C0

C. ϵr = C - C0

D. ϵr = C0 - C

Ans: ϵr =

Prove:

If there is a dielectric between the two sheets of the container, then the capacitance is C and when there is a dielectric, then the capacitance is C0. In these two cases, the ratio of the capacitance is always a constant number. This constant number is the dielectric constant of the dielectric medium.

That is, the dielectric constant of a medium,

ϵr = C/C0

21. Formula of Gauss?

Hints: q = charge, S = Gaussio floor area, ϕ = Electric flux, E = Electric Field, ϵ0 = Vacuum permittivity

A. ϵ0 ∮s . d = q (ans.)

B. ϵ0 ∮s = q

C. . d = q

D. ϵ0  . d = q

Ans:  ϵ0 ∮s . d = q

Prove:

We know, ϕ = ∮s  . d

The sum of the . dscalars for each floor element must be calculated by dividing the whole surface into innumerable tiny planes d, indicating this surface sum. The sum of these values ​​is the total electric flask of the entire surface. Therefore, , ϕ = ∮s dScosθ = ∮s () q/r2 dScos 0° = ∮s dS

However, the surface area of ​​a sphere of radius r, ∮s dS = r2

Therefore, , ϕ = × 4πr2

Or, ϕ = q/ϵ0

or, ϵ0 ϕ = q

So, ϵ0 ∮s . d = q

22. Formula of E?

Hints: q = charge, r = radius, E = electricfield, ϵ0 = Vacuum permittivity

A. E = × (ans.)

B. E = ×

C. E = ×

D. E = ×

Ans: E = ×

Prove:

We know, ϵ0 ∮s . d = q

Since, the directions of and are the same, their included angle is 0°

So, ϵ0 ∮s . d ∮s EdS cos 0° = E ∮s dS = E × 4πr2

Again, ϵ0E4πr2  = q

Or, E = ×

23. Formula of E? (figure\*)

Hints: E = Electric field, r = radius, λ = the maximum charge, ϵ0 = Vacuum permittivity

A. E = × (ans.)

B. E = ×

C. E = ×

D. E = × λr

Ans: E = ×

Prove:

We know,

ϵ0 ∮s . d = q

The Gaussian plane can be divided into three parts, I, II and III according to the figure.

So, ∮s  . d =

=

= E = E × 2πrh

Putting Gauss's formula in the above equation,

ϵ0  × E × 2πrh = q

But, q is λh

So, E = ×

24. Formula of E?

Hints: E = Electric field, r = radius, λ = the maximum charge, ϵ0 = Vacuum permittivity

A. E = × (ans.)

B. E = × π2

C. E = ×

D. E = ×

Ans: E = ×

Prove:

We know,

ϵ0 ∮s . d = q

Since, the directions of and are the same, their included angle is 0°

ϵ0 ∮s EdS cos 0° = q

or, ϵ0 E ∮s dS = q

or, ϵ0 E × 4πr2 = q

So, E = ×

25. Formula of any point near a wounded impermeable sheet of infinite expanse, E? (figure\*)

Hints: E = Electric field, r = radius, q = charge, ϵ0 = Vacuum permittivity

A. E = (ans.)

B. E =

C. E = 2ϵ0σ

D. E = ϵ0σ

Ans: E =

We know,

ϵ0 ∮s . d = q

The Gaussian plane can be divided into three parts, I, II and III according to the figure.

So, ∮s . d =

=

= E

= E × πr2 + E × πr2 = 2Eπr2

So, By putting Gauss's formula in the above equation.

ϵ0  × 2Eπr2  = q

or, E = q/2Eπr2  =