PHYSICS

Question Bank

Bihar Board

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2015
PHYSICS
Section-I (Objective Type)

Time : 1 Hour 10 Minutes] [Marks : 28

Instructions to the Candidates : See Question Paper 2016.

For the following Question Nos. 1 to 28 there is only one correct answer against each question. For each question, mark the correct option on the answer sheet. $28 \times 1 = 28$

1. The electric dipole moment of an electric dipole made up of two opposite charges having magnitude $+ 3.2 \times 10^{-19}$ C and $- 3.2 \times 10^{-19}$ C separated by a distance 2.4×10^{-10} m is
   (A) 7.68×10^{-27} C-m (B) 7.68×10^{-29} C-m
   (C) 7.86×10^{-29} C-m (D) 7.86×10^{-27} C-m

2. 64 identical drops each of capacity 5 μF combine to form a big drop. What is the capacity of big drop?
   (A) 164 μF (B) 20 μF (C) 4 μF (D) 25 μF

3. Kilowatt-hour (kWh) is the unit of
   (A) energy (B) power (C) torque (D) force

4. The algebraic sum of all currents meeting at any point in an electrical circuit is
   (A) infinite (B) positive (C) zero (D) negative

5. Dimension of permeability is
   (A) $MLT^{-2}I^{-2}$ (B) $MLT^{2}I^{-2}$ (C) $MLT^{2}I^{2}$ (D) $MLT^{-2}I$

6. Impedance of L-R circuit is
   (A) $R^2 + \omega^2 L^2$ (B) $\sqrt{R + \omega L}$ (C) $R + \omega L$ (D) $\sqrt{R^2 + \omega^2 L^2}$

7. The direction of propagation of electromagnetic wave is
   (A) parallel to $\vec{B}$ (B) parallel to $\vec{E}$
   (C) parallel to $\vec{B} \times \vec{E}$ (D) parallel to $\vec{E} \times \vec{B}$

8. When a ray of light enters a glass slab, its wavelength
   (A) increases (B) decreases
   (C) remains unchanged (D) data are not complete

9. The value of amplitude modulation index is
   (A) always 0 (B) between 1 and ∞
   (C) between 0 and 1 (D) always ∞

10. Boolean expression for NOR gate is
    (A) $A + B = Y$ (B) $\overline{A \cdot B} = Y$ (C) $A \cdot B = Y$ (D) $\overline{A + B} = Y$

11. The intensity of electric field at any point on the surface of a charged conductor is
    (A) zero (B) perpendicular to the surface
    (C) tangential to the surface (D) at 45° to the surface

12. Permittivity of free space is
    (A) 9×10^{9} mF^{-1} (B) 1.6×10^{19} C
    (C) 8.85×10^{-12} Fm^{-1} (D) 8.85×10^{-9} Fm^{-1}

13. Power of electric circuit is
(A) $V \cdot R$ (B) $V^2 \cdot R$ (C) $\frac{V^2}{R}$ (D) $V^2 \cdot R \cdot I$

14. Electron volt (eV) is the measure of
(A) charge (B) potential difference
(C) current (D) energy

15. Lenzs law is associated with
(A) charge (B) mass
(C) energy (D) principle of conservation of momentum

16. The final image in astronomical telescope is
(A) real and errect (B) real and inverted
(C) virtual and inverted (D) virtual and erect

17. When two converging lenses of same focal length f are placed in contact, then the focal length of the combination is
(A) f (B) $2f$ (C) $\frac{f}{2}$ (D) $3f$

18. The transverse nature of light wave supports
(A) interference (B) reflection (C) polarisation (D) dispersion

19. The colour of a thin film is due to
(A) scattering (B) interference (C) dispersion (D) diffraction

20. If ϕ is the phase difference between *ac* current and e.m.f., then the value of power factor is
(A) $\tan \phi$ (B) $\cos^2 \phi$ (C) $\sin \phi$ (D) $\cos \phi$

21. Unit of self-induction is
(A) Weber (B) Ohm (C) Henry (D) Gauss

22. The working of dynamo is based on the principle of
(A) heating effect of current (B) electromagnetic induction
(C) magnetic induction (D) electric induction

23. The equation of an ac is represented by $I = 0.6 \sin 100 \pi t$. The frequency of *ac* is
(A) 50π (B) 50 (C) 100π (D) 100

24. Nickel is
(A) diamagnetic (B) paramagnetic (C) ferromagnetic (D) none of these

25. Brewster's law is
(A) $\mu = \sin i_p$ (B) $\mu = \cos i_p$ (C) $\mu = \tan i_p$ (D) $\mu = \tan^2 i_p$

26. With the increase of temperature, the resistance of a semiconductor
(A) increases
(B) decreases
(C) sometimes increases and sometimes decreases
(D) remains unchanged

27. The ratio of peak value and r.m.s. value of ac is
(A) 2 (B) $\sqrt{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) $\frac{1}{2}$

28. Which frequency range is used for TV transmission?
(A) 30 Hz-300 Hz (B) 30 kHz-300 kHz
(C) 30 MHz-300 MHz (D) 30 GHz-300 GHz

ANSWERS

1. (B)	2. (B)	3. (A)	4. (C)	5. (B)	6. (D)	7. (D)
8. (B)	9. (C)	10. (D)	11. (B)	12. (C)	13. (C)	14. (D)
15. (C)	16. (C)	17. (C)	18. (C)	19. (B)	20. (D)	21. (C)
22. (B)	23. (B)	24. (C)	25. (C)	26. (B)	27. (B)	28. (B)

Section-II (Non-Objective Type)

Time : 2 Hour 05 Minutes] [Marks : 42

Instructions to the Candidates : See Question Paper 2016.

Question Nos. 1 to 11 are of short answer type. Each question carries 2 malrks.

$11 \times 2 = 22$

Short Answer Type Questions

1. Define electric dipole moment and write its SI unit.

Ans. The product of the distances between the two charges or any of charge in electric dipole is called electric dipole moment. Its S.I. unit is C-m.

2. Write two main features of Laser rays.

Ans. See answer Q.No. 2 in 2011.

3. What is the function of second plate in a parallel plate capacitor?

Ans. The second plate in a parallel capacitor controls the shape and decrease the capacitance of the plate. Hence, most of the charge is stored on the capacitance.

4. Write two uses of shunt.

Ans. The two uses of shunt are (i) It is used to protect ammeter and galvanometer from harm. (ii) Shunt is the used to deviate the current and changes the value of shunt to increase the scale of ammeter.

5. The charge on a metallic sphere of radius 9 cm is 4×10^{-6} C. Calculate the potential energy of charge on the conductor.

Ans. Potential energy, $U = \frac{1}{2} \cdot \frac{Q^2}{C}$

$\because \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ mF}^{-1}$ and, Radius of the sphere, $R = 9 \text{ cm} = 0.09 \text{ m}$

Capacitance of sphere, $C = 4\pi \in_0 R = \frac{1 \times 0.09\,\text{m}}{9 \times 10^9 \text{ mF}^{-1}} = 10^{-11}\text{F}$

Then, charge on the sphere, $Q = 4 \times 10^{-6}\text{C}$

$$U = \frac{1}{2} \times \frac{(4 \times 10^{-6}\text{C})^2}{10^{-11}\text{F}} = 8 \times 10^{-1}\text{ J} = 0.8\text{ J}.$$

6. When two resistors are connected in series and parallel, then their equivalent resistances are 16Ω and 3Ω respectively. Find out the resistance of each resistor.

Ans. In series, $\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow \frac{1}{3} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow \frac{R_1 + R_2}{R_1 R_2} = \frac{1}{3}$

$\Rightarrow \quad 16 \times 3 = R_1 R_2 \Rightarrow R_1 = \frac{48}{R_2}$

In parallel, $R' = R_1 + R_2 \Rightarrow 16 = R_1 + R_2 \Rightarrow \frac{48}{R_2} + R_2 = 16\,\Omega$

$\Rightarrow R_2^2 - 16R_2 + 48 = 0 \Rightarrow R_2 = 12\,\Omega$ or, $R_2 = 4\,\Omega$

$\therefore \quad R_1 = 4\,\Omega$ or, $R_1 = 12\,\Omega$

7. Name the energy losses in a transformer.

Ans. See answer Q.No. 29 in 2014.

8. The equation of an ac is $I = 20 \sin 200 \pi t$. Find out the frequency, peak value and r.m.s. value of the current.

Ans. Here, $I = 20 \sin 200\pi t$ ... (i)

But $I = I_0 \sin \omega t \Rightarrow I = I_0 \sin 2\pi ft$ $[\because \omega = 2\pi t]$ ... (ii)

By equating equation (i) and (ii), we get

$$2\pi f = 200\,\pi \Rightarrow f = \frac{200}{2} = 100\,\text{Hz} \quad \therefore \quad I_0 = 20\,\text{A}$$

Again, peak value of current, $I_0 = 20\,\text{A}$

And, root-mean-square (rms) value of current

$$\frac{I_0}{\sqrt{2}} = \frac{20}{\sqrt{2}}\,\text{A} = \frac{20\sqrt{2}}{2}\,\text{A} = 10\sqrt{2}\,\text{A} = 10 \times 1.414\,\text{A} = 14.14\,\text{A}$$

Hence, frequency of current, peak value and rms value are 100 Hz, 20A and 14.4 A respectively.

9. Two thin lenses of powers 5 D and 2 D are placed coaxially at a distance 20 cm apart. Find the focal length and power of the combination of lenses.

Ans. Power of first lens, $P_1 = 5\,\text{D}$ $\therefore$ Its focal length, $f_1 = \frac{1}{P_1} = \frac{1}{5}\,\text{m} = 20\,\text{cm}.$

Power of second lens, $P_2 = 2\,\text{D}$ $\therefore$ Its focal length, $f_2 = \frac{1}{P_2} = \frac{1}{2}\,\text{m} = 50\,\text{cm}.$

Distance between the lens, $d = 20\,\text{cm}$.

If the focal length of the combined lens is F, then

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2} = \frac{1}{20} + \frac{1}{50} - \frac{20}{20 \times 50} = \frac{1}{20} \quad \therefore \quad F = 20\,\text{cm} = 0.2\,\text{m}.$$

$\therefore$ Power of combined lens, $P = \frac{1}{F} = \frac{1}{0.2} = 5$ Diopter.

10. Distinguish between *n*-type and *p*-type semiconductors.

Ans. See answer Q.No. 7 in 2013.

11. Define modulation. Write its types.

Ans. Process of changing an electrical signal, such as by superimposing the signal's which behaves like signal carrier is called modulation.

There are three types of modulation: (i) Amplitude modulation, (ii) Frequency modulation, (iii) Phase modulation.

Question Nos. 12 to 15 are of long answer type. Answer must be explanatory and in your own language. All questions have alternative out of which you have to choose any one alternative. Each question carries 5 marks. $4 \times 5 = 20$

Long Answer Type Questions

12. Define electric intensity. Derive an expression for electric intensity at a point situated on the axis of electric dipole.

Ans. See answer Q.No. 12 in 2009.

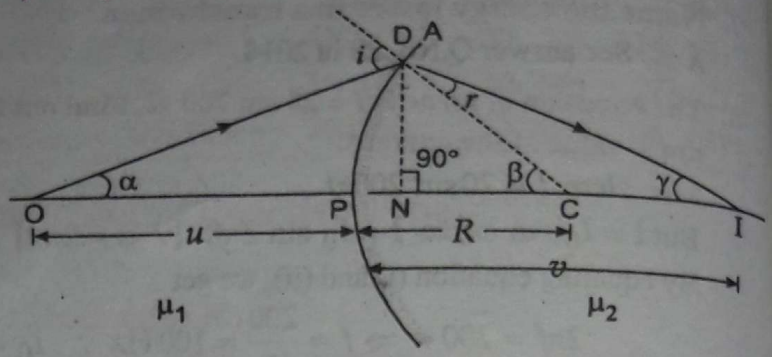
Or,

Define electric flux. State and prove Gauss theorem.

Ans. See answer Q.No. 12 (OR) in 2009.

13. Establish the formula $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{r}$

Ans. When two transparent media are separated by a spherical surface light incident on the surface gets refracted in to the medium on other side suppose two transparent media having refractive index μ_1 and μ_2 are separated by a spherical surface *AB*. Let *C* be the centre of curvature of *AB*. Consider a point object *O* in medium 1. Suppose the line *OC* cuts the spherical surface at *P*.



In ΔODC, $\alpha + \beta + 180° - i = 180°$ or, $i = \alpha + \beta$ ... (i)

In ΔCDI, $r + \gamma + 180° - \beta = 180°$ or, $r = \beta - \gamma$ ... (ii)

From Snell's law, $\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$

where *i* and *r* are small then, $\sin i \approx i$ and $\sin r \approx r$.

$$\frac{i}{r} = \frac{\mu_2}{\mu_1} \text{ or, } \mu_1 i = \mu_2 r \quad \text{[from (i) and (ii)]}$$

$$\mu_1(\alpha + \beta) = \mu_2(\beta - \gamma) \Rightarrow \mu_1\alpha + \mu_1\beta = \mu_2\beta - \mu_2\gamma$$

$$\Rightarrow \quad (\mu_2 - \mu_1)\beta = \mu_1\alpha + \mu_2\gamma \Rightarrow \mu_1\alpha + \mu_2\gamma = (\mu_2 - \mu_1)\beta \quad \text{... (iii)}$$

Now, here α, β and γ are small them $\tan\alpha \approx \alpha$, $\tan\beta \approx \beta$ and $\tan\gamma \approx \gamma$.

From figure, $\tan\alpha \approx \alpha = \frac{PD}{OP}$, $\tan\beta \approx \beta = \frac{PD}{PC}$ and $\tan\gamma \approx \gamma = \frac{PD}{PI}$

From equation (iii), $\mu_1 \frac{PD}{OP} + \mu_2 \frac{PD}{PI} = (\mu_2 - \mu_1)\frac{PD}{PC}$

$$\Rightarrow \quad PD\left(\frac{\mu_1}{OP} + \frac{\mu_2}{PI}\right) = PD\frac{(\mu_2 - \mu_1)}{PC}$$

$$\Rightarrow \quad \frac{\mu_1}{-u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}.$$

Or,

Write Huygens principle of light wave. Prove the laws of reflection or refraction of light on the basis of Huygens principle of light wave.

Ans. See answer Q.No. 12 in 2013.

14. Explain Biot-Savart law. With its help derive an expression for the magnetic field at any point on the axis of a current carrying circular loop.

Ans. See answer Q.No. 3 in 2009.

Or,

Define Kirchhoffs laws of electrical circuit. Derive an expression for a balanced. Wheat stone's bridge using Kirchhoffs law.

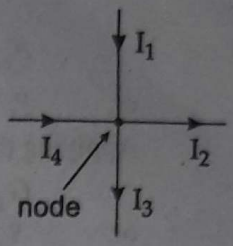
Ans. Kirchoff's law : The two Kirchhoff's laws tell us about the relationships between voltages and currents in circuits.

Kirchhoff's Junction law (or Kirchoff's current law) :

(i) The law is based on principle of conservation of charge.

(ii) The algebraic sum of all the current moving along junction is zero. i.e., $\Sigma I = 0$.

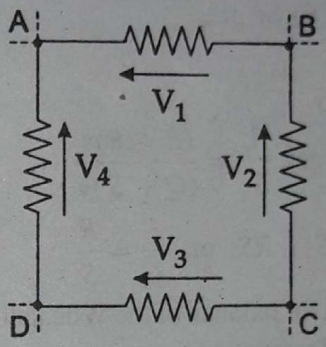
It can also be written as the sum of all the current towards at a point of the circuit is equal to sum of all the current away from the point.



Sign converntion : Current reaching at a junction is taken to be + ve while leaving the junction is – ve.

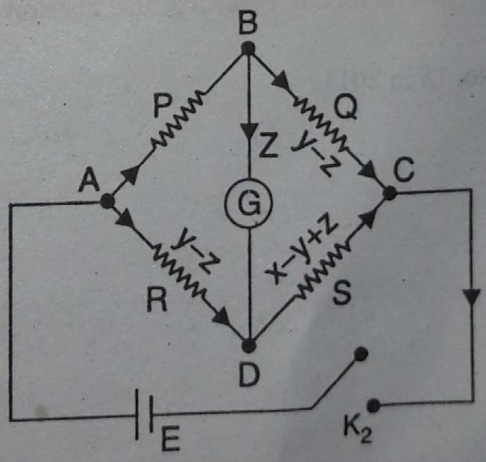
$$I_1 + I_2 + I_4 = I_3.$$

Kirchhoff's loop law or (Kirchhoff's voltage law) : The algebraic sum of voltages around a closed circuit loop is zero'. There's the phrase 'algebraic sum' again, so we must recognise that the direction of voltages matters when using Kirchhoff's Voltage Law.



Sign converntion : The four produce exactly the same relationship between the four voltages: all four can be $V_1 + V_2 = V_3 + V_4$.

Wheatstone bridge : Wheatstone bridge is an arrangement of four resistance P, Q, S and R, which are joined in a closed chain $ABCDA$. A galvanometer of resistance G is



connected across the diagonal BD and a cell E of e.m.f. 'e' and internal resistance r is connected across AC. This whole arrangement is called a Wheatstone bridge. Let us take this Wheatstone bridge as an example of a complex circuit to be solved by Kirchoff's rules is to assign value and directions to the current in compliance with the point rule in all the parts, without applying intuition about the directions of currents and remaining completely unmindful about the presence of the cells. Then to apply loop rule to loop $ABDA$.

$P_y + G_z - R(x - y) = 0$ as there is no cell in this loop.

or, $P_x - (P + R)y - G_z = 0$ ...(i)

Applying the loop rule to loop *BDCB*

$G_z + S(x - y + z) - Q(y - z) = 0$

or, $S_x - (Q + S)y + (Q + S + G)z = 0$ ...(ii)

From loop *ADCEA*,

$r(x - y) + S(x - y + z) + rx = 0$

$(R + S + r)x - (E + S)y + ZS = 0.$ ... (iii)

There are three unknown (x, y and z) and three equations. Hence we can solve them for x, y and z and find the current through all the branches of the bridge.

Condition for balance : A Wheatstone bridge is said to be balanced when there is no current through the galvanometer.

Putting $z = 0$ in (i) and (ii) we get,

$R_x = (P + R)y$ ... (iv)

$S_x = (Q + S)y$ ... (v)

Dividing (iv) by (v) we get, $\frac{R_x}{S_x} = \frac{(P + R)y}{(Q + S)y}$

or, $RQ + RS = PS + RS$ or, $\frac{P}{Q} = \frac{R}{S}$

is the required condition for balance of the Wheatstone bridge. This is used for the rapid and accurate measurement of resistance.

15. Give postulates of Bohr's theory. Explain hydrogen spectrum on the basis of Bohr's theory.

Ans. See answer Q.No. 15 in 2010.

Or,

Write down Einstein's photoelectric equation and explain the photoelectric effect on its basis.

Ans. See answer Q.No. 15 in 2011.

□