

HALF-YEARLY EXAMINATION

(SESSION : 2019-2020)

CLASS : XII

SUBJECT : PHYSICS

SUBJECT CODE : 042

TIME: 3 HRS.

MAXIMUM MARKS : 70

GENERAL INSTRUCTIONS

1. All questions are compulsory. There are **37** questions in all.
2. This question paper has **four sections** : Section A, Section B, Section C and Section D.
3. **Section A** contains twenty questions of **one mark each**, **Section B** contains seven questions of **two marks each**, **Section C** contains seven questions of **three marks each**, and **Section D** contains three questions of **five marks each**.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants where ever necessary.

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$$c = 3 \times 10^8 \text{ ms}^{-1};$$

$$h = 6.63 \times 10^{-34} \text{ Js};$$

$$e = 1.6 \times 10^{-19} \text{ C};$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1};$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2};$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$$

$$\text{Mass of electron} = 9.1 \times 10^{-31} \text{ kg};$$

$$\text{Mass of neutron} = 1.675 \times 10^{-27} \text{ kg};$$

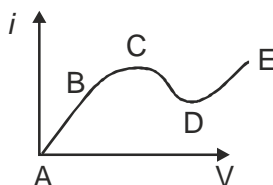
$$\text{Mass of proton} = 1.673 \times 10^{-27} \text{ kg};$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole};$$

$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

SECTION—A

1. The electric field at a point on equatorial line of a dipole is _____ to the direction of the dipole moment.
2. We know that electric field is discontinuous across the surface of a charge conductor. Is electric potential also discontinuous there?
3. From the graph between current i & voltage V shown, identify the portion corresponding the negative resistance:



a. DE

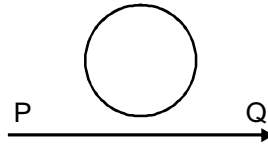
b. CD

c. BC

d. AB

4. If ' n ' cells of each emf ' ϵ ' and internal resistance ' r ' are connected in parallel then total emf and internal resistance will be
- a. $\epsilon, r/n$ b. ϵ, nr c. $n \epsilon, r/n$ d. $n \epsilon, nr$
5. Two wires A and B of the same material, having radii in the ratio 1 : 2 and carry currents in the ratio 4 : 1 then what is the ratio of drift speed of electrons in A and B ?
- a. 16 : 1 b. 1 : 16 c. 1 : 4 d. 4 : 1
6. **Assertion** : Two non ideal batteries are connected in parallel the equivalent emf is in between the value of the two emf's.
- Reason** : The equivalent internal resistance is smaller than either of the two internal resistances.
- a. Assertion is correct, Reason is correct, Reason is correct explanation of Assertion
- b. Assertion is correct, Reason is correct, Reason is not correct explanation of Assertion
- c. Assertion is correct, Reason is incorrect
- d. Both Assertion and Reason are incorrect
7. Consider a tightly wound 100 turn coil of radius 10 cm, carrying a current of 1 Amp. What is the magnitude of the magnetic field at the centre of the coil?
- a. $2\pi \times 10^{-4}$ T b. $4\pi \times 10^{-4}$ T c. $6\pi \times 10^{-4}$ T d. None of these
8. A proton and an α particles enters in a uniform magnetic field with same velocity, then ratio of the radii of path describe by them
- a. 1 : 2 b. 1 : 1 c. 2 : 1 d. None of these
9. When a charged particle circulates in a normal magnetic field, then the area of its circulation is proportional to it's
- a. kinetic energy b. momentum c. Its charge d. Magnetic fields intensity
10. **Assertion** : To protect any instrument from external magnetic field, it is put inside an iron box.
- Reason** : Iron has high permeability.
- a. Assertion is correct, Reason is correct, Reason is correct explanation of Assertion
- b. Assertion is correct, Reason is correct, Reason is not correct explanation of Assertion
- c. Assertion is correct, Reason is incorrect
- d. Both Assertion and Reason are incorrect

11. The current through the wire PQ is increasing. In which direction does the induced current flow in the closed loop?



12. A charged particle moves through a magnetic field in a direction perpendicular to it. Which characteristic remains unchanged?
- a. Velocity b. Kinetic energy c. Charge of particle d. Acceleration
13. An LCR series circuit is at resonance. Then which of the following statement is false?
- a. Phase difference between current and voltage is 90°
- b. Impedance is purely resistive c. Current is maximum
- d. Capacitive reactance is equal to inductive reactance
14. **Assertion :** The magnetic field energy stored in an inductor decreases with reversing the direction of current.
- Reason :** The magnetic field energy of an inductor is dependent on direction of current.
- a. Assertion is correct, Reason is correct, Reason is correct explanation of Assertion
- b. Assertion is correct, Reason is correct, Reason is not correct explanation of Assertion
- c. Assertion is correct, Reason is incorrect
- d. Both Assertion and Reason are incorrect
15. The frequencies of γ rays, x-rays and ultra-violet rays are denoted by n_1 , n_2 and n_3 respectively. Then
- a. $n_1 > n_2 > n_3$ b. $n_1 < n_2 < n_3$ c. $n_1 > n_2 < n_3$ d. $n_1 < n_2 > n_3$
16. Which part of electromagnetic waves is used in aircraft navigation?
17. Which of the following quantities do not change after refraction :
- a. Speed of light b. Wavelength c. Frequency d. None of these
18. A thin double convex lens has radii of curvature each of magnitude 40 cm and is made of glass with refractive index 1.65. Its focal length is nearly
- a. 20 cm b. 31 cm c. 35 cm d. 50 cm
19. For what distance is ray optics a good approximation when the aperture is 3 mm wide and the wavelength is 500 nm?
- a. 18 m b. 9 m c. 36 m d. 50 m
20. What is the speed of light in a denser medium of polarising angle 30° ?

SECTION—B

- 21.** Name the electromagnetic radiation to which waves of wavelength in the range of 10^{-2} m belong. Give one use of this part of em spectrum.
- 22.** A compound microscope consists of an objective lens of focal length 2.0 cm and an eye piece of focal length 6.25 cm, separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at the least distance of distinct vision (25 cm).
- 23.** A spherical conductor of radius 12 cm has a charge of 1.6×10^{-8} C distributed uniformly on its surface. What is the electric field.
 - a. inside the sphere
 - b. at a point 18 cm from the centre of the sphere?
- 24.** Explain the motion of charged particle in a uniform magnetic field. Obtain an expression for radius of the path if charged particle enters perpendicular to magnetic field.

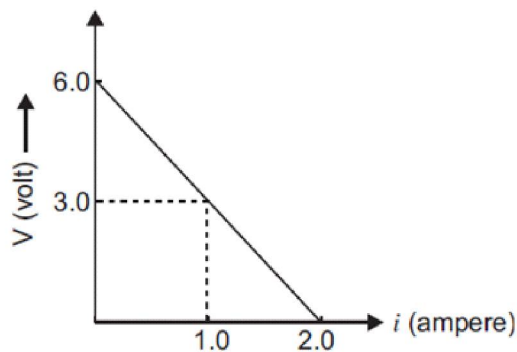
OR

Derive the magnetic field due to current carrying solenoid using Ampere's Circuital Law.

- 25.** Two point charges of + 3mC each are 100 cm apart. At what point on the line joining the charges will the electric intensity be zero?
- 26.** Two charges $+2\mu\text{C}$ and $-2\mu\text{C}$ are placed at points A and B, 6 cm apart :
 - a. Draw equipotential surface of the system.
 - b. What is the direction of the electric field at every point on this surface?
- 27.** Define the term: magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed ' v ', around an orbit of radius ' r ' in hydrogen atom.

SECTION—C

- 28.** The following graph shows the variation of terminal potential difference V , across a combination of three cells in series to a resistor, versus the current, i :



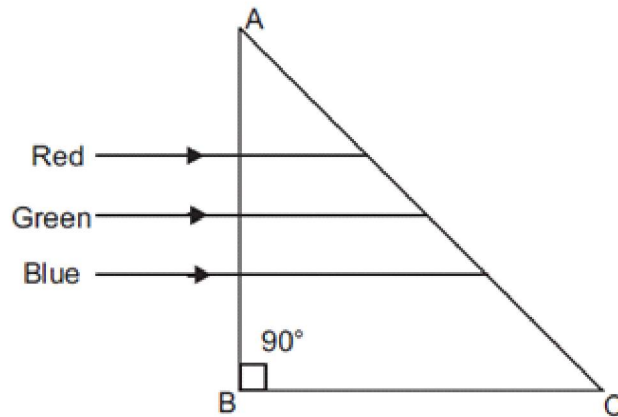
- a.** Calculate the emf of each cell.
- b.** For what current i will the power dissipation of the circuit be maximum?

29. Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence obtain the conditions for the angular width of secondary maxima and secondary minima.

OR

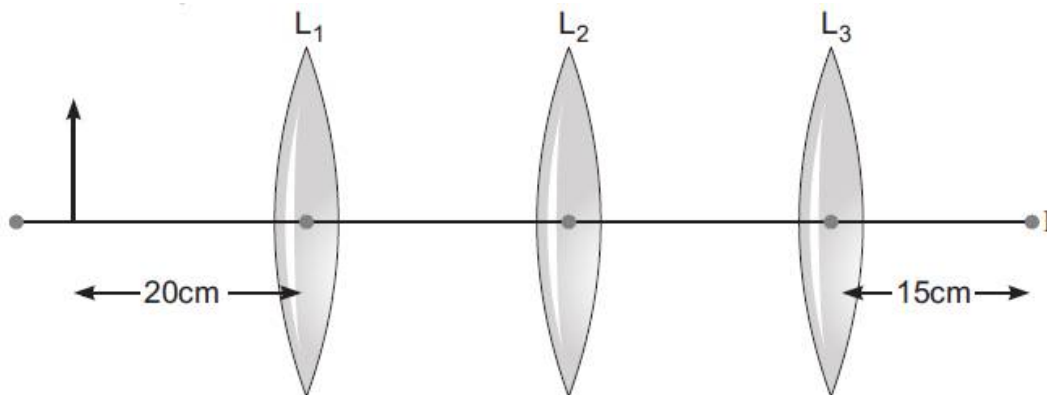
Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture 2×10^{-6} m. The distance between the slit and the screen is 1.5 m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.

30. In the figure given below, light rays of blue, green, red wavelengths are incident on an isosceles right-angled prism. Explain with reason, which ray of light will be transmitted through the face AC. The refractive index of the prism for red, green, blue light is 1.39, 1.424, and 1.476 respectively



OR

You are given three lenses L_1 , L_2 and L_3 each of focal length 15 cm. An object is kept at 20 cm in front of L_1 , as shown. The final real image is formed at the focus 'I' of L_3 . Find the separations between L_1 , L_2 and L_3 .



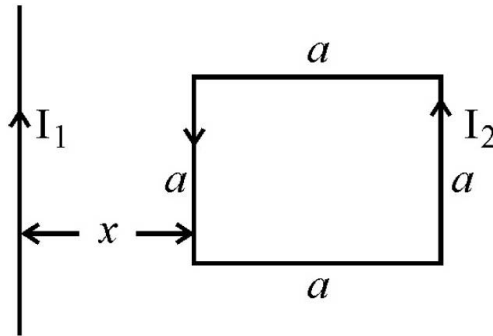
31. A fish lies at the bottom of a 4m deep water lake. A bird flies 6 m above the water surface and refractive index of water is $4/3$. Then find the distance between :
- a. Bird and image of fish b. Fish and image of bird.

OR

What is total internal reflection? State the conditions for it. How it is used in optical fibres? Explain briefly.

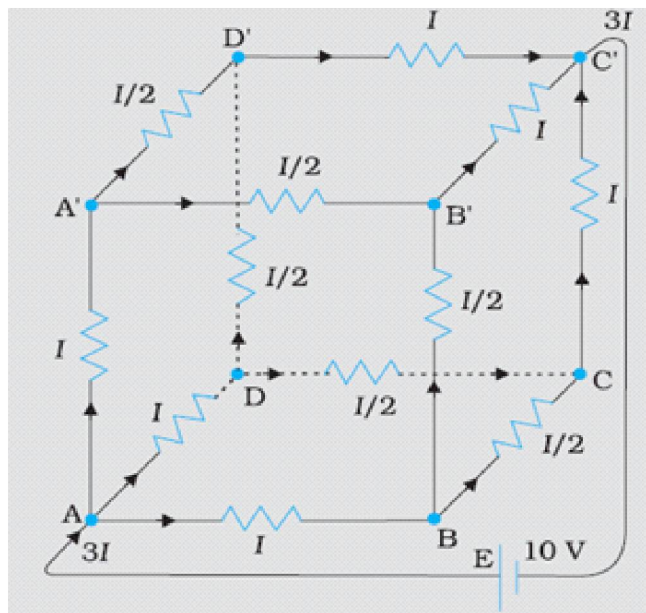
32. a. Define mutual inductance and write its S.I. unit.

b. A square loop of side 'a' carrying a current I_2 is kept at distance x from an infinitely long straight wire carrying a current I_1 , as shown in the figure. Obtain the expression for the resultant force acting on the loop.



33. Using Gauss's law derive an expression for the electric field intensity at any point near a uniformly charged sheet of charge/length σ C/m.

34. A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of resistance 1Ω . Determine the equivalent resistance of the network and the current along each edge of the cube

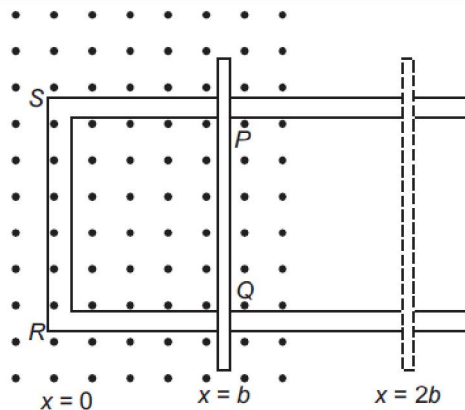


SECTION—D

35. a. Discuss the intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids.
- b. Two lenses of power + 15 D and –5 D are in contact with each other forming a combination of lens.
- What is the focal length of this combination?
 - An object of size 3 cm is placed at 30 cm from this combination lenses. Calculate the position and size of the image formed.

OR

- a. Draw a ray diagram to show the formation of the image of an object placed between the optical centre and focus of a convex lens. Deduce the relationship between the object distance, image distance and focal length under the conditions stated.
- b. A diverging lens of focal length f is cut into two identical parts, each forming a plano concave lens. What is the focal length of each part?
36. a. State Faraday's law of electromagnetic induction.
- b. Figure shows a rectangular conductor $PQRS$ in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from $x = 0$ to $x = b$ and is zero for $x > b$. Assume that only the arm PQ possesses resistance r . When the, arm PQ is pulled outward from $x = 0$ to $x = 2b$ and is then moved backward to $x = 0$ with constant speed v , obtain the expressions for the flux and the induced emf. Sketch the variations of these quantities with distance $0 < x < 2b$.



OR

- a. Draw a schematic diagram of a step-up transformer. Explain its working principle.
- b. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the two coils. In an ideal transformer, how is this ratio related to the currents in the two coils?
- c. How is the transformer used in large scale transmission and distribution of electrical energy over long distances?
37. Draw the magnetic field lines due to a current passing through a long solenoid. Use Ampere's circuital law, to obtain the expression for the magnetic field due to the current I in a long solenoid having n number of turns per unit length.

OR

- a. How is a toroid different from a solenoid?
- b. Use Ampere's circuital law to obtain the magnetic field inside a toroid.
- c. Show that in an ideal toroid, the magnetic field (i) inside the toroid and (ii) outside the toroid at any point in the open space is zero.

