This Question Paper contains 20 printed pages.
(Part - A & Part - B)

Sl.No. 0701365

054 (E)

(MARCH/APRIL 2022)
(SCIENCE STREAM)
(CLASS - XII)

પ્રશ્ન પેપરનો સેટ નંબર જેની સામેનું વર્તુળ OMR શીટમાં ઘટ્ટ કરવાનું રહે છે.
Set No. of Question Paper, circle against which is to be darken in OMR sheet.

07

Part - A : Time : 1 Hour / Marks : 50
Part - B : Time : 2 Hours / Marks : 50

(Part - A)

Time : 1 Hour] ***[Maximum Marks : 50***

Instructions :

1) **There are 50 objective type (M.C.Q.) questions in Part - A and all questions are compulsory.**
2) **The questions are serially numbered from 1 to 50 and each carries 1 mark.**
3) **Read each question carefully, select proper alternative and answer in the O.M.R. sheet.**
4) **The OMR sheet is given for answering the questions. The answer of each question is represented by (A) O, (B) O, (C) O, (D) O. Darken the circle ● of the correct answer with ball-pen.**
5) **Rough work is to be done in the space provided for purpose in the Test Booklet only.**
6) **Set No. of Question Paper printed on the upper-most right side of the Question Paper is to be written in the column provided in the OMR sheet.**
7) **Students may use a simple Calculator and log-table, if necessary.**
8) **Notations used in this question paper have proper meaning.**

1) Charge particles with the speed _____ can pass undeflected through the region of crossed electric field (E) and magnetic field (B) that serve as a velocity selector.

(A) $\frac{E}{B}$

(B) $\frac{1}{2}\frac{E}{B}$

(C) $\frac{1}{2}\frac{B}{E}$

(D) $\frac{B}{E}$

Rough Work

2) A solenoid of length 0.5 m has a radius of 1 cm and is made up of 1000 turns. It carries a current of 5 A. The magnitude of the magnetic field inside the solenoid is _____ T.

(A) $3\pi \times 10^{-3}$

(B) $2\pi \times 10^{-3}$

(C) $\pi \times 10^{-3}$

(D) $4\pi \times 10^{-3}$

3) Experimentally, one finds that the magnetisation of a paramagnetic material is _____ proportional to applied magnetic field and _____ proportional to the absolute temperature.

(A) directly, inversely

(B) inversely, inversely

(C) directly, directly

(D) inversely, directly

4) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5×10^{-2} J. The magnitude of magnetic moment of the magnet is _____ JT^{-1}.

(A) 0.72

(B) 0.18

(C) 0.36

(D) 0.54

5) A bar magnet is of length (size) l. The ratio of its equatorial field and axial field for the same distance r (where $r >> l$) is _____.

(A) 0.5

(B) 2

(C) 1

(D) 0

Rough Work

Rough Work

$\Phi = AN$

NBA

2NBA .

6) A conducting coil having number of turns N and cross section area A is kept in such a way that its plane remains perpendicular to the uniform magnetic field B. Now, if the number of turns of the coil is made double then the magnetic flux linked with coil = ____.

(A) N^2BA

(B) $\frac{NBA}{2}$

(C) NBA

(D) 2NBA

7) Current in a circuit falls from 5 A to 0 A in 0.1 s. If an average emf of 200 V induced, the self-inductance of the circuit would be _____H.

$L = \frac{\mathcal{E}}{dI/dt} = \frac{200 \times 0.1}{5}$

(A) 3

(B) 2

(C) 1

(D) 4

8) Faraday's law gives _____ of induced emf.

(A) only magnitude

(B) only direction

(C) both magnitude and direction

(D) none of the above

9) An impedance of LC circuit is _____.
(where $X_C > X_L$)

(A) $Z = \sqrt{\left(\frac{1}{\omega C}\right) - \omega L}$

(B) $Z = \frac{1}{\omega C} - \omega L$

(C) $Z = \omega C + \frac{1}{\omega L}$

(D) $Z = \left(\frac{1}{\omega C}\right)^2 - (\omega L)^2$

Rough Work

10) If P_o is an output power and P_i is an input power of a real step-up transformer then,

(A) $P_o < P_i$

(B) $P_o > P_i$

(C) $P_o = P_i$

(D) $P_o = \sqrt{2} P_i$

11) The power factor at the time of resonance is _____.

(A) ∞

(B) 1

(C) 0

(D) 0.5

12) An inductive reactance of an inductor is _____.

(A) $\frac{1}{\omega C}$

(B) ωC

(C) $\frac{1}{\omega L}$

(D) ωL

13) _____ current is obtained due to change in the electric field.

(A) Eddy

(B) Displacement

(C) Conduction

(D) Unidirectional

Rough Work

14) A light of an energy 6.48×10^{5} J is incident normally on nonreflecting surface. The momentum imparted on the surface is _____ N-s.

(A) 21.6×10^{-3}

(B) 6.21×10^{-3}

(C) 1.26×10^{-3}

(D) 2.16×10^{-3}

15) Which one of the following electromagnetic wave is of minimum wavelength?

(A) Ultraviolet rays

(B) X - rays

(C) Gamma rays

(D) Infrared

16) The refractive index of medium-3 with respect to medium-2 n_{32} = _____.

(A) $\frac{n_{12}}{n_{31}}$

(B) $\frac{n_{31}}{n_{12}}$

(C) $n_{31} \times n_{12}$

(D) $n_{13} \times n_{21}$

17) A magician during a show makes a glass lens with refractive index $n = 1.5$ disappear in a trough of liquid. The refractive index of liquid = _____.

(A) 0.75

(B) 3.0

(C) 1.5

(D) 0.15

Rough Work

18) The focal length of objective lens and eyepiece is f_o and f_e respectively. Magnifying power of the telescope = _____.

(A) $\frac{f_o}{f_e}$

(B) $f_o - f_e$

(C) $f_o + f_e$

(D) $\frac{f_e}{f_o}$

19) When light rays undergoes _____ internal reflections inside a raindrop a secondary rainbow is formed.

(A) 3

(B) 2

(C) 1

(D) 4

20) An object is placed at 15cm in front of a concave mirror of radius of curvature 20cm. The image distance would be _____cm.

(A) –30

(B) –28

(C) –22

(D) –32

21) When the width of an aperture is a and the wavelength is λ, for a distance equal to _____ ray optics is a good approximation.

(A) $\frac{\lambda^2}{a}$

(B) $\frac{\lambda}{a}$

(C) $\frac{a}{\lambda}$

(D) $\frac{a^2}{\lambda}$

22) The number of interference fringes occurring in the broad diffraction peak depends on the ratio _____.

(A) $\frac{d^2}{a}$

(B) $\frac{a}{d}$

(C) $\frac{d}{a}$

(D) $\frac{a^2}{d}$

Where d = distance between two slits

a = width of slit

Rough Work

23) Unpolarised light is incident on a plane glass surface. For an angle of incidence _____ the reflected and refracted rays are perpendicular to each other? Refractive index of glass = 1.5.

(A) 57°

(B) 47°

(C) 37°

(D) 67°

24) Which one of the following sentence is false?

(A) The central diffraction fringe is of maximum intensity

(B) All bright interference fringes are of equal intensities

(C) Interference fringes are of equal thickness

(D) Diffraction fringes are of equal thickness

Rough Work

25) Width of a slit is a. The focal length of the lens kept just along with the slit is f. The light of wavelength λ is made normally incident on the slit. The size of the central maximum on the screen is _____.

(A) $\frac{fa}{\lambda}$

(B) $\frac{\lambda a}{f}$

(C) $\frac{a}{f\lambda}$

(D) $\frac{f\lambda}{a}$

26) The slope of the graph of the stopping potential (V_0) → frequency (ν) for the photoelectric effect is equal to _____.

(A) $\frac{e}{h}$

(B) $\frac{h}{e}$

(C) h

(D) $\frac{h}{2\pi}$

$eV_0 = hf$.

$\frac{V_0}{f} = \frac{h}{e}$.

27) If Δx and Δp are the uncertainties in the specification of the position and the momentum of an electron respectively, then according to Heisenberg's uncertainty principle $\Delta x \cdot \Delta p =$ _____.

(A) $\frac{2\pi}{h}$

(B) $\frac{h}{e}$

(C) h

(D) $\frac{h}{2\pi}$

Rough Work

28) Photons are _____ electrically.

(A) neutral

(B) negatively charged

(C) positively charged

(D) some time positively charged and some time negatively charged

29) The dimensions of $\frac{me^4}{8\varepsilon_0^2 h^3 c}$ is _____.

(A) $M^0 L^{-1} T^0$

(B) $M^0 L^1 T^0$

(C) $M^0 L^0 T^0$

(D) $M^{-1} L^0 T^0$

30) The energy required to excite an electron of the hydrogen atom from its ground state to second excited state is _____ eV.

(A) 13.6

(B) 12.09

(C) 10.2

(D) 3.40

31) Which one of the following spectral line lies in Ultraviolet region?

(A) Paschen series

(B) Balmer series

(C) Lyman series

(D) Pfund series

Rough Work

32) The radius of the nucleus of $^{27}_{13}Al$ is _____.

(A) $3R_0$

(B) $R_0^{\frac{1}{3}}$

(C) R_0

(D) R_0^3

33) Nuclear force is acting between

(A) only proton - proton

(B) only neutron - proton

(C) only neutron - neutron

(D) all the nucleons

34) Tritium has a half - life of 12.5 y undergoing beta decay. The fraction of a sample remain undecayed after 25 y is _____.

(A) $\frac{1}{8}$

(B) $\frac{1}{4}$

(C) $\frac{1}{2}$

(D) $\frac{1}{16}$

35) If n_e = number of free electrons, n_h = number of holes then for pure semi conductors;

(A) $n_e = n_h$

(B) $n_h > n_e$

(C) $n_e > n_h$

(D) $n_e = n_h^2$

Rough Work

36) When p-n junction is kept in forward bias, _____.

(A) barrier potential increases

(B) current due to majority charge carrier decreases

(C) barrier potential decreases

(D) none of the given choices

37) If a body contains n_1 electrons and n_2 protons, the total amount of charge on the body is _____.

(A) $(n_2 + n_1)e$

(B) $\left(n_1^2 + n_2^2\right)e$

(C) $\left(n_1^2 - n_2^2\right)e$

(D) $(n_2 - n_1)e$

Rough Work

38) A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of 80 $\mu C\ m^{-2}$. The charge on the sphere is _____ mC.

(A) 1.45

(B) 5.41

(C) 4.51

(D) 45.1

39) An electric field line is a curve drawn in such a way that the tangent drawn at any point on the curve gives _____ at that point.

(A) magnitude of the electric field

(B) direction of the electric field

(C) both magnitude and direction of electric field

(D) none of the given choices

40) The dimensions of $\frac{Ke^2}{Gm_em_p}$ is _____.

(A) $M^0L^{-1}T^{-1}A^{-2}$

(B) $M^0L^1T^0A^1$

(C) $M^0L^0T^0A^0$

(D) $M^1L^{-1}T^0A^{-2}$

41) The number of electric field lines coming out of charge _____, kept in a vacuum is 1.13×10^{11}.

($\varepsilon_0=8.85\times10^{-12}\ C^2N^{-1}m^{-2}$)

(A) 2 C

(B) 1 mC

(C) 2 mC

(D) 1 C

42) The electric potential at a distance _____ due to the charge 4×10^{-7} C is 4×10^{4} V.

(A) 9 cm

(B) 9 mm

(C) 9 μm

(D) 9 m

43) The electric potentials at two points (0, 3) mm and (0, 4) mm in the region in which electric field $\vec{E} = 20\hat{i}$ NC^{-1} are V_A and V_B respectively then,

(A) $V_A > V_B$

(B) $V_A < V_B$

(C) $V_A = V_B$

(D) None of the given choices

44) An electron is accelerated by a potential difference of $\Delta V = 2$ volts. The energy gained by it would be _____ eV.

(A) 1.5 eV

(B) 1 eV

(C) 2 eV

(D) 0.5 eV

Rough Work

$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

$r = \frac{9\times10^{9}\times4\times10^{-7}}{4\times10^{4}}$

12 mm,

$E = 20\hat{i}$

$V = Ed$ $V = Ed$

$= 20\times3$ $= 20\times4$

$= 60$ $= 80$.

$\Delta E = 2$ V.

Rough Work

45) Two capacitors when connected in series, their equivalent capacitance is 3μF and when they are connected in parallel their equivalent capacitance is 16μF. Their values are respectively _____ μF and _____ μF.

(A) 8, 8

(B) 8, 16

(C) 16, 1

(D) 4, 12

46) Which of the following physical quantity has unit $m^2V^{-1}s^{-1}$?

(A) mobility

(B) electric field

(C) drift velocity

(D) resistivity

47) The value of the temperature co-efficient of resistivity (α) is _____ for metals.

(A) zero

(B) positive

(C) negative

(D) infinite

48) A steady current flows in a metallic conductor of non-uniform cross-section. Which of the following quantities is constant along the conductor?

(A) electric field

(B) current density

(C) current

(D) drift speed

49) n resistors each of equal value R combine to get maximum and minimum effective resistance. The ratio of maximum effective resistance to the minimum effective resistance is _____.

(A) $\frac{1}{n}$

(B) n^2

(C) n

(D) $\frac{1}{n^2}$

Rough Work

50) For a cyclotron, if v_a is the frequency of the applied voltage and v_c is the cyclotron frequency then the resonance condition is _____.

(A) $v_a < v_c$

(B) $v_a > v_c$

(C) $v_a = v_c$

(D) $v_a = \sqrt{2}\, v_c$

054 (E)

(MARCH/APRIL 2022)
(SCIENCE STREAM)
(CLASS - XII)

(Part - B)

Time : 2 Hours] *[Maximum Marks : 50*

Instructions :

1) **Write in a clear legible handwriting.**
2) **There are three sections in Part - B of the question paper and total 1 to 27 questions are there.**
3) **Separate instruction is given in each section. Read it carefully and answer accordingly.**
4) **The numbers at right side represent the marks of the question.**
5) **Start new section on new page.**
6) **Maintain sequence.**
7) **Students may use a simple Calculator and log-table, if necessary.**

SECTION - A

■ **Answer any eight questions from the following question No. 1 to 12 as directed. (Each of 2 marks)** **[16]**

1) Write any four properties of electric field lines. **[2]**

2) Derive an expression for capacitance of the parallel plate capacitor. **[2]**

3) Write only two statements for Kirchhoff's Rules. **[2]**

4) Explain Biot-Savart law in brief. **[2]**

5) Derive an expression for the periodic time of simple harmonic motion of an electric dipole kept in a uniform magnetic field. **[2]**

6) Explain in brief the phenomenon of self-induction. Derive the formula for self-induced emf. **[2]**

7) A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of the current in the circuit. **[2]**

8) Write any four characteristics of electromagnetic wave. **[2]**

9) Derive Brewster's law in the case of polarisation by reflection. **[2]**

10) Write any four points for photon picture of electromagnetic radiation. **[2]**

11) Explain atomic number and atomic mass number of the daughter element in the case of Alpha decay. Also write one example. [2]

12) Draw the logic symbol and write Truth table of NOR gate. [2]

SECTION - B

Answer any six questions from the following question No. 13 to 21.
(Each of 3 marks) [18]

13) Derive an expression for the electric field due to an infinitely long straight uniformly charged wire. [3]

14) A heating element using nichrome connected to a 230 V supply draws an initial current of 4.6 A which settles after a few seconds to a steady value of 2.3 A. What is the steady temperature of the heating element if the room temperature is 27 °C. [$\alpha = 1.7 \times 10^{-4}$ °C^{-1}] [3]

15) Two long and parallel straight wires A and B carrying currents of 8 A and 5 A in the same direction are separated by a distance of 4 cm. Estimate the force on a 10 cm section of wire A. [3]

16) A circular coil of radius 8 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3×10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10 Ω, calculate the maximum value of current in the coil. [3]

17) a) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. What is the refractive index of glass?

b) A convex lens has 15 cm focal length in air. What is focal length in water?

(Refractive index of air-water = 1.33 and Refractive index of air-glass = 1.5) [3]

18) A beam of light consisting of two wavelengths 6000 Å and 4000 Å, is used to obtain interference fringes in a Young's double-slit experiment.

a) Find the distance of the third dark fringe on the screen from the central maximum for wavelength 6000 Å.

b) What is the least distance from the central maximum where bright fringes due to both the wavelengths coincide?

(Distance between two slits = 0.1 mm. Take D = 100 cm) [3]

19) a) For what Kinetic energy of a neutron, will the associated de - Broglie wavelength be 1.40×10^{-10} m?

b) Find the de-Broglie wavelength of a neutron, in thermal equilibrium with matter, having an average Kinetic energy of $\frac{3}{2} K_B T$ at 300 K.

$[K_B = 1.38 \times 10^{-23}$ SI unit] [3]

20) What is nuclear chain reaction? State any two difficulties arising against sustaining a chain reaction. Also write the necessary precautions. [3]

21) Draw the circuit diagram of a full-wave rectifier. Explain full-wave rectification in brief. Also draw input-output waveforms. [3]

SECTION - C

■ **Answer any four questions from the following question No. 22 to 27. (Each of 4 marks)** [16]

22) Derive an electric potential at a distance r ($r >> a$) due to an electric dipole. Also write potential on the axis and in the equatorial plane. [4]

23) For potentiometer derive

a) $\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$

b) Formula for internal resistance of the cell.

(Draw necessary circuit diagrams) [4]

24) In the case of an AC voltage applied to an inductor, derive formula for an electric current i at time t. Also, derive an expression for an average power over a complete cycle. [4]

25) Derive $i + e = A + \delta$ for a triangular glass prism. Also write the condition for the angle of minimum deviation. Derive the formula for the refractive index of the material of the prism. [4]

26) Derive the exponential law for radioactive disintegration. Also draw the decay curve. [4]

27) Which characteristics of photoelectric effect are not explained by the wave nature of light. Explain Einstein's explanation. [4]