This Question Paper contains 20 printed pages.
(Part - A & Part - B)
Sl.No.

054 (E)

(MARCH, 2023)
(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.
01

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

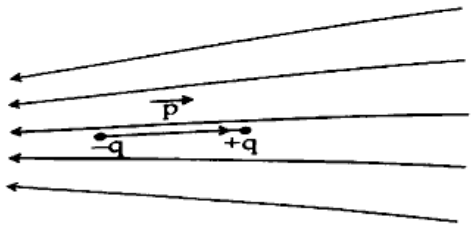
(Part - A)

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 OMR 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 this 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 Figure shows electric field in which electric dipole $\vec{p}$ is placed. Which of the following statement is correct?



(A) The dipole will not experience any force
(B) The dipole will experience a net force towards right
(C) The dipole will experience a net force towards left
(D) The dipole will experience a net force upward

Rough Work

Rough Work

2) The dimensional formula of electric flux is _____.

(A) $M^{-1}L^{3}T^{-3}A^{-1}$

(B) $M^{1}L^{3}T^{-3}A^{-1}$

(C) $M^{1}L^{-3}T^{-3}A^{-1}$

(D) $M^{1}L^{3}T^{3}A^{-1}$

3) A plastic rod rubbed with wool is found to have a negative charge of 8×10^{-7} C. The no. of electrons transferred (from which to which?) is _____.

(A) 5×10^{12}, from plastic rod to wool

(B) 5×10^{11}, from plastic rod to wool

(C) 5×10^{10}, from wool to plastic rod

(D) 5×10^{12}, from wool to plastic rod

4) How much charge should be placed on a spherical shell of radius 25 cm to have a surface charge density of $\frac{3}{\pi}$ C/m^2 ?

(A) 0.25 C

(B) 0.75 C

(C) 0.57 C

(D) 0.5 C

Rough Work

5) The Coulombian repulsive force between two alpha particles kept at a distance of 3 cm in air is _____ N.

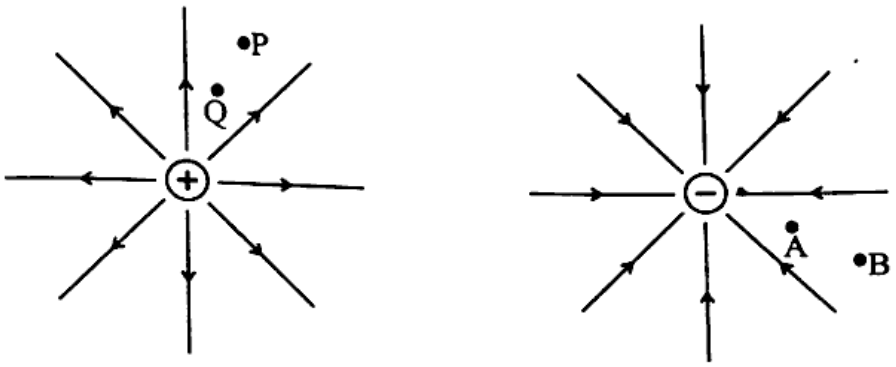
(A) 1.024×10^{-24}

(B) 1.024×10^{-25}

(C) 1.024×10^{-27}

(D) 1.024×10^{-23}

6) Figure shows the field lines of a positive and negative charge respectively. Give the sign of potential difference $V_Q - V_P$, $V_B - V_A$.



(A) +ve, +ve

(B) +ve, –ve

(C) –ve, +ve

(D) –ve, –ve

7) Energy of a charged capacitor is U. Now it is removed from a battery and then connected to two other identical uncharged capacitors in parallel. What will be the energy of each capacitor?

(A) U

(B) $3U/2$

(C) $U/4$

(D) $U/9$

Rough Work

8) The electric potential energy of $2\mu C$ charge is 3×10^{-5} J at a point in a uniform electric field. The electric potential at that point is _____ V.

(A) 6

(B) 15

(C) 5

(D) Zero

9) Equipotential surfaces at a very large distance from the collection of charges whose total sum is not zero are approximately _____.

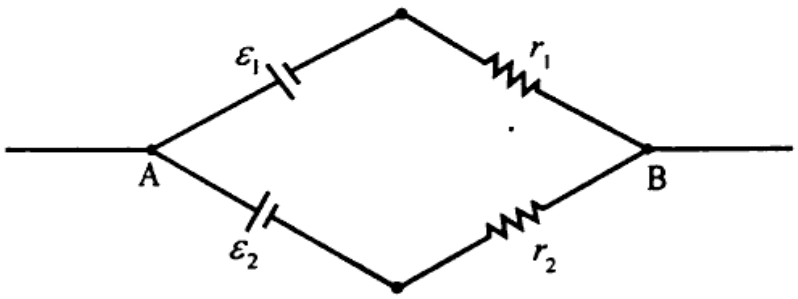
(A) spheres

(B) planes

(C) paraboloids

(D) ellipsoid

10) Two batteries of emf ε_1 & $\varepsilon_2 (\varepsilon_2 > \varepsilon_1)$ and internal resistance r_1 & r_2 respectively are connected in parallel as shown



(A) The equivalent emf $\varepsilon_{eq.}$ of the two cells is between ε_1 & ε_2 i.e. $\varepsilon_1 < \varepsilon_{eq.} < \varepsilon_2$

(B) The equivalent emf $\varepsilon_{eq.}$ is smaller than ε_1

(C) The equivalent emf is given by $\varepsilon_{eq.} = \varepsilon_1 + \varepsilon_2$

(D) $\varepsilon_{eq.}$ is independent of internal resistance r_1 & r_2

Rough Work

11) Loop rule of Kirchhoff's is a reflection of _____.

(A) Law of conservation of charge

(B) Ohm's law

(C) Law of conservation of momentum

(D) Law of conservation of energy

12) The colour bands of a carbon resistor with three bands having minimum value are _____ in order.

(A) black, brown, red

(B) black, black, silver

(C) black, brown, silver

(D) black, brown, gold

13) A steady current flows in a metallic conductor of non uniform cross-section, which of following quantities is constant along the conductor?

(A) current

(B) current density

(C) electric field

(D) drift speed

14) In a Cyclotron, a charged particle

(A) undergoes acceleration all the time

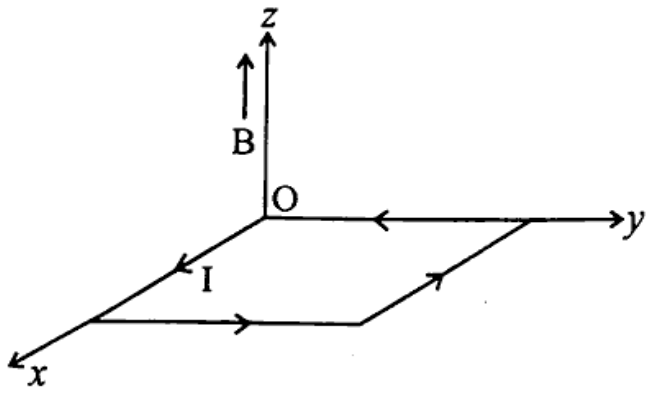
(B) speeds up between the dees because of magnetic field

(C) speeds up in a dee

(D) slows down within a dee and speeds up between dees

Rough Work

15) A uniform magnetic field of 0.3 T is established along the +ve Z direction. A rectangular loop of sides 10 cm and 5 cm carries a current of 12 A is placed as shown in figure. The torque acting on the loop is _____ Nm.



(A) $1.8\times10^{-2}\hat{i}$

(B) $-1.8\times10^{-2}\hat{j}$

(C) $-1.8\times10^{-2}\hat{i}$

(D) Zero

16) A galvanometer coil has a resistance of 10 Ω and the meter shows full scale deflection for 3 mA. The value of shunt to convert this meter into ammeter of range 0 to 10 A is _____ Ω.

(A) 1

(B) 2

(C) 3

(D) 4

17) Which of the following is not a unit of magnetic induction?

(A) Tesla

(B) Newton/meter-Ampere

(C) Weber/meter^2

(D) Newton-meter/Ampere

Rough Work

18) Ferromagnetic materials have _____ permeability and _____ retentivity.

(A) low, high

(B) high, low

(C) high, high

(D) low, low

19) In the magnetic meridian of a certain place, the horizontal component of earth's magnetic field is 0.20 G and dip angle is 30°. What is the magnetic field at this location?

(A) 0.23 G

(B) 0.32 G

(C) 0.42 G

(D) 0.82 G

20) A square of side L meter lies in the x - y plane in a region where the magnetic field is given by $\vec{B} = B_0\left(2\hat{i} + 4\hat{j} + 3\hat{k}\right)T$, where B_0 is constant. The magnitude of flux passing through the square is

(A) $2B_0L^2$ Wb

(B) $3B_0L^2$ Wb

(C) $4B_0L^2$ Wb

(D) $\sqrt{29}\,B_0L^2$ Wb

21) When current I passes through an inductor having self inductance of 4 H. If the current is made double what will be the new self inductance of the inductor.

(A) Zero

(B) 2 H

(C) 4 H

(D) 8 H

Rough Work

22) Inductive reactance _____.

(A) limits D.C. current

(B) limits D.C. voltage

(C) limits A.C. current

(D) stores the A.C. current

23) Magnetic flux linked with the coil is given by $\phi(t) = (2t^2 + 2t + 1)$ Wb and its resistance is 10 Ω. The current passing through the coil at $t = 2$ s is _____ A.

(A) 0.5

(B) 1

(C) 1.5

(D) 2

24) A power transmission line feeds input power at 2300 V to a stepdown transformer with its primary winding having 4000 turns. What should be the number of turns in the secondary in order to get output power at 230 V.

(A) 400

(B) 40

(C) 4000

(D) 2300

25) For circuits used for transporting electric power, a low power factor implies _____.

(A) power increases in transmission

(B) remains constant in transmission

(C) small power loss in transmission

(D) large power loss in transmission

Rough Work

26) Which of the following combination should be selected for better tuning of an LCR a.c. circuit used for communication?

(A) R = 20 Ω, L = 1.5 H, C = 35 μF

(B) R = 25 Ω, L = 2.5 H, C = 45 μF

(C) R = 15 Ω, L = 3.5 H, C = 30 μF

(D) R = 25 Ω, L = 1.5 H, C = 45 μF

27) If the rms current in a 50 Hz a.c. circuit is 5A, at time $t = 0$ current I is 0. The value of current I at $t = \frac{1}{300}$ seconds is _____ A.

(A) $5\sqrt{2}$

(B) $5\sqrt{\frac{3}{2}}$

(C) $\frac{5}{6}$

(D) $\frac{5}{\sqrt{2}}$

28) T.V. waves range from _____.

(A) 54 MHz - 890 MHz

(B) 88 MHz - 108 MHz

(C) 24.5 GHz - 229.5 GHz

(D) 400 GHz - 600 GHz

29) For a given electromagnetic waves the magnitude of electric field is 6.6 V/m at a point in space. The magnitude of magnetic field at this point is _____ T.

(A) 19.8×10^{-8}

(B) 6.6×10^{-8}

(C) 2.1×10^{-8}

(D) 2.2×10^{-8}

Rough Work

30) A small pin fixed on a table top is viewed from above from a distance of 100 cm. By what distance would the pin appear to be raised if it is viewed from the same point through a 9 cm thick glass slab held parallel to the table. Refractive index of glass = 1.5.

(A) 3 cm

(B) 6 cm

(C) 9 cm

(D) 5 cm

31) The amount of Rayleigh scattering is _____.

(A) directly proportional to wavelength

(B) inversely proportional to wavelength

(C) inversely proportional to fourth power of wavelength

(D) directly proportional to fourth power of wavelength

32) Power of plane mirror is _____.

(A) 0

(B) ∞

(C) +1

(D) −1

33) The earth takes 24 h to rotate once about the axis. How much time does the Sun takes to shift by 2°, when view from the earth?

(A) 240 s

(B) 480 s

(C) 720 s

(D) 960 s

Rough Work

34) Optical phenomenon taking place for mirror and lens respectively are _____ & _____.

(A) reflection, refraction

(B) interference, diffraction

(C) reflection, diffraction

(D) refraction, interference

35) A slit of size 'a' is illuminated by a parallel beam of light of wavelength λ. The angle at which this light is diffracted is approximately _____.

(A) λ/a

(B) λ/a^2

(C) a^2/λ

(D) a/λ

36) The refractive index of a medium is $\frac{3}{2}$. The speed of light in this medium is _____ m/s [Speed of light in vacuum is $c = 3 \times 10^8$ m/s]

(A) 3×10^8

(B) 2.5×10^8

(C) 2×10^8

(D) 3.5×10^8

Rough Work

37) In Young's double experiment the distance between two slits is 0.2 mm and the distance between slit and screen is 1.5 m. The wavelength of light used is 600 nm. The distance between any two consecutive bright fringes is _____ mm.

(A) 0.5

(B) 4.5

(C) 0.8

(D) 2.0

38) The intensity of incident unpolarized light on a polaroid is I_1 and the intensity of emergent polarized light from this polaroid is I_2. The relation between I_1 & I_2 is _____.

(A) $I_1 = I_2$

(B) $I_1 > I_2$

(C) $I_1 < I_2$

(D) $I_1 = 2I_2$

39) Unpolarized light is incident on a plane transparent surface. The reflected and refracted rays are found perpendicular to each other, then the angle of incidence is _____. [Refractive index of the medium is 1.73]

(A) 90°

(B) 45°

(C) 30°

(D) 60°

Rough Work

40) Variation of stopping potential V_0 with frequency (ν) of incident radiation for a given photosensitive material is straight line. [frequency (ν) of incident radiation is greater than threshold frequency (ν)].
The slope of this line is _____.

(A) ϕ_0/h

(B) h/ν

(C) h/e

(D) e/V_0

41) The de-Broglie wavelength (λ) associated with an electron accelerated through a potential difference of 121 V is _____.
[$m_e = 9.1 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34}$ Js]

(A) 1.12 Å

(B) 2.1 Å

(C) 12.0 Å

(D) 0.12 Å

42) Monochromatic light of frequency 6×10^{14} Hz is produced by laser. The power emitted is 2×10^{-3} W. The energy of the photon in this light beam is _____ eV.
[$h = 6.63 \times 10^{-34}$ Js, $1eV = 1.6 \times 10^{-19}$ J]

(A) 4.0

(B) 3.5

(C) 3.0

(D) 2.5

43) What is the shortest wavelength present in the Balmer series of spectral lines? [Rydberg's constant $R = 1.097 \times 10^7\ m^{-1}$]

(A) 26 nm

(B) 91 nm

(C) 365 nm

(D) 820 nm

Rough Work

44) What is the angular momentum of electron of Be^{+3} ion in $n = 5$ orbit?

(A) 5.3×10^{-34} Js

(B) 6.6×10^{-34} Js

(C) 3.3×10^{-34} Js

(D) 1.3×10^{-34} Js

45) What is the ratio of total energy of an electron in hydrogen atom in first excited state and third excited state?

(A) 1 : 1

(B) 3 : 1

(C) 4 : 1

(D) 1 : 4

46) According to mass energy equivalence relation, 9×10^{13} J of energy can be converted into _____ maximum mass.

[Speed of light $c = 3 \times 10^8$ m/s]

(A) 3 g

(B) 9 g

(C) 81 g

(D) 1 g

47) One of the fusion reaction in Sun is given by

$${}_1^2H + {}_1^1H \rightarrow {}_2^3He + \gamma + \_\_\_\_\_$$

Fill in the blank with correct option.

(A) 12.86 MeV

(B) 5.49 MeV

(C) 1.02 MeV

(D) 0.42 MeV

48) For a radioactive element half life is 1.5 days. How many minutes will it take to disintegrate this element by 75%?

Rough Work

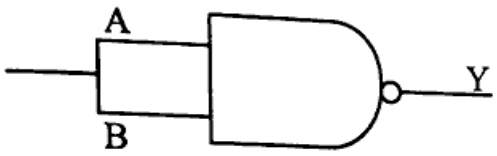
(A) 1260

(B) 4320

(C) 3240

(D) 2430

49) Given figure is the equivalent of which logic gate?



(A) OR

(B) AND

(C) NOT

(D) NOR

50) When a forward bias is applied to a p-n junction, it

(A) raises the potential barrier

(B) reduces the majority carrier current to zero

(C) lowers the potential barrier

(D) none of the above

054 (E)

(MARCH, 2023)
(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 18 questions are there.**
3) **All the questions are compulsory. Internal options are given.**
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

■ **Questions 1 to 8 do as directed. Each question carries 2 marks.** **[16]**

1) Derive an equation for an electric field due to infinitely long straight uniformly charged wire. **[2]**

2) At room temperature (27°C) the resistance of heating element is 100 Ω. What is the temperature of the element if the resistance is found to be 134 Ω, given that the temperature coefficient of material of the resistor is $1.7 \times 10^{-4}\,°C^{-1}$? **[2]**

3) State and explain Gauss's Law for magnetism. **[2]**

OR

3) Derive the equation $B = \frac{\mu_0}{4\pi}\frac{2m}{r^3}$ for the axial magnetic field for finite Solenoid. m is the magnetic moment of Solenoid & r is the distance of the point from the centre of Solenoid. **[2]**

4) Define mutual inductance and mention the factors on which mutual inductance depends. **[2]**

5) Write the four Maxwell's equations in reference to electromagnetic waves. **[2]**

6) If the magnetic field is parallel to the +ve x - axis and the charged particle is moving along +ve y - axis. Which direction would the Lorentz force act
a) for an electron b) for a proton? **[2]**

7) The half life of $^{238}_{92}U$ undergoing α-decay is 4.5×10^9 years. What is the activity of 1g of sample of $^{238}_{92}U$? **[2]**

8) Explain β-decay with appropriate example. [2]

OR

8) Differentiate between P-type and N-type Semiconductor (any four). [2]

SECTION - B

Question No. 9 - 14 do as directed. Each question carries 3 marks. [18]

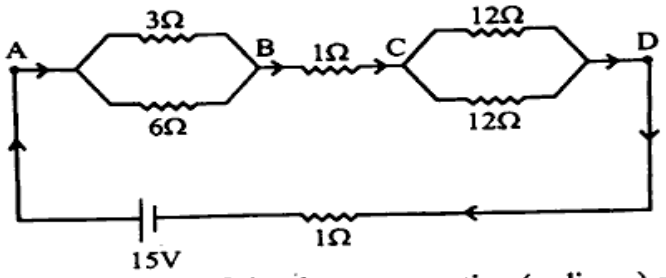
9) What is Potentiometer? Explain how can it be used to determine internal resistance of cell. Draw the circuit diagram and derive the equation. [3]

OR

9) A network of resistors is connected to a 15 V battery with internal resistance 1 Ω as shown in figure. [3]

a) Compute the equivalent resistance of the network.

b) Obtain current in 12 Ω & 6 Ω resistance.



10) A long straight wire of circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across the cross-section. Calculate the magnetic field in the region $r < a$ and $r > a$. [3]

11) A beam of light consisting of two wavelengths 650 nm and 520 nm is used to obtain interference fringes in Young's double slit experiment. Distance between two slits is 0.25 mm and slit & screen is 1 m. [3]

a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

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

12) State and explain Huygen's Principle. [3]

OR

12) Explain Davisson Germer experiment with proper diagram. Prove that this experiment confirms the wave nature of electrons and de Broglie relation. [3]

13) The work function of cesium is 2.14 eV. Find [3]

a) the threshold frequency of cesium, and

b) the wavelength of the incident light if the photo current is brought to zero by a stopping potential of 0.86V.

14) What is rectification? Explain half wave rectifier with proper circuit and draw the wave forms of input and output voltage. [3]

SECTION - C

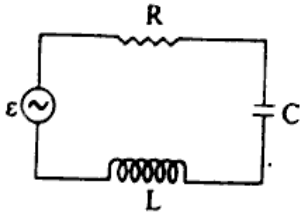
■ **Questions 15 to 18 do as directed. Each question carries 4 marks.** [16]

15) The plates of a parallel plate capacitor have an area of 90 cm^2 each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply. [4]

a) How much electrostatic energy is stored by the capacitor?

b) View this energy as stored in the electrostatic field between the plates and obtain the energy per unit volume u. Hence arrive at a relation between u and the magnitude of the electric field E between the plates.

16) Figure shows a series LCR circuit connected to a variable frequency 230 V a.c. source. L = 5 H, C = 80 μF, R = 40 Ω. [4]



a) Determine the source frequency which derives the circuit in resonance.

b) Obtain the impedance of the circuit and amplitude of current at the resonating frequency.

c) Determine the rms potential drops across the three elements of the circuit.

d) Show that the potential drop across the LC combination is zero at the resonating frequency.

OR

16) A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is connected to 230 V variable frequency supply. [4]

a) What is the source frequency for which current amplitude is maximum? Obtain the maximum value.

b) What is source frequency for which average power absorbed by the circuit is maximum? Obtain the value of maximum power.

c) For which frequencies of the source is the power transferred to the circuit is half the power at resonant frequency? What is the current amplitude at these frequencies?

d) What is the Q factor of the given circuit?

17) 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 15 cm. How far from the objective should an object be placed in order to obtain the final image at [4]

a) the least distance of distinct vision (25 cm) and

b) at infinity?

What is the magnifying power of microscope in each case?

18) State Bohr's postulates for atomic model. Derive the equations for orbital radius, orbital speed and total energy for an electron in n^{th} orbit in hydrogen atom. [4]

OR

18) Explain atomic spectra. Write the equation for Lyman series, Paschen series, Brackett series & Pfund series for hydrogen atom. [4]