This Question Paper contains 20 printed pages.

(Part - A & Part - B)

Sl.No. 0200029

054 (E)

(MAY, 2021)

SCIENCE STREAM

(CLASS - XII)

(Old Course)

Part - A : Time : 1 Hour / Marks : 50

Part - B : Time : 2 Hours / Marks : 50

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.

02

(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 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 calculator and log-table, if necessary.**
8) **The symbols used in the question - paper have their known - meanings.**

1) There exists an electric field of 100 N/C along Z-direction. The flux passing through a square of 10 cm sides placed on XY plane inside the electric field is _____ .

(A) 10 Vm

(B) 2.0 Vm

(C) 1.0 Nm^2/c

(D) 4.0 Nm^2/c

Rough Work

$E = 100\ N/C$

$A = 10\ cm \times 10\ cm$

$= 100\ cm^2$

$A = 10^{-2}\ m^2$

$\phi = E \cdot A$

$= 100 \times \frac{1}{100}$

$= 1$

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Rough Work

2) The number of electric field lines emerged out from 1C charge is _____. ($\varepsilon_0 = 8.85 \times 10^{-12}$ MKS)

(A) 1.13×10^{11}

(B) 8.85×10^{2}

(C) 9×10^{9}

(D) infinite

$\Phi = \frac{q}{\varepsilon_0}$

$= \frac{1}{8.85 \times 10^{-12}}$

$=$

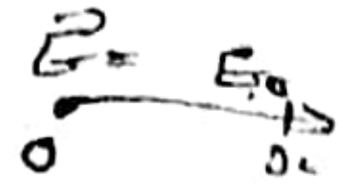
3) For a uniform electric field $\vec{E} = E_0(\hat{i})$, if the electric potential at $x = 0$ is zero, then the value of electric potential at $x = +x$ will be _____.

(A) x^2E_0

(B) $-xE_0$

(C) xE_0

(D) $-x^2E_0$



$E = -\frac{dV}{dl}$

$\therefore \int_0^x dV = -E \int_0^x dl$

$V = -E_0 x$

4) The capacitance of a variable capacitor joined with a battery of 100 V is changed from 2μF to 10μF. What is the change in the energy stored in it?

(A) 6.5×10^{-2} J

(B) 2.5×10^{-2} J

(C) 2×10^{-2} J

(D) 4×10^{-2} J

$V = 100$ V

$U = \frac{q^2}{2C}$

$\Delta U = \frac{1}{2} \Delta C V^2$

$= \frac{1}{2} \times 8 \times 10^{-6} \times 10^4$

5) 6 identical capacitors are joined in parallel and are charged with a battery of 10V. Now the battery is removed and they are joined in series with each other. In this condition what would be the potential difference between the free plates in the combination?

(A) 60 V

(B) 30 V

(C) 10 V

(D) $\frac{10}{6}$ V

$C_{eq} = 6C$

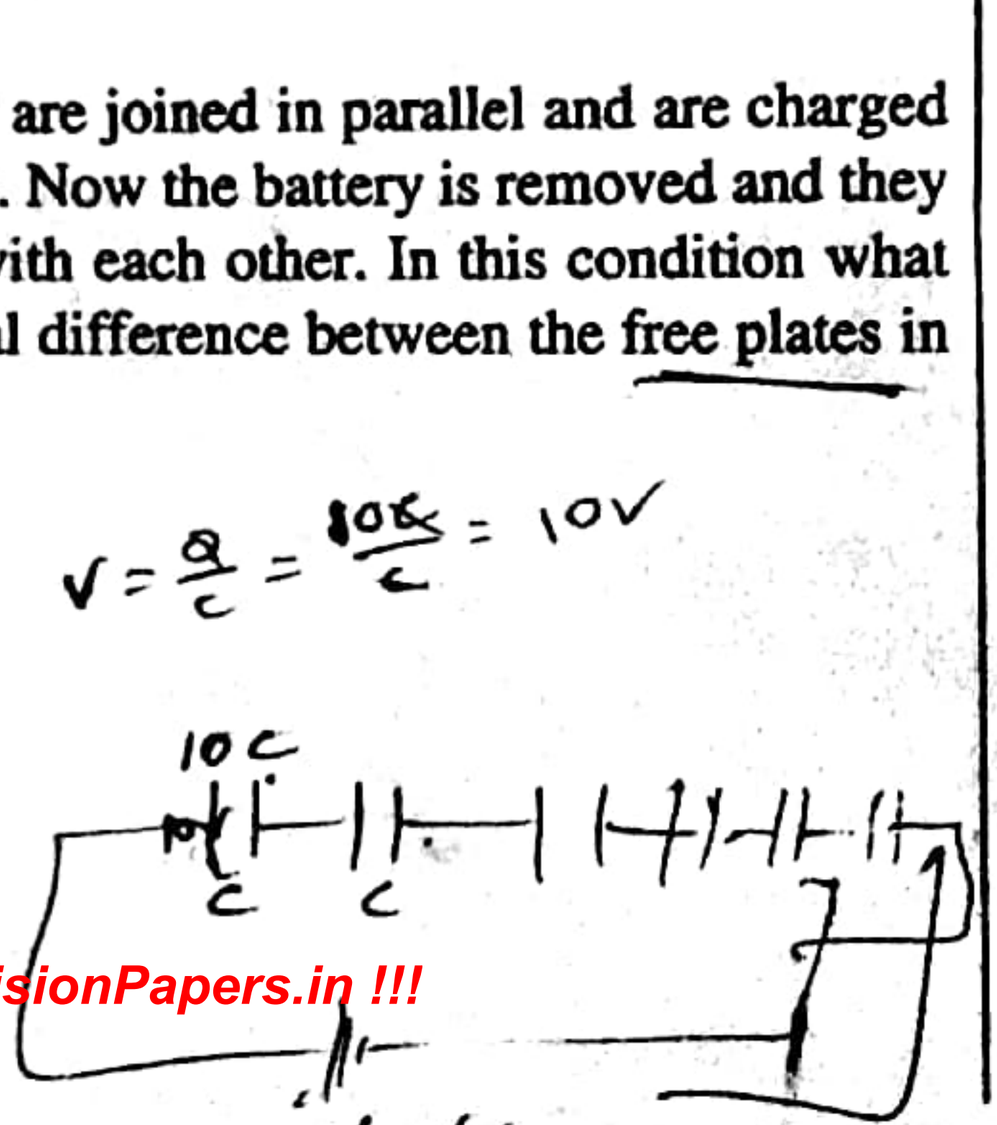
$V = 10V$

$Q = CV$

$Q = 60C$

$Q_{ind} = 10C$

$V = \frac{Q}{C} = \frac{10C}{C} = 10V$



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6) A current density of 2.5 Am^{-2} is found to exist in a conductor when an electric field of 5×10^{-8} Vm^{-1} is applied across it. The resistivity of a conductor is _____.

(A) 0.5×10^{-8} Ωm

(B) 2×10^{-8} Ωm

(C) 1×10^{-8} Ωm

(D) 12.5×10^{-8} Ωm

7) A resistive wire is stretched till its length is increased by 100%. Due to the consequent decrease in diameter, the change in the resistance of a stretched wire will be _____.

(A) 100%

(B) 200%

(C) 300%

(D) 50%

8) The resistance of a 10 m long potentiometer wire is 20 Ω. It is connected in series with a 3V battery and 10 Ω resistor. The potential difference between two points separated by distance 30 cm is equal to _____.

(A) 0.1 V

(B) 0.06 V

(C) 0.02 V

(D) 1.2 V

Rough Work

$J = 2.5\ A/m^2$

$E = 5 \times 10^{-8}\ V/m.$

$J = \frac{E}{S}$

$\rho = \frac{E}{J} = \frac{5 \times 10^{-8}}{2.5}$

$l_1 = l$

$l_2 = 2l$

$\frac{R_2}{R_1} =$

$\frac{R_1}{R_2} = 1 - \eta$

$R_{NEW} = n^2 R_{old}$

$R_{NEW} = 4R$

l_1

R_1

l_2

η_2

η_1

$l_1 = \frac{4R - R}{R} = \frac{3R}{R}$

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$I_1 = 100$

$I_2 = 101$

9) If the current in an electric bulb increases by 1%, what will be the change in the power of a bulb?

[Assume that the resistance of the filament of a bulb remains constant]

(A) increases by 2%

(B) decreases by 1%

(C) increases by 1%

(D) decreases by 2%

$P = I^2 R$

$P \propto I^2$

$\frac{P_2}{P_1} = \frac{I_2^2}{I_1^2} = \frac{101 \times 101}{10000}$

$P_2 = 1.0201 P_1$

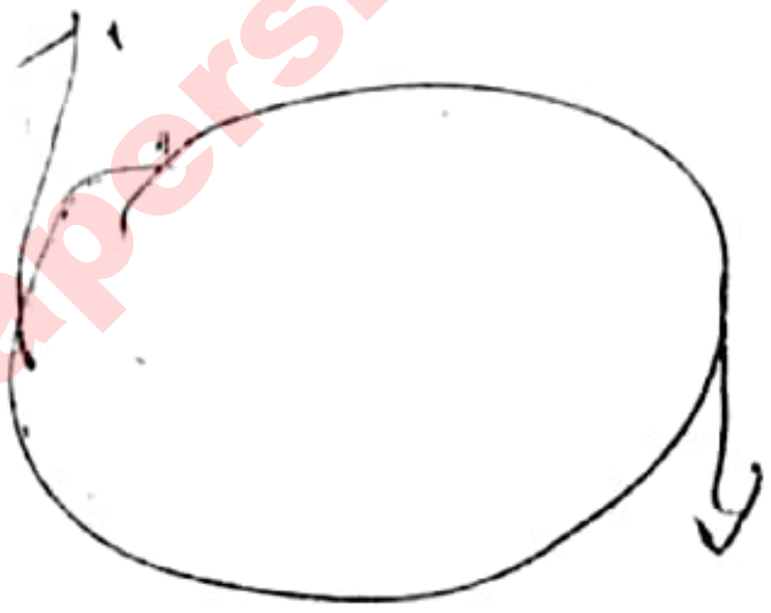
10) An electron performs circular motion of radius r, perpendicular to a uniform magnetic field B. The kinetic energy gained by this electron in half the revolution is _____. Velocity of the electron is v.

(A) Zero

(B) $\frac{1}{4} mv^2$

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

(D) $\pi r B e v$



11) A conducting wire of 1m length is used to form a circular loop. If it carries a current of 1 ampere, its magnetic moment will be _____ Am^2.

Answer

(A) $\frac{\pi}{4}$

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

(C) 2π

(D) $\frac{1}{4\pi}$

$l = 2\pi r$

$r = \frac{1}{2\pi}$

Area $= \pi r^2$

$= \pi \times \frac{1}{4\pi^2}$

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Rough Work

12) There are 100 turns per cm length in a very long solenoid. It carries a current of 5A. The magnetic field at its centre on the axis is _____ T.

(A) 9.42×10^{-2}

(B) 6.28×10^{-2}

(C) 3.14×10^{-2}

(D) 12.56×10^{-2}

$B = \mu_0 n I$

$= \mu_0 \frac{N}{l} I$

$= 4\pi \times 10^{-7} \times 1000 \times$

$= 20 \times 3.14$

13) A very long solenoid of length L has n layers. There are N turns in each layer. Diameter of the solenoid is D and it carries current I. The magnetic field at the centre of the solenoid is _____.

(A) independent of D

(B) inversely proportional to D

(C) directly proportional to D

(D) directly proportional to L

14) Let r be the distance of a point on the axis of a bar magnet from its centre. The magnetic field at r is always proportional to

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

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

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

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(D) not necessarily $\frac{1}{r^3}$ at all points

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Rough Work

15) A straight steel wire of length l has magnetic moment m. If the wire is bent in the form of a semicircle, the new value of the magnetic dipole moment is _____.

(A) $\frac{m}{2}$

(B) $\frac{2m}{\pi}$

(C) m

(D) $\frac{m}{\pi}$

16) At a place on Earth, the horizontal component of Earth's magnetic field is $\sqrt{3}$ times its vertical component. The angle of dip at this place is _____.

(A) $\frac{\pi}{3}$ rad

(B) $\frac{\pi}{2}$ rad

(C) 0

(D) $\frac{\pi}{6}$ rad

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17) Magnetization for vacuum is _____.

(A) infinite

(B) positive

(C) negative

(D) zero

Rough Work

18) A fish in a lake is at a 6.3 *m* horizontal distance from the edge of the lake. If it is just able to see a tree on the edge of the lake, its depth in the lake is _____ *m*. Refractive index of the water is 1.33.

(A) 7.5

(B) 5.52

(C) 6.30

(D) 1.55

19) A ray of light is incident normally on the surface of an equilateral prism made up of material with refractive index 1.5. The angle of deviation is _____.

(A) 60°

(B) 45°

(C) 30°

(D) 75°

20) The radii of curvature of both the sides of a convex lens are 15 cm and if the refractive index of the material of the lens is 1.5, then focal length of lens in air is _____ cm.

(A) 20

(B) 15

(C) 10

(D) 30

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Rough Work

21) Energy of photon is $E = hf$ and its momentum is $P = \frac{h}{\lambda}$, where λ is the wavelength of photon. With this assumption speed of light wave is _____.

(A) EP

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

(C) $\frac{P}{E}$

(D) $\left(\frac{E}{P}\right)^2$

22) Photons of energy 1eV and 2.5 eV successively illuminate a metal whose work function is 0.5 eV. The ratio of maximum speed of emitted electron is _____.

(A) 3 : 1

(B) 2 : 1

(C) 1 : 2

(D) 1 : 3

23) Mass of photon in motion is _____.

(A) hf

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

(C) $\frac{c}{hf}$

(D) $\frac{hf}{c^2}$

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Rough Work

24) When electric current in a coil steadily changes from +2A to –2A in 0.05 s, an induced emf of 8.0 V is generated in it. Then the self-inductance of the coil is _____ H.

(A) 0.8

(B) 0.4

(C) 0.2

(D) 0.1

25) A magnet is moving towards a coil along its axis and the emf induced in the coil is ε. If the coil also starts moving towards the magnet with the same speed, the induced emf will be _____.

(A) 2ε

(B) ε

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

(D) 4ε

26) Current of 2A passing through a coil of 100 turns gives rise to a magnetic flux of 5×10^{-3} Wb per turn. The magnetic energy associated with coil is _____.

(A) 5 J

(B) 0.5×10^{-3} J

(C) 5×10^{-3} J

(D) 0.5 J

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27) In an A.C. circuit in 1 second current reduces to zero value 120 times. Hence the frequency of A.C. current is _____ Hz.

(A) 60

(B) 100

(C) 50

(D) 120

Rough Work

28) Current of $\frac{50}{\pi}$Hz frequency is passing through an A.C. circuit having series combination of resistance R = 100 Ω and inductor L = 1H, then phase difference between voltage and current is _____.

(A) 30°

(B) 45°

(C) 60°

(D) 90°

29) For L-C-R A.C. circuit resonance frequency is 600 Hz and frequencies at half power points are 550 Hz and 650 Hz. What will be the Q-Factor?

(A) 6

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

(C) $\frac{1}{6}$

(D) 3

30) Which device is used to increase or decrease A.C. voltage?

(A) Transformer

(B) Voltmeter

(C) Oscillator

(D) Rectifier

31) Astronomers have found that the electromagnetic waves of wavelength 21 cm are continuously reaching the earth's surface. The frequency of this radiation is _____.

[C = 3×10^8 ms^{-1}]

(A) 1.43 kHz

(B) 1.43 MHz

(C) 1.43 GHz

(D) 1.43 Hz

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40) The wavelength of the first line of Lyman series is λ. The wavelength of the first line in Balmer series is _____.

(A) $\frac{9}{2}\lambda$

(B) $\frac{5}{27}\lambda$

(C) $\frac{27}{5}\lambda$

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

41) During the life time of a radioactive element as time passes the number of its nuclei decreases and along with that _____.

(A) activity decreases but λ remains constant

(B) activity and λ go on increasing

(C) activity and λ go on decreasing

(D) activity decreases but λ increases

42) 1g radioactive element reduces to $\frac{1}{3}$ g after 2 days. After total 6 days how much mass remain?

(A) $\frac{1}{9}$ g

(B) $\frac{1}{6}$ g

(C) $\frac{1}{27}$ g

(D) $\frac{1}{12}$ g

Rough Work

$n_1 = 1 \quad n_2 = 2$

$\frac{1}{\lambda} = R\left(1 - \frac{1}{4}\right)$

$\frac{1}{\lambda_L} = R\left(\frac{3}{4}\right)$

$R = \frac{4}{3\lambda}$

$n_1 = 2 \quad n_2 = 3$

$\frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right)$

$\frac{1}{\lambda_B} = \frac{4}{3\lambda}\left(\frac{5}{36}\right)$

$\lambda = \frac{27\lambda}{5}$

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Rough Work

36) To determine the position of a point like object precisely _____ light should be used.

(A) short wavelength

(B) long wavelength

(C) polarized

(D) intense

37) In Fraunhoffer diffraction by a single slit, the width of the slit is 0.01 cm. If the wavelength of light incident normally on the slit is 6000 Å the angular distance of second maximum from the mid line of central maximum is _____ rad.

(A) 0.075

(B) 0.15

(C) 0.015

(D) 0.030

38) According to Bohr's hypothesis, the angular momentum of the electron in any stationary orbit of radius r is proportional to

(A) $\sqrt{r}$

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

(C) r

(D) r^2

$Am\epsilon \frac{mvn}{Am} = \frac{nh}{2\pi}$.

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39) The radius of second orbit in an atom of hydrogen is R. What is its radius in third orbit?

(A) 9R

(B) 2.25R

(C) 3R

(D) $\frac{R}{3}$

$r_n = \frac{n^2}{Z} a_0$

$r_2 = 4 a_0$

$r_3 = 9 a_0$

$= \frac{9}{4} r_2$

$= 2.25 R$

40) The wavelength of the first line of Lyman series is λ. The wavelength of the first line in Balmer series is _____.

(A) $\frac{9}{2}\lambda$

(B) $\frac{5}{27}\lambda$

(C) $\frac{27}{5}\lambda$

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

41) During the life time of a radioactive element as time passes the number of its nuclei decreases and along with that _____.

(A) activity decreases but λ remains constant

(B) activity and λ go on increasing

(C) activity and λ go on decreasing

(D) activity decreases but λ increases

42) 1g radioactive element reduces to $\frac{1}{3}$ g after 2 days. After total 6 days how much mass remain?

(A) $\frac{1}{9}$ g

(B) $\frac{1}{6}$ g

(C) $\frac{1}{27}$ g

(D) $\frac{1}{12}$ g

Rough Work

$\frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right)$

$\frac{1}{\lambda_L} = R\left(\frac{3}{4}\right)$

$R = \frac{4}{3\lambda}$

$\frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right)$

$\frac{1}{\lambda_B} = \frac{4}{3\lambda}\left(\frac{5}{36}\right)$

$\lambda = \frac{27\lambda}{5}$

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Rough Work

43) The density of electron and holes in an intrinsic semiconductor is n_e and n_h respectively. Which of the following options are true?

(A) $n_e = n_h$

(B) $n_e > n_h$ N type

(C) $n_h > n_e$ P type.

(D) $n_h >> n_e$

44) When will the conductivity of a Ge semiconductor decrease?

(A) In making UV light incident

(B) On adding acceptor impurity

(C) On adding donor impurity

(D) On decreasing the temperature

45) For detecting the light,

(A) The LED has to be connected in forward bias mode

(B) The photodiode has to be reverse biased

(C) The photodiode has to be forward biased

(D) The LED has to be connected in a reverse bias mode

46) In order to operate _____ type of semiconductor, we have to apply the forward bias.

(A) varactor diode

(B) zener diode

(C) photo diode

(D) light emitting diode (LED)

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47) Which of the following is not a transmission channel?

(A) Free space

(B) Optical fiber

(C) Coaxial cable

(D) Receiver

48) In which section of the communication system, the noise signal get admixed with the information signal?

(A) Communication channel

(B) Receiver

(C) Transmitter

(D) Source of information

49) An electric dipole is placed in a uniform field. The resultant force acting on it _____.

(A) never be zero

(B) depends on its relative position

(C) always be zero

(D) depends on its dipole moment

50) The dimensions of permitivity [ε_0] are _____ . Take Q as the dimension of charge.

(A) $M^{-1}L^{-3}T^{2}Q^{2}$

(B) $M^{-1}L^{2}T^{-3}Q^{-1}$

(C) $M^{1}L^{-2}T^{-2}Q^{-2}$

(D) $M^{-1}L^{3}T^{-2}Q^{-2}$

Rough Work

$F = \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{R^2}$

$\varepsilon_0 = \frac{Q^2}{M^1L^1T^{-2}L^2}$

$= M^{-1}L^{-3}T^{2}Q^{2}$

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054 (E)

(MAY, 2021)
SCIENCE STREAM
(CLASS - XII)
(Old Course)

(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 27questions 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 calculator and log-table, if necessary.**

SECTION - A

■ **Out of the given question number 1 to 12 answer any 8. Each question carries 2 marks.** **[16]**

1) Define the linear charge density, surface charge density. Also give their units.

2) Derive the formula for the electric potential energy of an electric dipole in a uniform electric field.

3) The tungsten filament of bulb has resistance equal to 18 Ω at 20°C temperature. 0.185 A of current flows, when 30 V is connected to it. If $\alpha = 4.5 \times 10^{-3}\ k^{-1}$ for a tungsten, then find the temperature of the filament. Assume that Ohm's law is obey.

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4) When a galvanometer with a shunt is joined in an electrical circuit, 2% of the total current passes through the galvanometer. Resistance of galvanometer is G. Find the value of shunt.

5) An object lies on the principal axis of a concave mirror with radius of curvature 160 cm. Its image appear erect at a distance 70 cm from it. Determine the position of the object.

6) Write the characteristics of photoelectric emission.

7) Deduce an equation $U=\frac{1}{2}LI^2$ for an inductor.

8) Obtain the expression for current in an A.C. circuit containing only inductor. (Draw necessary figure and graph)

9) Give two points of comparison for interference and diffraction pattern.

10) Explain the stability of a nucleus.

11) In a given sample, at some instant, the rate of disintegration of radioactive element is 8000 dis-integration per second. At this instant, the number of undisintegrated nuclei of this element is 8×10^7. Find the decay constant.

12) Explain the depletion layer and depletion barrier of a PN junction diode.

SECTION - B

■ **Out of the given question number 13 to 21 answer any 6. Each question carries 3 marks.** **[18]**

13) The surface charge density of a very large surface is -3.0×10^{-6} cm^{-2}. From what distance should an electron of 150 eV energy be projected towards the plane so that its velocity becomes zero on reaching the plane? Charge of an electron = 1.6×10^{-19}C, 1eV = 1.6×10^{-19}J; $\varepsilon_0 = 9 \times 10^{-12}$ SI.

14) Obtain the formula for the capacitance of a parallel plate capacitor.

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15) In a certain region the electric potential is given by the formula $V(x, y, z) = 2x^2y + 3y^3z - 4z^4x$. Find the components of electric field and the vector electric field at point (1, 1, 1) in this field.

16) Obtain the formula for the Lorentz force on a moving electric charge in a uniform electric and magnetic field.

$F = F_e + F_B = \vec{q}\vec{E} + \vec{v} \times \vec{B}$

17) Monochromatic light of wavelength 3000Å is incident normally on a surface of area 4 cm^2. If the intensity of light is $150\frac{mW}{m^2}$, find the number of photons being incident on this surface in one second.
($h = 6.625 \times 10^{-34}$ J.s, $C = 3 \times 10^8$ ms^{-1})

18) In Fraunhoffer diffraction, the wavelength of light incident normally on the slit is $\frac{d}{2}$, where d is the width of the slit. What will be the maximum number of bright fringes formed on an infinitely extended screen placed at any distance from the slit.

19) The H_α - line in Balmer series of the hydrogen spectrum has a wavelength 6563Å. From this calculate the wavelength for the first line of the Lyman series (Ly_α).

20) At what temperature will the average molecular kinetic energy in gaseous hydrogen be equal to the binding energy of a hydrogen atom? Boltzmann constant $k_B = 1.38 \times 10^{-23}$ Jk^{-1}.

21) When a counter is brought near a patient injected with a radioactive dose, it records 16000 counts per minute. In equal circumstances, after 4 hours it records 500 counts per minute. Find the half time of a radioactive element in the given dose.

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SECTION - C

■ **Out of the given question number 22 to 27 answer any 4. Each question carries 4 marks.** **[16]**

22) Explain the method of finding the internal resistance of a cell using potentiometer.

23) The resistance of one aluminium and one copper wires having identical lengths is equal. Which of the two wires will be lighter $\rho_{Al} = 2.63 \times 10^{-8}\ \Omega m$; $\rho_{Cu} = 1.72 \times 10^{-8}\ \Omega m$ the density of the aluminium is $2.7 \times 10^{3}\ kgm^{-3}$ and density of copper is $9 \times 10^{3}\ kgm^{-3}$.

24) For a spherically curved surface, derive the relation

$$\frac{-n_1}{u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$$

25) In an ideal step-up transformer input voltage is 110 V and current flowing in the secondary is 10 A. If transformation ratio is 10, calculate output voltage, current in primary and input and output power.

26) In Young's experiment a beam of light of wavelength 6500Å and 5200Å is used. Find the minimum distance from the central bright fringe where bright fringes produced by both the wavelength get superposed. The distance between two slits is 0.5 mm and the distance between the slits and the screen is 100 cm.

27) Draw the circuit diagram of a half wave rectifier and explain the working of the circuit.

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