

Gujarat Board

QUESTION PAPER

Gujarat Secondary and Higher Secondary Education Board Previous Year Question Papers

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

054 (E)

(MARCH, 2024)
(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.

06

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) Choosing the correct option, complete the given nuclear fusion reaction that occurs in the sun.

$${}_{2}^{3}H + {}_{2}^{3}H \rightarrow {}_{2}^{4}He + {}_{1}^{1}H + {}_{1}^{1}H + _____.$$

(A) 0.42 MeV

(B) 1.02 MeV

(C) 12.86 MeV

(D) 5.49 MeV

Rough Work

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Rough Work

2) The radius of nuclei of $^{27}_{13}Al$ is _____. ($R_0 = 1.2$ fm)

(A) 3.0×10^{-15} m
(B) 3.6×10^{-15} m
(C) 3.2×10^{-14} m
(D) 3.6×10^{-12} m

3) Which of the following element has maximum binding energy per nucleon?

(A) Uranium
(B) Lithium
(C) Tungsten
(D) Iron

4) According to Einsteins mass-energy equivalent relation, the energy equivalent of 1mg of substance is _____.

(Speed of light in vacuum C = 3×10^8 m/s)

(A) 9×10^{13} J
(B) 9×10^{10} J
(C) 9×10^{-13} J
(D) 9×10^{-10} J

5) The atomic masses of two isotopes of an element are 34.98u and 36.98u and their relative abundance are 75.4% and 24.6% respectively, then the average atomic mass of the element is _____.

(A) 34.51 u
(B) 36.46 u
(C) 35.47 u
(D) 35.99 u

6) In a p-type semiconductor, which of the following statements is true?

(A) Electrons are majority charge carriers and trivalent atoms are the dopants
(B) Electrons are minority charge carriers and pentavalent atoms are the dopants
(C) Holes are minority carriers and pentavalent atoms are the dopants
(D) Holes are majority carriers and trivalent atoms are the dopants

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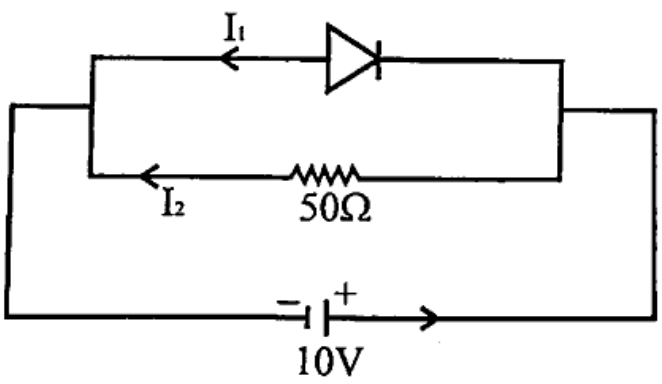
Rough Work

7) When a forward bias is applied to a p-n junction it _____.
(A) raises the potential barrier
(B) reduces the majority carrier to zero
(C) lowers the potential barrier
(D) potential barrier remain same

8) What type of semiconductor is CdS?
(A) Elemental
(B) Organic
(C) Inorganic
(D) Organic polymer

9) Which of the following substance have energy gap (Eg) more than 3eV?
(A) Metals
(B) Alloys
(C) Semiconductor
(D) Non-metals

10)



If a diode having infinite reverse-bias resistance is connected in a circuit as shown in figure, then I_1 and I_2 are respectively _____.
(A) 0.0A ; 0.2A
(B) 10.0A ; 0.0A
(C) 0.2A ; 0.0A
(D) 0.0A ; 0.0A

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Rough Work

11) If an electric charge 'q' is placed at the centre of a cube, then the flux associated with each surface of the cube is _____.

(A) $\frac{q}{\varepsilon_0}$

(B) $\frac{q}{6\varepsilon_0}$

(C) $\frac{q}{4\varepsilon_0}$

(D) $\frac{q}{2\varepsilon_0}$

12) The dimensional formula of electric field is _____.

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

(B) $[M^1 L^2 T^{-3} A^{-1}]$

(C) $[M^1 L^1 T^{-2} A^{-1}]$

(D) $[M^0 L^1 T^{-3} A^{-1}]$

13) Two identical conducting spheres A and B having charges $+q$ and $-q$ are kept at 'd' distance apart experience coulombian force F between them. If 50% of charge is transferred from sphere B to A then the new coulombian force between them is _____.

(A) F

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

(C) $\frac{F}{4}$

(D) $\frac{2F}{3}$

14) Three equal charges +q each are placed at the three vertices of an equilateral triangle. The electric field at the centroid of the triangle is _____.

(r is the length of the side of triangle)

(A) $\frac{3kq}{r^2}$

(B) $\frac{kq}{r^2}$

(C) zero

(D) $\frac{\sqrt{3}\,kq}{2r^2}$

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Rough Work

15) If two infinite plane sheets having same surface charge density σ are placed parallel to each other, then the electric field between the two sheet is _____.

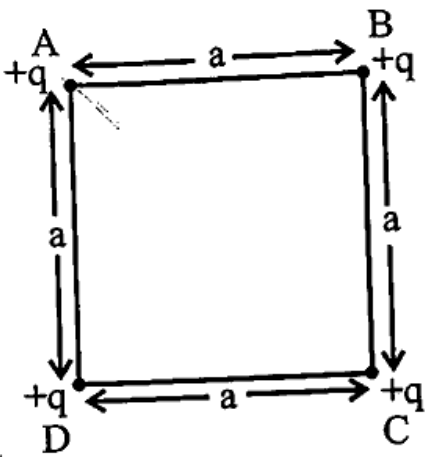
(A) zero

(B) $\frac{\sigma}{\varepsilon_0}$

(C) $\frac{\sigma}{2\varepsilon_0}$

(D) $\frac{2\sigma}{\varepsilon_0}$

16)



As shown in figure charges $+q$ each are placed at the four vertices of a square. Then the coulombian force acting on charge placed at vertex D is _____.

(A) $\left(\sqrt{2}+\frac{1}{2}\right)\frac{kq^2}{a^2}$

(B) $\left(\sqrt{2}-\frac{1}{2}\right)\frac{kq^2}{a^2}$

(C) $\frac{\sqrt{2}\,kq^2}{a^2}$

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

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Rough Work

17) Charge +Q is placed at the centre of a circular path of radius r. The work done to bring charge $+q$ from one end of the diameter to other end of the circular path in the electric field produced by charge +Q is _____.

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

(B) $\frac{kQq}{2r}$

(C) zero

(D) $\frac{2kQq}{r}$

18) By keeping a conductor in an external electric field and from the result obtained by electrostatics, which of the following options is wrong?

(A) Inside a conductor electrostatic field is zero

(B) At the surface of a charged conductor electric field must be perpendicular to the surface

(C) The interior of the conductor have excess charge in static situation

(D) Electrostatic potential is constant through out the volume of the conductor

19) A charged capacitor is disconnected from the battery and if the distance between the two plates of the capacitor is increased then _____.

(A) Charge on plate will decrease

(B) Charge on plate will remain same

(C) The potential difference between the two plates will decrease

(D) Capacitance of the capacitor will increase

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Rough Work

20) Which of the following molecule is not polar?

(A) HCl

(B) H_2O

(C) NH_3

(D) H_2

21) If a 12pF capacitor is connected to a 50V battery then the electrostatic energy stored in the capacitor is _____.

(A) 1.5×10^{-12} J

(B) 1.5×10^{-6} J

(C) 1.5×10^{-8} J

(D) 3×10^{-8} J

22) If a conducting wire of length L is uniformly stretched to double its length, then its conductivity becomes _____.

(A) double

(B) 4 times

(C) halved

(D) remain same

23) Resistivity of which of the following substance decrease on increasing the temperature?

(A) Copper

(B) Silicon

(C) Aluminium

(D) Nichrome

24) The storage battery of a car has an emf of 12V. If the internal resistance of the battery is 0.6Ω then the maximum current that can be drawn from the battery is _____.

(A) 20 A

(B) 25 A

(C) 30 A

(D) 72 A

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Rough Work

25) If a battery of 12 V is connected across the diametrically end points A & B of a conducting ring of radius R and the current drawn from the battery is I, then the magnetic field produced at the centre of the ring due to the ring is _____.

(A) Zero

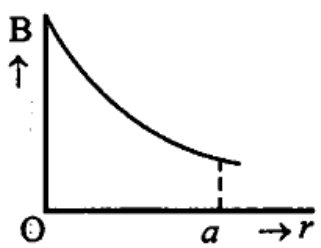
(B) $\frac{\mu_0 I}{2R}$

(C) $\frac{\mu_0 I}{4\pi R}$

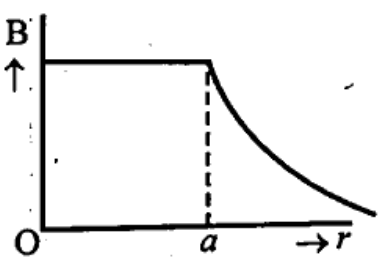
(D) $\frac{\mu_0 I}{R}$

26) Which of the following graph represents magnetic field (B) versus distance r from the centre of a long straight conducting wire of uniform cross sectional area carrying steady current I and radius a?

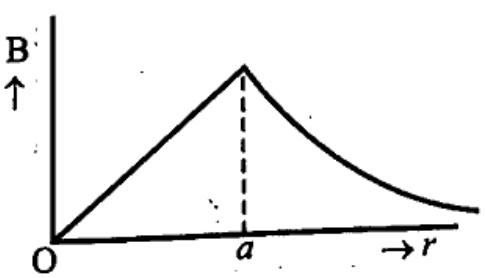
(A)



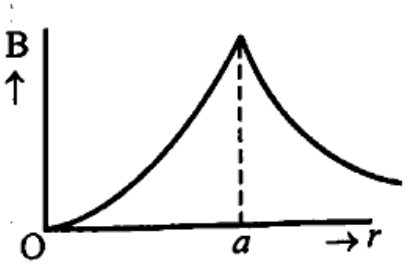
(B)



(C)



(D)



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27) A closely wound solenoid 120 cm long has 4 layers of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A. Estimate the magnitude of B inside the solenoid near its centre.

(A) $5.12\,\pi \times 10^{-7}$ T

(B) $5.12\,\pi \times 10^{-3}$ T

(C) $4.27\,\pi \times 10^{-3}$ T

(D) $8\,\pi \times 10^{-3}$ T

28) A conducting ring of radius R and one turn is formed from a conducting wire of length L and on passing current I the obtained magnetic dipole moment is m. If this wire is then converted to a ring of two turns and on passing electric current I, the new magnetic dipole moment obtained is _____.

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

(B) $2m$

(C) $\frac{m}{4}$

(D) $4m$

29) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25T experiences a torque of magnitude 4.5×10^{-2} J. The magnitude of the magnetic moment of the magnet will be _____ $J\,T^{-1}$.

(A) 0.18

(B) 0.36

(C) 0.54

(D) 0.72

30) The flux associated with a closed loop is $\phi_{(t)} = 3t^2 + 2t + 5$ weber. If the resistance of the loop is 14Ω, then the current induced in this coil in t = 2 sec is _____.

(A) 1 A

(B) 2 A

(C) 1.5 A

(D) 2.5 A

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Rough Work

31) Current in a circuit falls from 5.0A to 0.0 A in 0.1s. If an average emf of 100V induced then the value of self inductance of the circuit is _____.

(A) 0.5 H

(B) 1 H

(C) 2 H

(D) 4 H

32) Mutual inductance of a system of two coil does not depend on _____.

(A) No. of turns of the coil

(B) Distance between two coil

(C) The relative permeability of the medium within the coil

(D) Current passing through the coils

33) A 1.0m long metallic rod is rotated with an angular frequency 200 rad/s about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field of 0.5T parallel to the axis exist everywhere. The emf developed between the centre and the ring is _____.

(A) 100 V

(B) 200 V

(C) 50 V

(D) 400 V

34) From which of the following options the power factor of an A.C. circuit can be zero.

(A) R and L in series

(B) R and C in series

(C) L, C and R in series

(D) L and C in series

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35) An L-C-R series circuit is connected to an AC source of peak voltage 240V. The phase difference between voltage and current of this circuit is 45° and resistance is 100Ω, then the rms value of current through the circuit is _____.

(A) 5.25 A

(B) 1.7 A

(C) 3.5 A

(D) 1.2 A

36) Which of the following option represents Ampere - Maxwell Law? https://www.gujaratboardonline.com

(A) $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \frac{d\phi_E}{dt}$

(B) $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \varepsilon_0 \frac{d\phi_E}{dt}$

(C) $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \frac{d\phi_E}{dt}$

(D) $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \varepsilon_0 \frac{d\phi_E}{dt}$

37) Which of the following waves is used in speed gun to measure the speed of ball in cricket match?

(A) Radio wave

(B) Microwave

(C) Infrared waves

(D) Ultraviolet wave

38) The speed of light in a medium of refractive index 1.25 is _____.
(Speed of light in vacuum is 3×10^8 ms^{-1})

(A) 2.4×10^8 ms^{-1}

(B) 2.0×10^8 ms^{-1}

(C) 1.5×10^8 ms^{-1}

(D) 1.25×10^8 ms^{-1}

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39) A small telescope has an objective lens of focal length 140 cm and an eye piece of focal length 5 cm. The magnifying power of telescope for viewing distant object when the telescope is in normal adjustment is _____.

(A) 145

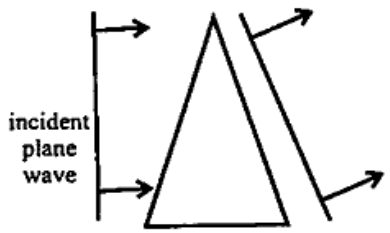
(B) 70

(C) 28

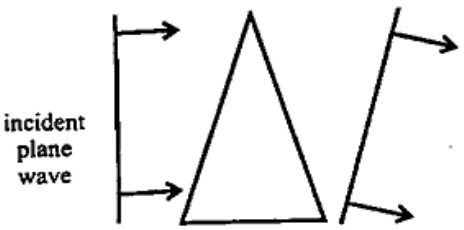
(D) 35

40) Which of the following figure is correct on the basis of Huygens principle for refraction of a plane wave by a thin prism.

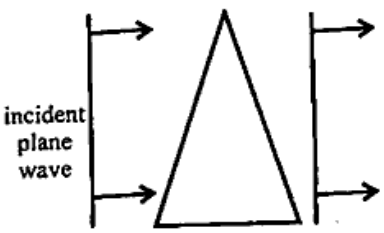
(A)



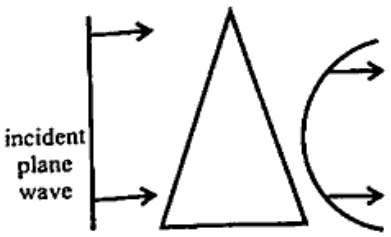
(B)



(C)



(D)



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Rough Work

41) Two waves having same intensity I_0 and originated from two non-coherent sources superpose at a point. The average intensity at that point is _____.

(A) I_0

(B) $2I_0$

(C) $3I_0$

(D) $4I_0$

42) In the case of Photoelectric effect, on increasing the frequency of incident light, _____.

(A) Photoelectric current increases

(B) Photoelectric current decreases

(C) Stopping potential increases

(D) Stopping potential decreases

43) The photoelectric cut-off voltage in a certain experiment is 1.5V. What is the maximum kinetic energy of photoelectrons emitted?

(A) 1.5 eV

(B) 3.0 eV

(C) 1.5 J

(D) 1.6×10^{-19} J

44) If de-Broglie wavelength of a dust particle of mass 1.0×10^{-9} kg is 3×10^{-25}m then the speed of the particle is _____.

($h = 6.625 \times 10^{-34}$ Js)

(A) 1.1 ms^{-1}

(B) 1.0 kms^{-1}

(C) 1.2 kms^{-1}

(D) 2.2 ms^{-1}

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Rough Work

45) Threshold frequency of which of the following metal does not lie in the ultraviolet region. (In case of photoelectric effect)

(A) Zinc

(B) Cadmium

(C) Magnesium

(D) Sodium

46) The momentum of a photon of light of frequency f is _____.

(A) $\frac{hc}{f}$

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

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

(D) hcf

47) If the radius of hydrogen atom in its first orbit is a_0, then its radius in third excited state is

(A) $3a_0$

(B) $4a_0$

(C) $9a_0$

(D) $16a_0$

48) The size of atom in Thomson's model is _____ the size in Rutherford's model.

(A) much greater than

(B) not different from

(C) much less than

(D) double

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Rough Work

49) In accordance with the Bohr's model, the quantum number that characterises the earth's revolution around the sun in an orbit of radius 1.5×10^{11}m with orbit speed 3×10^{4} m/s is _____.
(Mass of earth is 6.0×10^{24}kg, h = 6.625×10^{-34} Js)

(A) 2.6×10^{72}

(B) 2.6×10^{74}

(C) 2.6×10^{39}

(D) 2.6×10^{73}

50) Kinetic energy of electron in one of the orbit of hydrogen atom is x then its total energy is _____.

(A) $-x$

(B) $-\frac{x}{2}$

(C) $-2x$

(D) $-\frac{x}{8}$

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054 (E)

(MARCH, 2024)
(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) **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

■ **From the question nos. 1 to 12 given below. Answer any 8 questions (Each question carries 2 marks)** **[16]**

1) Derive the formula for the torque acting on a dipole placed in a uniform external electric field. **[2]**

2) An infinite line charge produces a field of 9×10^4 N/C at a distance of 2 cm. Calculate the linear charge density. **[2]**

3) Define mobility and write its formula, unit and dimensional formula. **[2]**

4) Write the characteristics of magnetic field lines. **[2]**

5) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid and hence obtain formula for magnetic energy per unit volume. **[2]**

6) A 100Ω resistor is connected to a 220V, 50 Hz AC supply. **[2]**
   a) What is the rms value of current in the circuit?
   b) What is the net power consumed over a full cycle?

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7) Derive the relation between focal length (f) and radius of curvature (R) for a spherical convex mirror with the help of a geometrical diagram of reflection of incident ray on a convex spherical mirror. [2]

8) Using Huygens principle, explain reflection of a plane wave by a plane reflecting surface. [2]

9) Light of frequency 7.21×10^{14} Hz is incident on a metal surface. Electrons with a maximum speed of 6.0×10^5 m/s are ejected from the surface. What is the threshold frequency for photoemission of electrons? [2]
($h = 6.625 \times 10^{-34}$ Js, $e = 1.6 \times 10^{-19}$ C, $m = 9.1 \times 10^{-31}$ kg)

10) A hydrogen atom initially in the ground level absorbs a photon which excites it to the $n = 4$ level. Determine the wavelength and frequency of photon. [2]
($h = 6.625 \times 10^{-34}$ Js, $C = 3 \times 10^8$ m/s)

11) Write any two features of nuclear binding force. [2]

12) Suppose a pure Si crystal has 5×10^{28} atom m^{-3}. It is doped by 1ppm concentration of pentavalent As. Calculate the number of electrons and holes. [2]
Given that ($n_i = 1.5 \times 10^{16}\ m^{-3}$).

SECTION - B

■ **From the question nos. 13 to 21 given below, answer any 6 questions.** [18]
(Each question carries 3 marks)

13) A spherical conductor of radius 12 cm has a charge of 1.6×10^{-7} C distributed uniformly on its surface. What is the electric field [3]

a) inside the sphere?

b) just outside the sphere?

c) at a point 18 cm from the centre of the sphere?

14) Obtain the formula for equivalent emf and equivalent internal resistance of a series combination of two cells of emf ε_1 and ε_2 and internal resistance r_1 and r_2 respectively. [3]

15) Obtain the formula for force acting between two parallel straight current carrying conductors and hence define one ampere. [3]

(P.T.O.)

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16) A horizontal straight wire 10m long extending from east to west is falling with a speed of 5.0 ms^{-1} at right angle to the horizontal component of the earth's magnetic field 3×10^{-5} Wb m^{-2}. [3]

a) What is the instantaneous value of the emf induced in the wire?

b) What is the direction of the emf?

c) Which end of the wire is at the higher electrical potential?

17) In actual transformers, small energy losses do occur. Give reason for it and how it can be reduced. (Any three) [3]

18) a) The radii of curvatures 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 the material of lens?

b) A convex lens of glass has 20 cm focal length in air. What is focal length in water? (Refractive index of air-water is 1.33. Refractive index of air-glass = 1.5) [3]

19) Discuss the intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids. [3]

20) Summarise any three experimental features and observation described in the experimental study of photoelectric effect. [3]

21) On the basis of Bohr's postulate obtain the formula for radius and total energy of electron in the n^{th} stable orbit for hydrogen atom. [3]

SECTION - C

■ **Answer any four questions from the following question nos. 22 to 27 as directed. (Each question carries 4 marks)** [16]

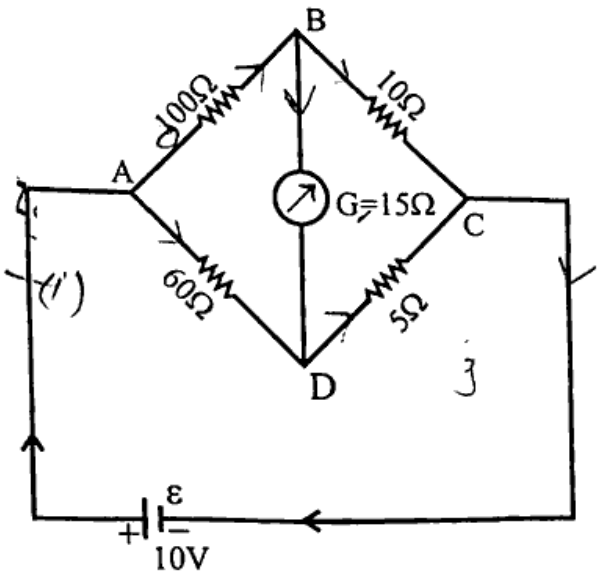
22) Derive the formula for electric potential due to an electric dipole at a point having position vector $\vec{r}$ with respect to the mid-point of the dipole and discuss the electric potential on [4]

a) equator

b) axis

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23) As shown in figure, resistances are connected in the four arms of a Wheatstone bridge. [4]



A galvanometer of 15Ω resistance is connected across BD. Calculate the current through galvanometer when a potential difference of 10V is maintained across AC.

24) A sinusoidal voltage of peak value 283 V and frequency 50Hz is applied to a series LCR circuit in which R = 3Ω, L = 25.48mH and C = 796 μF. Find [4]

(a) the impedance of the circuit

(b) the phase difference between the voltage across the source and the current,

(c) the power dissipated in the circuit and

(d) the power factor.

25) Draw the ray diagram for the formation of image by a compound microscope and obtained the formula for magnification. [4]

26) How long can an electric lamp of 100W be kept glowing by fusion of 2.0 kg of deuterium? Take the fusion reaction as [4]

$$_{1}^{2}H + {}_{1}^{2}H \rightarrow {}_{2}^{3}He + n + 3.27\,MeV$$

27) Explain full wave rectification with the help of proper circuit diagram and draw the waveform of input and output voltage. [4]

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