

Time : 3 hrs.

M.M. : 70

General Instructions :

1. There are 33 questions in all . All questions are compulsory.
2. This question paper has 5 sections: Section A, Section B, Section C, Section D and Section E.
3. All the questions are compulsory.
4. Section A consists of 16 question, 12 MCQ and 4 Assertion Reasoning based questions of 1 mark each. Section B contains 5 question of 2 marks each. Section C contains 7 questions of 3 marks each. Section D contains 2 case study based questions of 4 marks each. Section E contains 3 questions of 5 marks each.
5. Use of calculator is not allowed.

Section-A

1. Which of the following statement is true ? The electric field at a point is
 - a) always continuous
 - b) continuous if there is a charge at that point.
 - c) discontinuous only if there is a negative charge at that point.
 - d) discontinuous if there is a charge at that point.
2. A wire is stretched so as to change its length by 0.1%, the percentage increase in its resistance will be _____
 - (a) 0.2%
 - b) 0.02%
 - c) 0.5%
 - d) 0.05%
3. The magnetic susceptibility of substance is ideal diamagnetic substance is
 - (a) +1
 - (b) 0
 - (c) -1
 - (d) ∞
4. A circular current carrying coil produces a magnetic field B_0 at its centre. The coil is rewound so as to have three turns and the same current is passed through it. The new magnetic field at the centre is:
 - a) $3B_0$
 - b) $\frac{B_0}{3}$
 - c) $\frac{B_0}{9}$
 - (d) $9B_0$
5. An infinitely long cylinder is kept parallel to a uniform magnetic field directed along positive Z-axis. The direction induced current as seen from the Z-axis will be

- a) Zero
 b) anti clockwise of the +ve Z-axis
 c) clockwise of the +ve z-axis
 d) along the magnetic field

6. The correct option, if speeds of Gamma rays, X-rays and microwave are V_g , V_x and V_m respectively will be

- a) $V_g > V_x > V_m$ ~~b) $V_g < V_x < V_m$~~ c) $V_g = V_x = V_m$ d) $V_g < V_x > V_m$

7. A metal coin is at the bottom of a beaker filled with a liquid refractive index $4/3$ to a height of 6cm. To an observer look from above the surface of liquid, coin will appear at a depth.

- a) 1.5cm ~~(b) 6.75 cm~~ (c) 4.5cm d) 7.5cm

8. Threshold wavelength for a metal having work function W_0 is λ . What is the threshold wavelength for the metal having work function $2W_0$?

- (a) 4λ (b) 2λ ~~(c) $\lambda/2$~~ d) $\lambda/4$

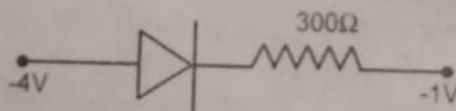
9. If K. E of free electron is doubled, its de Broglie wavelength will change by factor

- a) $\frac{1}{\sqrt{2}}$ b) $\sqrt{2}$ c) $\frac{1}{2}$ (d) 2

10. The longest wavelength in Balmer series of hydrogen spectrum will be

- (a) 6557 Å (b) 1216 Å ~~(c) 4800 Å~~ (d) 5600 Å

11. What is the current in the circuit shown below.



- a) 0A b) $10^{-3}A$ c) 1A d) 0.1A

12. In the depletion region of a diode

- a) there are mobile charges.
 b) equal number of holes and electrons exists, making the region neutral.
 c) recombination of holes and electrons has taken place.
 d) Immobile charged ions do not exist.

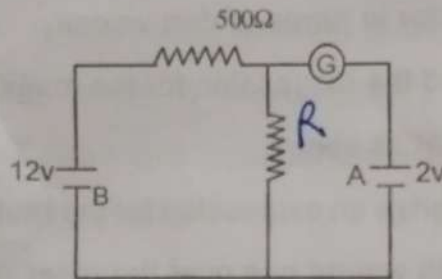
For the following question, two statements are given one labelled Assertion (A) other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true but R is not the correct explanation A.
 (c) A is true but R & is false
 (d) A is false and R is also false.

13. Assertion (A) : It is advantageous to transmit electric power at high voltage.
Reason (R) : High voltage means high current.
14. Assertion (A) : When radius of circular loop carrying current is doubled, its magnetic moment becomes four times.
Reason (R): Magnetic moment depends on the area of the loop.
15. Assertion (A) : Nuclear force is the strongest interaction known in nature.
Reason (R) : Nuclear force is a short range force.
16. Assertion (A): Conductivity of n-type semiconductor is greater than that of a p-type semiconductor.
Reason (R): Electrons have greater mobility than holes.

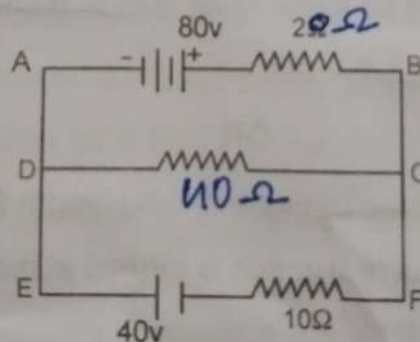
Section-B

17. In the circuit shown in figure, the galvanometer G gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of R.



OR

Using Kirchhoff's rules, Calculate the current through the 40Ω and 20Ω resistors in the following circuit :



18. Define the current sensitivity of a moving coil galvanometer. "Increasing the current sensitivity may not necessarily increase the voltage sensitivity." Justify this statement.
19. Gamma rays and radio waves travel with the same velocity in free space. Distinguish between them in terms of their origin and the main application.
20. Find the ratio of intensities of two points P and Q on a screen in YDSE when waves from

sources S_1 and S_2 have phase difference of (i) 0° (ii) $\frac{\pi}{2}$ respectively.

- ✓ 21. An α -particle when accelerated through a potential difference of V volts has a wavelength λ associated with it. In order to have the same wavelength, by what potential difference a proton must be accelerated?

Section-C

22. (a) Draw equipotential surfaces and corresponding electric field lines for the

- (i) single point charge $q < 0$
 (ii) uniform electric field

(b) Can we create electric field in which all the lines of force are parallel but their density increases continuously in a direction perpendicular to the lines of force.

- ✓ 23. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain an expression for the current through a conductor in terms of drift velocity.

- ✓ 24. Using Biot-Savart's law to find the expression for the magnetic field due to a circular loop of radius r carrying current I at its centre.

- 25. Define mutual inductance. Derive an expression for the mutual inductance of two long Co-axial solenoids of same length wound one over the other.

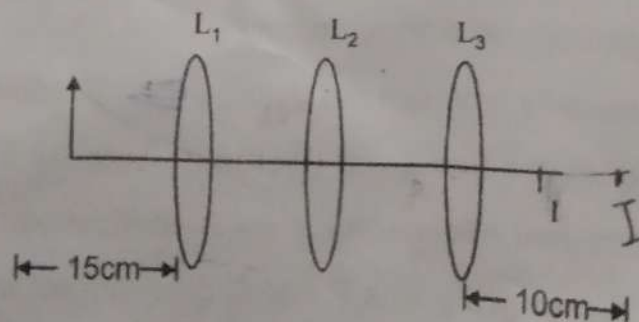
- ✓ 26. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in a medium of refractive index 1.65.

(a) Will it behave as a converging or a diverging lens ~~in the two cases?~~

(b) How will its focal length change ?

OR

▶ You are given three lenses L_1, L_2, L_3 each of focal length 10cm. An object is kept at 15 cm in front of L_1 as shown. The final real image is formed at the focus of L_3 . Find the separation between (i) L_1, L_2 (ii) L_2 and L_3



- ✓ 27. a) Distinguish between Nuclear fission and nuclear fusion.

b) Calculate the ratio of the nuclear density of the gold isotope ${}_{79}^{197}\text{Au}$ and silver isotope ${}_{47}^{107}\text{Ag}$

26. a) State Bohr's postulate to define stable orbits in hydrogen atom.

b) A hydrogen atom initially in the ground state absorbs a photon which excites it to the $n = 4$ level. Estimate the frequency of the photon.

Section - D

29. Each point on a wave front is a source of new disturbance this is called secondary wave front. They spread in all directions with speed of light. A wave front is locus of particles which are vibrating in same phase. Light will take time to travel from source to observer. Speed of light in any medium is less than speed of light in vacuum.

i) Speed of light in two different media is V_1 and V_2 . What is the ratio of their wavelengths?

a) $\frac{\lambda_1}{\lambda_2}$

b) $\frac{\lambda_2}{\lambda_1}$

c) $\frac{3\lambda_2}{\lambda_1}$

d) $\frac{\lambda_1}{2\lambda_2}$

ii) The characteristic which remain unchange after reflection or refraction is :

a) speed

b) wavelength

c) frequency

d) momentum

iii) Speed of light in diamond (refractive index for diamond = 2.47) is

a) 1.2×10^8 m/s

b) 1.7×10^8 m/s

c) 1.9×10^8 m/s

d) 10^8 m/s

iv) Wavelength of light of 487 nm in water is

(a) 300 nm

(b) 520 nm

(c) 350 nm

(d) 366 nm

30. In forward bias arrangement, the p-side of a P-N junction is connected to the positive terminal of battery and n-side to negative terminal of battery the current first increases very slowly till a certain threshold voltage is reached. Beyond this value, the diode current increases exponentially even for a very small increment in diode bias voltage. In reverse bias, the current suddenly increases at very high reverse bias. This is called break down voltage.

i) What is the approximate value of threshold voltage for Si diode?

a) 0.7V

(b) 0.14V

c) 0.7eV

d) 0.14eV

ii) Which of the following is a semi conductor device that emit's visible light when it is forward biased ?

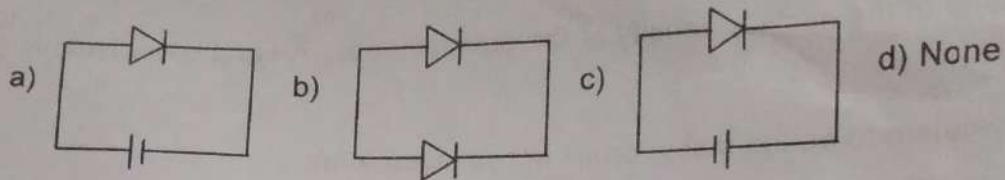
a) Transistor

b) LED

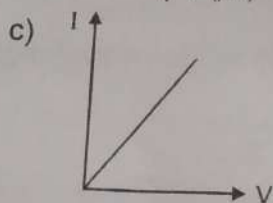
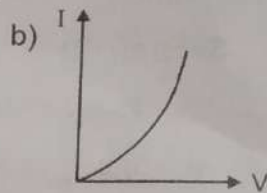
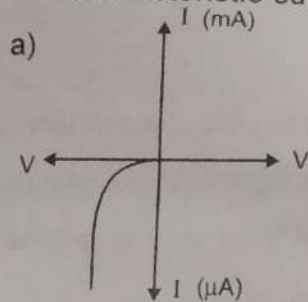
c) p-n junction

d) none of these

iii) Which diagram represents the reverse bias of a P-N junction diode ?



iv) The characteristic curve for P-N junction in forward bias is



d) None

(Section-E)

31. Using Gauss's law, obtain an expression for electric field intensity due to a uniformly charged spherical shell of radius R at a point.

- (a) outside the shell.
- (b) on the surface
- (c) inside the shell

Also, plot the graph of electric field with distance from centre of Shell.

OR

✓ Derive an expression for capacitance of a parallel plate capacitor when a dielectric slab of thickness t and dielectric constant K is inserted between the plates. Also discuss the case when the dielectric slab fills the entire space between the plates.

✓ 32. What is a transformer? Describe briefly with the help of labelled diagram, the working of the transformer. Why the efficiency of transformer is never unity? Write any three energy losses in a transformer.

OR

State condition under which the resonance occurs in series LCR circuits and derive expression for resonant frequency. Draw the graph showing ~~with~~ variation of peak current with frequency of a. c. source used.

33. (a) Draw a ray diagram showing image formation in a compound microscope (final image is formed at least distance of distinct vision).
- (b) "A telescope resolves whereas a microscope magnifies." Justify this statement.
- (c) The focal length of objective and the eye-piece of a compound microscope are 1 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

OR

- (a) An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $\frac{4\sqrt{2}}{5}$.

- ✓ (b) Deduce the relation $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ for two thin lenses kept in contact coaxially.