ARMY PUBLIC SCHOOL BARRACKPORE
CLASS XII
HALF YEARLY
SESSION- 2024-25
SUB-PHYSICS (042)
SET-A

23 SEP 2024

Maximum Marks: 70 Marks **Time Allowed: 3 Hrs**

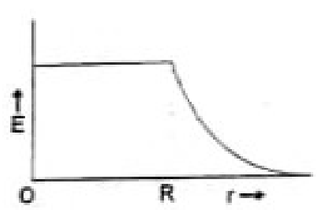
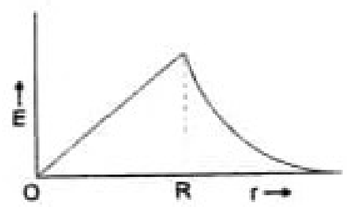
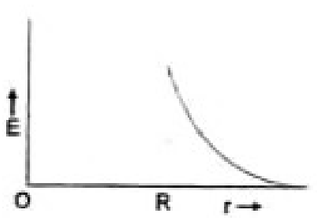
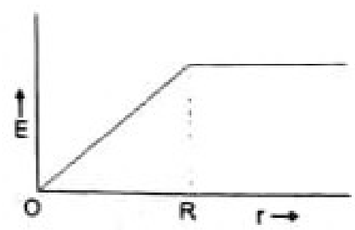
neral Instructions:

There are 33 questions in all. All questions are compulsory.
This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
All the sections are compulsory.
Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **tion B** contains five questions of two marks each, **Section C** contains seven questions of three marks h, **Section D** contains two case study-based questions of four marks each and **Section E** contains three g answer questions of five marks each.
There is no overall choice. However, an internal choice has been provided in one question in Section B, question in Section C, one question in each CBQ in Section D and all three questions in Section E. You e to attempt only one of the choices in such questions.
Use of calculators is not allowed.
You may use the following values of physical constants where ever necessary
$3 \times 10^8 ms^{-1}$
$6.626 \times 10^{-34} Js$
$1.602 \times 10^{-19} C$
$4\pi \times 10^{-7} TmA^{-1}$

$\frac{}{\epsilon_0} = 9 \times 10^9 Nm^2C^{-2}$

ss of electron $m_e = 9.1 \times 10^{-31}$ kg
ss of neutron $m_n = 1.675 \times 10^{-27}$ kg
ss of the proton $m_n = 1.673 \times 10^{-27}$ kg
zmann constant $k = 1.381 \times 10^{-23} JK^{-1}$
gadro' number $N_A = 6.022 \times 10^{23} mol^{-1}$
lius of earth = 6400 km

SECTION A

	QUESTION	MARKS
	The electric field due to a uniformly charged sphere of radius R as a function of the distance from its centre is represented graphically by (a)  (b)  (c)  (d) 	1
	A square sheet of side 'a' is lying parallel to XY plane at z=a . The electric field in the region is $E=cz^2k$. The electric flux through the sheet is (a) a^4c (b) 1/3 a^3c (c) 1/3 a^4c (d) 0	1

SECTION-E

A parallel plate is charged by a battery. When the battery remains connected, a dielectric slab is inserted in the space between the plates. Explain what changes if any, occur in the values of

(i)potential difference between the plates
(ii)electric field strength between the plates
(iii)capacitance
(iv)charge on the plates
(v)energy stored in the capacitor?

1+1+1+1+1

OR

(a)An electric dipole is held in a uniform electric field (i)Using suitable diagram show that it does not undergo any translatory motion, and (ii)derive an expression for torque acting on it and specify its direction.

(b)Derive an expression for the work done in rotating an electric dipole in a uniform electri field.

32. (a)What is impedance?

(b)A series LCR circuit is connected to an ac source having voltage $V=V_o\sin\omega t$. Derive expression for the impedance ,instantaneous current and its phase relationship to the applied voltage . Find the expression for resonant frequency.

OR

Explain with the help of a labelled diagram , the principle and working of an ac generator Write the expression for the e.m.f generated in the coil in terms of speed rotation . Can th current produced by an ac generator be measured with a moving coil galvanometer?

33. A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at (i) the least distance of distinct vision and (ii)infinity.

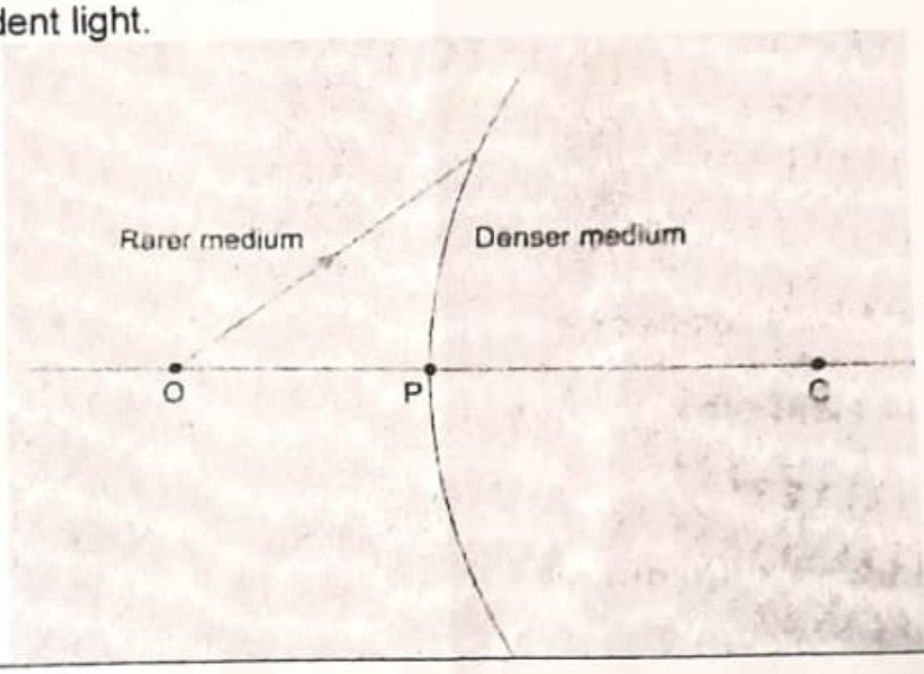
What is the magnifying power of the microscope in each case?

OR

A spherical surface of radius of curvature R , separated a rarer and denser medium as shown in the figure.

Complete the path of the incident ray of light , Showing the formation of a real image . Hence derive the relation connecting object distance 'u' , image distance 'v' , radius of curvature R and refractive indices μ_1 and μ_2 of two media.

Briefly explain ,how the focal length of a convex lens changes , with increases in wavelength of incident light.



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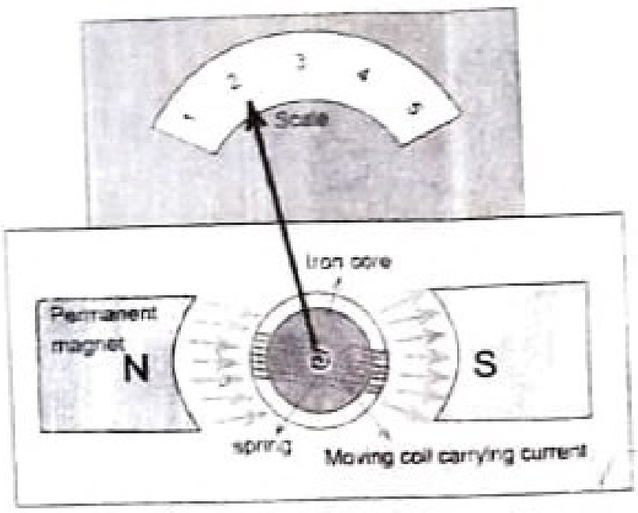
Moving coil galvanometer operates on Permanent Magnet Moving Coil (PMMC) mechanism and was designed by the scientist Darsonval.

Moving coil galvanometers are of two types
(i) Suspended coil
(ii) Pivoted coil type or tangent galvanometer.

Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.



Front view of a Moving Coil Galvanometer

(i) A moving coil galvanometer is an instrument which
(a) is used to measure emf
(b) is used to measure potential difference
(c) is used to measure resistance
(d) is a deflection instrument which gives a deflection when a current flows through its coil

(ii) To make the field radial in a moving coil galvanometer.
(a) number of turns of coil is kept small
(b) magnet is taken in the form of horse-shoe
(c) poles are of very strong magnets
(d) poles are cylindrically cut

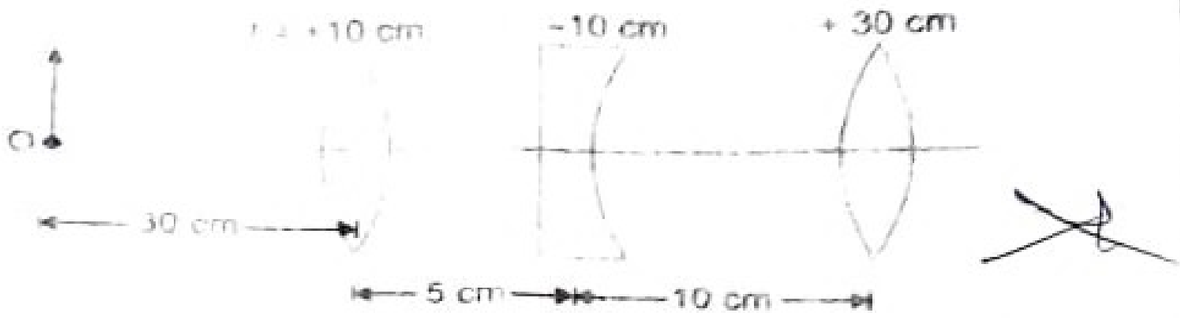
(iii) The deflection in a moving coil galvanometer is
(a) directly proportional to torsional constant of spring
(b) directly proportional to the number of turns in the coil
(c) inversely proportional to the area of the coil
(d) inversely proportional to the current in the coil

(iv)In a moving coil galvanometer, having a coil of N-turns of area A and carrying current I is placed in a radial field of strength B. The torque acting on the coil is
(a) NA^2B^2I
(b) $NABI^2$
(c) N^2ABI
(d) NABI

OR

To increase the current sensitivity of a moving coil galvanometer, we should decrease
(a) strength of magnet
(b) torsional constant of spring
(c) number of turns in coil
(d) area of coil

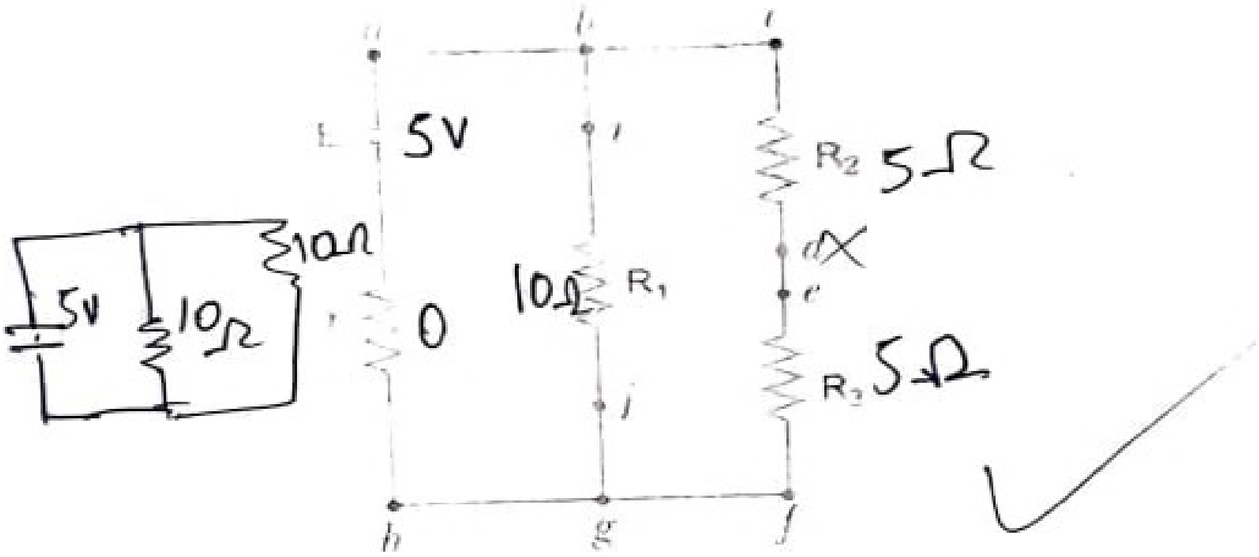
Find the position of the image formed of an object 'o' by the lens combination given in the figure.



28. Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence , obtain the relation for the refractive index(μ) in terms of angle of prism 'A' and angle minimum deviation(δ_m).

SECTION-D

29. The experiment was set up with the circuit diagram shown in figure 4
Given that R_1=10Ω R_2 = R_3 = 5 Ω r=0 Ω and E= 5 V



(i)The points with same potential are
(a) b,c,d (b) f,h,j (c) d,e,f (d) a,b,j

(ii)The current through branch bg is
(a) 1 A (b) 1/3 A (c) ½ A (d)2/3 A

(iii)The power dissipated in R_1 is
(a) 2 W (b) 2.5 W (c) 3 W (d)4.5 W

(iv)The potential difference across R_3 is
(a) 1.5 V (b) 2 V (c) 2.5 V (d) 3 V

OR

The potential difference (V_A-V_B) between the points A and B in the given figure is

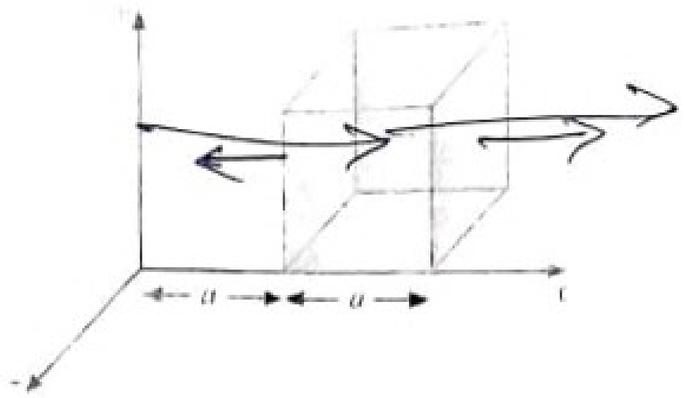
(a) -3 V (b) + 3 V (c) -13 V (d)+ 13 V

A bar magnet of magnetic moment 6 J/T is aligned at 60° with a uniform external magnetic field of 0.44 T. Calculate (a) the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic field, (ii) opposite to the magnetic field, and (b) the torque on the magnet in the final orientation in case (ii).

24. State Gauss's law in electrostatics. A cube with each side 'a' is kept in an electric field given by E=Cxi(as is shown in the figure) where C is a positive dimensional constant . Find out 3

(i)the electric flux through the cube, and Ca^3.

(ii)the net charge inside the cube. $Ca^3\varepsilon_0$

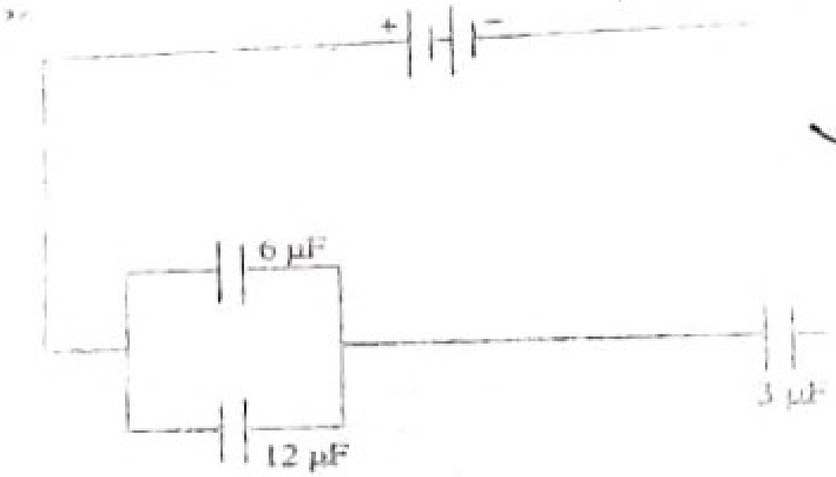


25. In the following arrangement of capacitors , the energy stored in the 6μF capacitor is E. Find the value of the following : 3

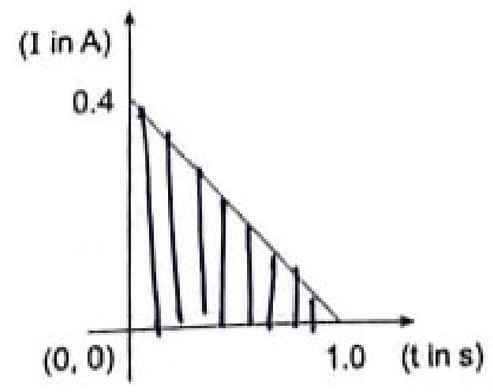
(i)Energy stored in 12μF capacitor.

(ii)Energy stored in 3μF capacitor.

(iii)Total energy drawn from the battery.



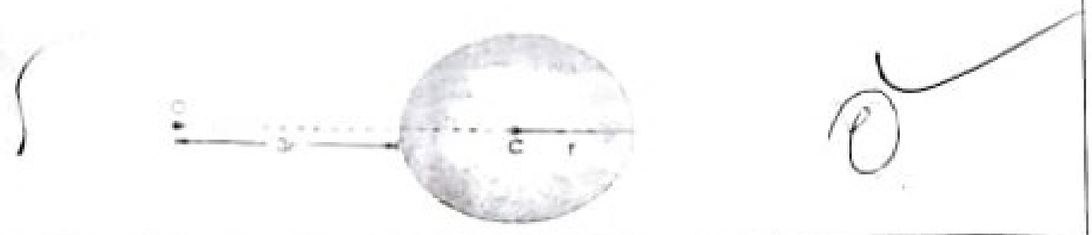
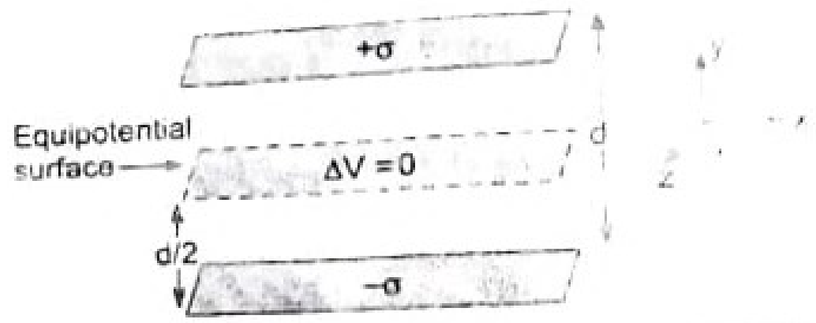
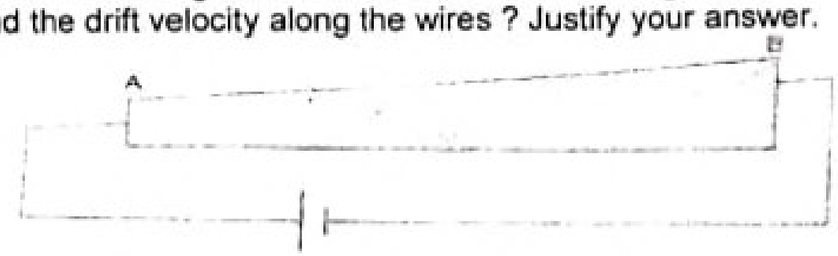
26. When a conducting loop of resistance 10 Ω and area 10 cm² is removed from an external magnetic field acting normally, the variation of induced current-I in the loop with time t is as shown in the figure. 3



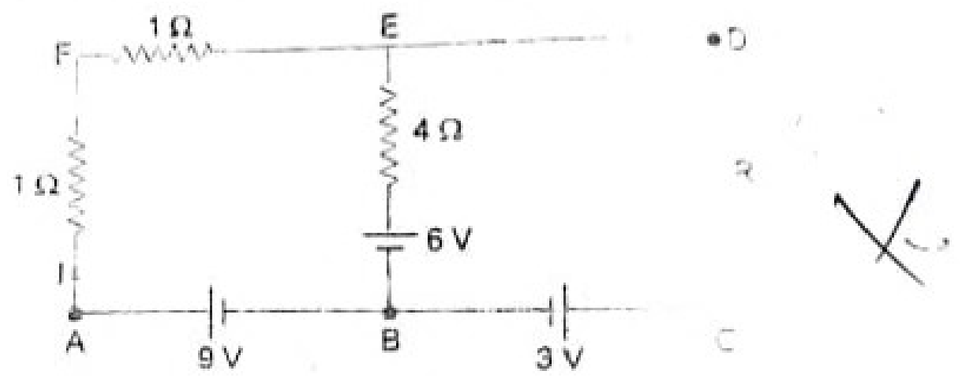
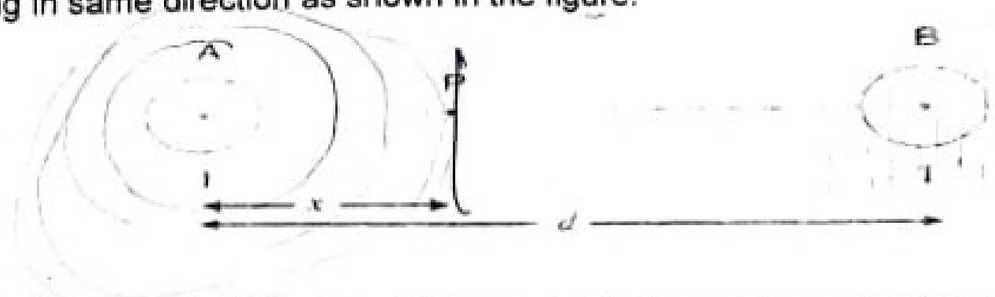
(a) total charge passed through the loop.

(b) change in magnetic flux through the loop.

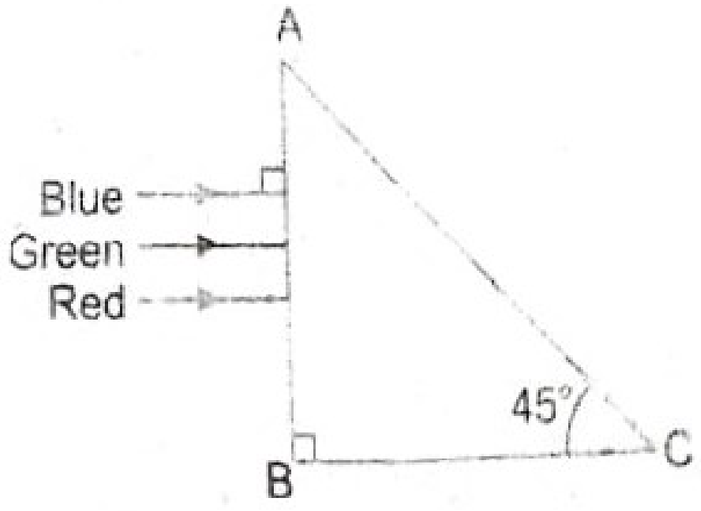
(c) magnitude of the magnetic field applied.

	A point object is placed at o in front of a glass sphere as shown in figure. Show the formation of image by the sphere. 	2
20.	Two uniformly large parallel thin plates having charge densities +σ and -σ are kept in the X-Z plane at a distance 'd' apart . Sketch an equipotential surface due to electric field between the plates . If a particle of mass m and charge '-q' remains stationary between the plates , what is the magnitude and direction of this fields? 	2
21.	A steady current flows through a wire AB , as shown in the figure . What happens to the electric field and the drift velocity along the wires ? Justify your answer. 	2

SECTION-C

22.	Using Kirchoff's rules determine the value of unknown resistance R in the circuit so that no current flows through 4 Ω resistance . Also find the potential difference between A and D. 	3
23.	Two long straight parallel wires A and B separated by a distance d , carrying equal current I flowing in same direction as shown in the figure.  (a)Find the magnetic field at a point P situated between them at a distance x from one wire. (b)Show graphically the variation of the magnetic field with distance x for 0<x<d. OR	3

12. A beam of light consisting of red , green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red , green and blue wavelength are 1.39 , 1.44 and 1.47 respectively.
The prism will



a) not separate the three colours at all
b) separate the red colour part from the green and blue colours
c) separate the blue colour part from the red and green colours
d) separate all the three colours from one another.

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false.
d) If both Assertion and Reason are false.

13. Assertion (A): A proton and an electron , with same momenta , enter in a magnetic field in a direction at right angled to the lines of the force. The radius of the paths followed by them will be same. 1
Reason (R): Electron has less mass than the proton.

14. Assertion(A): If a convex lens is kept in water , its converging power decreases. 1
Reason (R): The refractive index of convex lens relative to water is less than that relative to air.

15. Assertion (A): Electric field is always normal to equipotential surfaces and along the direction of decreasing order of potential. 1
Reason(R): Negative gradient of electric potential is electric field.

16. Assertion (A): A convex lens of focal length 30 cm can't be used as a simple microscope in normal settings. 1
Reason (R): For normal settings , the angular magnification of simple microscope is m=D/f.

SECTION B

17. (a)State Gauss's law for magnetism . Explain its significance. 2
(b)Write the four important properties of the magnetic field lines due to a bar magnet.

18. (a)A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of current in the circuit. 2
(b) What is the net power absorbed by the circuit in a complete cycle?

OR

A 60 W load is connected to the secondary of a transformer whose primary draws line voltage. Source If a current of 0.54 A flows in the load, what is the current in the primary coil? Comment on the type of transformer being used.