DAV PUBLIC SCHOOLS, JHARKHAND ZONE – B

HALF YEARLY EXAMINATION – 2024-25

CLASS - XII **TIME : 3 HOURS**

SUBJECT: PHYSICS (042) **Maximum Marks: 70**

General Instructions:

Read the following instructions carefully and follow them:

(i) This question paper contains 33 questions. All questions are compulsory.

(i) This question paper is divided into five Sections - Sections A, B, C, D and E.

(iii) In Section A - Questions no. 1 to 16 are Multiple Choice (MCQ) type questions. Each question carries 1 marks.

(iv) In Section B-Questions no. 17 to 21 are Very Short Answer type questions. Each question carries 2 marks.

(v) In Section C-Questions no. 22 to 28 are Short Answer type questions. Each question carries 3 marks.

(vi) In Section D-Questions no. 29 to 30 are case study based questions. Each question carries 4 marks.

(vii) In Section E-Questions no. 31 and 33 are Long Answer type question. Each question carries 5 marks.

(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section A.

(ix) Use of calculators is not allowed.

You may use the following values of physical constants wherever necessary:

$c = 3 \times 10^8$ m/s

$h = 6.63 \times 10^{-34}$*Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ TmA1

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 $N^{-1}m^{-2}$

$1/4\pi\varepsilon_0 = 9 \times 10^9$ Nm^2C^{-2}

Mass of electron (m) = 9.1×10^{-31} kg

Mass of neutron = 1.675×10^{-27} kg

Mass of proton = 1.673×10^{-27}kg

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION -A

1. Two parallel large thin metal sheets have equal surface densities 26.4 x 10^{-12} C/m2 of opposite signs.The electric field between these sheets is

(a)1.5 N/C

(b)1.5 x 10^{-16} N/C

(c) 3 x 10^{-10} N/C

(d)3 N/C

2. The capacitors of capacitances C1 and C2 are connected in parallel. If a charge Q is given to the combination, the ratio of the charge on the capacitor C_1 to the charge on C_2 will be

(a)C_1 / C_2

(b)$\sqrt{C_1} / \sqrt{C_2}$

(c) $\sqrt{C_2} / \sqrt{C_1}$

(d) C_2 / C_1

3. The drift velocity of the free electrons in a conducting wire carrying a current I is v. If in a wire of the same metal, but of double the radius, the current be 2I, then the drift velocity of the electrons will be

(a) v/4 (b) v / 2

(c) v (d) 4v

4. A cell of emf E is connected across an external resistance R. When current 'I is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The inter resistance 'r' of the cell is

(a) [(E-V)/E] / R (b) (E-V) / R

(c) [(E-V)/R] / I (d) [(E-V)/V] / R

5. A micro-ammeter has a resistance of 100Ω and a full scale range of 50 m uA. It can be used as a higher range ammeter or voltmeter provided resistance is added to it. Pick the correct and resistance combinations.

(a) 50 v range and 10 kΩ resistance in series (b) 10 V range and 200 kΩ resistance in series

(c) 5 mA range with 1Ω resistance in parallel (d) 10 mA range with 1Ω resistance in parallel.

6. The current sensitivity of a galvanometer increases by 20%. If its resistance also increase by 25%, the voltage sensitivity will

(a) decrease by 1% (b) increase by 5%

(c) increase by 10% (d) decrease by 4%

7. A bioconvex lens of glass having refractive index 1.47 is immersed in a liquid.it becomes invisible and behaves as a plane glass plate .the refractive index of the liquid is

(a)1.47 (b)1.62

(c)1.33 (d)1.51

8. Larger aperture of objective lens in an astronomical telescope

(a)increase the resolving power of telescope

(b)decreases the brightness of the images

(c)increase the size of the images

(b) decreases the length of the telescope

9. Refractive index of water is 5/3.A light source is placed in water at a depth of 4m .then what must be the minimum radius of disc placed at water surface so that the light of source can be stopped ?

(a) 3 m (b) 4 m

(c) 5 m (d) infinite

10. The intensity ratio of the maximum and minimum in an interference pattern produced by two coherent sources of light is 9:1.The intensities of the used light sources are in ratio

(a)3:1 (b)4:1

(c)9:1 (d)10:1

11. In the wave picture of light ,the intensity I of light is related to the amplitude A of the wave as

(a) $I \alpha \sqrt{A}$ (b) $I \infty \alpha A$

(c) $I \alpha A^2$ (d) $I \alpha 1/A^2$

12. In the single –slit diffraction experiment ,the width of the slit is halved .the width of the central maximum ,in the diffraction pattern ,will become

(a) half (b) twice

(c) four times (d)one -fourth

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(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 of A.
(c) A is true but R is false.
(d) A is false and R is also false.

13. **Assertion (A):** A convex lens of focal length 30 cm can't be used as a simple microscope in normal setting.
Reason (R): For normal setting, the angular magnification of simple microscope is $M = \frac{D}{f}$

14. **Assertion (A):** The capacitance of a parallel plate capacitor increase when a dielectric constant medium is filled between the plates.

Reason (R): capacitance of a parallel plate capacitor is directly proportional dielectric constant medium between the plates

15. **Assertion (A):** The drift velocity of electrons in a metallic conductor decreases with rise of temperature of conductor.
Reason (R): On increasing temperature, the collision of electrons with lattice ions increases; this hinders the drift of electrons.

16. **Assertion (A):** Two parallel conducting wires carrying currents in same direction ,come close to each other

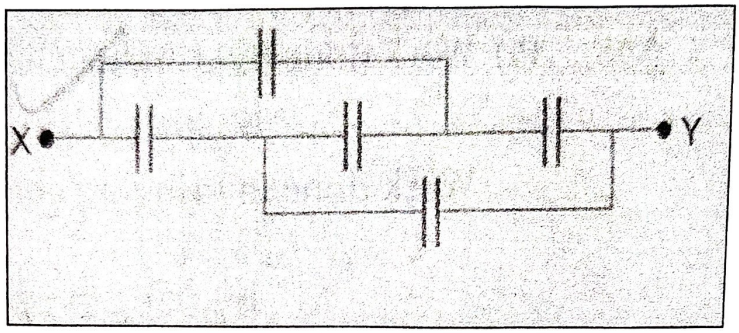
Reason (R): parallel currents attract and anti-parallel currents repel.

SECTION -B

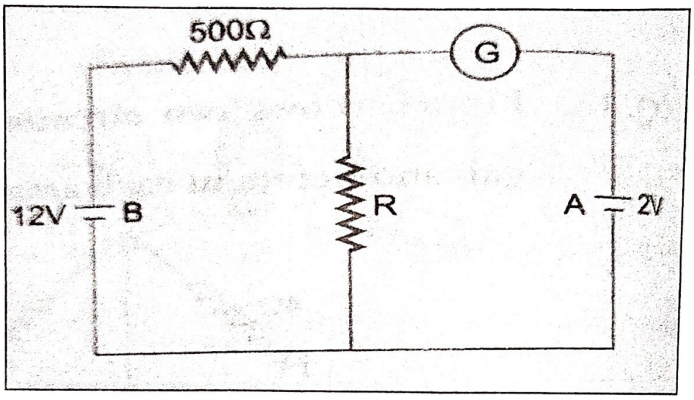
17. Two point charges $q_1 = +1\mu C$ and $q_2 = +\mu C$ are placed 2m apart in air.At what distance from q_1 along the line joining the two charges will the net electric field be zero?

OR

Find the equivalent capacitance of the network shown in the figure, when each capacitor is of 1 uF. When the ends X and Y are connected to a 6 V battery, find out (i) the charge and (ii) the energy stored in the network.

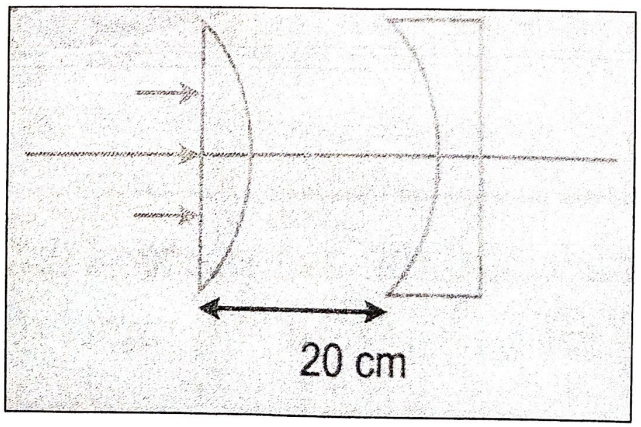


18. In the circuit shown in the figure, the galvanometer 'G' gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of the resistor R.



19. A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in a circular orbit with higher frequency?

20.In the given figure the radius of curvature of curved face in the plano convex and the plano -concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5..Find the final position of the image formed.



OR

A small pin fixed on a table top is viewed from above from a distance of 50 cm. By what distance the pin appear to be raised if it is viewed from the same point through a 15 cm thick glass slab held parallel to the table? Refractive index of glass= 1.5. Does the answer depend on the location of the slab?

21. Find the intensity at a point on a screen in Young's double slit experiment where the interfering waves of equal intensity have a path difference of (i) $\lambda/4$ and (ii) $\lambda/3$.

SECTION -C

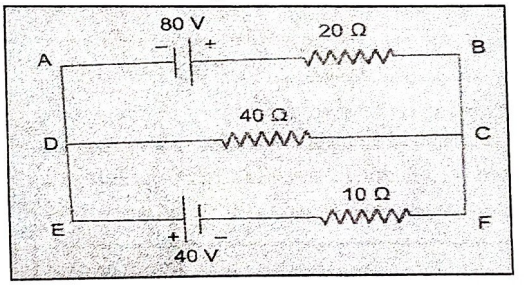
22. A hollow conducting sphere of inner radius r1 and outer radius r2, has a charge Q on its surface. A point charge –q is also placed at the centre of the sphere.
a) What is the surface charge density on the (i) inner and (ii) outer surface of the sphere ?
(b) Use Gauss' law of electrostatics to obtain the expression for the electric field at point lying outside the sphere.

23. Show that the potential energy of a dipole making angle θ with the direction of the field is given by $U(\theta)=-P.E$. Hence find out the amount of work done in rotating it from the position of unstable equilibrium to the stable equilibrium.

OR

Derive an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant K and thickness t =d/2 but of same area as that of the plates is inserted between the capacitor plates.(d= separation between the plates).

24. Use Kirchhoff's rules calculate the current through the 40Ω and 20Ω resistors in the following circuit.



25. (a) (i) A circular loop of area A, carrying a current I is placed in a uniform magnetic field B.

Write the expression for the torque t acting on it in a vector form.

(ii) If the loop is free to turn, what would be its orientation of stable equilibrium? Show that in this orientation, the flux of net field (external field + the field produced by the loop) is maximum.
(b) Find out the expression for the magnetic field due to a long solenoid carrying a current having n number of turns per unit length.

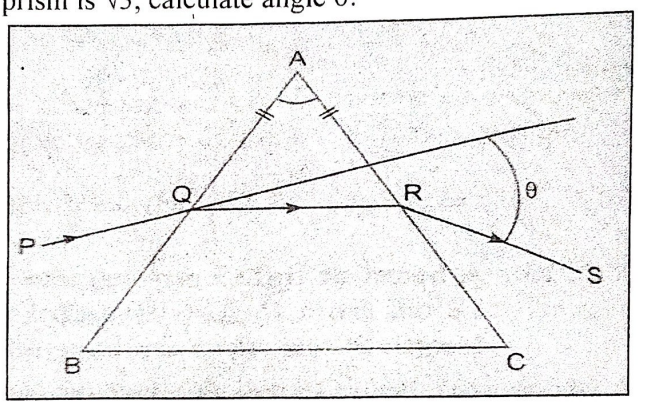
26. (i) Name the phenomenon on which the working of an optical fibre is based.

(ii) What are the necessary conditions for this phenomenon to occur?
(iii) Draw a labelled diagram of an optical fibre and show how light propagates through the opticalfibre using this phenomenon.

27. An object is placed in front of a concave mirror of focal length of 12 cm.There are two possible positions of the object for which the image formed is three times the size of the object.
(a) Draw the ray diagram for the each case, and
b) Find the distance between the two positions of the object.

OR

A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other refracting face AC as RS such that AQ=AR. If the angle of prism A = 60° and refractive index of material of prism is $\sqrt{3}$, calculate angle θ.

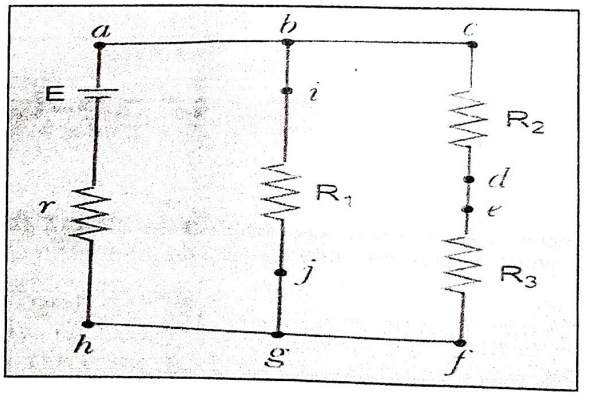


28. A plane wavefront of light of wavelengthλ is incident normally on a narrow slit of width 'a' and a diffraction pattern is observed on a screen at a distance 'D' from the slit.
(i) Depict the intensity distribution in the pattern observed.
(ii) Obtain the expression for the first maximum from the central maximum.

SECTION –D

29. Read the following and answer the questions that follows

An experiment was set up with the circuit diagram shown in figure. Given that R1=10 R2 = R3 = 5, r = 0 and E = 5V



(i) the points with the same potential are

(a) b,c,d (b) f,h,j (c) d,e,f (d) a,b,j

(ii) The current through branch b g is

(a) 1A (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) 3W (d) 4.5 W

(iv)The potential differences across R3 is

(a) 1.5 V (b) 2V (c)2.5 V (d)3V

30. Read the following paragraph and answer the questions that follows

An electron with speed $v_o << c$ moves in a circle of radius r_o, in a uniform magnetic field. This electron is able to traverse a circular path as magnetic field is perpendicular to the velocity of the electron. A force acts on the particle perpendicular to both V_o and B. This force continuously deflects the particle sideways without changing its speed and the particle will move along a circle perpendicular to the field. The time required for one revolution of the electron is To

(i) If the speed of the electron is now doubled to $2v_o$. The radius of the circle will change to

(a) $5r_o$ (b) $2r_o$ (c) 3rg (d) $r_o/6$

(ii) If v_o-$2v_o$, then the time required for one revolution of the electron will change to

(a) $8T_o$ (b) $4T_o$ (c) T_o (d) $T_o/2$

(iii) A charged particle is projected in a magnetic field $B=(2i+4j)) \times 10^2$ T. The acceleration of the particle is found to bea = $(xi+2j)$ ms^{-2}. Find the value of x.

(a) 2 ms^{-2} (b) -7 ms^{-2} (c) -2 ms^2 (d) 2 ms^2

(iv) If the given electron has a velocity not perpendicular to B, then trajectory of the electron is

(a) straight line (b) circular (c) helical (d) elliptical

OR

(iv) If this electron of charge (e) is moving parallel to uniform magnetic field with constant velocity v, the force acting on the electron is

(a) Bev (b) Be/v (c) B/ev (d) zero

SECTION -E

31. Find an expression for the electric field strength at a distant point situated (i) on the axis and (ii) along the equilateral line of an electric dipole.

OR

Derive an expression for the electric field intensity at appoint on the equatorial line of an electric dipole of dipole moment P and length 2a.what is the direction of this field?

32. With the help of a ray diagram show the information of image of a point objet due to refraction of light at a spherical surface separating two media of refractive indices μ_1 and μ_2 ($\mu_2 > \mu_1$) respectively. Using this diagram, derive the relation $\frac{\mu 2}{v} - \frac{\mu 1}{u} = \frac{\mu 2 - \mu 1}{R}$.

Write the sign convention used? What happens to the focal length of convex lens when it is immersed in water?

OR

Draw the labeled ray diagram for the formation of images by a compound microscope. Derive an expression for its total magnification(magnifying power) when the final images is formed at the near point .
Why both objective and eyepiece of a compound microscope must have short focal lengths?
(b)Draw a ray diagram showing the images formation by a compound microscope .hence obtain expression for total magnification when the images is formed at infinity.

33. Define the term wave front. Explain Huygen's principle/ theory. Using wave theory verify the law of reflection/refraction.

OR

Describe diffraction of light due to a single slit. Explain formation of pattern of fringes obtained on the screen and plot showing variation of intensity with angle θ in single slit diffraction.

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