Roll Number		

SET A

INDIAN SCHOOL MUSCAT
SECOND PRELIMINARY EXAMINATION
PHYSICS

CLASS: XII | Sub. Code: 042 | Time Allotted: 3 Hrs

11.02.2019 | Max. Marks: 70

General Instructions:

1. All questions are compulsory. There are 27 questions in all.
2. This question paper has five sections: Section A, Section B, Section C and Section D.
3. Section A contains five questions of one mark each, Section B contains seven questions of two marks each, Section C contains twelve questions of three marks each and Section D contains three questions of five marks each.
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   $c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ Js, $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}
   $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}, $1/4\pi\varepsilon_0 = 9 \times 10^9$ N m^2 C^{-2}, $m_e = 9.1 \times 10^{-31}$ kg
   mass of neutron = 1.675×10^{-27} kg, mass of proton = 1.673×10^{-27} kg
   Radius of earth =6400 km

SECTION A

1. Two charges of magnitudes – 2Q and + Q are located at points (a, 0) and (4a, 0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at the origin? 1

2. Two materials, copper and silicon are cooled from 300 K to 60 K. What will be the effect on their resistivity? 1

OR

Can terminal potential difference be greater than emf of a cell? Justify.

3. The vertical component of earth's magnetic field is $\sqrt{3}$ times the horizontal component. Find the angle of dip. 1

4. How does the fringe width of interference fringes change when the whole apparatus of Young's experiment is kept in water of refractive index 4/3? 1

OR

Parallel rays of red and blue wavelengths enter a convex lens. Will they converge at the same point? Justify.

5. Define Modulation factor or Index. Write its S.I unit. 1

SECTION B

6. Two metallic wire of same material have the same length but cross-sectional area in the ratio 1:2. They are connected in series. Compare the drift velocities of electrons in the two wires. 2

7. A circuit is set up by connecting inductance L = 100 mH, resistor R=100 ohm and a capacitor of reactance 200 ohm in series. An alternating emf of $150\sqrt{2}$ V, $\frac{500}{\pi}$ Hz is applied across this series combination. Calculate the power dissipated in the resistor. 2

OR

(a) Obtain the resonant frequency of a series LCR circuit with L = 2 H, C = 32 μF and R = 10 Ohm.

(b) What is the quality factor (Q) of this circuit?

8. Derive the expression for mutual inductance of two long co-axial solenoids. 2

9. (a) State Law of Malus. 2

(b) Draw a graph showing the variation of intensity (I) of polarized light transmitted by an analyser with angle (θ) between polarizer and analyser.

OR

(a) Define the term 'linearly polarised light.'

(b) When does the intensity of transmitted light become maximum when a polaroid sheet is rotated between two crossed polaroids?

10. Write Einstein's photoelectric equation and point out any one characteristic property of photons on which this equation is based. 2

11. Give reasons for: 2

(a) In a natural uranium reactor heavy water is preferred as moderator to ordinary water.

(b) Cadmium rods are provided in the reactor.

12. Draw block diagram of communication system. What is the function of transducer? 2

OR

Would sky waves be suitable for transmission of TV signals of 60 MHz frequency? Give reason.

A TV tower has a height of 50 m. What is the maximum distance up to which this TV transmission can be received?

SECTION C

13. A parallel plate capacitor is charged by a battery. After some time, the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. How will (i) the capacitance of the capacitor (ii) potential difference between the plates and (iii) the energy stored in the capacitor be affected? Justify your answer in each case. 3

14. Draw the circuit diagram of a potentiometer, which can be used to determine the internal resistance of a given primary cell. Derive the necessary formula and describe the method to find the internal resistance of the cell. 3

15. Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width. 3

16. Derive an expression for the velocity V_c of positive ions passing undeflected through a region where crossed and uniform electric field E and magnetic field B are simultaneously present. Draw and justify the trajectory of identical positive ions whose velocity has a magnitude less than $|V_c|$. 3

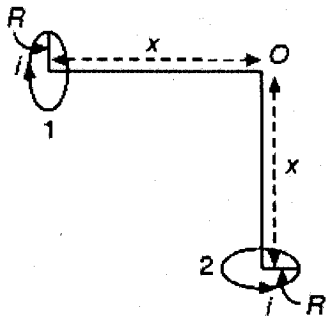
OR

Obtain the expression for force per unit length experienced by two parallel conductors of infinite length carrying current in the same direction and hence define one ampere.

17. (a) How are electromagnetic waves produced? Sketch a schematic diagram depicting oscillating electric and magnetic fields of an EM wave propagating along positive Z-direction. 3

(b) Identify the electromagnetic radiations used (i) in remote switches of house hold electronic devices. (ii) as a diagnostic tool in medicine.

18. Two small identical circular coils marked 1 and 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O. 3



19. State Huygen's principle. Use Huygen's principle to verify the laws of refraction when light travels from denser to rarer medium. 3

20. Deduce de-Broglie wavelength of electrons accelerated by a potential of V volts. Draw a schematic diagram of a localised wave describing the wave nature of moving electrons. 3

OR

Derive the relationship of de-Broglie wavelength λ associated with a particle of mass m in terms of stopping potential.

21. State the law of radioactive decay. Plot a graph showing the number (N) of undecayed nuclei as a function of time (t) for a given radioactive sample having half-life $T_{1/2}$. Depict in the plot the number of undecayed nuclei at (i) $t = 3\ T_{1/2}$ and (ii) $t = 5\ T_{1/2}$. 3

OR

(a) Deduce the expression $N = N_0 e^{\lambda t}$ for the law of radioactive decay.

(b) Write symbolically the process expressing the β^+ decay of $^{22}_{11}Na$.

22. Draw a circuit diagram of a full wave rectifier and explain its working. Draw the input and output waveforms. 3

OR

Explain with the help of a circuit diagram how a Zener diode can be used as a DC voltage regulator. Draw its I-V characteristics.

23. Draw the circuit diagram to study the characteristics of ***npn*** transistor in common emitter configuration. Sketch typical input and output characteristics for such a configuration. 3

24. (a) State briefly any two reasons explaining the need for modulating a signal. 3

(b) Draw a labelled block diagram of a simple modulator for obtaining an AM signal.

SECTION D

25. (a) Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates. 5

(b) A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has a thickness 3d/4. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

OR

An electric dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. Write the express for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression. For which orientation of the dipole in the field the torque is (i) maximum (ii) zero.

26. (a) Explain with the help of a labelled diagram, the principle and working of an ac generator. Write the expression for the *emf* generated in the coil in terms of speed of rotation. Can the current produced by an *ac* generator be measured with a moving coil galvanometer? 5

(b) A 100-turn coil of area 0.1 m^2 rotates at half a revolution per second. It is placed in a

magnetic field 0.1 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil.

OR

What are eddy currents? How are they produced? In what sense eddy currents are considered undesirable in a transformer? How can they be minimized? Give two applications of eddy currents.

27. (a) A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 ($n_2 > n_1$). Draw the ray diagram and deduce the relation between the object distance (u), image distance (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium. 5

(b) A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length.

OR

(a) Draw the ray diagram showing refraction of light through a glass prism and hence obtain the relation between the refractive index of the prism, angle of prism and angle of minimum deviation.

(b) Determine the value of the angle of incidence for a ray of light travelling from a medium of refractive index $n_1 = \sqrt{2}$ into the medium of refractive index $n_2 = 1$, so that it just grazes along the surface of separation.

End of the Question Paper

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SET B

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   mass of neutron = 1.675×10^{-27} kg, mass of proton = 1.673×10^{-27} kg
   Avogadro's no. = 6.023×10^{23} per gm mole, Boltzmann constant = 1.38 × 10-23 JK^{-1}

SECTION A

1. A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points. 1

   OR

   Why is it difficult to perform electrostatic experiments on a humid day?
2. Define current sensitivity of a galvanometer. Write its S.I unit. 1
3. The vertical component of earth's magnetic field is $\sqrt{3}$ times the horizontal component. Find the angle of dip. 1
4. How does the angular separation between fringes in single slit diffraction experiment change when the distance of separation between the slit and screen is doubled? 1
5. The amplitude of modulating signal is kept less than that of the carrier wave. Give reason. 1

   OR

   Why ground wave propagation is not suitable for high frequencies?

SECTION B

6. Answer the following: (i) Why are the connections between resistors in a meter bridge made of thick copper strips? (ii) Which material is used for the meter bridge wire and why? 2
7. A wheel of 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the earth's magnetic field. The Earth's magnetic field at the plane is 0.4 G and the handle of dip is 60^0. Calculate the emf induced between the axle and the rim of the wheel. 2
8. A bulb B and an inductor L are connected in series to the AC mains. The bulb glows with some brightness. How will the glow of the bulb change when a (a) a soft iron core (b) bismuth core is introduced inside the inductor? Give reasons. 2
9. Give reasons for: 2
   (a) In a natural uranium reactor heavy water is preferred moderator to ordinary water.
   (b) Cadmium rods are provided in the reactor.

10. Write Einstein's photoelectric equation and point out any one characteristic property of photons on which this equation is based. 2

OR

(a) Define the term threshold frequency as used in photoelectric effect.

(b) Plot a graph showing the variation of photoelectric current as a function of anode potential for two light beams having the same frequency but different intensities and $I_2 > I_1$.

11. a) State Law of Malus. 2

(b) Draw a graph showing the variation of intensity (I) of polarized light transmitted by an analyser with angle (θ) between polarizer and analyser.

OR

(a) Define the term 'linearly polarised light.'

(b) When does the intensity of transmitted light become maximum, when a polaroid sheet is rotated between two crossed polaroids?

12. We do not choose to transmit an audio signal by just directly converting it to an EM wave of the same frequency. Give two reasons for the same. 2

OR

Explain the function of repeater and demodulator in a communication system.

SECTION C

13. State Huygen's principle. Use Huygen's principle to verify the laws of refraction when light travels from denser to rarer medium. 3

14. (a) In a potentiometer why is it necessary to (i) use a long wire and (ii) use a driving cell whose emf is taken to be greater than the emfs of the primary cells? 3

(b) In a potentiometer experiment, if the area of the cross-section of the wire increases uniformly from one end to the other, draw a graph showing how potential gradient would vary as the length of the wire increases from one end.

OR

Draw the circuit diagram of a potentiometer, which can be used to compare the *emf*s of two cells. Describe the method to compare the *emf*s of the cells and derive the necessary formula.

15. Draw a labelled ray diagram of a reflecting telescope. Mention its two advantages over the refracting telescope. 3

16. (a) Using Biot-Savart Law, deduce an expression for the magnetic field on the axis of a circular current loop. 3

(b) Draw the magnetic field line due to a circular loop carrying current.

OR

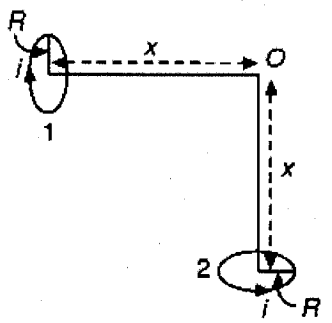
Derive an expression for the velocity V_c of positive ions passing undeflected through a region where crossed and uniform electric field E and magnetic field B are simultaneously present. Draw and justify the trajectory of identical positive ions whose velocity has a magnitude less than $| V_c |$.

17. (a) How are electromagnetic waves produced? 3

(b) Sketch a schematic diagram depicting oscillating electric and magnetic fields of an EM wave propagating along positive Z direction.

(c) Identify the electromagnetic radiations used (i) in remote switches of house hold electronic devices. (ii) as a diagnostic tool in medicine.

18. Two small identical circular coils marked 1, 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O. 3



19. Using Gauss' law, obtain the expression for the electric field due to uniformly charged spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r < R. 3

20. Explain the output characteristic of *npn* transistor in CE configuration. Draw the circuit diagram used to obtain the output characteristics of the transistor. Also plot the output characteristic. 3

21. (a) State the law of radioactive decay. 3

(b) Plot a graph showing the number (N) of undebased nuclei as a function of time (t) for a given radioactive sample having half-life $T_{1/2}$. Depict in the plot the number of undecayed nuclei at (i) t $=3T_{1/2}$ and (ii) t = $5T_{1/2}$.

OR

(a) Deduce the expression $N = N_0 e^{\lambda t}$ for the law of radioactive decay.

(b) Write symbolically the process expressing the β^+ decay of $^{22}_{11}Na$.

22. Explain with the help of a circuit diagram how a Zener diode can be used as a DC voltage regulator. Draw its I-V characteristics 3

OR

Draw a circuit diagram of a full wave rectifier. Explain its working. Draw the input and output waveforms.

23. A proton and an α-particle are accelerated through the same potential. Which of the two has: 3
(a) greater value of de-Broglie wavelength associated with it and (b) less kinetic energy? Justify your answer.

24. (a) What is ground wave propagation? 3

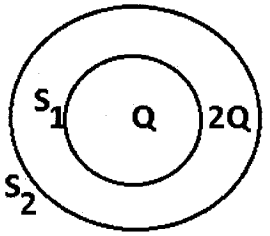
(b) Why is this mode of communication not suitable for high frequency signal wave transmission?

(c) Why is it not possible to use sky wave propagation for transmission of TV signals?

SECTION D

25. (a) State Gauss theorem in Electrostatics. Apply Gauss theorem to find the electric field strength near an infinite plane sheet of charges. 5

(b) S_1 and S_2 are two hollow spheres enclosing Q and 2Q respectively in air as in the figure. i) What is the ratio of the electric flux through S_1 and S_2? ii) How will the electric flux through S_1 change, if a medium of dielectric constant 5 is introduced inside S_1.



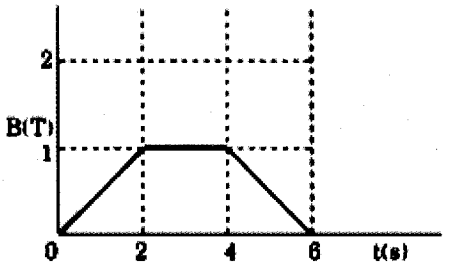
(OR)

(a) Derive an expression for the force and torque on an electric dipole kept in a uniform electric field. Show that the system is under translational equilibrium.

(b) A system has two charges $q_A = 2.5 \times 10^{-7}$C and $q_B = -2.5 \times 10^{-7}$C located at points A = (0, 0, -15 cm) and B = (0, 0, +15 cm) respectively. What are the total charge and electric dipole moment of the system?

26. (a) State Faraday's law of electromagnetic induction. 5

(b) The magnetic field through a circular loop of wire 12 cm in radius and 8.5 ohm resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.



(c) Show that Lenz's law is a consequence of conservation of energy.

(OR)

(a) Describe, with the help of a suitable diagram, the working principle of a step-up transformer. Obtain the relation between input and output voltages in terms of the number of turns of primary and secondary windings and the currents in the input and output circuits.

(b) Mention two important energy losses in actual transformers and state how these can be minimized?

27. (a) State the essential conditions for diffraction of light. 5

(b) Find the relation for width of central maximum in terms of wavelength 'λ', width of slit 'a', and separation between slit and screen 'D'.

(c) If the width of the slit is made double the original width, how does it affect the size and intensity of the central band?

OR

(a) Draw a labelled schematic ray diagram of astronomical telescope in normal adjustment.

(b) You are given three lenses of power 0.5D, 4D and 10D to design a telescope. Which lenses should be used as objective and eyepiece? Justify

(c) Why is the aperture of the objective preferred to be large?

End of the Question Paper

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SECTION A

1. The amplitude of modulating signal is kept less than that of the carrier wave. Give reason. 1

OR

Why ground wave propagation is not suitable for high frequencies?

2. A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points. 1
3. Two materials, copper and silicon are cooled from 300 K to 60 K. What will be the effect on their resistivity? 1

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Can terminal potential difference be greater than emf of a cell? Justify.

4. How does the fringe width of interference fringes change when the whole apparatus off Young's experiment is kept in water of refractive index 4/3? 1

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Parallel rays of red and blue wavelengths enter a convex lens. Will they converge at the same point? Justify.

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7. A circuit is set up by connecting inductance L = 100 mH, resistor R=100 ohm and a capacitor of reactance 200 ohm in series. An alternating emf of $150\sqrt{2}$ V, $\frac{500}{\pi}$ Hz is applied across this series combination. Calculate the power dissipated in the resistor. 2

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(a) Obtain the resonant frequency of a series LCR circuit with L = 2 H, C = 32 μF and R = 10

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8. Two metallic wire of same material have the same length but cross-sectional area in the ratio 1:2. They are connected in series. Compare the drift velocities of electrons in the two wires. 2

9. Write Einstein's photoelectric equation and point out any one characteristic property of photons on which this equation is based. 2

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Explain the function of repeater and demodulator in a communication system.

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SECTION C

13. Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width. 3

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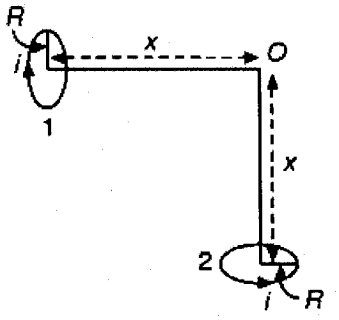

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(b) A 100-turn coil of area 0.1 m^2 rotates at half a revolution per second. It is placed in a magnetic field 0.1 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil.

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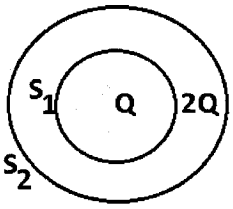

OR

(a) Derive an expression for the force and torque on an electric dipole kept in a uniform electric field. Show that the system is under translational equilibrium.

(b) A system has two charges $q_A = 2.5 \times 10^{-7}$C and $q_B = -2.5 \times 10^{-7}$C located at points A = (0, 0, -15cm) and B = (0, 0, +15cm) respectively. What are the total charge and electric dipole moment of the system?

End of the Question Paper