

Sahodry School

QP-30

FIRST TERMINAL EXAMINATION 2014-15

TIME-3HR

XII - PHYSICS

MM-70

Jivanan

12-62

XII - B

General instructions

- i. All questions are compulsory.
- ii. There are 26 questions in total. Questions 1 to 5 are very short answer questions and carry one mark each.
- iii. Questions 6 to 10 carry two marks each, questions 11 to 22 carry three marks each, question 23 is value-based question carry four marks and questions 24 to 26 carry five marks each.
- iv. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all questions of five marks each. You have to attempt only one of the given choices in such question.
- v. Use of calculators is not permitted. However you may use log tables if necessary.
- vi. You may use the following values of physical constants wherever necessary.

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

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

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

$$\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

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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 on the square.
 2. A wire of resistivity ρ is stretched to double its length. What will be its new resistivity?

3. In a series LCR circuit, the voltage across an inductor, a capacitor and a resistor are 30V, 30V and 60V respectively. What is the phase difference between the applied voltage and the current in the circuit?
4. Two thin lenses of power +6D and -2D are in contact. What is the focal length of the combination?
5. Write the formula for magnetic moment of a current loop.
6. Write the relation between the following:
- 1) Direction of propagation and the direction of oscillation, of the electric and magnetic field vectors of an e.m wave.
 - 2) Velocity of an e.m wave in vacuum and the permeability and permittivity of free space.
7. A concave lens has the same radius of curvature for both sides and has a refractive index 1.6 in air. In the second case, it is immersed in a liquid of refractive index 1.4. Calculate the ratio of the focal lengths of the lens in the two cases.
8. A parallel plate capacitor with air between the plates is charged. A dielectric is inserted between the plates. What will happen to its electric potential? Give reasons for your answer.

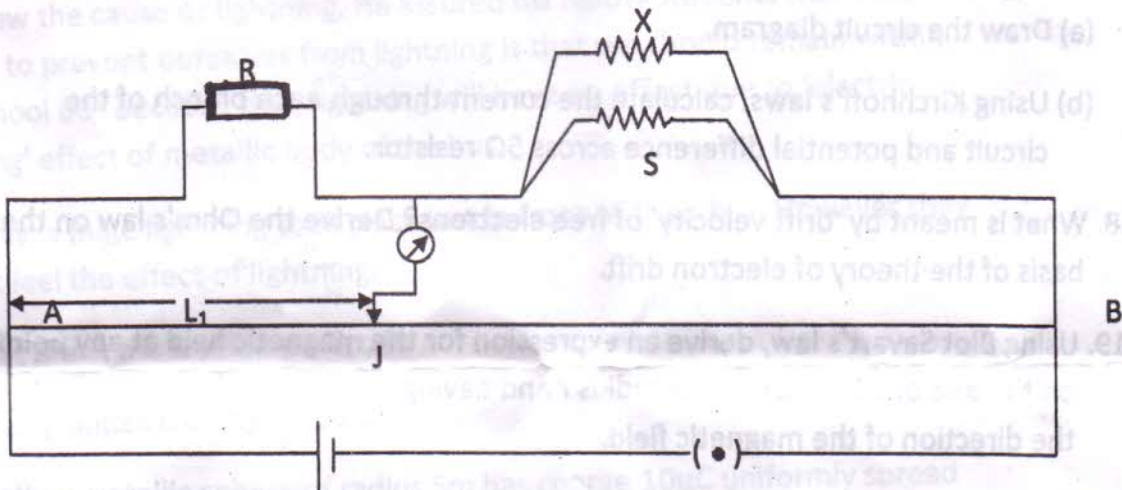
OR

- a) Two insulated charged copper spheres A and B have their centres separated by a distance of 50cm. What is the mutual force of electrostatic repulsion if charge on each is $6.5 \times 10^{-7} \text{C}$? The radii of A and B are negligible compared to the distance of separation.
 - b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved?
9. Draw a ray diagram to illustrate image formation by an astronomical telescope. Write the expression for its magnifying power in normal adjustment position.
10. Explain with the help of a graph the variation of conductivity with temperature for metallic conductor.

11. A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface. Using Gauss's law, derive an expression for an electric field at a point outside the shell. Draw a graph of electric field $E(r)$ with distance r from the centre of the shell for $0 \leq r < \infty$.

12. 1) State the principle of working of a meter bridge.

2) In a bridge balance point is found at a distance L_1 with resistance R and S as shown in the figure. When an unknown resistance X is connected in parallel with the resistance S , the balance point shifts to a distance L_2 . Find the expression for X in terms of L_1 , L_2 and S .



13. Derive the expression for the force between two parallel straight conductors carrying current in the same direction and write the nature of the force. Hence define an ampere.

14. What are eddy currents? How are these produced? In what sense are eddy currents considered in a transformer and how are these reduced in such device?

15. A series LCR circuit is made by making $R=200\Omega$, $L=4/\pi$ H, $C=50/\pi \mu\text{F}$. This series combination is connected across an ac source of 220V, 50Hz. Calculate

1) the impedance of the circuit

- 2) The peak value of the current flowing in the circuit
- 3) Calculate the power factor of this circuit and compare this value with the one at its resonant frequency.
16. What does the term 'phasors' in a.c. circuit analysis mean? An a.c. source of voltage $v = v_m \sin \omega t$ is applied across a pure inductor inductance L . Obtain an expression for the current, i , flowing in the circuit. Also draw the (i) phasor diagram (ii) graphs of v and i versus ωt for this circuit.
17. Two cells of emf 1.5V and 2V and internal resistance 1 ohm and 2 ohm respectively are connected in parallel to pass a current in the same direction through an external resistance of 5 ohm,
- (a) Draw the circuit diagram.
- (b) Using Kirchhoff's laws, calculate the current through each branch of the circuit and potential difference across 5Ω resistor.
18. What is meant by 'drift velocity' of free electrons? Derive the Ohm's law on the basis of the theory of electron drift.
19. Using Biot Savart's law, derive an expression for the magnetic field at any point on the axis of a circular coil of radius r and having N number of turns. Indicate the direction of the magnetic field.
20. Name the three elements required to specify the earth's magnetic field at a given place. Define these elements using a labeled diagram.

OR

- Explain how will you convert a galvanometer into an ammeter to read a maximum current of 'I' ampere. An ammeter is always connected in series with a circuit. Why?
21. Suppose that the electric field amplitude of an electromagnetic wave $E_0 = 120 \text{ NC}^{-1}$ and that its frequency is $\nu = 50 \text{ MHz}$. Determine B_0 , ω , k and λ .
22. A metallic rod of length 'l' and resistance R is moving normal to a uniform magnetic field B with a velocity v . Deduce expression for

- 1) the emf induced and
- 2) the induced current, in the metallic rod

23. A group of 20 students of a school were going on a educational trip in their school bus. When their bus was passing through a lonely forest area, it started raining. After sometime rain became heavy and there was lightning and thundering too. Some students of the group were afraid of lightning and wanted the bus driver to stop the bus so that they can take shelter somewhere below a tree or a thatched roof to save themselves from lightning.

Rajeev, who was a member of the students group, had science background and knew the cause of lightning. He assured his fellow students that best course to prevent ourselves from lightning is that we should remain within our school bus because then lightning will have no effect due to 'electric shielding' effect of metallic body of the bus.

Suddenly, a huge lightning took place just in front of their bus. However they did not feel the effect of lightning.

- 1) What is electric shielding effect?
- 2) What qualities did Rajeev possess?
- 3) A hollow metallic sphere of radius 5m has charge $10\mu\text{C}$ uniformly spread over its entire surface. What is the value of electric field and electric potential at a point inside the hollow sphere?

24. 1) Define capacitance of a capacitor. Give its SI unit. For a parallel plate capacitor, prove that the total energy stored in a capacitor is $\frac{1}{2} CV^2$.
- 2) Find the ratio of the potential difference that must be applied across the (i) parallel, (ii) series combination of two identical capacitors so that the energy stored, in two cases becomes same.

Or

An electric dipole is held in uniform electric field

- 1) Prove that no translatory force acts on it.
- 2) Derive an expression for torque acting on the dipole.

- 3) Calculate the work done on rotating a dipole in an electric field through 180° from its equilibrium position.
- 4) Two point charges are $4\mu\text{C}$ and $-2\mu\text{C}$ are separated by a distance of 1m in air. Calculate at what point on the line joining the two charges is the electric potential zero.

25. Derive an expression for the magnetic field along the axis of an air cored solenoid using Ampere's circuital law. Sketch the magnetic field lines for a finite solenoid. Explain why the field at the exterior mid point is weak while at the interior it is uniform and strong.

OR

Explain with the help of a labeled diagram the working principle of a cyclotron. Show that the cyclotron frequency does not depend on the speed of the particle. Write one of the uses and point out one of the drawbacks of the cyclotron.

26. Draw a graph to show the variation of angle of deviation δ with the angle of incidence i , when rays of monochromatic light pass through a prism of

refracting angle 'A'. Deduce the relation $\mu = \sin \frac{(A+\delta_m)}{2}$.

A monochromatic beam of light incident at an angle of 40° on a prism suffers minimum deviation. If the angle of the prism is 60° , find the angle of minimum deviation.

OR

Derive the relation between distance of object, distance of image and radius of curvature of a convex spherical surface, when refraction takes place from rarer to denser medium and the image formed is virtual. State the assumptions and conventions of sign used.