INDIAN SCHOOL AL WADI AL KABIR

DEPARTMENT OF SCIENCE 2020-21

Subject: Physics (042)

Maximum Marks: 70 Marks Time Allowed: 3 hours

General Instructions:

(1) All questions are compulsory. There are 33 questions in all.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case-based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

(4) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

SECTION- A

All questions are compulsory. In case of internal choices, attempt any one of them

1. What is the dimensional formula for ε_o.

2. what is the potential of earth or any conductor connected to earth?

Or

The earth is considered as a conducting sphere, find capacity of the earth.

3. A copper wire is stretched by 0.2%. what is the percentage change in its resistance?

4. define an ideal voltmeter.

Or

Write dimensional formula of magnetic field.

5. What do you understand by magnetic dipole? Write the formula for magnetic dipole moment in term of pole strength.

6. Two coils have mutual inductance of 1.5 H. If current in primary circuit is raised to 5 amp in one millisecond after closing the circuit. What is the emf induced in the secondary coil?

7. The resistance of a coil for dc is 10 Ω. An ac is sent through it. Will its resistance remain the same?

Or

Sketch a graph to show the reactance of (i) a capacitor (ii) an inductor varies as a function of frequency.

8. An em wave exerts pressure on the surface on which it is incident. Justify.

9. Light of wavelength 6000Å in air enters a medium of refractive index 1.5. What are the wavelength and frequency of light in that medium?

Or

Write the nature of equivalent lens which is obtained by combination of a convex and a concave lens of equal focal length.

10. Plot a graph for kinetic energy Vs stopping potential. Write the slope in the diagram.

For question numbers 11, 12, 13 and 14, two statements are given-one labelled Assertion (A) and the 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 of A
(c) A is true but R is false
(d) A is false and R is also false

11. Assertion: - Balmer series lies in visible reason of electromagnetic spectrum.
Reason: - Balmer means visible, hence series lies in visible region.
(a) (b) (c) (d)

12. Assertion: - A prism is the source of colours of light.
Reason: - A prism has same refractive index for different colours of light.
(a) (b) (c) (d)

13. Assertion: - A domestic electric appliance, working on a three pin, will continue working even if the top pin is removed.
Reason: - The third pin is used only as a safety device.
(a) (b) (c) (d)
14. Assertion: - If two long parallel wires, hanging freely are connected to a battery in series, they come closer to each other.
Reason: - Force of attraction acts between the two parallel wires in series carrying current.
(a) (b) (c) (d)

SECTION- B

Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

15. We may define electro- static potential at a point in an electrostatic field as the amount of work done in moving a unit positive test charge from infinity to that point against the electrostatic forces, along any path. Due to a single charge q, potential at a point distant r from the charge is $V = \frac{1}{4\pi\varepsilon_\circ}\frac{q}{r}$. The potential can be positive or negative. However, it is a scalar quantity. The total amount of work done in bringing various charges to their respective positions from infinitely large mutual separations gives us the electric potential energy of the system of charges. Whereas electric potential is measured in volt, electric potential energy is measured in joule. You are given a square of each side 1.0 metre with four charges **+1 x 10^{-8}C, -2 x 10^{-8}C, + 3 x 10^{-8}C and +2 x 10^{-8}C** placed at the four corners of the square. With the help of the passage given above, choose the most appropriate alternative for each of the following questions;

(i) Electric potential and electric potential energy
(a) both are scalars, (b) both are vectors,
(c) electric potential is scalar and electric potential energy is vector.
(d) electric potential is vector and electric potential energy is scalar.

(ii) Potential at a point due to a given charge varies inversely as the square of the distance of the point from the charge. The statement is
(a) true (b) false

(iii) Potential at the centre of the square is
(a) 5.09 x 10^2 V (b) 5.09 x 10^3 V
(c) 5.09 V (d)8.23 x 10^2 V

(iv) The relation between joule and volt is

(a) 1 joule = $\frac{1\ \text{coulomb}}{1\text{volt}}$ (b) 1 joule = $\frac{1\ \text{volt}}{1\text{coulomb}}$

(c) 1 volt = $\frac{1\ \text{joule}}{1\text{coulomb}}$ (d) 1 volt = $\frac{1\ \text{coulomb}}{1\text{joule}}$

(V) Potential energy of the system of four charges is

(a) 12.73×10^{7} J (b) -6.4×10^{-7}J

(c) 12.73×10^{-9} J (d) -12.73×10^{-9} J

16. A transformer is an electrical device which is used for changing the a.c. voltages. It is based on the phenomenon of mutual induction. It can be shown that, $\frac{Es}{Ep} = \frac{Ip}{Is} = \frac{Ns}{Np} = K$. where the symbols have their standard meaning. For a step-up transformer, K> 1 and for a step-down transformer, K <1. The above relations are on the assumption that efficiency of transformer is 100%. In fact, efficiency

$$\eta = \frac{\text{output power}}{\text{input power}} = \frac{EsIs}{EpIp}$$

The number of turns in the primary and Secondary coils of a transformer are 2000 and 50 respectively. The primary coil is connected to main supply of 120 V and secondary to a night bulb of 0.6 Ω. The efficiency of transformer is 80%.

(i) Voltage across the secondary coil of transformer is

(a) 120 V (b) 360 V (c) 40 V (d) 3 V

(ii) Current in night bulb is

(a) 5 A (b) 3A (c) 0.5 A (d) 0.6 A

(iii) Current in primary coil is

(a) 15 A (b) $\frac{5}{3}$ A (c) $\frac{5}{32}$ A (d) 0.6 A

(iv) Power in primary coil is

(a) $\frac{12}{225}$ W (b) $\frac{75}{4}$ W (c) 120 W (d) 50 W

(v) power in the secondary coil

(a) 15 W (b) 225 W (c) 120 W (d) 7 W

SECTION-C

All questions are compulsory. In case of internal choices, attempt anyone.

17. Two slits are made 1 mm apart and the screen is placed 1 m away. What is the fringe separation when the blue green light of 500 nm is used?

18. Two identical coherent waves each of intensity I_o are producing interference pattern. What are the values of resultant intensity at a point of (i) constructive interference (ii) destructive interference?

19. Calculate the speed of light in a medium whose critical angle is 30º.

Or

For some angle of incidence, the angles of refraction in media P, Q and R are 35º,25º and 15º respectively. In which medium will the velocity of light be minimum?

20. Show that the rate of change of magnetic flux has the same units as induced emf.

Or

(i) Name the physical quantity which is measured in weber amp^{-1}.

(ii) What is one henry?

21. Why no two electric field lines of force can intersect each other?

Or

Sketch the electric field lines for a positive charge and a dipole.

22. Draw VI characteristics for ohmic and non ohmic conductors.

23. Write the relation for the force $\vec{F}$ acting on a charge q moving with a velocity $\vec{v}$ through a magnetic field $\vec{B}$ in a vector notation. Using this relation, deduce the condition under which this force will be (i) minimum (ii) maximum.

24. What is magnetic dipole moment of a circular loop? Give its direction if any. Write its dimension.

25. A planner loop of irregular shape encloses an area of 7.5 x 10^{-4} m^2, and carries a current of 12 A. sense of flow of current appears to be clockwise to an observer. What is the magnitude and direction of magnetic moment vector associated with current loop?

SECTION-D

All questions are compulsory. In case of internal choices, attempt any one.

26. State Ohm's law and deduce it from the knowledge of drift velocity of free electrons in a conductor carrying current.

27. Describe a simple experiment to show that currents are induced by currents.

Or

An aircraft with a wingspan of 40 m flies with a speed of 1080 kmh^{-1} in the eastward direction at a constant altitude in the northern hemisphere, where the vertical component of earth's magnetic field is 1.75 x10^{-5} T. find the emf that develops between the tips of the wings.

28. 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?

29. Define, (i) threshold frequency, (ii) cut-off voltage. Why stopping potential is kept negative?

Or

Plot graph with slope, (i) frequency Vs stopping potential, and (ii) frequency Vs maximum K.E.

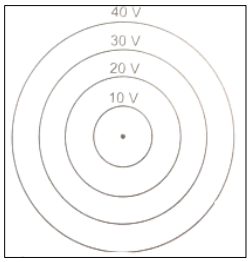
30. Using Bohr's postulates find the radius of the first energy level of H-atom.

SECTION-E

31. (a) Two isolated metal spheres A and B have radii R and 2R respectively and same charge 'q'. Find which of the two spheres have greater capacitance.

(b) Show that the equipotential surfaces are closer together in the regions of strong field and far apart in the regions of weak field. Draw equipotential surfaces for an electric dipole.

(a) Concentric equipotential surfaces due to a charged body placed at a the centre are shown. Identify the polarity of the charge and draw the electric field lines due to it



Or

Show by graph how ‘q’ given to a capacitor varies with its potential difference. using the graph or otherwise, prove that the energy of a capacitor is 1/2 CV^2. Calculate the energy density of the electrostatic field in a parallel plate capacitor.

32. (i) State Faraday's law of electromagnetic induction.

(ii) Explain, with the help of a suitable example, how we can show that Lenz’s law is consequences of the principle of conservation of energy.

(iii) Use the expression for Lorentz force acting on the charge carriers of a conductor to obtain the expression for the induced EMF across the conductor of length ‘*l*’ moving with velocity ‘*v*’ through a magnetic field ‘B’ acting perpendicular to its length.

Or

Describe briefly with the help of a labelled diagram the basic elements of an ac generator.

State its underlying principle.

Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field.

Write the expression for the instantaneous value of the emf induced in the rotating loop.

33. (a)What is meant by wavefront? Explain three types of wavefront.

(b) State Huygens principle and prove the laws of reflection on the basis of wave theory.

Or

(i) A plane wavefront is incident on (a) a prism (b) a convex lens (c) a concave mirror. Draw the shapes of the refracted/reflected wavefront in each case.

(ii) In Young’s double slit experiment, the light has a frequency of 6 x 10^{14} Hz and distance between the centres of adjacent fringes s 0.75 mm. if the screen is 1.5 m away, what is the distance between the slits?