S R Study Material

SAMPLE PAPER 1 2024-25

Class 12 - Physics

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

General Instructions:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. All the sections are compulsory.
4. **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.

Section A

1. Holes are charge carriers in **[1]**

   a) intrinsic and p-type semiconductors
   b) n-type semiconductor
   c) intrinsic semiconductor only
   d) p-type semiconductor only

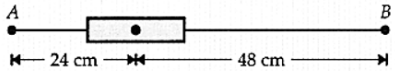
2. A Wheatstone bridge is balanced for four resistors R_1, R_2, R_3 and R_4 with a Lechlanche cell between A and C and a galvanometer between B and D. The positions of the cell and the galvanometer are interchanged. The balance will **[1]**

   a) Change and can be obtained by changing R_1
   b) decrease by about 9%
   c) Change and can be obtained by changing R_4
   d) Not change

3. An observer looks at a tree of height 15 metre with a telescope of magnifying power 10. To him, the tree appears **[1]**

   a) 10 times taller
   b) 15 times nearer
   c) 10 times nearer
   d) 15 times taller

4. A bar magnet of length 3 cm has points A and B along its axis at distances of 24 cm and 48 cm on the opposite sides. Ratio of magnetic fields at these points will be **[1]**



a) $\frac{1}{2\sqrt{2}}$

b) 4

c) 3

d) 8

5. How many 1μF capacitors must be connected in parallel to store a charge of 1C with a potential of 110 V across the capacitors? **[1]**

a) 9090

b) 909

c) 990

d) 900

6. A voltmeter has range V. What resistance should be connected in series with it to increase its range to nV? Initial resistance is R_0. **[1]**

a) $\frac{R_0}{n}$

b) (n - 1)R_0

c) nR_0

d) (n + 1)R_0

7. An inductor of inductance 10 H is connected in series with a resistance R = 6 ohm. A 12-volt battery is connected for a long time. When the circuit is switched off, the induced emf in the inductor, if current reduces to zero in 10 ms, is **[1]**

a) 2000 V

b) 1000 V

c) 4000 V

d) 3000 V

8. A closely wound solenoid of 800 turns and area of cross section $2.5 \times 10^{-4}\mathrm{m}^2$ carries a current of 3.0 A. It is free to turn about the vertical direction and a uniform horizontal magnetic field of 0.25 T is applied. Magnitude of torque on the solenoid when its axis makes an angle of 30° with the direction of applied field is **[1]**

a) 0.075 J

b) 0.09 J

c) 0.065 J

d) 0.06 J

9. Newton gave the corpuscular theory on the basis of: **[1]**

a) Wavefront

b) Newton's rings

c) Colours of thin films

d) Rectilinear motion

10. In air the value of the total electric flux emitted from the unit positive charge is **[1]**

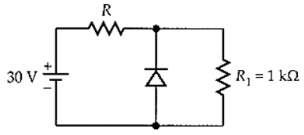
a) ε_0

b) $(4\pi\varepsilon_0)^{-1}$

c) $(\varepsilon_0)^{-1}$

d) $4\pi\varepsilon_0$

11. If the current in a diode is five times that in R_1 and breakdown voltage of the diode is 6 volt, find the value of R. **[1]**



a) $\frac{1000}{3}\Omega$

b) $\frac{2000}{3}\Omega$

c) 1000 Ω

d) 2000 Ω

12. A lamp and a screen are set up 100 cm apart and a convex lens is placed between them. The two positions of the lens forming real images on the screen are 40 cm apart. What is the focal length of the lens? **[1]**

a) 15 cm

b) 21 cm

c) 18 cm

d) 12 cm

13. **Assertion (A):** The kinetic energy of photoelectrons emitted from metal surface does not depend on the intensity of incident photon. **[1]**

Reason (R): The ejection of electrons from metallic surface is not possible with the frequency of incident photons below the threshold frequency.

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 but R is true.

14. **Assertion:** Circuits containing high capacity capacitors, charged to high voltage should be handled with caution, even when the current in the circuit is switched off. **[1]**

Reason: When an isolated capacitor is touched by hand or any other part of the human body, there is an easy path to the ground available for the discharge of the capacitor.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

15. **Assertion (A):** White light falls on a double slit with one slit is covered by a green filter. The bright fringes observed are of green colour. **[1]**

Reason (R): The fringes observed are coloured.

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 but R is true.

16. **Assertion:** By only knowing the power factor for a given L-C-R circuit, it is not possible to tell whether the applied alternating voltage leads or lags the current. **[1]**

Reason: For certain value of cos θ (power factor) two values of θ are possible as cos (-θ) = cos θ.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

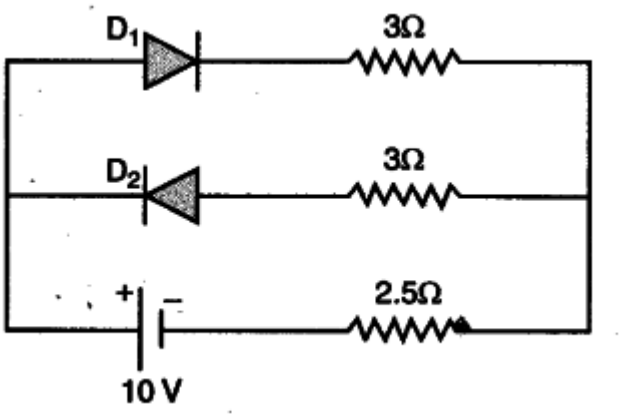
d) Assertion is wrong statement but reason is correct statement.

Section B

17. Hertz, in his historical experiment, produced stationary e.m. waves and measured the distance between two successive nodes. Explain how this measurement enabled him to show that e.m. waves travelled with the same speed as the speed of light. **[2]**

18. A bar magnet 30 cm long is placed in the magnetic meridian with its north pole pointing geographical south. The neutral point is found at a distance of 30 cm from its centre. Calculate the pole strength of the magnet. Given B_H = 0.34 G. **[2]**

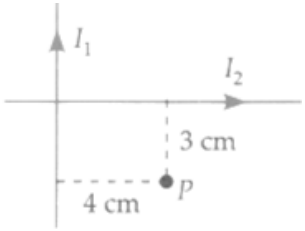
19. Assuming that the two diodes D_1 and D_2 used in the electric circuit shown in the figure are ideal, find out the value of the current flowing through 2.5 Ω resistor **[2]**



20. i. Define the terms: **impact parameter** and distance of **closest approach** for an α-particle in the Geiger-Marsden scattering experiment. **[2]**

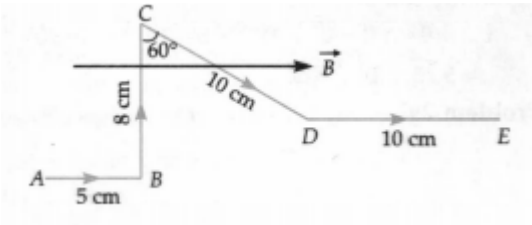
ii. What will be the value of the impact parameter for scattering angle (I) $\theta = 0^o$ and (II) $\theta = 180^o$?

21. Two infinitely long insulated wires are kept perpendicular to each other. They carry currents $I_1 = 2A$ and $I_2 = 1.5$ A. (i) Find the magnitude and direction of the magnetic field at P. (ii) If the direction of current is reversed in one of the wires, what would be the magnitude of the field B? **[2]**



OR

Find the magnitude of the force on each segment of the wire as shown in Fig. if a magnetic



field of 0.30 T, is applied parallel to AB and DE. Take the value of the current, flowing in the wire as 1 ampere.

Section C

22. At 0°C, the resistance of a conductor B is n times that of conductor A. The temperature coefficients of A and B are α_1 and $\alpha_2$respectively. For the series combination of the two conductors, find **[3]**

i. the resistance at 0°C and

ii. the temperature coefficient of resistance

23. Explain the formation of depletion layer and barrier potential in a p-n junction diode. **[3]**

24. Sketch a graph between the frequency of incident radiations and stopping potential for a given photosensitive material. What information can be obtained from the value of intercept on the potential axis? **[3]**

A source of light of frequency greater than the threshold frequency is placed at a distance of 1 m from the cathode of a photo-cell. The stopping potential is found to be V. If the distance of the light source from the cathode is reduced, explain giving reasons, what change will you observe in the

i. photoelectric current,

ii. stopping potential?

25. Define the terms (i) mass defect (ii) binding energy for a nucleus and state the relation between the two for a **[3]**

given nuclear reaction for which the B.E. / nucleon of the product nucleus/nuclei is more than that for the original nucleus/nuclei. Is this nuclear reaction exothermic or endothermic in nature? Justify your choice.

26. a. Draw the graph of radius of orbit (r_n) in hydrogen atom as a function of orbit number (n). **[3]**

b. In a hydrogen atom, find the ratio of the time taken by the electron to complete one revolution in the first excited and in the second excited states.

27. In a diffraction pattern due to a single slit, how will the angular width of central maximum change, if **[3]**

a. Orange light is used in place of green light,

b. the screen is moved closer to the slit,

c. the slit width is decreased?

Justify your answer in each case.

28. Two concentric circular coils X and Y of radii r_1 and r_2 ($r_1 > r_2$) having N_1 and N_2 turns respectively are placed **[3]** coaxially with centres coinciding. Obtain an expression for

i. the mutual inductance for the arrangement, and

ii. the magnetic flux linked with coil Y when current I flows through coil X.

OR

A metallic rod of length l and resistance R is rotated with a frequency ν, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius l, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere.

i. Derive the expression for the induced emf and the current in the rod.

ii. Due to the presence of the current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.

iii. Hence obtain the expression for the power required to rotate the rod.

Section D

29. **Read the text carefully and answer the questions:** **[4]**

All the known radiations from a big family of electromagnetic waves which stretch over a large range of wavelengths. Electromagnetic wave include radio waves, microwaves, visible light waves, infrared rays, UV rays, X-rays and gamma rays. The orderly distribution of the electromagnetic waves in accordance with their wavelength or frequency into distinct groups having widely differing properties is electromagnetic spectrum.

(a) Which wavelength of the Sun is used finally as electric energy?
radio waves, infrared waves, visible light, microwaves

a) microwaves b) visible light

c) radio waves d) infrared waves

(b) Which of the following electromagnetic radiations have the longest wavelength?
X-rays, γ-rays, microwaves, radiowaves

a) γ-rays b) microwaves

c) radiowaves d) X-rays

(c) Which one of the following is not electromagnetic in nature?
X-rays, gamma rays, cathode rays, infrared rays

a) gamma rays b) infrared rays

c) X-rays

d) cathode rays

OR

The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is

a) gamma rays, ultraviolet, infrared, microwave

b) microwave, gamma rays, infrared, ultraviolet

c) microwave, infrared, ultraviolet, gamma rays

d) infrared, microwave, ultraviolet, gamma rays.

(d) Which of the following has minimum wavelength?

X-rays, ultraviolet rays, γ-rays, cosmic rays

a) X-rays

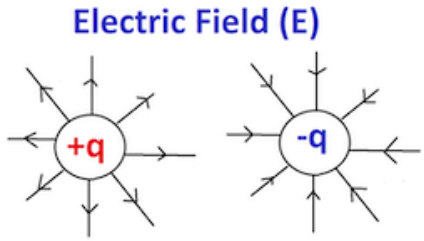
b) cosmic rays

c) ultraviolet rays

d) γ-rays

30. **Read the text carefully and answer the questions:** **[4]**

Electric field intensity at any point is the strength of the electric field at that point. It is also defined as the force experienced by unit positive charge placed at that point. Electric Field Intensity is a vector quantity. It is denoted by **E**. When placed within the electric field, the test charge will experience an electric force - either attractive or repulsive.



(a) The Electric field at a point is

a) discontinuous only if there is a negative charge at that point

b) always continuous

c) continuous if there is charge at that point

d) continuous if there is no charge at that point

(b) A charge is distributed uniformly over a ring of radius **a**. Obtain an expression for the electric intensity E at a point on the axis of the ring. Hence the points at large distances from the ring, it behaves like a point charge is:

a) E = $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{x}$

b) E = $\frac{1}{2\pi\varepsilon_0} \cdot \frac{Q}{x^2}$

c) E = $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{x^4}$

d) E = $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{x^2}$

(c) Force acting on an electron in a uniform electric field of 5×10^4 N/C is:

a) 8×10^{-15} N

b) -7×10^{-15} N

c) -8×10^{-15} N

d) 7×10^{-15} N

(d) At a particular point, the electric field depends upon:

a) source charge Q only

b) both Q and q

c) test charge q_0 only d) neither Q nor q

OR

Four charges of the same magnitude and same sign are placed at the corners of a square, of each side 0.1 m. then electric field intensity at the centre of the square is:

a) 0.01 N/C b) 0.25 N/C

c) zero d) 0.1 N/C

Section E

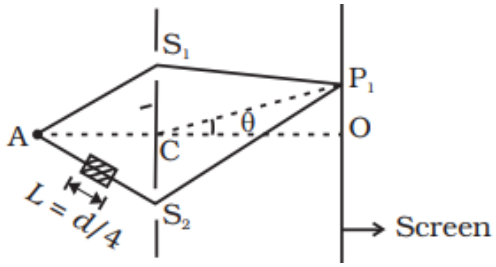
31. **[5]**

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 relationship 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.

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 small transparent slab containing material of μ = 1.5 is placed along AS_2 (Figure). What will be the distance from O of the principal maxima and of the first minima on either side of the principal maxima obtained in the absence of the glass slab?



AC = CO = D, $S_1C = S_2C = d << D$

32. **[5]**

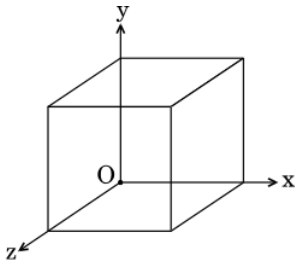
i. Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates.

ii. A slab of material of dielectric constant k has the same area as the plates of a parallel plate $\frac{3d}{4}$ capacitor but has a thickness -. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

OR

a. Two-point charges q_1 and q_2 are kept r distance apart in a uniform external electric field $\vec{E}$. Find the amount of work done in assembling this system of charges.

b. A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by V = 10x + 5, where V is in volt and x is in m.



Find the

i. electric field $\vec{E}$, and

ii. total electric flux through the cube.

33. a. State the condition for resonance to occur in series LCR a.c. circuit and derive an expression for resonant frequency. **[5]**

b. Draw a plot showing the variation of the peak current (i_m) with frequency of the a.c, source used. Define the quality factor Q of the circuit.

OR

Draw an arrangement for winding of primary and secondary coils in a transformer with two coils on a separate limb of the core.

State the underlying principle of a transformer. Deduce the expression for the ratio of secondary voltage to the primary voltage in terms of the ratio of the number of turns of primary and secondary winding. For an ideal transformer, obtain the ratio of primary and secondary currents in terms of the ratio of the voltages in the secondary and primary voltages.

Write any two reasons for the energy losses which occur in actual transformers.

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