S.R. Study Material

S R SAMPLE PAPER 1

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. A p-type semiconductor can be obtained by adding **[1]**

   a) phosphorus to pure germanium
   b) gallium to pure silicon
   c) arsenic to pure silicon
   d) antimony to pure germanium

2. When a current flows in a wire, there exists an electric field in the direction of: **[1]**

   a) flow of current
   b) perpendicular to the flow of current
   c) opposite to the flow of current
   d) at an angle of 45° to the flow of current

3. Which of the following is used in optical fibers? **[1]**

   a) Scattering
   b) Refraction
   c) Diffraction
   d) Total internal reflection

4. Magnetic field due to a magnet 2 cm long having a pole strength of 100 Am at a point 10 cm from each pole is **[1]**

   a) $8 \times 10^{-4} T$
   b) $4 \times 10^{-5} T$
   c) $2 \times 10^{-5} T$
   d) $2 \times 10^{-4} T$

5. If we carry a charge once around an equipotential path, then work done by the charge is **[1]**

   a) infinity
   b) negative
   c) zero
   d) positive

6. When a charged particle enters in a uniform magnetic field, its kinetic energy. **[1]**

a) decreases
b) becomes zero
c) remains constant
d) increases

7. The average emf induced in which current changes from 0 to 2 A in 0.05 sec is 8 V. The self-inductance of the coil is: **[1]**

a) 0.4 H
b) 0.2 H
c) 0.1 H
d) 0.8 H

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. What is its associated magnetic moment? **[1]**

a) 0.4 J/T
b) 0.8 J/T
c) 0.6 J/T
d) 0.5 J/T

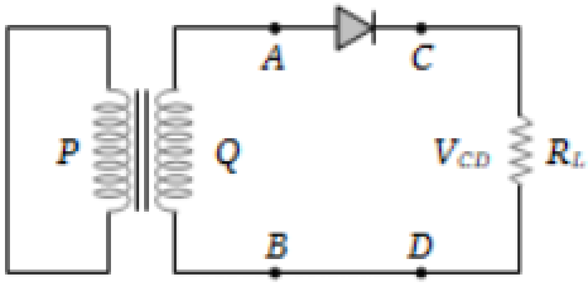
9. Light propagates rectilinearly, because of its **[1]**

a) wave nature
b) frequency
c) wavelength
d) velocity

10. Electric charges under the action of electric forces is called: **[1]**

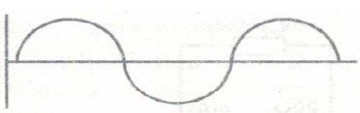
a) electric field lines.
b) electrostatic
c) electric flux
d) electric field

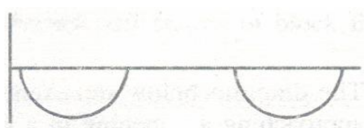
11. In the half wave rectifier circuit shown which one of the following wave forms is true for V_{CD}, the output across C and D? **[1]**



a) 

b) 

c) 

d) 

12. The largest telescope in the world has a reflector with an aperture of 200 inches in order to achieve **[1]**

a) low dispersive power
b) least spherical aberration
c) high resolving power
d) high accommodation power

13. **Assertion (A):** Photosensitivity of a metal is high if its work function is small. **[1]**
Reason (R): Work function = hf_0 where f_0 is 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:** Positive charge always moves from a higher potential point to a lower potential point. **[1]**

Reason: Electric potential is a vector quantity.

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):** In Young's double slit experiment the fringes become indistinct if one of the slits is covered with cellophane paper. **[1]**

Reason (R): The cellophane paper decreases the wavelength of light.

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 (A):** When capacitive reactance is smaller than the inductive reactance in LCR current, e.m.f. leads the current. **[1]**

Reason (R): The phase angle is the angle between the alternating e.m.f. and alternating current of the circuit.

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.

Section B

17. Two charges 5×10^{-8} C and -3×10^{-8} C are located 16 cm apart. At what point (s) on the line joining the two charges is the electrical potential zero? Take the potential at infinity to be zero. **[2]**

18. A bar magnet is placed in a uniform magnetic field with its magnetic moment making an angle θ with the field. **[2]**

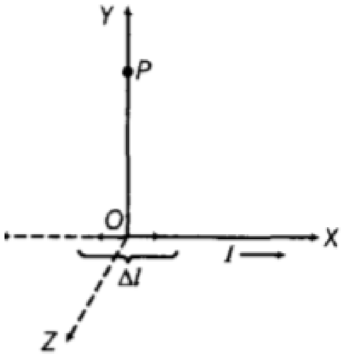
i. Write an expression for the torque acting on the magnet and hence define its magnetic moment.
ii. Write an expression for the potential energy of the magnet in this orientation. When is this energy minimum?

19. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier. **[2]**

20. If Bohr's quantisation postulate (angular momentum = $\frac{nh}{2\pi}$) is a basic law of nature, it should be equally valid for the case of planetary motion also. Why then do we never speak of quantisation of orbits of planets around the sun? **[2]**

21. An element M = $\triangle\, l = \triangle x\ \hat{i}$ is placed at the origin (as shown in figure) and carries a current I = 2 A. Find out the magnetic field at a point P on the Y-axis at a distance of 1.0 m due to the element $\Delta x = 1\ cm$. Also, give the **[2]**

direction of the field produced.



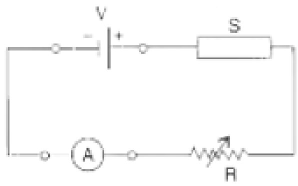
OR

A horizontal overhead power line carries a current of 90 A in east to west direction. What is the magnitude and direction of the magnetic field due to the current 1.5 m below the line?

Section C

22. a. State Ohm's Law. Represent it mathematically. **[3]**
 b. Define 1 ohm.
 c. What is the resistance of a conductor through which a current of 0.5 A flows when a potential difference of 2V is applied across its ends?

23. i. In the following diagram S is a semiconductor. Would you increase or decrease the value of R to keep the reading of the ammeter A constant when S is heated? Give reason for your answer. **[3]**



 ii. Draw the circuit diagram of a photodiode and explain its working. Draw its $\frac{I}{V}$ characteristics.

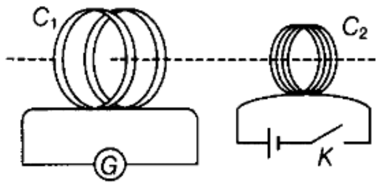
24. Ultra-violet light of wavelength 200 nm from a source is incident on a metal surface. If the stopping potential is -2.5 V, **[3]**
 a. Calculate the work function of the metal, and
 b. How would the surface respond to a high intensity red light of wavelength 6328 A produced by a laser?

25. Describe how Chadwick discovered neutrons. Is neutron a stable particle when isolated? **[3]**

26. The total energy of an electron in the first excited state of the hydrogen atom is about –3.4 eV. **[3]**
 a. What is the kinetic energy of the electron in this state?
 b. What is the potential energy of the electron in this state?
 c. Which of the answers above would change if the choice of the zero of potential energy is changed?

27. In Young's double slit experiment, monochromatic light of wavelength 630 nm illuminates the pair of slits and produces an interference pattern in which two consecutive bright fringes are separated by 8.1 mm. Another source of monochromatic light produces the interference pattern in which the two consecutive bright fringes are separated by 7.2 mm. Find the wavelength of light from the second source. What is the effect on the interference fringes, when the monochromatic source is replaced by a source of white light? **[3]**

28. A current is induced in coil C_1 due to the motion of current carrying coil C_2. **[3]**



i. Write any two ways by which a large deflection can be obtained in the galvanometer G.

ii. Suggest an alternative device to demonstrate the induced current in place of a galvanometer.

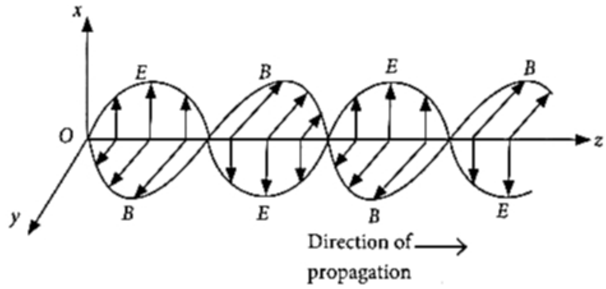
OR

A magnetic field B is confined to a region $r \leq a$ and points out of the paper (the z-axis), r = 0 being the centre of the circular region. A charged ring (charge = Q) of radius b, b > a and mass m lies in the x-y plane with its centre at the origin. The ring is free to rotate and is at rest. The magnetic field is brought to zero in time Δt. Find the angular velocity ω of the ring after the field vanishes.

Section D

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

A stationary charge produces only an electrostatic field while a charge in uniform motion produces a magnetic field, that does not change with time. An oscillating charge is an example of accelerating charge. It produces an oscillating magnetic field, which in turn produces an oscillating electric fields and so on. The oscillating electric and magnetic fields regenerate each other as a wave which propagates through space.



(i) Magnetic field in a plane electromagnetic wave is given by $\vec{B} = B_0 \sin(kx + \omega t)\hat{j}$ T

Expression for corresponding electric field will be (Where c is speed of light.)

a) $\vec{E} = B_0 c \sin(kx + \omega t)\hat{k}$ V/m

b) $\vec{E} = -B_0 c \sin(kx - \omega t)\hat{k}$ V/m

c) $\vec{E} = -B_0 c \sin(kx + \omega t)\hat{k}$ V/m

d) $\vec{E} = \frac{B_0}{c} \sin(kx + \omega t)\hat{k}$ V/m

(ii) The electric field component of a monochromatic radiation is given by $\vec{E} = 2E_0\hat{i}\cos kz \cos \omega t$. Its magnetic field $\vec{B}$ is then given by

a) $-\frac{2E_0}{c}\hat{j}\sin kz \sin \omega t$

b) $\frac{2E_0}{c}\hat{j}\sin kz \sin \omega t$

c) $\frac{2E_0}{c}\hat{j}\sin kz \cos \omega t$

d) $\frac{2E_0}{c}\hat{j}\cos kz \cos \omega t$

(iii) A plane em wave of frequency 25 MHz travels in a free space along x-direction. At a particular point in space and time, $E = (6.3\hat{j})$ V/m. What is magnetic field at that time?

a) 0.089 μT

b) 0.124 μT

c) 0.021 μT

d) 0.095 μT

OR

A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 V m^{-1}. The magnetic induction (B) along z-axis is

a) 3.1×10^{-8} T

b) 3×10^{-5} T

c) 3×10^{-6} T

d) 9.3×10^{-6} T

(iv) A plane electromagnetic wave travelling along the x-direction has a wavelength of 3 mm. The variation in the electric field occurs in the y-direction with an amplitude 66 V m^{-1}. The equations for the electric and magnetic fields as a function of x and t are respectively

a) $E_y = 11\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_y = 11 \times 10^{-7}\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

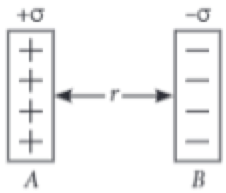
b) $E_y = 66\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_z = 2.2 \times 10^{-7}\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

c) $E_x = 33\cos \pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_x = 11 \times 10^{-7}\cos \pi \times 10^{11}\left(t - \frac{x}{c}\right)$

d) $E_y = 33\cos \pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_z = 1.1 \times 10^{-7}\cos \pi \times 10^{11}\left(t - \frac{x}{c}\right)$

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

Surface charge density is defined as charge per unit surface area of surface charge distribution. i.e., $\sigma = \frac{dq}{dS}$.
Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs having magnitude of 17.0×10^{-22} Cm^{-2} as shown. The intensity of electric field at a point is E = $\frac{\sigma}{\varepsilon_0}$, where ε_0 = permittivity of free space.



(i) E in the outer region of the first plate is

a) 1.5×10^{-25} N/C

b) 1.9×10^{-10} N/C

c) 17×10^{-22} N/C

d) zero

(ii) E in the outer region of the second plate is

a) zero

b) 1.9×10^{-10} N/C

c) 17×10^{-22} N/C

d) 1.5×10^{-15} N/C

(iii) E between the plates is

a) 1.9×10^{-10} N/C

b) 1.5×10^{-15} N/C

c) zero

d) 17×10^{-22} N/C

(iv) The ratio of E from right side of B at distances 2 cm and 4 cm, respectively is

a) 1 : 2

b) 1 : $\sqrt{2}$

c) 2 : 1

d) 1 : 1

OR

In order to estimate the electric field due to a thin finite plane metal plate, the Gaussian surface considered is

a) cylindrical

b) none of these

c) spherical

d) straight line

Section E

31. A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length **[5]**

6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at

a. the least distance of distinct vision (25 cm), and
b. at infinity?

What is the magnifying power of the microscope in each case?

OR

i. Derive an expression for path difference in Young's double-slit experiment and obtain the condition for constructive and destructive interference at a point on the screen.
ii. The intensity at the central maxima in Young's double-slit experiment is IQ. Find out the intensity at a point where the path difference is $\frac{\lambda}{6}$, $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$.

32. i. Describe briefly the process of transferring the charge between the two plates of a parallel plate capacitor when connected to a battery. Derive an expression for the energy stored in a capacitor. **[5]**
ii. A parallel plate capacitor is charged by a battery to a potential difference V. It is disconnected from the battery and then connected to another uncharged capacitor of the same capacitance. Calculate the ratio of the energy stored in the combination to the initial energy on the single capacitor.

OR

A spherical capacitor has an inner sphere of radius 12 cm and an outer sphere of radius 13 cm. The outer sphere is earthed and the inner sphere is given a charge of $2.5\mu C$. The space between the concentric spheres is filled with a liquid of dielectric constant 32.

a. Determine the capacitance of the capacitor.
b. What is the potential of the sphere?
c. Compare the capacitance of this capacitor with that of an isolated sphere of radius 12 cm. Explain why the latter is much smaller.

33. i. Prove that an ideal capacitor in an ac circuit does not dissipate power. **[5]**
ii. An inductor of 200 mH, a capacitor of 400 μf, and a resistor of 10 Ω are connected in series to ac source of 50 V of variable frequency. Calculate the
   a. the angular frequency at which maximum power dissipation occurs in the circuit and the corresponding value of the effective current and
   b. value of Q-factor in the circuit.

OR

An ac voltage V = $V_0 \sin \omega t$ is applied to a pure inductor L. Obtain an expression for the current in the circuit. Prove that the average power supplied to an inductor over one complete cycle is zero.