S R Study Material

SAMPLE PAPER 2 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. Basic materials used in the present solid state electronic devices like diode, transistor, ICs, etc are **[1]**

   a) Semiconductors b) metals

   c) insulators d) conductors

2. $m^2V^{-1}s^{-1}$ is the SI unit of which of the following? **[1]**

   a) Potential gradient b) Mobility

   c) Drift velocity d) Resistivity

3. The objective of a telescope has a focal length of 1.2 m. It is used to view a 10.0 m tall tower 2 km away. What is the height of the image of the tower formed by the objective? **[1]**

   a) 4 mm b) 2 mm

   c) 6 mm d) 8 mm

4. Magnetism in substances is caused by **[1]**

   a) hidden magnets b) orbital motion of electrons only

   c) due to spin and orbital motions of electrons both d) spin motion of electrons only

5. An electric dipole consisting of charges + q and - q separated by a distance L is in stable equilibrium in a **[1]**

uniform electric field $\vec{E}$. The electrostatic potential energy of the dipole is

a) zero
b) - qLE
c) - 2 qEL
d) qLE

6. A vertical straight conductor carries a current vertically upwards. A point P lies to the east of it at a small distance and another point Q lies to the west in the same direction. The magnetic field at P is: **[1]**

a) greater or less than at Q, depending upon the strength of the current
b) greater than at Q
c) less than at Q
d) same as at Q

7. When the current changers from + 2 A to - 2 A in $0 \cdot 05\ s$, an e.m.f. of 8 V is induced in the coil. The coefficient of self-induction of the coil is: **[1]**

a) $0 \cdot 2\ H$
b) $0 \cdot 1\ H$
c) $0 \cdot 4\ H$
d) $0 \cdot 8\ H$

8. A bar magnet is cut into two equal halves parallel to its magnetic axis. The physical quantity that remains unchanged is: **[1]**

a) moment of inertia
b) pole strength
c) magnetic moment
d) magnitude of magnetisation

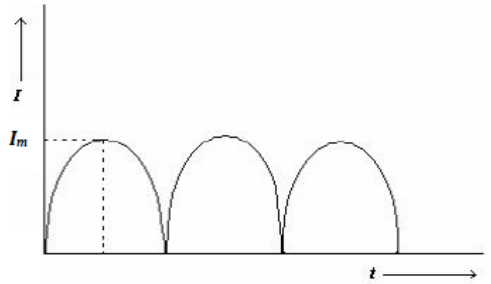
9. The main condition for diffraction to be observed is **[1]**

a) size of obstacle should be much larger than the wavelength of the wave
b) size of obstacle should be comparable to the wavelength of the wave
c) for any size of obstacle
d) size of obstacle should be much smaller than the wavelength of the wave

10. The number of electrons for one coulomb of charge is **[1]**

a) 6.25×10^{19}
b) 6.25×10^{23}
c) 6.25×10^{21}
d) 6.25×10^{18}

11. The output current I versus time (t) curve of a full wave rectifier is shown in the figure. The average value of the output current in this case is **[1]**



a) I_m
b) $\frac{2I_m}{\pi}$
c) $\frac{I_m}{\pi}$
d) Zero

12. A beam of monochromatic light is refracted from vacuum into a medium of refractive index $1 \cdot 5$. The wavelength of refracted light will be **[1]**

a) smaller
b) same

c) dependent on intensity of refracted light
d) larger

13. **Assertion (A):** Photoelectric current increases with an increase in intensity of incident radiation, for a given frequency of incident radiation and the accelerating potential. **[1]**

Reason (R): Increase in the intensity of incident radiation results in an increase in the number of photoelectrons emitted per second and hence an increase in the photocurrent.

a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
b) Both Assertion (A) and Reason (R) are true, but Reason (R) is **not** the correct explanation of the Assertion (A).
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false and Reason (R) is also false.

14. **Assertion (A):** Electric field is discontinuous across the surface of a spherical charged shell. **[1]**

Reason (R): Electric potential is continuous across the surface of a spherical charged shell.

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.

15. **Assertion (A):** One of the condition for interference is that the two source should be very narrow. **[1]**

Reason (R): One broad source is equal to large number of narrow sources.

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

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. A slab of material of dielectric constant K has the same area as the plates of a parallel-plate capacitor but has a thickness ($\frac{3}{4}$)d, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates? **[2]**

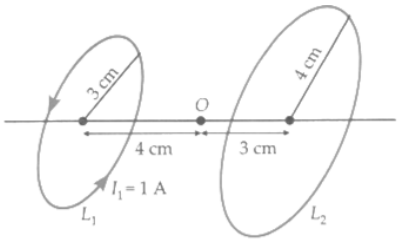
18. Distinguish between diamagnetic and ferromagnetic materials in terms of **[2]**

i. susceptibility and
ii. their behaviour in a non-uniform magnetic field

19. Explain the formation of depletion region in a p-n junction. **[2]**

20. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted? **[2]**

21. Two coaxial circular loops L_1 and L_2 of radii 3 cm and 4 cm are placed as shown. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero? **[2]**

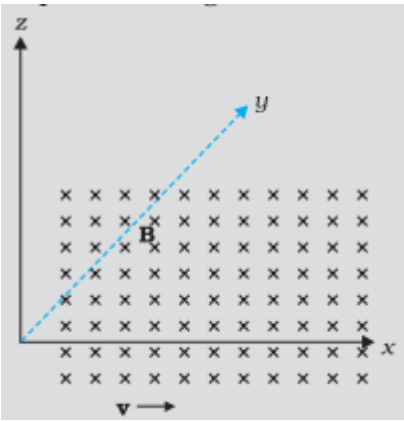


OR

If the magnetic field is parallel to the positive y-axis and the charged particle is moving along the positive x-axis (Fig.), which way would the Lorentz force be for

a. an electron (negative charge),

b. a proton (positive charge).



Section C

22. A student connects a cell, of emf ε_2 and internal resistance r_2 with a cell of emf ε_1 and internal resistance r_1, such that their combination has a net internal resistance less than r_1. This combination is then connected across a resistance R. **[3]**

Draw a diagram of the 'set-up' and obtain an expression for the current flowing through the resistance.

23. Draw the energy band diagrams for conductors, semiconductors and insulators. Which band determines the electrical conductivity of a solid? How is the electrical conductivity of a semiconductor affected with rise in its temperature? Explain. **[3]**

24. When light of frequency v_1 is incident on a photosensitive surface, the stopping potential is V_1. If the frequency of incident radiation becomes $\frac{v_1}{2}$, the stopping potential changes to V_2. Find out the expression for the threshold frequency for the surface in terms of V_1 and V_2. **[3]**

If the frequency of incident radiation is doubled, will the maximum kinetic energy of the photoelectrons also be doubled? Give reason.

25. **[3]**
    i. The density of the nuclear matter is tremendously larger than the physical density of the material. Explain.
    ii. The nuclear forces are not coulomb forces between nucleons. Explain.
    iii. Draw a plot of the potential energy between a pair of nucleons as a function of distance between them inside a nucleus.

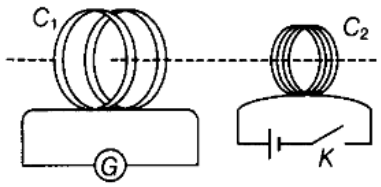
26. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron? **[3]**

27. In Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is λ is k units. Find the intensity at a point where the path difference is **[3]**

    i. $\frac{\pi}{4}$
    ii. $\frac{\pi}{3}$

iii. $\frac{\pi}{2}$

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

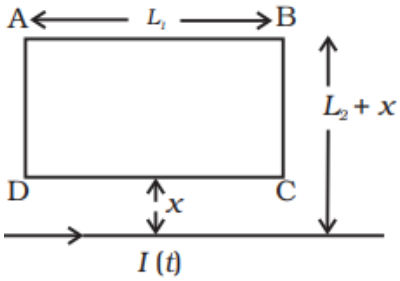


i. Write any two ways by which a large deflection can be obtained in the galvanometer G.

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

OR

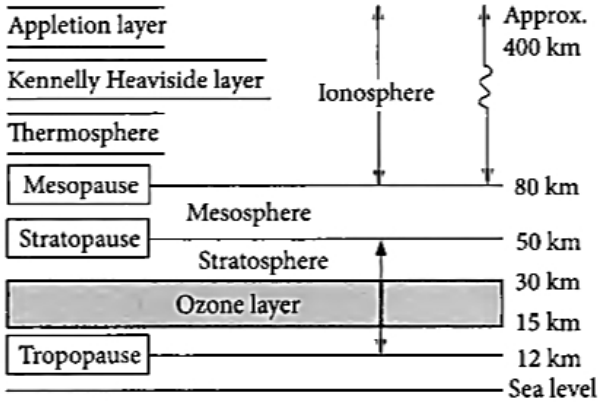
A rectangular loop of wire ABCD is kept close to an infinitely long wire carrying a current $I(t) = I_0 (1 - \frac{t}{T})$ for $0 \leq t \leq T$ and I(0) = 0 for t > T (Figure). Find the total charge passing through a given point in the loop, in time T. The resistance of the loop is R.



Section D

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

Radio waves are produced by the accelerated motion of charges in conducting wires. Microwaves are produced by special vacuum tubes. Infrared waves are produced by hot bodies and molecules also known as heat waves. UV rays are produced by special lamps and very hot bodies like Sun.



(a) Solar radiation is

i. transverse electromagnetic wave

ii. longitudinal electromagnetic waves

iii. both longitudinal and transverse electromagnetic waves

iv. none of these.

a) Option (i) b) Option (iv)

c) Option (iii) d) Option (ii)

(b) What is the cause of greenhouse effect?

a) Ultraviolet rays b) X-rays

c) Infrared rays

d) Radiowaves

(c) Biological importance of ozone layer is

a) it stops ultraviolet rays

b) none of these.

c) it reflects radiowaves

d) It layer reduces greenhouse effect

OR

Earth's atmosphere is richest in

a) ultraviolet

b) infrared

c) X-rays

d) microwaves

(d) Ozone is found in

a) troposphere

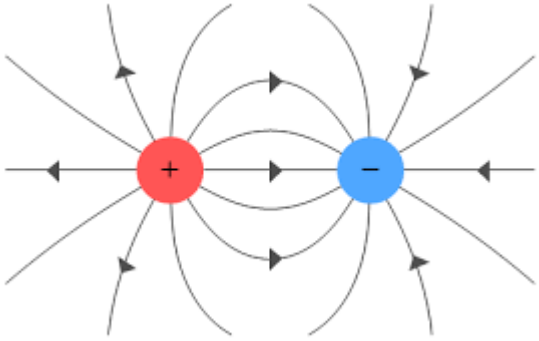
b) mesosphere

c) ionosphere

d) stratosphere

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

Electric charge is the physical property of matter that causes it to experience a force when placed in an electromagnetic field. There are two types of charges positive and negative charges. Also, like charges repel each other whereas unlike charges attract each other.



(a) Charge on a body which carries 200 excess electrons is:

a) -3.2×10^{-17} C

b) -3.2×10^{-18} C

c) 3.2×10^{18} C

d) 3.2×10^{-17} C

(b) Charge on a body which carries 10 excess electrons is:

a) 1.6×10^{-18} C

b) 1.6×10^{-21} C

c) 2.6×10^{-18} C

d) -1.6×10^{-18} C

(c) Mass of electron is:

a) 1.6×10^{-19} kg

b) 9.1×10^{-31} g

c) 9.1×10^{-31} kg

d) 1.6×10^{-19} g

(d) A body is positively charged, it implies that:

i. there is only a positive charge in the body

ii. there is positive as well as negative charge in the body but the positive charge is more than negative charge

iii. there is equally positive and negative charge in the body but the positive charge lies in the outer regions

iv. the negative charge is displaced from its position

a) Option (iii)

b) Option (iv)

c) Option (ii)

d) Option (i)

OR

On rubbing, when one body gets positively charged and other negatively charged, the electrons transferred from positively charged body to negatively charged body are:

a) both valence electrons and electrons of the inner shell

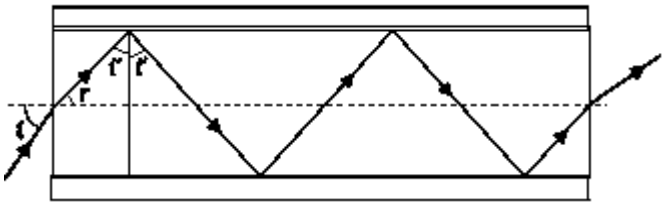
b) electrons of outer shells

c) electrons of inner shells

d) valence electrons only

Section E

31. i. Figure shows a cross-section of a light pipe made of a glass fibre of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44. What is the range of the angles of the incident rays with the axis of the pipe for which total reflections inside the pipe take place as shown in the figure. **[5]**



ii. What is the answer, if there is no outer covering of the pipe?

OR

a. Derive the relation a sin $\theta = \lambda$ for the first minimum of the diffraction pattern produced due to a single slit of width **a** using light of wavelength λ.

b. State with reason, how the linear width of central maximum will be affected if (i) monochromatic yellow light is replaced with red light, and (ii) distance between the slit and the screen is increased.

c. Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases.

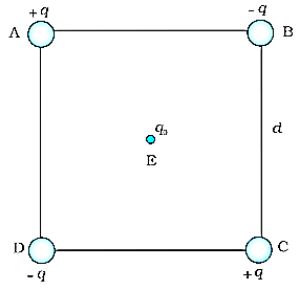
32. a. Deduce the expression for the energy stored in a charged capacitor **[5]**

b. Show that the effective capacitance C of a series combination of three capacitors C_1, C_2 and C_3 is given by

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}.$$

OR

Four charges are arranged at the corners of a square ABCD of side d, as shown in fig.



a. Find the work required to put together this arrangement.

b. A charge q_0 is brought to the center E of the square, the four charges being held fixed at its corners. How much extra work is needed to do this?

33. i. With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated. **[5]**

ii. The coil of an ac generator consists of 100 turns of wire, each of area 0.5 m^2. The resistance of the wire is 100 Ω. The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of rotation, at a constant angular speed of 60 radian per second. Calculate the maximum emf generated and power dissipated in the coil.

OR

Derive an expression for the impedance of a series LCR circuit connected to an ac supply of variable frequency. Plot a graph showing the variation of current with the frequency of the applied voltage. Explain briefly how the phenomenon of resonance in the circuit can be used in the tuning mechanism of a radio or a TV set.