Sub. Code 042

Roll No._____

D.A.V. INSTITUTIONS, CHHATISGARH

SAMPLE PAPPER(10) 2023-24

CLASS – XII, SUBJECT – 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 one 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 question Section E. You

   have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

   (i) $c = 3 \times 10^8$ m/s

   (ii) $m_e = 9.1 \times 10^{-31}$ Kg

   (iii) $h = 6.64 \times 10^{-34}$ Js

   (iv) $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

   (v) $e = 1.6 \times 10^{-19}$ C

   (vi) $\epsilon_0 = 8.854 \times 10^{-12}$ C^{2}N^{-1}m^{-2} (vii) Avogadro's no. $= 6.023 \times 10^{23}$ per gram mole

SECTION – A

Q1. Which of the following is an equipotential potential surface :

(a) concentric circles

(b) concentric circle around a charge

(c) surface of a charged conductor

(d) both b and c

Q2. Electric field intensity due to a short dipole remains directly proportional to – (r → distance

of a point from centre of dipole):

(a) $1/r^2$

(b) $1/r$

(c) $1/r^3$

(d) r

Q3. An electric current is passed through a circuit containing two wires of same material, connected in parallel.

If the lengths and radii of the wires are in the ratio of 3:2 and 2:3, then the ratio of the current passing

through the wire will be :

(a) 3 : 2

(b) 2 : 3

(c) 8 : 27

(d) 27 : 8

Q4. To convert a moving coil galvanometer into on ammeter of given range, we must connect:

(a) a low resistance in series

(b) a low resistance in parallel

(c) a high resistance in parallel

(d) a high resistance in series

Q5. When a charge of 1C moving with velocity 1 m/s normal to a magnetic field experiences a

force 1 N ,then the magnitude of the magnetic field is :

(a) 1 Gauss

(b) 1 Tesla

(c) 1 σOerested

(d) none

Q6.The large scale transmission of electrical energy over long distances is done with the use of transformers.

The voltage output of the generator is stepped-up because of

(a) reduction of current

(b) reduction of current and voltage both

(c) power loss is cut down

(d) a and c both

Q7. The current in the primary coil of a pair of coils changes from 7 A to 3 A in 0.4 s. The mutual inductance

between the two coils is 0.5 H. The induced emf in the secondary coil is :

(a) 50 V

(b) 75 V

(c) 100 V

(d) 220 V

Q8. Electromagnetic wave having having frequency 5 x 10^5 Hz is

(a) Ultraviolet wave

(b) Radio wave

(c) Microwave

(d) X – rays

Q9. Taking the Bohr radius as $r_0 = 53$ pm, the radius of Li^{++} ion on the basis of Bohr's model, will be about

  (a) 53 pm (b) 27pm (c) 18 pm (d) 13 pm

Q10. The work function for a metal surface is 4.14 eV. The threshold wavelength for this metal surface is

  (a) 4125 A° (b) 2062.5 A° (c) 3000 A° (d) 6000 A°

Q11. Magnifying power of a microscope depends on :

  (a) colour of light (b) focal length of objective and colour of light.

  (c) focal length of eyepiece and colour of light (d) focal length of eyepiece and objective.

Q12. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling

  through the slab, the first colour to emerge is

  (a) red (b) green (c) blue (d) violet

For Questions 13 to 16, two statement are given one labeled Assertion (A) and other labeled Reason (R).

Select the correct answer to these questions from the options as gives below.

  (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

  (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

  (c) If Assertion is true but Reason is false.

  (d) If both Assertion and Reason are false.

Q 13. **ASSERTION (A) :** A convex mirror cannot form real images.

       REASON (R) : Convex mirror converges the parallel rays that are incident on it.

Q14. **ASSERTION (A) :** Wavefront emitted by a point source of light in an isotropic medium is spherical.

       REASON (R) : Isotropic medium has same refractive index in all directions.

Q15. **ASSERTION (A) :** de – Broglie wavelength is significant for microscopic particles.

      REASON (R) : de – Broglie wavelength is inversely proportional to the mass of a particle when

             velocity is kept constant.

Q16. **ASSERTION (A) :** Electromagnetic radiation exerts pressure.

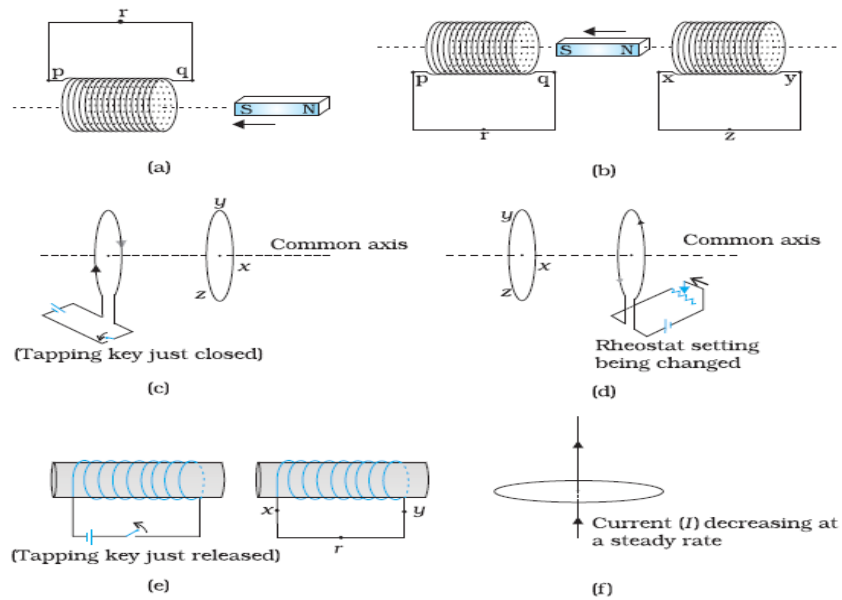   **REASON (R) :** Electromagnetic waves carry momentum and energy.

SECTION – B

Q17. The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5 W and at steam point is 5.39 W. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 5.795 W. Calculate the temperature of the bath

Q18. The susceptibility of a magnetic material is -2.6×10^{-5}. Identify the type of magnetic material and state its two properties.

Q19. A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is ¾ th of the angle of prism. Calculate the speed of light in the prism.

Q20. Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through single slit.

Q21. Plot suitable graphs to show the variation of photoelectric current with the collector plate potential for the incident radiation of (i) the same intensity but different frequencies v_1, v_2 and v_3 ($v1 < v_2 < v_3$)

(ii) the same frequency but different intensities I_1, I_2 and I_3 ($I_1 < I_2 < I_3$)

OR

Define the distance of closet approach. An α - particle of kinetic energy K is bombarded on a thin gold foil. The distance of the closet approach is r . What will be the distance of closet approach for an α – particle of double the kinetic energy ?

.SECTION – C

Q22. Two cells of emf E_1 and E_2 have their internal resistance r_1 and r_2 respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other

Q23. Show that the potential energy of a dipole making angle θ with the direction of the field is given by $U(\theta) = -\vec{P}.\vec{E}$ .Hence find out the amount of work done in rotating it from the position of unstable equilibrium to the stable equilibrium.

Q24. Deduce an expression for magnetic field on the axis of a current carrying circilar loop.

Q25. Predict the direction of induced current in the situations described by the following Figs. (a) to (f).

(a)   (b)

(Tapping key just closed)
(c)

Rheostat setting
being changed
(d)

(Tapping key just released)
(e)

Current (I) decreasing at
a steady rate
(f)

Q26. Using Huygen's constructions draw a figure showing the propagation of a plane wave refractive at a plane surface separating two media. Hence verify snell's law of refraction

Q27. Draw the graph showing the variation of binding energy per nucleon with the mass number and explain with the help of this plot the release of energy in the processes of nuclear fission and fusion.

Q28. Draw V – I characteristics of p – n junction diode. Answer the following questions, giving reasons:

(i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage ?

(ii) Why does the reverse current show a sudden increase at the critical voltage ?

OR

Draw the circuit diagram of a full wave rectifier and explain its working. Also give the input and output waveform

SECTION – D

CASE STUDY BASED QUESTIONS

Read the following paragraph and answer the question that follow :

Q29. A semiconductor diode is basically a pn junction with metallic contacts provided at the ends for the

application of an external voltage. It is a two terminal device. When an external voltage is applied across a

semiconductor diode such that p-side is connected to the positive terminal of the battery and n – side to the

negative terminal it is said to be forward biased. When an external voltage is applied across the diode

such that n-side is positive and p-side is negative, it is said to be reverse biased. An ideal diode is one whose resistance in forward biasing is zero and the resistance is infinite in reverse biasing. When the diode is forward biased, it is found that beyond forward voltage called knee voltage, the conductivity is very high. When the biasing voltage is more than the knee voltage the potential barrier is overcome and the current increases rapidly with increase in forward voltage. When the diode is reverse biased, the reverse bias voltage produces a very small current about a few microamperes which almost remains constant with bias. This small current is reverse saturation current.

(i) In the given figure, a diode D is connected to an external resistance $R = 100 \ \Omega$ and an emf of 3.5 V. If the barrier potential developed across the diode is 0.5 V, the current in the circuit will be
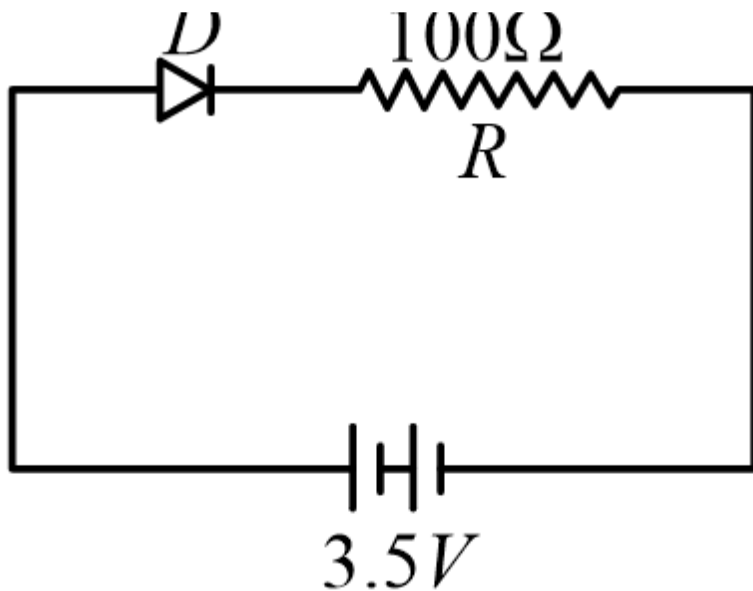
   (a) 40 mA   (b) 20 mA   (c) 30 mA   (d) 35 mA

(ii) In a p – n junction diode

  (a) the current in the reversed biased condition is generally very small

  (b) the current in the reverse biased condition is small but the forward biased current is independent of the
    bias voltage.

 (c) the reverse biased current is strongly dependent on the applied voltage.

(d) the forward biased current is very small in comparison to reverse biased current.

(iii) In the middle of the depletion layer of a reverse biased p – n junction, the

    (a) electric field is zero   (b) potential is maximum

    (c) electric field is maximum   (d) potential is zero

(iv) We can classify diode as

    (a) bilateral device   (b) ohmic device

    (c) non ohmic device   (d) passive element

OR

The dominant mechanism for the motion of charge carriers in forward and reveres biased silicon junctions are

  (a) drift in forward bias, diffusion in reverse bias   (b) diffusion in forward and drift in reverse bias

  (c) diffusion in both forward and reverse bias   (d) drift in both forward and reverse bias

Q30. **Band theory of solid:** Consider that the Si or Ge Crystal contains N atoms. Electrons of each atom will have discrete energies in different orbits. The electron energy will be same if all the atoms are isolated, i.e separated from each other by a large distance. However, in a crystal, the atoms are close to each other (2A to 3A) and therefore the elections interact with each other and also with the neighboring atomic cores. The overlap will be more felt by the electrons in the outermost orbit while the inner orbit or core electron energies may remain unaffected. Therefore, for understanding electron energies in Si or Ge crystal, we need to consider the changes in the energies of the electrons in outermost orbit only. For Si the outermost orbit is the third orbit (n= 3), while for Ge it is the forth orbit (n =4). Each SI and Ge has four valence electrons, but Ge at given temperature has more free electrons and a higher conductivity compared to SI. So, silicon is more widely used for semiconductor devices, since it can be used at much higher temperature than germanium.

(i)The energy of electrons of atoms of a substance will be same if

    (a) atoms are isolated   (b) atoms are closely spaced

    (c) atoms are excited.   (d) atoms are charged.

(ii) In a crystal, the distance between two atoms is

    (a) 200A to 300 A   (b) 2A to 3 micron   (c) 2A to 3 A   (d) 2mm to 3 mm

(iii)The overlap will be more felt by the electron when there are

(a) in the outermost orbit   (b) in the innermost orbit   (c) free   (d) in any orbit

(iv) For Silicon and Germanium the outermost orbits are respectively

(a) n = 3 and n = 4   (b) n = 4 and n = 3   (c) n = 4 and n = 5 (d) n =5 and n =4

<center>OR</center>

Why Silicon is more widely used for semiconductor devices?

(a)It can be used at much higher temperatures than Germanium.

(b)It is cheaper than germanium

(c)It has higher conductivity than germanium

(d)None of the above

<center>**SECTION – E**</center>

Q31. (a) Derive an expression for the electric potential at any point along the axial line of electric dipole.

(b) Find the electrostatic potential at a point on equatorial line of an electric dipole.

<center>**OR**</center>

(a) Use gauss's law to obtain an expression for the electric field due to an infinitely long thin wire with

uniform linear charge density σ.

(b) An electric dipole of length 2 cm is placed with its axis making an angle of 60with respect to uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the magnitude of charge on the dipole , and its potential energy.

Q32. (a) The primary coil of an ideal step up transformer has 100 turns and transformation ratio is also 100.

The input voltage and power are 220 V and 1100 W respectively. Calculate

(a) The number of turns in the secondary coil.

(b) The current in the primary coil.

(c) The voltage across the secondary coil.

(d) The current in the secondary coil.

(e) The power in the secondary coil.

<center>**OR**</center>

An inductor, capacitor and resistor are connected in series, with an A.C source. Derive expression for the

instantaneous current and its phase relationship to the applied voltage. Find the expression for resonant

frequency.

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Q33.(a) Draw a neat and clean diagram of Astronomical telescope and hence find an expression for magnifying

power of the telescope in normal adjustment.

(c) Reflective telescope is better than refractive telescope, give two reasons to support this statement.

OR

(i) Derive the mirror formula. What is the corresponding formula for a thin lens ?

(ii) draw a ray diagram to show the image formation by a concave mirror when the object is kept between its

focus and the pole. Using this diagram, derive the magnification formula for the image formed.

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