O.P. JINDAL SCHOOL, PATRATU
MODEL QUESTIONS

Class: XII M.M.: 70
Subject: Physics Duration: 180 Min.

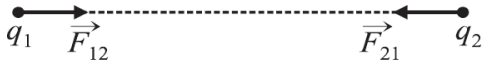
General Instructions:

- ☑ This question paper contains 35 questions. All questions are compulsory.
- ☑ This question paper is divided into five Sections A, B, C, D and E.
- ☑ In Section A Questions no. 1 to 18 are Multiple Choice (MCQ) type questions, carrying 1 mark each.
- ☑ In Section B Questions no. 19 to 25 are Very Short Answer (VSA) type questions, carrying 2 marks each.
- ☑ In Section C Questions no. 26 to 30 are Short Answer (SA) type questions, carrying 3 marks each.
- ☑ In Section D Questions no. 31 to 33 are Long Answer (LA) type questions carrying 5 marks each.
- ☑ In Section E Questions no. 34 and 35 are case-based questions carrying 4 marks each.

SECTION-A

A. Answer the following questions:

1. Which of the following is not the property of an equipotential surface? 01
   (a) They do not cross each other.
   (b) The work done in carrying a charge from one point to another on an equipotential surface is zero.
   (c) For a uniform electric field, they are concentric spheres.
   (d) They can be imaginary spheres.
2. An electric dipole placed in an electric field of intensity 2×10^5 N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2 cm is- 01
   (a) 7 μC (b) 8 mC (c) 2 mC (d) 5 mC
3. A metallic plate exposed to white light emits electrons. For which of the following colours of light, the stopping potential will be maximum?
   (a) Blue (b) Yellow (c) Red (d) Violet
4. When alpha particles are sent through a thin gold foil, most of them go straight through the foil, because-
   (a) alpha particles are positively charged
   (b) the mass of an alpha particle is more than the mass of an electron
   (c) most of the part of an atom is empty space
   (d) alpha particles move with high velocity
5. An electron is moving along positive X-axis in a magnetic field which is parallel to the positive Y-axis. In what direction will the magnetic force be acting on the electron?
   (a) Along -x axis (b) Along -z axis (c) Along +z axis (d) Along -y axis
6. The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then-
   (a) X is paramagnetic and Y is ferromagnetic (b) X is diamagnetic and Y is ferromagnetic
   (c) X and Y both are paramagnetic (d) X is diamagnetic and Y is paramagnetic
7. An ammeter of resistance 0.81 ohm reads up to 1 A. The value of the required shunt to increase the range to 10 A is-
   (a) 0.9 ohm (b) 0.09 ohm (c) 0.03 ohm (d) 0.3 ohm
8. An electron with angular momentum L moving around the nucleus has a magnetic moment given by-
   (a) e L/2m (b) e L/3m (c) e L/4m (d) e L/m
9. According to Coulomb's law, which is the correct relation for the following figure?



   (a) $q_1 q_2 > 0$ (b) $q_1 q_2 < 0$ (c) $q_1 q_2 = 0$ (d) $1 > q_1/q_2 > 0$
10. The electric potential on the axis of an electric dipole at a distance r from it's centre is V. Then the potential at a point at the same distance on its equatorial line will be-
    (a) 2V (b) -V (c) V/2 (d) Zero

11. The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B.

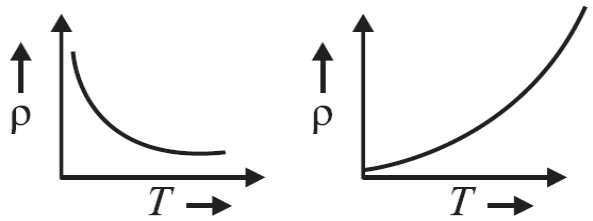


fig. (i) fig. (ii)

(a) material A is copper and material B is germanium
(b) material A is germanium and material B is copper
(c) material A is nichrome and material B is germanium
(d) material A is copper and material B is nichrome

12. Two concentric and coplanar circular loops P and Q have their radii in the ratio 2:3. Loop Q carries a current 9 A in the anticlockwise direction. For the magnetic field to be zero at the common centre, loop P must carry-

(a) 3A in clockwise direction (b) 9A in clockwise direction
(c) 6 A in anti-clockwise direction (d) 6 A in the clockwise direction.

13. Which of the following statement is NOT true about the properties of electromagnetic waves?

(a) These waves do not require any material medium for their propagation
(b) Both electric and magnetic field vectors attain the maxima and minima at the same time
(c) The energy in electromagnetic wave is divided equally between electric and magnetic fields
(d) Both electric and magnetic field vectors are parallel to each other

14. In a Young's double slit experiment, the path difference at a certain point on the screen between two interfering waves is $\frac{1}{8}$ th of the wavelength. The ratio of intensity at this point to that at the centre of a bright fringe is close to

(a) 0.80 (b) 0.74 (c) 0.94 (d) 0.85

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

(a) 4125 A^0 (b) 2062.5 A^0 (c) 3000 A^0 (d) 6000 A^0

16. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of the n =3 orbit is-

(a) 1.01 x 10^{-10} m (b) 1.59 X 10^{-10} m
(c) 2.12 x 10^{-10} m (d) 4.77 X 10^{-10} m

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 and 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

17. Assertion(A): The photoelectrons produced by a monochromatic light beam incident on a metal surface have a spread in their kinetic energies.
Reason(R): The energy of electrons emitted from inside the metal surface, is lost in collision with the other atoms in the metal.

18. Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface.
Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

SECTION-B

B. 19. The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 A^0 . Calculate the short wavelength limit for the Balmer series of the hydrogen spectrum.

20. A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is 27.0°C and the temperature coefficient of resistance of nichrome is 1.70×10^{-4} °C^{-1} ?

21. Show that the least possible distance between an object and its real image in a convex lens is 4f, where f is the focal length of the lens.

OR

In an astronomical telescope in normal adjustment a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line whose length is l. What is the angular magnification of the telescope?

22. (a) Name the device which utilizes unilateral action of a p-n diode to convert ac into dc.
(b) Draw the circuit diagram of full wave rectifier.

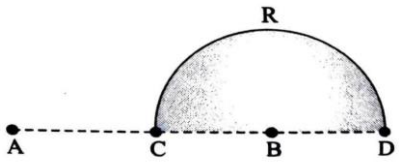
23. What is the nuclear radius of ^{125}Fe, if that of ^{27}Al is 3.6 fermi?

24. 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 and of magnitude 17.7×10^{-22} C/m^2 . What is electric field intensity E:
(a) in the outer region of the first plate (b) between the plates?

25. Electromagnetic waves with wavelength
(a) λ_1 is suitable for radar systems used in aircraft navigation.
(b) λ_2 is used to kill germs in water purifiers.
(c) λ_3 is used to improve visibility in runways during fog and mist conditions.
Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude.

SECTION-C

26. Charges (+q) and (–q) are placed at the points A and B respectively which are a distance 2L apart. C is the midpoint between A and B. What is the work done in moving a charge +Q along the semicircle CRD.



OR

(a) Draw the equipotential surface for
(i) A pair of similar point charges (ii) An electric dipole
(b) State some properties of equipotential surface.

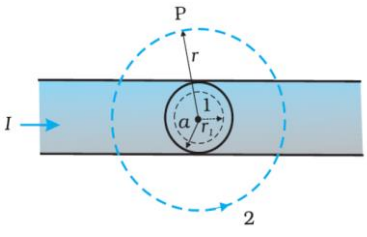
27. (a) Define mutual inductance and write its SI unit.
(b) Two circular loops, one of small radius r and other of larger radius R, such that R >> r, are placed coaxially with centres coinciding. Obtain the mutual inductance of the arrangement.

OR

Two long straight parallel current carrying conductors are kept ‘a’ distant apart in air. The direction of current in both the conductors is same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere

28. The total energy of an electron in the first excited state of the hydrogen atom is about –3.4 eV.
(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?

29. The given figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region r < a and r > a.



30. An ac voltage $V = V_0 \sin\omega t$ is applied across a pure inductor of inductance L. Find an expression for the current i flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\frac{\pi}{2}$. Also draw graphs of V and i versus t for the circuit.

SECTION-D

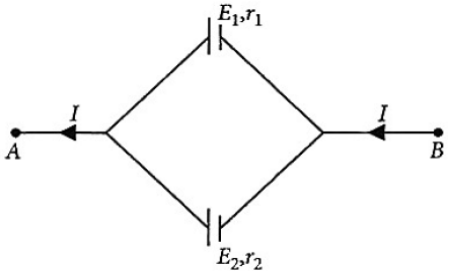
31. (a) Explain the term drift velocity of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of drift velocity.

(b) Two cells of emf's E_1 and E_2 and internal resistances r_1 and r_2 respectively are connected in parallel as shown in the figure. Deduce the expression for the

(i) equivalent emf of the combination

(ii) equivalent internal resistance of the combination

(iii) potential difference between the points A and B.



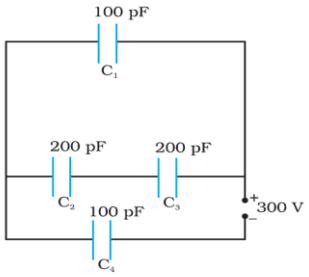
OR

(a) State the two Kirchhoff's rules used in the analysis of electric circuits and explain them.

(b) Derive the equation of the balanced state in a Wheatstone-bridge using Kirchhoff's laws.

32. (a) Derive an expression for the capacitance of a parallel plate capacitor with air present between The two plates.

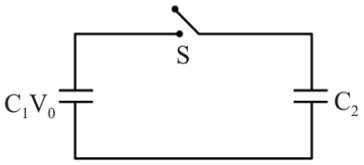
(b) Obtain the equivalent capacitance of the network shown in figure. For a 300 V supply, determine the charge on each capacitor.



OR

(a) A dielectric slab of thickness 't' is kept between the plates of a parallel plate capacitor with plate separation 'd' (t<d). Derive the expression for the capacitance of the capacitor.

(b) A capacitor of capacity C_1 is charged to the potential of V_0. On disconnecting with the battery, it is connected with an uncharged capacitor of capacity C_2 as shown in the adjoining figure. Find the ratio of energies before and after the connection of switch S.



33. (a) Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2 . Hence derive lens maker's formula.

(b) A converging lens has a focal length of 10 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) Define a wavefront. How is it different from a ray?

(b) Using Huygens's construction of secondary wavelets draw a diagram showing the passage of a plane wavefront from a denser to a rarer medium. Using it verify Snell's law.

(c) In a double slit experiment using light of wavelength 600nm and the angular width of the fringe formed on a distant screen is 0.1°. Find the spacing between the two slits.

(d) Write two differences between interference pattern and diffraction pattern.

SECTION-E

34. Types of Lenses and their combination:
A convex or converging lens is thicker at the centre than at the edges. It converges a beam of light on refraction through it. It has a real focus. Convex lens is of three types: Double convex lens, Plano convex lens and Concavo-convex lens.

Concave lens is thinner at the centre than at the edges. It diverges a beam of light on refraction through it. It has a virtual focus. Concave lenses are of three types: Double concave lens, Plano concave lens and Convexo-concave lens.

When two thin lenses of focal lengths f_1 and f_2 are placed in contact with each other along their common principal axis, then the two-lens system is regarded as a single lens of focal length f and

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

If several thin lenses of focal length f_1 , f_2 , ... f n are placed in contact, then the effective focal length of the combination is given by

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \ldots\ldots\ldots + \frac{1}{f_n}$

and in terms of power, we can write

$P = P_1 + P_2 + \ldots\ldots\ldots + P_n$

The value of focal length and power of a lens must be used with proper sign consideration.

(i) Two thin lenses are kept coaxially in contact with each other and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be

(a) -26.7cm (b) 60cm (c) 80cm (d) 30cm

(ii) A spherical air bubble is embedded in a piece of glass. For a ray of light passing through the bubble, it behaves like a

(a) converging lens (b) diverging lens

(c) mirror (d) thin plane sheet of glass

(iii) Lens generally used in magnifying glass is

(a) single concave lens (b) single convex lens

(c) combination of convex lens of lower power and concave lens of lower focal length

(d) Planoconcave lens

(iv) The magnification of an image by a convex lens is positive only when the object is placed

(a) at its focus F (b) between F and 2F

(c) at 2F (d) between F and optical centre

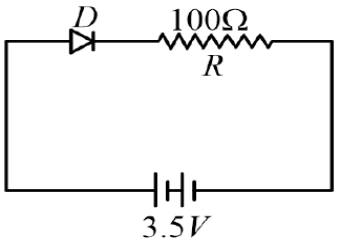
OR

A convex lens of 20 cm focal length forms a real image which is three times magnified. The distance of the object from the lens is

(a) 13.33 cm (b) 14 cm (c) 26.66 cm (d) 25 cm

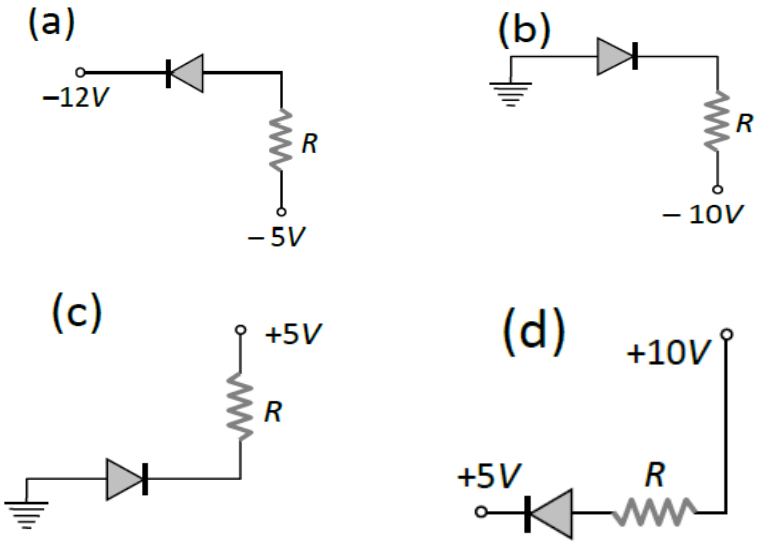
35. A semiconductor diode is basically a pn junction with metallic contacts provided at the ends for the application of an external voltage. It is a two-terminal device. When an external voltage is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery 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 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) 35 mA (d) 30 mA

(ii) In which of the following figures, the p-n diode is reverse biased?



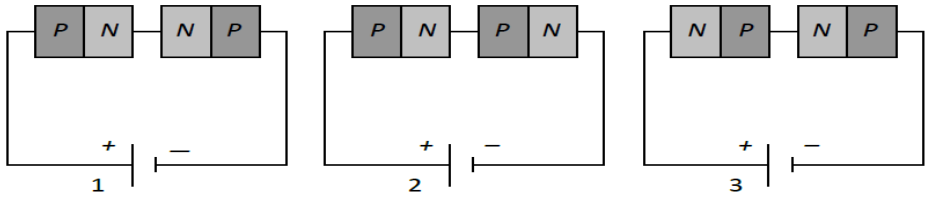
(iii) Based on the V-I characteristics of the diode, we can classify diode as

(a) bilateral device (b) ohmic device

(c) non-ohmic device (d) passive element

OR

Two identical PN junctions can be connected in series by three different methods as shown in the figure. If the potential difference in the junctions is the same, then the correct connections will be



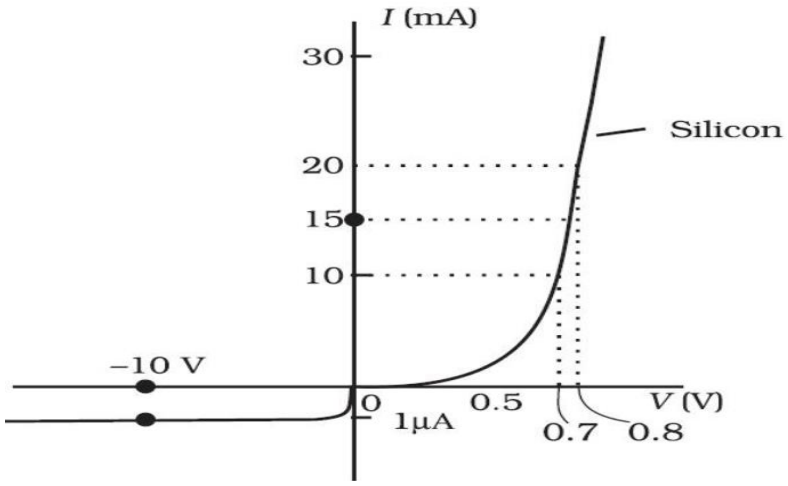
(a) in the circuits (1) and (2)

(b) in the circuits (2) and (3)

(c) in the circuits (1) and (3)

(d) only in the circuit (1)

(iv)



The V-I characteristic of a diode is shown in the figure. The ratio of the resistance of the diode at I = 15 mA to the resistance at V = -10 V is

(a) 100 (b) 10^6 (c) 10 (d) 10^{-6}