SECTION-A (ONE MARK EACH)

1. ASSERTION(A): The electrical conductivity of a semiconductor increases on doping.
   REASON(R): Doping always increases the number of electrons in the semiconductor
   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 1
   c) A is true but R is false
   d) A is false and R is also false

2. ASSERTION(A):focal length of the lens is depend on the curvature of the surfaces.
   REASON(R): focal length of a lens is depend on the refractive indices of the lens and the surrounding medium.
   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 1
   c) A is true but R is false
   d) A is false and R is also false

3. ASSERTION(A): The electrical conductivity of a semiconductor increases on doping.
   REASON(R): Doping always increases the number of electrons in the semiconductor
   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 1
   c) A is true but R is false
   d) A is false and R is also false

4. A current carrying loop is placed in a uniform magnetic field. The torqe acting on it does not depend upon
   (a) area of loop   (b) value of current   (c) magnetic field   (d) None of these

5. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
   (a) become zero   (b) become infinite   (c) become small, but non-zero (d) remain unchanged

6. When interference of light takes place
   (a) energy is created in the region of maximum intensity
   (b) energy is destroyed in the region of maximum intensity
   (c) conservation of energy holds good and energy is redistributed
   (d) conservation of energy does not hold good

7. A conducting wire is bent in the shape of a square and another wire of equal length into a circle. If they carry equal currents, their magnetic moments are in the ratio of 1
   (A) $2 : \pi$ (B) $\pi : 2$ (C) $\pi : 4$ (D) $4 : \pi$

8. A moving coil galvanometer can be converted into an ammeter by
   (a) introducing a shunt resistance of large value in series.
   (b) introducing a shunt resistance of small value in parallel.
   (c) introducing a resistance of small value in series.
   (d) introducing a resistance of large value in parallel

9. A charge particle is placed between the plates of a charged parallel plate capacitor. It experiences a force F. If one of the plates is removed, the force on the charge particle becomes
   (A) F   (B) 2F   (C)zero   (D) Zero 2F

10. An air-filled parallel plate capacitor is connected across a battery. After it is fully charged, the battery is disconnected. Now a dielectric slab is inserted between the plates of the capacitor to fill the space completely. Then the
    (A) capacitance will decrease.   (B) electric field between the plates will increase.
    (C) potential difference between the plates will increase.   (D) charge on plates will remain the same.

11. Balmer series lies in which spectrum?
    a.   a. Ultraviolet b. Visible   c. Infrared   d. Partially Visible

12. The potential difference applied across a given conductor is doubled. The mobility of the electrons in the conductor

(A)is doubled.   (B) is halved.   (C) remains unchanged.   (D) becomes four times.

13. Which of the following factors is the induced charge in an electromagnetic induction independent of?
     a.   A. Time   b. Resistance of the coil   c. Change of flux   d. None of the above

14. In a pure capacitive circuit if the frequency of ac source is doubled, then its capacitive reactance will be
(a) remains same   (b) doubled   (c) halved   (d) zero

15. SI unit of permittivity of free space is
(a) Farad   (b) Weber   (c) $C^2N^{-1}\,m^{-2}$ (d) $C^2N^{-1}\,m^{-2}$

16. In the given figure current from A to B in the straight wire is decreasing. The direction of induced current in the loop is A
(a) clockwise
(b) anticlockwise
(c) changing
(d) nothing can be said

17. The nature of parallel and anti-parallel currents are
(a) parallel currents repel and antiparallel cur¬rents attract.
(b) parallel currents attract and antiparallel cur-rents repel.
(c) both currents attract. '
(d) both currents repel.

18. A window is provided in the middle of a wall. Its image is obtained on the opposite wall at a distance 'd' from it using a lens. If the window and its image are of the same size, then the focal length of the lens used is
(A) +4/d   (B) + 2/d   (C) – 4/d   (D) –2/d
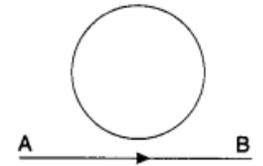
SECTION-B (TWO MARKS EACH)

19. A glass lens of refractive index 1.45 disappears when immersed in a liquid What is the . value of refractive index of the liquid?

20. Write down two conditions to obtain the sustained interference fringe pattern of light.

21. Write three basic properties of photons which are used to obtain Einstein's photoelectric equation. Use this equation to draw a plot of maximum kinetic energy of the electrons emitted versus frequency of incident radiation

22. Derive an expression for the current density of a conductor in terms of the drift speed of electrons.

23. Given a uniform electric held $E = 2 \times 10^3$ i N/C, find the flux of this held through a square of side 20 cm, whose plane is parahel to the YZ-plane. What would be the flux through the same square if the plane makes an angle of 30° with the X-axis?

24. The radius of innermost electron orbit of a hydrogen atom is 5.3×10^{-11} What is the radius of orbit in the second excited state?

25. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.

OR

A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor, but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

SECTION – C (THREE MARKS EACH)

26. Using biota-savart's law, derive the expression for the magnetic field in the vector form at a point on the axis of a circular current loop.

27. Draw a neat labelled ray diagram of an astronomical telescope in normal adjustment. Explain briefly working.

28. A 100 Ⓓ capacitor in series with a 40 ohm resistance is connected to a 100 ⒹⒹ 60 Hz supply calculate (i) the reactance (ii) the impedance (iii) maximum current in the circuit.

OR

The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition form an energy level -0.85 eV to -3.4eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

29. The magnetic field through a circular loop of wire, 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the current induced in the loop and plot a graph showing induced current as a function of time.
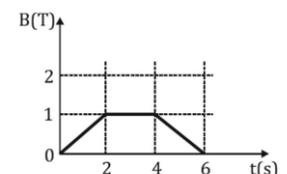
30. The graph shows the variation of photocurrent for a photosensitive metal
    a. What does X and A on the horizontal axis represent?
    b. Draw this graph for three different values of frequencies of incident radiation υ1, υ 2 and υ 3 (υ 3>υ 2>υ1) for the same intensity.
    c. Draw this graph for three different values of intensities of incident radiation I1, I2 and I3 (I3> I2>I1) having the same frequency
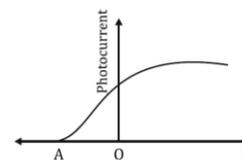
SECTION – D (FIVE MARKS EACH)

31. Using Gauss' law, deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point.

    (i) Outside   (ii) Inside the shell.

    Plot a graph showing the variation of the electric field as a function of r > R and r < R (r is the distance from the centre of a shell)

32. Write two points of difference between an interference pattern and a diffraction pattern.

    The ground state energy of hydrogen atom is -13.6 eV. The photon emitted during the transition of electron from n=3 to n=1 state, is incident on a photosensitive material of unknown work function .The photoelectrons are emitted from the material with the maximum kinetic energy of 9eV.Calculate the threshold wavelength of the material used

33. (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.

SECTION – E (FOUR MARKS EACH)

34. CASE STUDY 1

Potential Energy of the Proton

Potential difference (ΔV) between two points A and B separated by a distance x, in a uniform electric field E is given by $\Delta V = -Ex$, where x is measured parallel to the field lines. If a charge q_0 moves from P to Q, the change in potential energy (ΔU) is given as $\Delta U = q_0\Delta V$. A proton is released from rest in uniform electric field of magnitude 4.0×10^8 V m^{-1} directed along the positive X-axis. The proton undergoes a displacement of 0.25 m in the direction of E.

Mass of a proton = 1.66×10^{-27} kg and charge of proton = 1.6×10^{-19} C
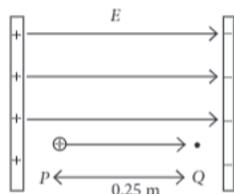
(i) The change in electric potential of the proton between the points A and B is
    (a) -1×10^8 V
    (b) 1×10^8 V
    (c) 6.4×10^{-19} V
    (d) -6.4×10^{-19} V

(ii) The change in electric potential energy of the proton for displacement from A to B is
    (a) 1.6×10^{11} J
    (b) 0.5×10^{23} J
    (c) -1.6×10^{-11} J
    (d) 3.2×10^{22} J

(iii) The mutual electrostatic potential energy between two protons which are at a distance of 9×10^{-15} m, in $_{92}U^{235}$ nucleus is
    (a) 1.56×10^{-14} J
    (b) 5.5×10^{-14} J
    (c) 2.56×10^{-14} J
    (d) 4.56×10^{-14} J

(iv) If a system consists of two charges 4 mC and –3 mC with no external field placed at (–5 cm, 0, 0) and (5 cm, 0, 0) respectively. The amount of work required to separate the two charges infinitely away from each other is

(a) –1.1 J

(b) 2 J

(c) 2.5 J

(d) 3 J

35. CASE STUDY 2:

Average Power Associated with an Inductor and Capacitor

The power averaged over one full cycle of a.c. is known as average power. It is also known as true power.

$$P_{av} = V_{rms}I_{rms} \cos \phi = \frac{V_0 I_0}{2} \cos \phi .$$

Root mean square or simply rms watts refer to continuous power.

A circuit containing a 80 mH inductor and a 60 µF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible.

80 mH   60 µF

230 V, 50 Hz

(i) The value of current amplitude is

(a) 15 A

(b) 11.63 A

(c) 17.65 A

(d) 6.33 A

(ii) Find rms value.

(a) 6 A

(b) 5.25 A

(c) 8.23 A

(d) 7.52 A

(iii) The average power transferred to inductor is

(a) zero

(b) 7 W

(c) 2.5 W

(d) 5 W

(iv) The average power transferred to the capacitor is

(a) 5 W

(b) zero

(c) 11 W

(d) 15 W