SHREE RADHEY COACHING CENTER

Plot No. 233 Flat no. 102 Niti Khand 1 Indirapuram

CLASS 12 - PHYSICS

Monthly Mega Test

Time Allowed: 3 hours **Maximum Marks: 70**

Section A

1. There is a uniform field of strength $10^3 \mathrm{Vm}^{-1}$ along the y-axis. A body of mass 1g and charge 10^{-6}C is projected into the field from the origin along the positive x-axis with a velocity of $10 \mathrm{ms}^{-1}$. Its speed (in ms^{-1}) after 10 second will be (neglect gravitation) **[1]**

   a) $10\sqrt{2}$ b) 20
   c) $5\sqrt{2}$ d) 10

2. A parallel plate capacitor of capacity 100 $\mu\mathrm{F}$ is charged by a battery of 50 volts. The battery remains connected and if the plates of the capacitor are brought closer so that the distance between them becomes half the original distance, the additional energy given by the battery to the capacitor in joules is: **[1]**

   a) 1.25×10^{-3} b) 0.125×10^{-3}
   c) 12.5×10^{-3} d) 125×10^{-3}

3. A current passes through a wire of non-uniform cross section. Which of the following quantities are independent of the cross section? **[1]**

   a) Current density b) Drift speed
   c) Free electron density d) The charge crossing in a given time interval

4. The equivalent resistance of two resistances P and Q which are in series is **[1]**

   a) $\frac{PQ}{(P+Q)}$ b) $\frac{P \times P}{P+Q}$
   c) $\frac{Q \times Q}{(P+Q)}$ d) P + Q

5. If only 2% of the current is to pass through a galvanometer of resistance G, then resistance of shunt will be **[1]**

   a) 50G b) 49G
   c) $\frac{G}{50}$ d) $\frac{G}{49}$

6. Newton gave the corpuscular theory on the basis of: **[1]**

   a) Wavefront b) Newton's rings
   c) Colours of thin films d) Rectilinear motion

7. The maximum number of possible interference maxima for slit separation equal to twice the wavelength in Young's double-slit experiment is: **[1]**

a) three
b) infinite
c) zero
d) five

8. 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

9. A carbon dioxide laser emits a sinusoidal electromagnetic wave that travels in vacuum in the negative x-direction. The wavelength is 10.6μm and the field is parallel to the z-axis, with E_{max} = 1.5 MV/m. Vector equation for E as function of time and position is **[1]**

a) E(x, t) = -E_{max} cos $\left(5.93 \times 10^5\ x + 1.78 \times 10^{14}\ t\right)$
b) E(y, t) = E_{max} cos $\left(5.93 \times 10^5\ y - 1.78 \times 10^{14}\ t\right)$
c) E(x, t) = E_{max} cos $\left(5.93 \times 10^5\ x + 1.78 \times 10^{14}\ t\right)$
d) E(y, t) = E_{max} cos $\left(5.93 \times 10^5\ y + 1.78 \times 10^{14}\ t\right)$

10. The photon of frequency ν has a momentum associated with it. If c is the velocity of light, then momentum is **[1]**

a) hν/c
b) hν/c^2
c) hνc
d) ν/c

11. Fill in the blanks: **[1]**

The lines joining the places of equal dip or inclination are called ________ lines.

12. Fill in the blanks: **[1]**

Susceptibility is ________ for paramagnetic substances.

13. Fill in the blanks: **[1]**

The electric fields created by time-varying magnetic fields having non-vanishing loop integrals are called ________ fields.

OR

Fill in the blanks:

The magnitude of induced emf is the rate of change of ________.

14. Average life and decay constant is related as ________. **[1]**

15. Fill in the blanks: **[1]**

A ________ is an instrument used for comparing the luminous intensities of two sources of light.

16. Complete the following nuclear reactions: **[1]**

i. ${}_{5}^{10}B + {}_{0}^{1}n \rightarrow {}_{2}^{4}He + \ldots\ldots$
ii. ${}_{42}^{94}Mo + {}_{1}^{2}H \rightarrow {}_{43}^{95}Te + \ldots\ldots$

17. The isotope ${}_{8}^{16}O$ has 8 protons, 8 neutrons and 8 electrons while ${}_{4}^{8}Be$ has 4 protons, 4 neutrons and 4 electrons. Yet the ratio of their atomic masses is not exactly same. Why? **[1]**

18. How is forward biasing different from reverse biasing in a p-n junction diode? **[1]**

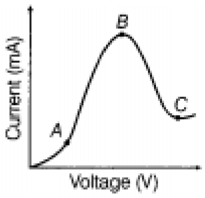
19. How will the photoelectric current change on decreasing the wavelength of incident radiation **[1]**

for a given photosensitive material?

20. Why should a photodiode be operated at a reverse bias? **[1]**

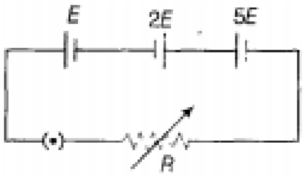
OR

The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any over which the semiconductor has a negative resistance.



Section B

21. Three cells of emf E, 2E and 5E having internal resistances r, 2r and 3r respectively are connected across a variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R. **[2]**



22. A capacitor made of two parallel plates, each of area **A** and separation **d** is charged by an external dc source. Show that during charging, the displacement current inside the capacitor is the same as the current charging the capacitor. **[2]**

23. Draw a graph showing the variation of stopping potential with frequency of the incident radiation. What does the slope of the line with frequency axis indicate? **[2]**

24. **[2]**
   i. Identify the part of the electromagnetic spectrum used in
      a. radar and
      b. eye surgery. Write their frequency range.
   ii. Prove that the average energy density of the oscillating electric fields is equal to that of the oscillating magnetic field.

25. A magnet is suspended so that it may oscillate in the horizontal plane. It performs 20 oscillations per minute at a place where the angle of dip is 30° and 15 oscillations per minute, where the angle of dip is 60°. Compare the earth's total magnetic field at these two places. **[2]**

26. An electron jumps from fourth to first orbit in an atom. How many maximum number of spectral lines can be emitted by the atom? To which series these lines correspond? **[2]**

OR

The wavelength of the first member of the Balmer series in hydrogen spectrum is 6563 $\overset{\circ}{A}$. What is the wavelength of the first member of Lyman series?

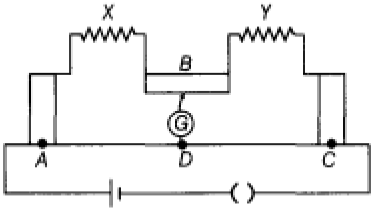
27. Write two characteristics features to distinguish between n-type and p-type semiconductors. **[2]**

OR

Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

Section C

[3]

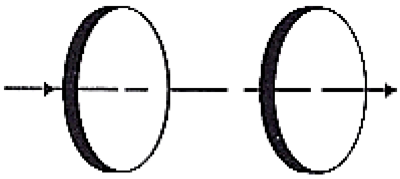
28. 

The figure shows experimental set up of a meter bridge. When the two unknown resistances X and Y are inserted, the null point D is obtained 40 cm from the end A. When a resistance of 10Ω is connected in series with X, the null point shifts by 10cm.
Find the position of the null point when the 100 resistance is instead connected in series with resistance Y. Determine the values of the resistances X and Y.

29. i. Derive with the help of a diagram the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I. **[3]**
ii. How is a toroid different from a solenoid?

30. An ac circuit consists of a series combination of circuit elements X and Y. The current is ahead of the voltage in phase by $\frac{\pi}{4}$. Element X is a pure resistor of 100 Ω. **[3]**
i. Name the circuit element Y.
ii. Calculate the rms value of current, if rms value of voltage is 141 V.
iii. What will happen if the ac source is replaced by a dc source?

31. Figure shows a capacitor made of two circular plates each of radius 12 cm, and separated by 5.0 cm. The capacitor is being charged by an external source . The charging current is constant and equal to 0.15 A. **[3]**



i. Calculate the capacitance and the rate of charge of potential difference between the plates.
ii. Obtain the displacement current across the plates.
iii. Is Kirchoff's first rule (junction rule) valid at each plate of the capacitor. Explain.

32. i. In what way is diffraction from each slit related to the interference pattern in a double slit experiment. **[3]**
ii. Two wavelengths of sodium light 590 nm and 596 nm are used, in turn to study the diffraction taking place at single slit of aperture $2 \times 10^{-4} m$. The distance between the slit and the screen is 1.5 m. Calculate the separation between the positions of the first maxima of the diffraction pattern obtained in the two cases.

OR

For a single slit of width a the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum for two narrow slits separated by a distance a. Explain.

33. 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]**

34. i. Explain how a potential barrier is developed in a p-n junction diode. **[3]**

ii. Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode in reverse bias. Plot the V-I characteristics in this case.

Section D

35. a. State the principle of superposition and use it to obtain the expression for the total electric force exerted at a point charge due to an assembly of n discrete point charges. **[5]**

b. Three charges 10 μC, 5 μC and -5μC are placed in air at the three corners A, B and C of an equilateral triangle of side 0.1m. Find the resultant force experienced by charge placed at corner A.

OR

A parallel plate capacitor is charged to a potential difference V by a DC source. The capacitor is then disconnected from the source. If the distance between the plates is doubled, state with reason, how the following will change -

i. Electric field between the plates?
ii. Capacitance?
iii. Energy stored in the capacitor?

36. A 25.0 pF capacitor, a 0.10 H inductor and a 25.0 ohm resistor are connected in series with an ac source whose emf is E = 310 sin 314t. **[5]**

i. What is the frequency of the emf?
ii. Calculate
   a. the reactance of the circuit
   b. the impedance of the circuit and
   c. the current in the circuit.

OR

An electron emitted by a heated cathode and accelerated through a potential difference of 2.0 kV, enters a region with uniform magnetic field of 0.15 T. Determine the trajectory of the electron if the field

a. is transverse to its initial velocity,
b. makes an angle of 30° with the initial velocity.

37. a. Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision. **[5]**

b. The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focused on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm. Calculate the focal length of the objective and the eyepiece.

OR

a. Explain, using a suitable diagram, how unpolarized light gets linearly polarized by scattering.
b. Describe briefly the variation of the intensity of transmitted light when a polaroid sheet kept between two crossed polaroids is rotated. Draw the graph depicting the variation of intensity with the angle of rotation. How many maxima and minima would be observed when θ varies from 0 to π?