

भौतिक विज्ञान (सैद्धान्तिक)

PHYSICS (Theory)

निर्धारित समय : 3 घण्टे

अधिकतम अंक : 70

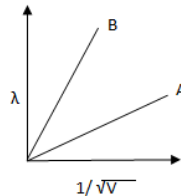
Time allowed : 3 hours

Maximum Marks : 70

General Instructions :

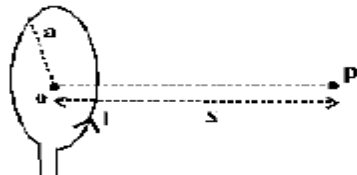
- (i) All questions are compulsory.
- (ii) There are **29** questions in total. Questions **1** to **8** are very short answer type questions and carry **one** mark each.
- (iii) Questions **9** to **16** carry **two** marks each, questions **17** to **25** carry **three** marks each, question **26** carry four marks & questions 27 to 29 carry 5 marks each.
- (iv) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the choices in such questions.
- (v) Use of calculators is **not** permitted. However, you may use log tables if necessary.
- (vi) You may use the following values of physical constants wherever necessary :
- $c = 3 \times 10^8$ m/s
 $h = 6.63 \times 10^{-34}$ Js
 $e = 1.6 \times 10^{-19}$ C
 $\mu_0 = 4\pi \times 10^{-7}$ T mA⁻¹
 $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ Nm²C⁻²
 $m_e = 9.1 \times 10^{-31}$ kg

- Can an electric potential at any point in space be zero while intensity of the electric field at that point is not zero? 1
- A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colours respectively. Calculate the value of current, in A through the resistor. 1
- The ratio of the vertical component to the horizontal component of earth's magnetic field at a given place is 1. What is the angle of dip at that place? 1
- What is the phase difference between voltage and current in LCR circuit at resonance? 1
- The two lines A and B shown in the graph plot the de-Broglie wavelength λ as function of $1/\sqrt{V}$ (V is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of heavier mass? 1

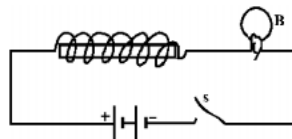


6. Two nuclei have mass numbers in the ratio 1:8, what is the ratio of their nuclear radii? 1
7. A device X can convert one form of energy into another. Another device Y can be regarded as a combination of a transmitter and a receiver. Name the devices X and Y. 1
8. Give one example each of a 'system' that uses the (i) Sky wave (ii) Space wave 1
9. Define electric field intensity. Write its S.I unit. Write the magnitude and direction of electric field intensity due to an electric dipole of length $2a$ at the midpoint of the line joining the two charges. 2
10. Keeping the voltage of the charging source constant, what would be the percentage change in the energy stored in a parallel plate capacitor if the separation between its plates were to be decreased by 10%?. 2
11. A student records the following data for the magnitudes (B) of the magnetic field at axial points at different distances x from the centre of a circular coil of radius a carrying a current I . Verify (for any two) that these observations are in good agreement with the expected theoretical variation of B with x . 2

$x \rightarrow$	$x = 0$	$x = a$	$x = 2a$	$x = 3a$
$B \rightarrow$	B_0	$0.25\sqrt{2}B_0$	$0.039\sqrt{5}B_0$	$0.010\sqrt{10}B_0$

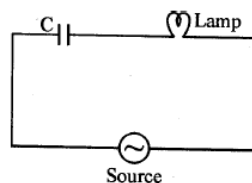


12. How is the mutual inductance of a pair of coils affected when: 2
- (i) Separation between the coils is increased?
- (ii) The number of turns of each coil is increased?
13. Fig. shows a light bulb (B) and iron cored inductor connected to a DC battery through a switch (S). 2
- (i) What will one observe when switch (S) is closed?
- (ii) How will the glow of the bulb change when the battery is replaced by an ac source of rms voltage equal to the voltage of DC battery? Justify your answer in each case.

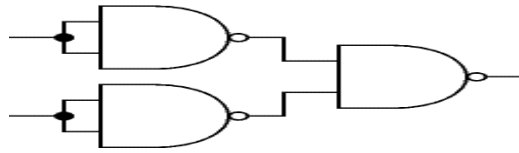


OR

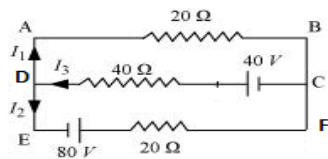
An electric lamp having coil of negligible inductance connected in series with a capacitor and an AC source is glowing with certain brightness. How does the brightness of the lamp change on reducing the (i) capacitance, and (ii) the frequency? Justify your answer.



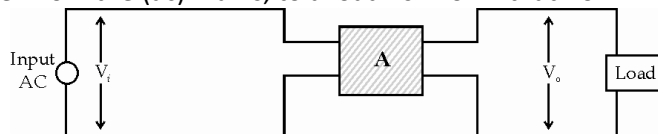
14. Draw a labelled ray diagram to show the formation of an image by a compound microscope. Write the expression for its magnifying power. 2
15. Define the term 'Activity' of a radioactive substance. State its SI unit. 2
- Two different radioactive elements with half lives T_1 and T_2 have N_1 and N_2 (undecayed) atoms respectively present at a given instant. Determine the ratio of their activities at this instant.
16. Write the truth table for the circuit given below consisting of NAND gate only. 2
- Identify the logic operation performed by the circuit.



17. What does the term LOS communication mean? A transmitting antenna at the top of a tower has a height 32m & the height of the receiving antenna is 50m. What is the maximum distance between them for satisfactory communication in LOS mode? Given radius of the earth: 6.4×10^6 m. 3
18. State Gauss's theorem in electrostatics. Apply this theorem to derive an expression for electric field intensity at a point near an infinitely long straight charged wire. 3
19. Write the mathematical relation for the resistivity of material in terms of relaxation time, number density and mass and charge of charge carriers in it. Explain, using this relation, why the resistivity of a metal increases and that of semi-conductor decreases with rise in temperature. 3
20. State Kirchoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I_1 in the electric circuit given below. 3



21. Box 'A', in the set up shown below, represents an electric device often used/needed to supply, electric power from the (ac) mains, to a load. is known that $V_o < V_i$. 3



- (a) Identify the device A and draw its symbol.
 (b) Draw a schematic diagram of this electric device. Explain its principle and working. Obtain an expression for the ratio between its output and input voltages.
22. Electromagnet waves with wavelength are: 3
- (i) λ_1 are used to kill germs in water purifiers.
 - (ii) λ_2 are used in TV communication systems
 - (iii) λ_3 play an important role in maintaining the earth's warmth.
 - iv) λ_4 Used to detect fracture in bones
- Name the part of electromagnetic spectrum to which these radiations belong. Arrange these wavelengths in decreasing order of their magnitude.
23. A convex lens, of focal length 20cm, is placed coaxially with a convex mirror of radius of curvature 20cm. The two are kept 15cm apart from each other. A point object is placed 60cm in front of the convex lens. Find the position of the image formed by this combination.
24. Sketch a graph between frequency of incident radiations and stopping potential for a given photosensitive material. What information can be obtained from the value of the intercept on the potential axis? 3
- A source of light of frequency greater than the threshold frequency is placed at a distance of 1 m from the cathode of a photo-cell. The stopping potential is found to be V. If the distance of the light source from the cathode is reduced, explain giving reasons, what change will you observe in the
- (i) photoelectric current,
 - (ii) stopping potential.

OR

- Define the terms threshold frequency and stopping potential in relation to the phenomenon of photoelectric effect. How is the photoelectric current affected on increasing the (i) frequency (ii) intensity of the incident radiations and why?
25. Draw the graph to show variation of binding energy per nucleon with mass number of different atomic nuclei. Explain, with the help of this graph, the release of energy by the process of nuclear fusion. 3

26. During summer vacation Radha and Rani decided to go for a 3 D FILM. They have heard about this film through their friends. They were asked to buy special glasses to view the film. Before they go for a movie, they approached their Physics teacher to know about these glasses.

Physics teacher explained when two polarizer's are kept perpendicular to each other (crossed polarizer's) the left eye sees only the image from the left end of the projector and the right eye sees only the image from the right lens. The two images have the approximate perspectives that the left and right eyes would see in reality the brain combine the images to produce a realistic 3-D effect.

- a) What qualities do these girls possess? 2
b) Discuss the intensity of transmitted light when a Polaroid sheet is rotated between two cross Polaroids. 2

27. State Biot-Savart law, giving the mathematical expression for it. 5
Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis. How does a circular loop carrying current behave as a magnet?

OR

With the help of a labelled diagram, state the underlying principle of a cyclotron. Explain clearly how it works to accelerate the charged particles. Show that cyclotron frequency is independent of speed of the particle. Is there an upper limit on the energy acquired by the particle? Give reason.

28. Draw a ray diagram to show refraction of a ray of monochromatic light passing through a glass prism. 5
Deduce the expression for the refractive index of glass in terms of angle of Prism and angle of minimum deviation.
(b) Explain briefly how the phenomenon of total internal reflection is used in fibre optics.

OR

- (i) A thin lens, having two surfaces of radii of curvature R_1 and R_2 , made from a material of refractive index μ_1 , is kept in a medium of refractive index μ_2 . Derive the Lens Maker's formula for this 'set-up'
(ii) A convex lens is placed over a plane mirror. A pin is now positioned so that there is no parallax between the pin and its image formed by this lens-mirror combination. How can this observation be used to find the focal length of the convex lens? Give appropriate reasons in support of your answer.

29. Draw the circuit diagram used to study the characteristics of an npn transistor in common emitter configuration. Give the shape of these characteristics & use them to define the (i) input resistance & (ii) current amplification factor of the given transistor. 5

(OR)

What is an oscillator? Under what conditions an amplifier can be converted in to an oscillator? With the help of circuit diagram explain the working of transistor as an oscillator.