PART - III

PHYSICS

(Time Allowed: 3 Hours) [Maximum Marks: 150]

Instructions: (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use Black or Blue ink to write and pencil to draw diagrams.

பதிலிய - I/PART - I

(i) அலாதினி எலட்டக்குழும் எலக்கோயிலே எந்தவகை வாசகர் என்று இருந்தது

(ii) சிப்பர் எலக்கோயில் வாங்கமுத்து என்று இருந்தது

Note: (i) Answer all the questions.

(ii) Choose and write the correct answer.
1. \[ A(\overline{A} + B) = ? \]
   \( (a) \) A \hspace{1cm} \( (b) \) \( \overline{B} \) \hspace{1cm} \( (c) \) AB \hspace{1cm} \( (d) \) A + B
   \[ \overline{A}(\overline{A} + B) = ? \]
   (a) A \hspace{1cm} (b) B \hspace{1cm} (c) AB \hspace{1cm} (d) A + B

2. மீண்டும் பரம்பரையுடன் கூறிய என்று தொடர்புபடுத்துப்:
   \( (a) \) \( ^{15}\text{P}^{31} \) \hspace{1cm} \( (b) \) \( ^{15}\text{P}^{32} \) \hspace{1cm} \( (c) \) \( _{11}\text{Na}^{23} \) \hspace{1cm} \( (d) \) \( _{11}\text{Na}^{24} \)
   The radio isotope used in agriculture is:
   (a) \( ^{15}\text{P}^{31} \) \hspace{1cm} (b) \( ^{15}\text{P}^{32} \) \hspace{1cm} (c) \( _{11}\text{Na}^{23} \) \hspace{1cm} (d) \( _{11}\text{Na}^{24} \)

3. \( _{4}\text{Be}^{8} \) அணுக்குறிகளின் அளவு:
   \( (a) \) \( 1.3 \times 10^{-15} \) m \hspace{1cm} \( (b) \) \( 2.6 \times 10^{-15} \) m
   \( (c) \) \( 1.3 \times 10^{-13} \) m \hspace{1cm} \( (d) \) \( 2.6 \times 10^{-13} \) m
   The nuclear radius of \( _{4}\text{Be}^{8} \) nucleus is:
   (a) \( 1.3 \times 10^{-15} \) m \hspace{1cm} (b) \( 2.6 \times 10^{-15} \) m
   (c) \( 1.3 \times 10^{-13} \) m \hspace{1cm} (d) \( 2.6 \times 10^{-13} \) m

4. கரிம கலனால் இறுதி துணைக்கூறியல் 60° போக்சலைந்த அராமிக துணைக்கூறியால் போக்சலைந்த அராமிகான அளவு இடைந்து\( 2 \times 10^{8} \) m/s-1 வல்லது, அராமிக துணைக்கூறியால் இருந்து விளைவாக்காதில்கியான தொடர்பு:
   \( (a) \) \( 30° \) \hspace{1cm} \( (b) \) \( \sin^{-1}(0.75) \)
   \( (c) \) \( \sin^{-1}\left(\frac{1}{\sqrt{3}}\right) \) \hspace{1cm} \( (d) \) \( \sin^{-1}(0.6666) \)
   A ray of light travelling in air is incident on a denser surface at an angle of 60°. If the velocity of light in the denser medium is \( 2 \times 10^{8} \) m/s-1, the angle of refraction inside the denser medium is:
   (a) \( 30° \) \hspace{1cm} (b) \( \sin^{-1}(0.75) \)
   (c) \( \sin^{-1}\left(\frac{1}{\sqrt{3}}\right) \) \hspace{1cm} (d) \( \sin^{-1}(0.6666) \)
5. $^{13}N$ is a beta-emitter, 10.1 minutes half-life. The half-life is given in minutes:

(a) 5.05 minutes
(b) 20.2 minutes

(c) $\frac{10.1}{0.6931}$ minutes

The half-life of $^{13}N$ is 10.1 minutes. Its mean life time is:

(a) 5.05 minutes
(b) 20.2 minutes
(c) $\frac{10.1}{0.6931}$ minutes
(d) infinity

6. In amplitude modulation, the bandwidth is:

(a) equal to the signal frequency
(b) twice the signal frequency
(c) thrice the signal frequency
(d) four times the signal frequency

7. A beam of cathode rays moves from left to right in a plane of the paper and it enters into a uniform magnetic field acting perpendicular to the plane of the paper and inwards. Now, the cathode rays are deflected:

(a) downwards
(b) upwards
(c) in a direction perpendicular to the plane of the paper and inwards
(d) in a direction perpendicular to the plane of the paper and outwards
8. Electromagnetic induction is not used in:
(a) transformer  (b) room heater
(c) AC generator  (d) choke coil

9. A wire of length 1 m is made into a circular loop and it carries a current of 3.14 A. The magnetic dipole moment of the current loop (in Am²) is:
(a) 1  (b) 0.5  (c) 0.25  (d) 0.314

10. When a dielectric slab is introduced between the plates of a charged parallel plate capacitor, its:
(a) potential increases
(b) electric field decreases
(c) charge increases
(d) capacitance decreases
11. The Voltage at B in the figure is:
   (a) 5.3 V  (b) 5.7 V  (c) 6.3 V  (d) 6 V

12. In an electromagnetic wave:
   (a) power is equally transferred along the electric and magnetic fields
   (b) power is transmitted in a direction perpendicular to both the fields
   (c) power is transmitted along electric field
   (d) power is transmitted along magnetic field

13. The length of the rod placed inside a rocket is measured as 1 m by an observer inside the rocket which is at rest. When the rocket moves with a speed of $36 \times 10^6$ km/hr the length of the rod as measured by the same observer is:
   (a) 0.997 m  (b) 1.003 m  (c) 1 m  (d) 1.006 m
14. Avalanche breakdown (Avalanche breakdown) is primarily dependent on the phenomenon of:
(a) collision  (b) ionisation
(c) doping     (d) recombination

15. Atomic spectrum should be:
(a) pure line spectrum  (b) emission band spectrum
(c) absorption line spectrum  (d) absorption band spectrum

16. The chromium ions doped in the ruby rod:
(a) absorbs red light  (b) absorbs green light
(c) absorbs blue light  (d) emits green light

17. 0.6 μC are placed on 1 μC in the system. A, B, C, D, E, F. A and B are two hollow metal spheres of radii 50 cm and 1 m carrying charges 0.6 μC and 1 μC respectively. They are connected externally by a conducting wire. Now the charge flows from:
(a) A to B till the charges become equal
(b) A to B till the potentials become equal
(c) B to A till the charges become equal
(d) B to A till the potentials become equal
18. **Radio Communication Methods**:

(a) Ground wave propagation  
(b) Line of sight direction  
(c) Ionomospheric propagation  
(d) Curvature of the earth

High frequency waves follow:

19. **X-ray**:

(a) Phenomenon of conversion of kinetic energy into radiation  
(b) Conversion of momentum  
(c) Conversion of energy into mass  
(d) Principle of conservation of charge

20. **Electric Dipole**:

(a) A sphere whose centre coincides with the centre of the electric dipole  
(b) A plane surface inclined at an angle of 45° with the axis of the electric dipole  
(c) A plane surface passing through the centre of the electric dipole and perpendicular to the axis of the electric dipole  
(d) Any plane surface parallel to the axis of the electric dipole

The equipotential surface of an electric dipole is:

21. **Mass Defect and Binding Energy**:

(a) 27.93 eV  
(b) 27.93 keV  
(c) 27.93 MeV  
(d) 27.93 GeV

The mass defect of a certain nucleus is found to be 0.03 amu. Its binding energy is:

(a) 27.93 eV  
(b) 27.93 keV  
(c) 27.93 MeV  
(d) 27.93 GeV
22. An ideal voltmeter has:
(a) zero resistance
(b) finite resistance less than G but greater than zero
(c) resistance greater than G but less than infinity
(d) infinite resistance

23. The instantaneous emf and current equations of an RLC series circuit are
\[ e = 200 \sin \left( \omega t - \frac{\pi}{6} \right) \]
\[ i = 20 \sin \left( \omega t + \frac{\pi}{6} \right) \]

24. The elliptical orbits of electron in the atom was proposed by:
(a) J.J. Thomson
(b) Bohr
(c) Sommerfeld
(d) de Broglie
25. The unit of permittivity is:
(a) $C^2 N^{-1} m^{-2}$
(b) $N m^{-1}$
(c) $N m^{-2} C^{-2}$
(d) $NC^2 m^{-2}$

26. In an electromagnetic wave, the phase difference between electric field $\vec{E}$ and magnetic field $\vec{B}$ is:
(a) $\frac{\pi}{4}$
(b) $\frac{\pi}{2}$
(c) $\pi$
(d) zero

27. At the threshold frequency the velocity of the electrons is:
(a) zero
(b) maximum
(c) minimum
(d) infinite

28. 1 Wh (Watt hour) is equal to:
(a) $36 \times 10^5 J$
(b) $36 \times 10^4 J$
(c) $3600 J$
(d) $3600 J s^{-1}$
29. A rectangular coil of wire is placed in a uniform magnetic field such that the plane of the coil is parallel to the magnetic field. The magnetic flux linked with the coil and the emf induced are respectively:
(a) zero and zero  
(b) zero and maximum  
(c) maximum and zero  
(d) maximum and maximum

30. Lenz's law is in accordance with the law of:
(a) conservation of charges  
(b) conservation of flux  
(c) conservation of momentum  
(d) conservation of energy

Note: Answer any fifteen questions.

31. State Gauss’s law in electrostatics.

32. Write any three properties of electric lines of force.

33. Define mobility. Give its unit.

34. A 10 Ω resistance is connected in series with a cell of emf 10 V. A voltmeter is connected in parallel to a cell, and it reads 9.9 V. Find the internal resistance of the cell.
35.  
Define temperature coefficient of resistance.

36.  
Calculate the magnetic induction at a point 10 cm from a long straight wire placed in air carrying a current of 10 A.

37.  
What are the methods of producing induced emf?

38.  
An aircraft having a wingspan of 20.48 m flies due north at a speed of 40 ms\(^{-1}\). If the vertical component of earth’s magnetic field at the place is \(2 \times 10^{-5}\) T, calculate the emf induced between the ends of the wings.

39.  
Distinguish between interference and diffraction.

40.  
Write any three uses of polaroids.

41.  
State Moseley’s law. Write its equation.
42. In Millikan’s experiment, an oil drop of mass $4.9 \times 10^{-14}$ kg is balanced by applying a potential difference of 9.8 kV between the two plates which are 12.8 mm apart. Calculate the number of elementary charges on the drop. (Take $g = 10 \text{ ms}^{-2}$)

43. Write the uses of electron microscope.

44. What is beta-decay? Give an example.

45. Write any three uses of nuclear reactor.

46. Draw the circuit diagram of a voltage regulator using zener diode.

47. When negative feedback is applied to an amplifier of gain 50, the gain after feedback falls to 25. Calculate the feedback ratio.

48. What are universal gates? Why are they called so?

49. Write the advantages of integrated circuits (ICs).

50. What is skip distance?
Note:
(i) Answer question number 51 compulsorily.
(ii) Answer any six of the remaining 11 questions.
(iii) Draw diagrams wherever necessary.

51. The area of a single plate of a parallel plate capacitor is 90 cm². The plates are 2.5 mm apart and the plates are charged at 400 V. Find the capacitance of the capacitor. Also, calculate the energy stored in the capacitor.

\[
\text{C} = \frac{\text{Area}}{\text{Separation}} = \frac{90 \text{ cm}^2}{2.5 \text{ mm}} = 36 \text{ mF} \\
\text{Energy} = \frac{1}{2} \text{CV}^2 = \frac{1}{2} \times 36 \text{ mF} \times 400^2 \text{ V}^2 = 28800 \text{ J} 
\]

The plates of a parallel plate capacitor have an area of 90 cm² each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply. How much electrostatic energy is stored by the capacitor?

OR

Three charges +1 μC, +3 μC and −5 μC are kept at the vertices of an equilateral triangle of sides 60 cm. Find the electrostatic potential energy of the system of charges.

52. Write any five applications of Superconductors.

53. State Faraday’s first law of electrolysis. How is it verified experimentally?
54. Write the special features of Magnetic Lorentz force.

55. Obtain an expression for the current flowing in a circuit containing resistance only to which alternating emf is applied. Explain the phase relationship between voltage and current with a graph.

56. In Young’s double slit experiment two coherent sources of intensity ratio of 64 : 1 produce interference fringes. Calculate the ratio of maximum and minimum intensities.

57. Write any five properties of canal rays.

58. What is photoelectric effect? State the laws of photoelectric emission.

59. Explain time dilation with an example.
60. 

\[ 3\text{Li}^6 + \text{n}^1 \rightarrow \text{He}^4 + \text{H}^3 \]

\[ 3\text{Li}^6 \text{ Molecular Weight} = 6.015126 \text{ amu} \]

\[ \text{H}^3 \text{ Molecular Weight} = 3.016049 \text{ amu} \]

\[ \text{He}^4 \text{ Molecular Weight} = 4.002604 \text{ amu} \]

\[ \text{n}^1 \text{ Molecular Weight} = 1.008665 \text{ amu} \]

Calculate the energy released in the following reaction.

\[ 3\text{Li}^6 + \text{n}^1 \rightarrow \text{He}^4 + \text{H}^3 \]

Given:

Mass of \(3\text{Li}^6\) nucleus = 6.015126 amu
Mass of \(\text{H}^3\) nucleus = 3.016049 amu
Mass of \(\text{He}^4\) nucleus = 4.002604 amu
Mass of \(\text{n}^1\) = 1.008665 amu

61. 

Explain the working of a half wave diode rectifier.

62. 

What is an optical fiber? Write its advantages.

**PART - IV**

(4x10 = 40)

(i) 

(ii) 

**Note:**

(i) Answer any four questions.

(ii) Draw diagrams wherever necessary.

63. 

Derive an expression for electric field due to an electric dipole at a point on its axial line.
64. Explain with neat diagram the principle, construction and working of a cyclotron.

65. Explain in detail the principle, construction and working of a single phase AC generator.

66. Explain Raman effect with the help of energy level diagram.

67. Describe the J.J. Thomson method for determining the specific charge of an electron.

68. Explain the construction and working of a Bainbridge mass spectrometer. Mention its use.

69. What is an operational amplifier? Explain its working as a non-inverting amplifier.

70. With the functional block diagram explain the working of a monochrome TV transmitter.