PART - III

PHYSICS

(தமிழ் மற்றும் ஐந்து மொழி / Tamil & English Versions)

தேர்வு : 3 மணி நேரம்

Time Allowed : 3 Hours

[ மதிப்பிட்டு பங்களித்த மதிப்பு : 150

[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 Blue or Black ink to write and underline and pencil to draw diagrams.

பகுதி - I/PART - I

தலைப்பு:

(i) ஆயத்துண்டு விளக்குமுறைமை விளக்கியலியல்

(ii) வி.டி. விளக்குமுறை விளக்கியல் பாகங்கள்

Note:

(i) Answer all the questions.

(ii) Choose and write the correct answer.
1. Positive rays of the same element produce two different traces in a Bainbridge mass spectrometer. The positive ions have:
   (a) same mass with different velocity
   (b) same mass with same velocity
   (c) different mass with same velocity
   (d) different mass with different velocity

2. The Logic gate for which the output is '1', only when both the inputs are '0' is:
   (a) OR  (b) NAND  (c) EXOR  (d) NOR

3. The electrostatic force between two point charges kept at a distance 'd' apart, in a medium $\varepsilon_r=6$, is 0.3 N. The force between them at the same separation in vacuum is:
   (a) 20 N  (b) 0.5 N  (c) 1.8 N  (d) 2 N
4. Two point charges $+4q$ and $+q$ are placed 30 cm apart. At what point on the line joining them the electric field is zero?

(a) 15 cm from the charge $+q$
(b) 7.5 cm from the charge $+q$
(c) 20 cm from the charge $+4q$
(d) 5 cm from the charge $+q$

5. The effective resistance between points A and B in the given network is:

(a) $2.5 \, \Omega$  (b) $10 \, \Omega$  (c) $0.4 \, \Omega$  (d) $11 \, \Omega$
6. The part of the AC generator that passes the current from the coil to the external circuit is:
(a) field magnet  (b) split rings
(c) slip rings  (d) brushes

7. The ratio of nuclear density to the density of mercury is about:
(a) $1.3 \times 10^{10}$  (b) 1.3  (c) $1.3 \times 10^{13}$  (d) $1.3 \times 10^{4}$

8. In the nuclear reaction $^{80}\text{Hg}^{198} + X \rightarrow ^{79}\text{Au}^{198} + ^1\text{H}^1$, $X$ stands for:
(a) proton  (b) electron  (c) neutron  (d) deuteron

9. In a thermocouple, when the temperature of cold junction is increased (but less than neutral temperature) the temperature of inversion:
(a) increases  (b) decreases
(c) does not change  (d) first increases and then decreases
10. An oscillator is:
(a) an amplifier with feedback
(b) converter of a.c. to d.c. energy
(c) nothing but an amplifier
(d) an amplifier without feedback

11. The first excitation potential energy or the minimum energy required to excite the hydrogen atom from ground state:
(a) 13.6 eV  (b) 10.2 eV  (c) 3.4 eV  (d) 1.89 eV

12. Which one of the following is not an electromagnetic wave?
(a) X-rays
(b) γ-rays
(c) Ultra Violet rays (UV rays)
(d) β-rays

13. In hydrogen atom, which of the following transitions produces spectral line of maximum wavelength?
(a) 2 → 1  (b) 4 → 1  (c) 6 → 5  (d) 5 → 2
A dipole is placed in a uniform electric field, with its axis parallel to the field, it experiences:
(a) only a net force
(b) only a torque
(c) both a net force and torque
(d) neither a net force nor a torque

The instantaneous current in an AC circuit containing a pure inductor is \( i = I_0 \sin \omega t \). The instantaneous emf is:

(a) \( e = E_0 \sin \left( \omega t + \frac{\pi}{2} \right) \)
(b) \( e = E_0 \sin \left( \omega t - \frac{\pi}{2} \right) \)
(c) \( e = E_0 \sin (\omega t - \pi) \)
(d) \( e = E_0 \sin (\omega t + \pi) \)

In holography, which of the following are recorded on the photographic film?
(a) amplitude and frequency
(b) phase and frequency
(c) phase and amplitude
(d) amplitude, phase and frequency
17. **Electrical Energy:**

\[ (\text{a}) \ H = \frac{I^2}{R} \ t \quad (\text{b}) \ H = V^2Rt \quad (\text{c}) \ H = VIt \quad (\text{d}) \ H = IR^2t \]

**Joule’s law of heating is:**

(a) \( H = \frac{I^2}{R} \ t \)    (b) \( H = V^2Rt \)    (c) \( H = VIt \)    (d) \( H = IR^2t \)

18. 6 \mu C moves between two points of potential difference of magnitude 1.2 \times 10^{-5} J. Find the potential difference between the points.

\[ (\text{a}) \ 6 \ V \quad (\text{b}) \ 2 \ V \quad (\text{c}) \ 12 \ V \quad (\text{d}) \ 72 \ V \]

The work done in moving 6 \mu C charge between two points is 1.2 \times 10^{-5} J. Find the potential difference between two points:

(a) \ 6 \ V \quad (b) \ 2 \ V \quad (c) \ 12 \ V \quad (d) \ 72 \ V

19. **Electromagnetic Waves:**

(\text{a}) Electromagnetic waves are not affected by electric currents.

(\text{b}) Electrical energy is transferred in an electromagnetic wave.

(\text{c}) Electrical energy is transferred in an electromagnetic wave.

(\text{d}) Magnetic field is transferred in an electromagnetic wave.

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 transferred along magnetic field.
20. The purpose of dividing each frame into two fields so as to transmit 50 views of the picture per second is:
(a) to avoid flicker in the picture
(b) the fact that handling of higher frequencies is easier
(c) that 50 Hz is the power line frequency in India
(d) to avoid unwanted noises in the signals

21. The decay constant of a free neutron is:
(a) 0.013 minute$^{-1}$
(b) 0.053 minute$^{-1}$
(c) 3 minutes
(d) 0.069 minute$^{-1}$

22. In the forward bias characteristic curve, a diode appears as:
(a) a high resistance
(b) a capacitor
(c) an OFF switch
(d) an ON switch

23. The unit of grating element is:
(a) no unit
(b) metre
(c) metre$^{-1}$
(d) degree
24. The maximum carrier swing allowed in frequency modulation is:
   (a) 455 kHz  (b) 10.7 MHz  (c) 75 kHz  (d) 150 kHz
   The maximum carrier swing allowed in frequency modulation is:
   (a) 455 kHz  (b) 10.7 MHz  (c) 75 kHz  (d) 150 kHz

25. According to Bohr's postulates, which of the following quantities take discrete values?
   (a) Kinetic energy  (b) Potential energy
   (c) Angular momentum  (d) Momentum

26. The momentum of the electron having wavelength 2 Å is:
   (a) $3.3 \times 10^{-24}$ kgms$^{-1}$  (b) $6.6 \times 10^{-24}$ kgms$^{-1}$
   The momentum of the electron having wavelength 2 Å is:
   (a) $3.3 \times 10^{-24}$ kgms$^{-1}$  (b) $6.6 \times 10^{-24}$ kgms$^{-1}$
   (c) $3.3 \times 10^{-24}$ kgms$^{-1}$  (d) $6.6 \times 10^{-24}$ kgms$^{-1}$

27. According to relativity, the length of a rod in motion:
   (a) is same as its rest length  (b) is more than its rest length
   (c) is less than its rest length  (d) may be more or less than or equal to rest length depending on the speed of the rod
28. 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

29. In Raman effect, wavelength of incident light is 5890 Å. The wavelength of stokes and antistokes lines are respectively:
(a) 5885 Å and 5880 Å  (b) 5895 Å and 5900 Å
(c) 5885 Å and 5895 Å  (d) 5895 Å and 5885 Å

30. In RLC series AC circuit at resonance:
(a) Resistance is zero
(b) Net reactance is zero
(c) impedance is maximum
(d) voltage leads the current by a phase angle $\frac{\pi}{2}$
31. What are the applications of capacitors?

32. An infinite line charge produces a field of \(9 \times 10^4 \text{ NC}^{-1}\) at a distance of 2 cm. Calculate the linear charge density.

33. Define current density? Give its unit.

34. The resistance of a platinum wire at 0°C is 4 Ω. What will be the resistance of the wire at 100°C if the temperature coefficient of resistance of platinum is 0.0038/°C?

35. Distinguish between primary cell and secondary cell.

36. State tangent law.

37. What is electromagnetic induction?

38. Calculate the power loss in the form of heat when a power of 11,000 W is transmitted at 220 V.
39. What are emission and absorption spectra?

40. Why the centre of Newton's rings is dark?

41. Write any three uses of Laser in medical field.

42. A Coolidge tube operates at 24,800 V. What is the maximum frequency of X-radiation emitted from Coolidge tube?

43. Write three uses of electron microscope.

44. Write any three properties of β rays.

45. What is mass defect?

46. What is Light Emitting Diode (LED)? Give its symbol.

47. Give the Barkhausen conditions for oscillation.
48. **What is bandwidth of an amplifier?**

Define bandwidth of an amplifier.

49. **What is the Boolean expression for the logic diagram shown in figure? Evaluate its output if A=1, B=1, C=1.**

![Logic Diagram]

50. **Write any three merits of satellite communication.**

51. **Define electric potential at a point. Obtain an expression for electric potential at a point due to a point charge.**
52. State and verify Faraday’s second law of electrolysis through an experiment.

53. State and explain Kirchhoff’s voltage law for electrical networks.

54. Two parallel wires each of length 5 m are placed at a distance of 10 cm apart in air. They carry equal currents along the same direction and experience a mutually attractive force of $3.6 \times 10^{-4}$ N. Find the current through the conductors.

55. Obtain an expression for the coefficient of mutual induction between two long solenoids.

56. In Young’s double slit experiment, the intensity ratio of two coherent sources is 81 : 1. Calculate the ratio between maximum and minimum intensities.

57. Explain the spectral series of hydrogen atom (diagram is not necessary).

58. Write any five applications of photoelectric cell.
59. A metallic surface when illuminated with light of wavelength 3333 Å emits electrons with energies up to 0.6 eV. Calculate the work function of the metal.

OR

A metallic surface when illuminated with light of wavelength 3333 Å emits electrons to a potential difference of 2.5 × 10⁻⁸ V. What is the time interval measured by an observer at rest? What is the time interval as measured by an observer moving with a velocity V = 0.73c?

60. Explain the binding energy curve (graph is not necessary).

61. Explain the pin-out configuration of an operational amplifier with the diagram.

62. What are the advantages and disadvantages of Frequency Modulation?
64. Derive an expression for the force on a current carrying conductor placed in a magnetic field. Find the magnitude of the force.

65. Obtain an expression for the current in an AC circuit containing a pure inductance only. Find the phase relationship between voltage and current. Draw the necessary graph.

66. On the basis of wave theory explain total internal reflection. Write the conditions for total internal reflection to take place.

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

68. What is a nuclear reactor? Explain the functions of (i) moderator (ii) control rods and (iii) neutron reflector. Mention two uses of a nuclear reactor (diagram not necessary).

69. With a neat circuit response diagram, explain the working of a single stage CE amplifier. Draw the frequency response curve.

70. With the help of a block diagram, explain the function of superheterodyne AM receiver.