B

Part III — PHYSICS

(New Syllabus)

(English Version)

Time Allowed : 3 Hours]   [Maximum Marks : 150

PART – I

N. B. :   i)   Answer *all* the questions.

     ii)   Choose and write the correct answer.

     iii)   Each question carries *one* mark. $30 \times 1 = 30$

1. Two photons, each of energy 2·5 eV are simultaneously incident on the metal surface. If the work function of the metal is 4·5 eV then from the surface of the metal

     a)   one electron will be emitted

     b)   two electrons will be emitted

     c)   more than two electrons will be emitted

     d)   not a single electron will be emitted.

2. One *amu* is equal to

     a)   931 eV

     b)   mass of carbon atom

     c) $1 \cdot 66 \times 10^{-27}$ kg

     d)   mass of oxygen atom.

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3. The time taken by a radioactive element to reduce to $e^{-1/2}$ times its original amount is its

   a) half-life period

   b) $\dfrac{\text{half-life period}}{2}$

   c) mean-life period

   d) $\dfrac{\text{mean-life period}}{2}$

4. The radio-isotope used in agriculture is

   a) $_{15}P^{32}$

   b) $_{11}Na^{23}$

   c) $_{27}Co^{60}$

   d) $_{11}Na^{24}$.

5. Based on quark model a neutron is represented as

   a) uud

   b) udd

   c) $udd^{\prime}$

   d) $u^{\prime}du$.

6. In LCR series a.c. circuit, the phase difference between current and voltage is 30°. The reactance of the circuit is 17·32 Ω . The value of resistance is

   a) 30 Ω

   b) 10 Ω

   c) 17·32 Ω

   d) 1·732 Ω.

7. In an electromagnetic wave, the phase difference between electric field $\vec{E}$ and magnetic field $\vec{B}$ is

   a) $\dfrac{\pi}{4}$

   b) $\dfrac{\pi}{2}$

   c) π

   d) zero.

8. Velocity of the electromagnetic waves through vacuum is

   a) $\sqrt{\mu_0 \epsilon_0}$

   b) $\dfrac{1}{\sqrt{\mu_0 \epsilon_0}}$

   c) $\sqrt{\dfrac{\mu_0}{\epsilon_0}}$

   d) $\sqrt{\dfrac{\epsilon_0}{\mu_0}}$.

9. In a plane diffraction grating, the unit of grating element is

   a) no unit

   b) metre

   c) metre^{-1}

   d) degree.

10. A ray of light is incident on a glass plate at its polarising angle. The angle between the incident ray and the reflected ray is

   a) 57·5°

   b) 32·5°

   c) 90°

   d) 115°.

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11. Which of the following quantities is a scalar ?

    a) Electric force

    b) Electric field

    c) Dipole moment

    d) Electric potential.

12. Torque on a dipole in a uniform electric field is maximum when angle between $\vec{P}$ and $\vec{E}$ is

    a) 0°

    b) 90°

    c) 45°

    d) 180°.

13. Potential energy of two equal negative point charges of magnitude 2 μC placed 1 m apart in air is

    a) 2 J

    b) 0·36 J

    c) 4 J

    d) 0·036 J.

14. A hollow metallic spherical shell carrying an electric charge produces no electric field at points

    a) on the surface of the sphere

    b) inside the sphere

    c) at infinite distance from the centre of the sphere

    d) outside the sphere.

15. The colour code on a carbon resistor is red-red-black. The resistance of the resistor is

    a) 2·2 Ω

    b) 22 Ω

    c) 220 Ω

    d) 2·2 kΩ.

16. The potential barrier of silicon PN junction diode is approximately

    a) 0·3 V

    b) 0·7 V

    c) 1·1 V

    d) 10 V.

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17. The colour of light emitted by a LED depends on

    a)   its reverse bias

    b)   amount of forward current

    c)   its forward bias

    d)   type of semiconductor material.

18. The Boolean expression to represent NAND operation is

    a) $Y = A + B$

    b) $Y = A.B$

    c) $Y = \bar{A}$

    d) $Y = \overline{AB}$.

19. High frequency waves follow

    a)   ground wave propagation

    b)   ionospheric propagation

    c)   the curvature of the earth

    d)   the line of sight direction.

20. In an AM superheterodyne receiver, the local oscillator frequency is 1·245 MHz. The tuned station frequency is

    a)   455 kHz

    b)   790 kHz

    c)   690 kHz

    d)   990 kHz.

21. The energy of the electron in the first orbit of hydrogen atom is − 13·6 eV. Its potential energy is

    a)   − 13·6 eV

    b)   13·6 eV

    c)   − 27·2 eV

    d)   27·2 eV.

22. In hydrogen atom, which of the following transitions produce spectral line of maximum frequency ?

    a) $2 \rightarrow 1$

    b) $6 \rightarrow 2$

    c) $4 \rightarrow 3$

    d) $5 \rightarrow 1$.

23. In an X-ray tube, the intensity of the emitted X-ray beam is increased by

    a)   increasing the filament current

    b)   decreasing the filament current

    c)   increasing the target potential

    d)   decreasing the target potential.

24. The chromium ions doped in the ruby rod

    a)   absorbs red light

    b)   absorbs green light

    c)   absorbs blue light

    d)   emits green light.

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25. According to the theory of relativity the length of a rod in motion

      is less than its rest length

b)   is same as its rest length

c)   is more than its rest length

d)   may be more or less than or equal to rest length depending upon the speed of the rod.

26. Nichrome is used as heating element because it has

a)   very low resistance   b)   low melting point

c)   high specific resistance   d)   high conductivity.

27. Of the following devices which has small resistance ?

a)   Voltmeter   b)   Ammeter of range 0 – 10 A

c)   Moving coil Galvanometer   d)   Ammeter of range 0 – 1 A.

28. An *emf* of 12 V is induced when the current in the coil changes from 2 A to 6 A in 0·5s. The coefficient of self-induction of the coil is

a)   1·5 H   b)   6 H

c)   0·3 H   d)   30 H.

29. In an a.c. circuit with an inductor

a)   voltage lags current by $\frac{\pi}{2}$

b)   voltage and current are in phase

c)   voltage leads current by π

d)   current lags voltage by $\frac{\pi}{2}$.

30. The unit of henry can also be written as

a) $V \, A \, s^{-1}$ b) $Wb^{-1} \, A$

c) $\Omega \, s$ d)   all of these.

                                          [Turn over

PART – II

N. B. : Answer any *fifteen* questions.   15 × 3 ≠ 45

31. State Gauss' law in electrostatics.

32. Why is it safer to be inside a car than standing under a tree during lightning ?

33. Write any three applications of superconductors.

34. A manganin wire of length 2 m has a diameter of 0·4 mm with a resistance of 70 Ω . Find the resistivity of the material.

35. State Kirchhoff's (i) current law and (ii) voltage law.

36. Define Peltier coeficient and write its unit.

37. State Faraday's laws of electromagnetic induction.

38. An aircraft having a wing span 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 2×10^{-5} T, calculate the *e.m.f.* induced between the ends of the wings.

39. Why does the sky appear blue in colour ?

40. In Young's experiment, the width of the fringe obtained with light of wavelength 6000 Å is 2 mm. Calculate the fringe width if the entire apparatus is immersed in a liquid of refractive index 1·33.

41. Write the principle of Millikan's oil drop experiment.

42. Calculate the longest wavelength that can be analysed by a rock salt crystal of spacing d = 2·82 Å in the first order.

43. Write any three uses of photoelectric cells.

44. What is pair production and annihilation of matter ?

45. Write any three properties of neutron.

46. Define input impedance of a transistor connected in common emitter mode.

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

48. Draw the circuit diagram for OR gate using diodes.

49. What is an extrinsic semiconductor ?

50. Write any three applications of RADAR.

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PART – III

N. B. : i)   Answer the Question No. **60** compulsorily.

     ii)   Answer any *six* of the remaining 11 questions,

     iii) Draw diagrams wherever necessary.   7 × 5 = 35

51. Three capacitors each of capacitance 9 *pf* are connected in series. (i) What is the total capacitance of the combination ? (ii) What is the potential difference across each capacitor if the combination is connected to 120 V supply ?

52. Obtain the condition for bridge balance in Wheatstone's bridge.

53. State and verify Faraday's second law of electrolysis.

54. A rectangular coil of 500 turns and of area $6 \times 10^{-4} \, m^2$ is suspended inside a radial magnetic field of induction 10^{-4} T by a suspension wire of torsional constant 5×10^{-10} Nm per degree. Calculate the current required to produce deflection of 10°.

55. What are the reasons for various energy losses in a transformer ? Explain how they can be minimised.

56. State and prove Brewster law.

57. Mention any five properties of *X*-rays.

58. Derive Einstein's photoelectric equation.

59. Explain time-dilation with an example.

60. Find the energy released when two $_1H^2$ nuclei fuse together to form a single $_2He^4$ nucleus. Given the binding energies per nucleon of $_1H^2$ and $_2He^4$ are 1·1 MeV and 7·0 MeV respectively.

OR

A reactor is developing energy at the rate of 32 MW. Calculate the required number of fissions per second of $_{92}U^{235}$. Assume that energy per fission is 200 MeV.

61. Explain the working of a bridge rectifier with a neat circuit diagram.

62. Write the advantages and disadvantages of digital communication.

PART – IV

N. B. : i)   Answer any *four* questions in detail.

ii)   Draw diagrams wherever necessary.   4 × 10 = 40

63. What is an electric dipole ? Derive an expression for the electric field due to an electric dipole at a point on its axial line.

64. Derive an expression for the magnetic induction due to an infinitely long straight conductor carrying current. Write the expression for the magnetic induction when the conductor is placed in a medium of permeability μ.

65. A source of an alternating *e.m.f.* is connected to a series combination of a resistor R_1, an inductor L and a capacitor C. Obtain with the help of a voltage phasor diagram and impedance diagram, expressions for

    i)   effective voltage

    ii)   the impedance

    iii)   phase relationship between the current and voltage.

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

67. Draw a neat diagram of He – Ne laser and explain its working with the help of energy level diagram.

68. Describe the principle and action of a Bainbridge mass spectrometer in determining the isotopic masses.

69. Sketch the circuit of a Colpitts oscillator and explain its working.

70. Make an analysis of amplitude modulated wave. Plot the frequency spectrum.

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