Part III — PHYSICS

(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. Photon has

   a)   energy but zero mass   b)   mass but zero energy

   c)   zero mass and zero energy   d)   infinite mass and energy.

2. If the nuclear radius is $2 \cdot 6 \times 10^{-15}$ m, the mass number will be

   a)   2   b)   4

   c)   8   d)   16.

3. Slow neutrons are neutrons having energies between

   a)   1000 eV to 2000 eV   b)   2000 eV to 0·5 MeV

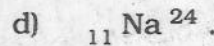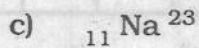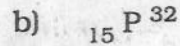   c)   0 eV to 1000 eV   d)   0·5 MeV to 10 MeV.
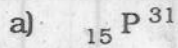
4. In the nuclear reaction,

$$_{80}Hg^{198} + X \rightarrow {_{79}Au^{198}} + {_{1}H^{1}}$$

X stands for

   a)   proton   b)   electron

   c)   neutron   d)   deuteron.

[Turn over

5. The radio-isotope used in agriculture is

   a) $_{15}P^{31}$

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

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

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

6. The Q-factor (quality factor) of an a.c. circuit containing a resistance R, inductance L and capacitor C is

   a) $Q = \dfrac{1}{\sqrt{LC}}$

   b) $Q = \dfrac{1}{R}\sqrt{\dfrac{C}{L}}$

   c) $Q = \dfrac{1}{R}\sqrt{\dfrac{L}{C}}$

   d) $Q = \dfrac{1}{\sqrt{LR}}$.

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

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

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

   c) π

   d) zero.

8. If the velocity of light in a medium is $2 \cdot 25 \times 10^{8}$ ms^{-1} then the refractive index of the medium will be

   a) $1 \cdot 5$

   b) $0 \cdot 5$

   c) $1 \cdot 33$

   d) $1 \cdot 73$.

9. A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light ?

   a) Bands disappear

   b) Diffraction pattern becomes narrower and crowded together

   c) No change

   d) Diffraction pattern becomes broader and farther apart.

10. The polarising angle for water is $53° 4'$. If the light is incident at this angle on the surface of water, the angle of refraction in water is

    a) $53° 4'$

    b) $26° 30'$

    c) $30° 4'$

    d) $36° 56'$.

B

11. Which of the following quantities is scalar ?

   a) Dipole moment

   b) Electric force

   c) Electric field

   d) Electric potential.

12. The unit of electric field intensity is

   a) Vm

   b) CN^{-1}

   c) VC^{-1}

   d) NC^{-1}.

13. When an electric dipole of dipole moment P is aligned parallel to the electric field E then the potential energy of the dipole is given as

   a) PE

   b) zero

   c) $-PE$

   d) $\dfrac{PE}{\sqrt{2}}$.

14. The capacitance of a parallel plate capacitor increases from 5 µF to 60 µF when a dielectric is filled between the plates. The dielectric constant of dielectric is

   a) 65

   b) 55

   c) 12

   d) 10.

15. If the length of a copper wire has a certain resistance R, then on doubling the length its specific resistance

   a) will be doubled

   b) will be $\frac{1}{4}$ th

   c) will become four times

   d) will remain the same.

16. In common emitter (CE) amplifiers, the phase reversal between input and output voltages is

   a) 0°

   b) 90°

   c) 270°

   d) 180°.

17. In a Colpitts oscillator circuit

   a) capacitive feedback is used

   b) tapped coil is used

   c) no tuned LC circuit is used

   d) no capacitor is used.

B

18. The following arrangement performs the logic function of

a)   AND   b)   EXOR

c)   OR   d)   NAND.

19. The purpose of dividing each frame into two fields so as to transmit 50 views of the picture per second is

a)   the fact that handling of higher frequencies is easier

b)   that 50 Hz is the power line frequency in India

c)   to avoid unwanted noises in the signals

d)   to avoid flicker in the picture.

20. Printed documents to be transmitted by fax are converted into electrical signals by the process of

a)   reflection   b)   scanning

c)   modulation   d)   light variation.

21. The spectral series of hydrogen atom in *UV* region are called

a)   Balmer series   b)   Lyman series

c)   Paschen series   d)   Pfund series.

22. The energy of a photon of characteristic *X*-ray from a Coolidge tube comes from

a)   the kinetic energy of the free electrons of the target

b)   the kinetic energy of ions of the target

c)   the kinetic energy of the striking electron

d)   an atomic transition in the target.

23. The chromium ions doped in the ruby rod

   a) absorb red light   b) absorb green light

   c) absorb blue light   d) emit green light.

24. Maser materials are

   a) diamagnetic ions   b) paramagnetic ions

   c) ferromagnetic ions   d) non-magnetic ions.

25. The wavelength of matter wave is independent of

   a) mass   b) velocity

   c) momentum   d) charge.

26. Nichrome is used as heating element, because it has

   a) low specific resistance   b) low melting point

   c) high specific resistance d) high conductivity.

27. In a thermocouple, the temperature of the cold junction is 20°C, the neutral temperature is 270°C. Then the temperature of inversion is

   a) 520°C   b) 540°C

   c) 500°C   d) 510°C.

28. Electromagnetic induction is not used in

   a) transformer   b) room heater

   c) AC generator   d) choke coil.

29. Which of the following cannot be stepped up in a transformer ?

   a) Input current   b) Input voltage

   c) Input power   d) All of these.

30. For a d.c. circuit, the value of capacitive reactance $\left(X_c \right)$ is

   a) zero   b) infinity

   c) $\dfrac{\pi}{2}$ d) π.

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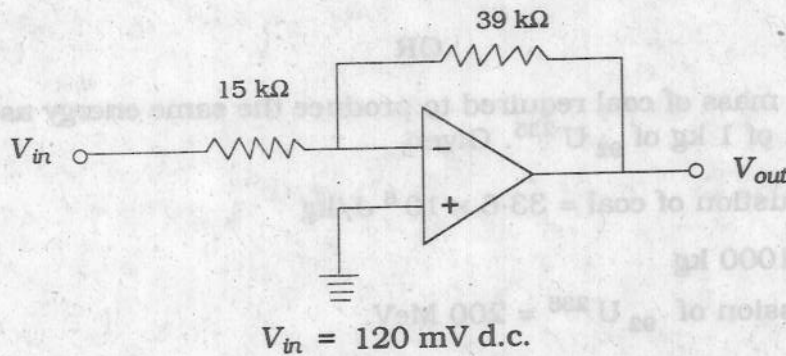
PART – II

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

31. Define electric flux. Give its unit.

32. Explain the working of a microwave oven.

33. Define temperature coefficient of resistance.

34. Distinguish between electric power and electric energy.

35. An iron box of 400 W power is used daily for 30 minutes. If the cost per unit is 75 paise, find the weekly expense on using the iron box.

36. Define ampere in terms of force.

37. Give the differences between AF choke and RF choke.

38. A capacitor of capacitance 2 μF is in an a.c. circuit of frequency 1000 Hz. If the r.m.s. value of the applied e.m.f. is 10 V, find the effective current flowing in the circuit.

39. On what factors does the amount of optical rotation depend ?

40. A light of wavelength 6000 Å falls normally on a thin air film, 6 dark fringes are seen between two points. Calculate the thickness of the air film.

41. What are the two important facts established by Laue experiment ?

42. Write any three applications of laser in industry.

43. What is the de Broglie wavelength of electron of kinetic energy 120 eV ?
$$\left(h = 6{\cdot}626 \times 10^{-34}\,Js\,;\ m = 9{\cdot}1 \times 10^{-31}\ kg \right)$$

44. What are cosmic rays ?

45. Write any three properties of nuclear force.

46. What is an integrated circuit ?

47. What is an extrinsic semiconductor ?

48. What are the advantages of negative feedback ?

B

49. Find the output of the ideal operational amplifier shown in the figure for the input of V_{in} = 120 mV direct current.

V_{in} = 120 mV d.c.

50. Define modulation factor.

PART – III

N. B. :
    i)   Answer Question No. **60** compulsorily.
    ii) Answer any *six* of the remaining 11 questions.
    iii) Draw diagrams wherever necessary.　　　　　$7 \times 5 = 35$

51. Two positive charges of 12 μC and 8 μC respectively are 10 cm apart. Find the work done in bringing them 4 cm closer, so that they are 6 cm apart.

52. Explain the determination of the internal resistance of a cell using voltmeter.

53. State Faraday's first law of electrolysis and describe the experimental verification.

54. In a hydrogen atom electron moves in an orbit of radius 0·5 Å making 10^{16} revolutions per second. Determine the magnetic moment associated with orbital motion of the electron.

    $\left(\text{Given } e = 1·6 \times 10^{-19} \text{ C}\right)$

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

56. State and explain Brewster's law.

57. State and obtain Bragg's law.

58. What are the applications of Photoelectric cells ?

59. Explain time dilation.

B

60. 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.

OR

Calculate the mass of coal required to produce the same energy as that produced by the fission of 1 kg of $_{92}U^{235}$. Given

Heat of combustion of coal = $33 \cdot 6 \times 10^6$ J/kg

1 ton = 1000 kg

Energy per fission of $_{92}U^{235} = 200$ MeV.

1 eV = $1 \cdot 6 \times 10^{-19}$ J

Avogadro Number, $N = 6 \cdot 023 \times 10^{23}$.

61. What is an AND gate ? Explain the function of AND gate using electrical circuit and using diodes.

62. What are the advantages and disadvantages of Digital Communication ?

PART – IV

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

ii) Draw diagrams wherever necessary. $4 \times 10 = 40$

63. What is an electric dipole ? Derive an expression for electric potential due to an electric dipole.

64. Explain in detail the principle, construction and theory of a tangent galvanometer.

65. Discuss with theory the method of inducing e.m.f. in a coil by changing its orientation with respect to the direction of the magnetic field.

66. Discuss the theory of interference in thin transparent film due to reflected light and obtain condition for the intensity to be maximum and minimum.

67. Explain Millikan's oil drop experiment to determine the charge of an electron.

68. Discuss the principle and action of a Bainbridge mass spectrometer to determine the isotopic masses.

69. Explain with neat circuit diagram, the working of single stage CE amplifier.

70. With the help of a block diagram, explain the functions of various units in the monochrome television transmitter.

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