

SEAL

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Series :

a

Question Booklet No.

330025

DT/08/24

PAPER—II

PHYSICS

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Time : 2 Hours

Maximum Marks : 100

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1. If the vector sum of two forces is perpendicular to their vector differences, then the forces

- [A] are equal in magnitude
- [B] are not equal in magnitude
- [C] cannot be predicted
- [D] are perpendicular to each other

2. Angular momentum is

- [A] scalar
- [B] an axial vector
- [C] a polar vector
- [D] 60° east of north

3. Two forces acting at an angle of 120° have a resultant force of 10 kg-wt which is perpendicular to one of the forces. What will be the magnitude of that force?

- [A] $10\sqrt{3}$ kg-wt
- [B] $20\sqrt{3}$ kg-wt
- [C] 10 kg-wt
- [D] $(10/\sqrt{3})$ kg-wt

4. If the critical angle for the medium of a prism is C and the angle of prism is A , for what relation between A and C , there will be no emergent ray?

- [A] $A < 2C$
- [B] $A = 2C$
- [C] $A > 2C$
- [D] $A \leq 2C$

5. When the convex side of the plano convex lens is silvered, it behaves like a

- [A] concave mirror of focal length $f/2$
- [B] convex mirror of focal length $f/2$
- [C] concave mirror of focal length $R/2\mu$
- [D] convex mirror of focal length $R/2\mu$

6. A light-ray incidents on a plane mirror at an angle of 30° . After incidence, the light-ray will deviate with what angle?

- [A] 30°
- [B] 60°
- [C] 90°
- [D] 120°



7. A propagating electromagnetic wave can be produced by

- [A] a charge moving at constant velocity
- [B] a stationary charge
- [C] a chargeless particle
- [D] an accelerating charge

8. Which of the following wavelengths falls in X-ray region?

- [A] 1 \AA
- [B] 10 \AA
- [C] 10^{-2} \AA
- [D] 10^{-3} \AA

9. Which one is **not** e.m. wave?

- [A] X-rays
- [B] γ -rays
- [C] Cathode rays
- [D] Microwaves



10. Which of the following attributes **does not** apply to the state of matter in thermodynamics?

- [A] Temperature
- [B] Pressure
- [C] Work
- [D] Volume

11. The lengthwise contraction of electric field lines indicates

- [A] repulsion between same charges
- [B] attraction between opposite charges
- [C] no relation between force and contraction
- [D] electric field lines do not move on straight path

12. Gauss's law is valid for

- [A] any closed surface
- [B] only regular closed surface
- [C] any open surface
- [D] only irregular open surface

13. Charge on a conducting metal sphere is present

- [A] on the surface of sphere
- [B] inside the sphere
- [C] outside the sphere
- [D] both inside and outside sphere

14. In case of α -particles, consider the following :

- (i) Mass equals to that of helium atom.
- (ii) Charge of $+2e$ units.
- (iii) Size less than 10^{-15} m.
- (iv) Speed around that of speed of light.

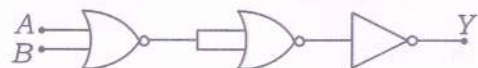
Which of the options are **correct** combination?

- [A] (i) and (ii)
- [B] (ii) and (iii)
- [C] (i), (ii) and (iii)
- [D] (i), (ii) and (iv)

15. A radioactive substance has a half-life of 20 min. It takes t_1 time to decay $2/3$ of it and t_2 for decaying $1/3$ of it. The approximate time interval ($t_2 - t_1$) will be

- [A] 14 min
- [B] 20 min
- [C] 25 min
- [D] 7 min

16. The given electrical network is equivalent to



- [A] AND gate
- [B] OR gate
- [C] NOR gate
- [D] NOT gate

17. Doping is

- [A] process of adding an impurity to a pure semiconductor
- [B] process of obtaining semiconductor from its ore
- [C] melting of a semiconductor
- [D] purification of a semiconductor

18. A pure Si crystal has 5×10^{28} atoms per m^3 . It is doped with 1 ppm concentration of Arsenic-V. What will be the number of holes in doped crystal, if number of intrinsic pairs is 1.5×10^{16} per m^3 ?

- [A] $4.5 \times 10^9 \text{ m}^{-3}$
- [B] 10^{16} m^{-3}
- [C] $2.25 \times 10^{32} \text{ m}^{-3}$
- [D] $5 \times 10^{22} \text{ m}^{-3}$

19. The ratio of angular speeds of minute hand and hour hand of a watch is

- [A] 1 : 12
- [B] 6 : 1
- [C] 12 : 1
- [D] 1 : 6

20. An athlete completes one round of a circular track of radius R in 40 seconds. His displacement at the end of 140 seconds will be

- [A] $2R$
- [B] $4\pi R$
- [C] $7\pi R$
- [D] $4R$

21. A body is in uniform circular motion. The angular momentum of the body will remain conserved about which point on the plane of the motion?

- [A] On the circumference of the circle
- [B] Centre of the circle
- [C] Inside the circle
- [D] Outside the circle



22. An object is placed at 15 cm from a convex lens of focal length 10 cm. Where should one place another convex mirror of radius of curvature 12 cm, such that image will coincide with object?

- [A] 18 cm
- [B] 17 cm
- [C] 14 cm
- [D] 20 cm

23. Fringes are produced on a screen that is positioned at a certain distance from the slits in a two-slit experiment using monochromatic light. The fringe width changes by 3×10^{-5} m, if the screen is moved 5×10^{-2} m in the direction of the slits. If the slit-width is 10^{-3} m, the wavelength of light used is

- [A] 6000 Å
- [B] 5000 Å
- [C] 3000 Å
- [D] 4500 Å

24. When a convex lens and a concave lens separated by d are brought into contact. The combination's focus length will

- [A] become zero
- [B] remain the same
- [C] increase
- [D] decrease

25. The penetrating power of X-rays increases with the increase in its

- [A] velocity
- [B] intensity
- [C] frequency
- [D] wavelength

26. In a plane electromagnetic wave, which of the following has an average value of zero?

- [A] Electric field
- [B] Magnetic potential
- [C] Electric energy
- [D] Magnetic energy

27. The frequency of a wave is 6×10^5 Hz. The wave is

- [A] radio wave
- [B] microwave
- [C] X-rays
- [D] None of the above

28. $\Delta U + \Delta W$ is valid for (symbols have their usual meanings)

- [A] adiabatic process
- [B] isothermal process
- [C] isobaric process
- [D] isochoric process



29. Gauss's law states that the electric field of a straight wire that is infinitely long is proportional to (where symbols have their usual meanings)

- [A] R
- [B] $1/r^2$
- [C] $1/r^3$
- [D] $1/r$

30. On the axis of an electric dipole, a point P is located at a distance x from the midpoint. At point P , the electric potential is proportional to

- [A] $\frac{1}{x^2}$
- [B] $\frac{1}{x^3}$
- [C] $\frac{1}{x^4}$
- [D] $\frac{1}{x^{1/2}}$

31. Isobars are

- [A] atoms having the same number of neutrons
- [B] atoms that have the same mass number and different atomic number
- [C] atoms having the same atomic number but different mass number
- [D] None of the above

32. In a nuclear reactor, the fission chain reaction can be managed by adding

- [A] iron rods
- [B] graphite rods
- [C] cadmium rods
- [D] None of the above

33. In a p - n junction, drift current is caused by
- [A] charge carriers density
 - [B] electric field
 - [C] collision of electrons
 - [D] None of the above
34. In a p - n junction diode, the depletion region forms because of
- [A] movement of dopant atoms
 - [B] diffusion of both electrons and holes
 - [C] drift of electrons only
 - [D] drift of holes only
35. In a transistor
- [A] there is 1 p - n junction
 - [B] there are 2 p - n junctions in series
 - [C] there are 3 p - n junctions in series
 - [D] None of the above
36. Two balls of equal mass are in contact with each other on a table. A third ball of same mass strikes them symmetrically and comes to rest after impact. The coefficient of restitution is
- [A] $2/3$
 - [B] $1/3$
 - [C] $1/6$
 - [D] $\sqrt{3/2}$
37. Two identical balls X and Y having velocities 0.5 m/s and -0.3 m/s collide elastically in one dimension. The velocities of balls Y and X after the collision respectively will be
- [A] -0.5 m/s and 0.3 m/s
 - [B] 0.5 m/s and -0.3 m/s
 - [C] -0.3 m/s and 0.5 m/s
 - [D] 0.3 m/s and 0.5 m/s
38. A double convex lens's faces have radii of curvature of 10 cm and 15 cm respectively. Its focal length is 12 cm. What is the refractive index of the material of the lens?
- [A] 1.0
 - [B] 1.33
 - [C] 1.25
 - [D] 1.5
39. The image formed by an objective of a compound microscope is
- [A] virtual and diminished
 - [B] real and diminished
 - [C] real and enlarged
 - [D] virtual and enlarged
40. The optical power of a thin glass lens with a refractive index of 1.5 is -8 D while in air. In a liquid medium with a refractive index of 1.6 , its optical power will be
- [A] 1 D
 - [B] -1 D
 - [C] 25 D
 - [D] -25 D
41. Which of the following shows greenhouse effect?
- [A] Ultraviolet rays
 - [B] Infrared rays
 - [C] X-rays
 - [D] None of the above



42. The direction of propagation of an electromagnetic wave is
- [A] perpendicular to electric field
 - [B] perpendicular to both electric and magnetic fields
 - [C] perpendicular to magnetic field
 - [D] parallel to electric and magnetic fields
43. Electromagnetic waves are transverse in nature because they exhibit
- [A] polarization
 - [B] interference
 - [C] reflection
 - [D] diffraction
44. A bicycle tire unexpectedly blows out. This can be an example of
- [A] isothermal process
 - [B] isobaric process
 - [C] isochoric process
 - [D] adiabatic process
45. Three charges $+2q$, $-q$ and $-q$ lie at the vertices of a triangle. The value of E and V at centroid of triangle will be
- [A] $E \neq 0$ and $V \neq 0$
 - [B] $E = 0$ and $V = 0$
 - [C] $E \neq 0$ and $V = 0$
 - [D] $E = 0$ and $V \neq 0$
46. The angle formed by the equipotential surface and the electric lines of force is
- [A] 0°
 - [B] 45°
 - [C] 90°
 - [D] 180°
47. Nuclear forces exist between
- [A] proton-neutron
 - [B] proton-proton
 - [C] neutron-neutron
 - [D] All of the above
48. Which of the following radiations has the least wavelength?
- [A] γ -rays
 - [B] β -rays
 - [C] α -rays
 - [D] X-rays
49. The highly doped portion of the transistor that generates a high number of majority carriers is referred to as
- [A] emitter
 - [B] base
 - [C] collector
 - [D] None of the above



50. If the ratio between I_C and I_E is 0.98 in common emitter amplifier, the current gain will be

- [A] 4.9
- [B] 7.8
- [C] 49
- [D] 78



51. Angular momentum of the particle rotating with a central force is constant due to

- [A] constant linear momentum
- [B] zero torque
- [C] constant torque
- [D] constant force

52. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same, which of the following will **not** be affected?

- [A] Moment of inertia
- [B] Angular momentum
- [C] Angular velocity
- [D] Rotational kinetic energy

53. The focal length of two lenses of power $-15D$ and $+5D$ which are in contact with each other will be

- [A] -10 cm
- [B] $+20$ cm
- [C] $+10$ cm
- [D] -20 cm

54. An observer uses a telescope of magnifying power 20 to look at a distant tree that is 10 meters tall. The tree appears to the observer

- [A] 10 times nearer
- [B] 20 times taller
- [C] 20 times nearer
- [D] 10 times taller

55. When monochromatic red light is used in place of blue light, the focal length of a convex lens will

- [A] increase
- [B] decrease
- [C] remain same
- [D] Not depend on colour of light

56. When a gas is compressed adiabatically, its temperature

- [A] falls
- [B] remains constant
- [C] rises
- [D] becomes zero

57. If a light wave travels in a vacuum along y -axis. The wavefront will be represented by

- [A] $y = \text{constant}$
- [B] $x = \text{constant}$
- [C] $z = \text{constant}$
- [D] $x + y + z = \text{constant}$

58. Wave which cannot travel in vacuum is

- [A] X-rays
- [B] infrasonic
- [C] ultraviolet
- [D] radio waves

59. A 3 MHz electromagnetic wave travels from a vacuum into a dielectric material with a permittivity of 4, then

- [A] the wavelength is doubled and frequency remains unchanged
- [B] the wavelength is doubled and frequency becomes half
- [C] the wavelength is halved and frequency remains unchanged
- [D] the wavelength and frequency both remain unchanged

60. Which of the following is **not** the property of equipotential surface?
- [A] They do not cross each other
 [B] The rate of change of potential with distance is zero
 [C] For a uniform electric field, they are concentric spheres
 [D] They can be imaginary spheres
61. What is the impact parameter of a head-on collision between a nucleus and an α -particle?
- [A] Zero
 [B] Infinite
 [C] 10^{-10} m
 [D] 10^{10} m
62. The existence of positive charged nucleus in an atom was first established by which of the following models/experiments?
- [A] Bohr's theory of hydrogen atom
 [B] Positive rays analysis
 [C] α -particle scattering experiment
 [D] Thomson's model of atom
63. In a CB configuration transistor amplifier, $I_c = 1$ mA, $\alpha = 0.95$, then what will be the approximate value of base current?
- [A] 1.95 mA
 [B] 0.05 mA
 [C] 1.05 mA
 [D] 0.95 mA
64. Which of the following gates is suitable for use as a foundation element in any kind of digital circuit?
- [A] OR
 [B] NOT
 [C] AND
 [D] NAND

65. A body of mass $M = 5$ units is moving with a uniform speed $V = 3\sqrt{2}$ units in the XY plane along the line $Y = X + 4$. What will be its angular momentum about the origin?
- [A] 0 unit
 [B] 60 units
 [C] $20\sqrt{2}$ units
 [D] $30\sqrt{10}$ units
66. The moment of inertia of a cubic body of mass m and side l about one of its edges is equal to
- [A] $(2/3)ml^2$
 [B] $(4/3)ml^2$
 [C] $3ml^2$
 [D] $(8/3)ml^2$
67. A simple pendulum is suspended from the ceiling of a lift. The time-period of the pendulum when the lift is stationary is T . If the lift ascends with an acceleration of $g/3$, what will be the time-period of the pendulum?
- [A] $T/2$
 [B] $(\sqrt{3}/2)T$
 [C] $(\sqrt{3}/4)T$
 [D] $T/4$
68. A light of wavelength 520 nm is incident normally on a plane diffraction grating having 5000 lines per cm. What will be the maximum number of orders of diffracted images observed in a screen?
- [A] 2
 [B] 3
 [C] 4
 [D] 5



69. Two coherent point sources are separated by a small distance. The fringes obtained on the screen will be

- [A] straight lines
- [B] semi circles
- [C] concentric circles
- [D] points

70. Two coherent sources produce waves of different intensities. After interference, the ratio of maximum intensity to the minimum intensity is 16. The intensity of the waves is in the ratio of

- [A] 4 : 1
- [B] 25 : 9
- [C] 16 : 9
- [D] 5 : 3

71. What will be the ratio of maximum and minimum intensities of fringes in an interference experiment, if the ratio of amplitudes of coherent waves

is $\frac{a_1}{a_2} = \frac{1}{3}$?

- [A] 2
- [B] 18
- [C] 4
- [D] 9

72. When an object is placed at a distance u_1 from a lens, a real image is formed and when placed at a distance u_2 , a virtual image is formed. Both the images have same magnification. The focal length of the lens is

- [A] $u_1 + \frac{u_2}{2}$
- [B] $\frac{u_1 - u_2}{2}$
- [C] $\frac{u_1 + u_2}{2}$
- [D] $u_1 + u_2$

73. The Sun's energy source is

- [A] burning of hydrogen
- [B] fission reactions involving hydrogen
- [C] fusion reactions involving hydrogen
- [D] moon

74. The energy of electromagnetic radiation is 14.4 eV. Where does it fall within the electromagnetic spectrum? (Assuming $h = 6.6 \times 10^{-34}$ J-s and $e = 1.6 \times 10^{-19}$ C)

- [A] Ultraviolet region
- [B] Visible region
- [C] X-ray region
- [D] γ -ray region



75. It is possible to deflect electromagnetic radiation by

- [A] electric field only
- [B] magnetic field only
- [C] both electric and magnetic fields
- [D] None of the above

76. For which of the following processes, the entropy change is zero?

- [A] Isobaric process
- [B] Isothermal process
- [C] Adiabatic process
- [D] None of the above

77. In a uniform electric field, a dipole is positioned. The minimum potential energy of the system is obtained when the angle formed by the axis of the dipole and the field is

- [A] zero
- [B] π
- [C] $\pi/2$
- [D] 2π

78. The momentum of an electron revolving in n^{th} orbit is given by (where symbols have their usual meanings)

- [A] $\frac{nh}{2\pi r}$
- [B] $\frac{nh}{2r}$
- [C] $\frac{nh}{2\pi}$
- [D] $\frac{2\pi r}{nh}$

79. Let i_e , i_c and i_b represent emitter current, collector current and the base current of a transistor, then

- [A] $i_c > i_e$
- [B] $i_b > i_c$
- [C] $i_b > i_e$
- [D] $i_e > i_c$

80. A ray of light travelling in water incident on its surface open to air. If the angle of incident is less than the critical angle. Then there will be

- [A] only a reflected ray and no refracted ray
- [B] only a refracted ray and no reflected ray
- [C] a reflected ray and a refracted ray and the angle between them would be less than $(180^\circ - 2\theta)$
- [D] a reflected ray and a refracted ray and the angle between them would be greater than $(180^\circ - 2\theta)$

81. To increase the magnifying power of a compound microscope

- [A] the focal lengths of the objective and the eye piece should be small
- [B] objective should have small focal length and the eye piece should have large
- [C] both objective and eye piece should have large focal lengths
- [D] the objective should have large focal length and eye piece should have small

82. The number of lenses in a terrestrial telescope is

- [A] 2
- [B] 3
- [C] 4
- [D] 6

83. $E = E_0 \sin(kx - \omega t)$ describes an electromagnetic wave traveling through a vacuum. Out of all options given, which is wavelength independent?

- [A] k
- [B] Ω
- [C] k/ω
- [D] $k\omega$

84. The velocity at which electromagnetic waves travel is

- [A] equal to the velocity of sound
- [B] equal to the velocity of light
- [C] less than the velocity of light
- [D] None of the above



85. Which of the following electromagnetic spectrum regions will absorb energy due to molecular vibrations?

- [A] Ultraviolet
- [B] Microwave
- [C] Infrared
- [D] Radio waves



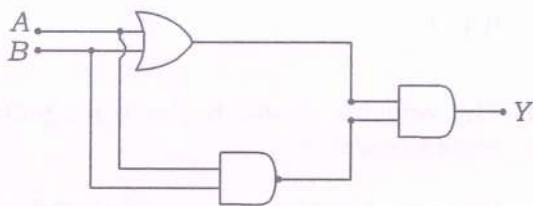
86. The work done in rotating an electric dipole of moment p from a position parallel to a uniform electric field to a position perpendicular to it (by 90°) is given by

- [A] $2 pE$
- [B] pE
- [C] $pE/2$
- [D] zero

87. In the equation $E_n = -\frac{13.6}{n^2} \text{ eV}$, the negative sign indicates that

- [A] electrons are free to move
- [B] electrons are bound to the nucleus
- [C] kinetic energy of electron is equal to potential energy of electron
- [D] atom is radiating energy

88. Name the gate represented by the following circuit.



- [A] AND gate
- [B] NAND gate
- [C] OR gate
- [D] XOR gate

89. An image is formed on a screen by a converging lens. When an opaque screen covers the upper portion of the lens,

- [A] half the image will disappear
- [B] complete image will be formed of same intensity
- [C] half image will be formed of same intensity
- [D] complete image will be formed of decreased intensity

90. 'Mirage' is a phenomenon due to

- [A] reflection of light
- [B] refraction of light
- [C] total internal reflection of light
- [D] diffraction of light

91. If two coils are wound on a cylindrical rod one above the other and each coil has an inductance of 0.1 H, the coefficient of mutual induction will be

- [A] 0.4 H
- [B] 0.3 H
- [C] 0.2 H
- [D] 0.1 H

92. When the armature plane of an alternating current generator is perpendicular to the magnetic field,

- [A] both magnetic flux and e.m.f. are maximum
- [B] both magnetic flux and e.m.f. are zero
- [C] both magnetic flux and e.m.f. are half of their respective maximum values
- [D] magnetic flux is maximum and e.m.f. is zero

93. A time-varying magnetic field is applied to a coil that has been short-circuited. The current that is induced in the coil causes a loss of electrical power. If number of turns is quadrupled and the wire radius halved, the electrical power dissipated would be

- [A] halved
- [B] the same
- [C] doubled
- [D] quadrupled

94. Which singly ionized carbon level has an energy equal to the hydrogen atom's ground state energy?

- [A] 4
- [B] 8
- [C] 1
- [D] 6

95. The fundamental frequency in the ripple of a full wave rectifier circuit running on 50 Hz mains will be

- [A] 50 Hz
- [B] 70.7 Hz
- [C] 100 Hz
- [D] 25 Hz



96. The refractive index of the air on a hot summer night is lowest close to the ground and rises with height. When a light beam is focused horizontally, according to Huygens principle, the light beam

- [A] becomes narrower
- [B] goes horizontally without any deflection
- [C] bends towards
- [D] bends upwards

97. Focal length of a plane mirror is

- [A] zero
- [B] infinite
- [C] very less
- [D] one

98. Two coils are placed close to each other. The mutual inductance of pair of coils depends upon

- [A] relative position and orientation of coils
- [B] the material of the wire of the coils
- [C] the current in two coils
- [D] the rate at which current is changing in coils

99. In an alternating current generator, a coil with n turns of same area a and total resistance r , rotates with frequency ω in a magnetic field B . The maximum value of e.m.f. generated in the coil is

- [A] $narB\omega$
- [B] naB
- [C] $narB$
- [D] $naB\omega$

100. A solenoid of length 0.30 m has 2000 turns with area of cross-section is $1.2 \times 10^{-3} \text{ m}^2$. A coil of 300 turns is wound around its central section. If an initial current of 2 A in a solenoid is reversed in 0.25 s, then the e.m.f. induced in the coil is

- [A] $6 \times 10^{-4} \text{ V}$
- [B] $4.8 \times 10^{-3} \text{ V}$
- [C] $6 \times 10^{-2} \text{ V}$
- [D] 48.3 mV

SPACE FOR ROUGH WORK



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