Entrance Examination for Admission to the P.G. Courses in the Teaching Departments, 2023

CSS

PHYSICS WITH SPECIALIZATION IN SPACE PHYSICS/RENEWABLE ENERGY/APPLIED ELECTRONICS/NANO SCIENCE

General Instructions

1. The Question Paper is having 100 Objective Questions, each carrying one mark.

2. The answers are to be (✓) 'tick marked' **only** in the "**Response Sheet**" provided.

3. **Negative marking** : **0.25 marks** will be deducted for each wrong answer .

Time : 2 Hours   **Max. Marks : 100**

To be filled in by the Candidate									
Register Number	in Figures								
	in words								

Choose appropriate answer from the options in the questions.

(100 × 1 = 100 marks)

1. The single particle density of states of a free electron gas with particle energy E is proportional to

   a) E b) $E^{1/2}$

   c) E^2 d) $E^{2/3}$

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2. Which of the following symmetry is violated in weak interactions?

   a) Space   b) Parity

   c) Angular momentum   d) Rotation

3. If a Lagrangian is cyclic generalized co-ordinate q, then which of the following is generally true

   a) $\dfrac{dH}{dq} = 0$ b) $\dfrac{dL}{d\dot{q}} = 0$

   c) $\dfrac{dH}{d\dot{q}} = 0$ d) $\dfrac{dL}{dt} = 0$

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4. The volume of a radiation cavity at 200 K is adiabatically increased from 10 cm^3 to 640 cm^3. The temperature of the cavity changes to

   a) 800 K   b) 700 K

   c) 600 K   d) 500 K

5. The wavelength of Ruby laser is

   a) 633 nm   b) 694 nm

   c) 514 nm   d) 532 nm

6. The number of distinct ways of placing four indistinguishable balls into five distinguishable boxes is

   a) 50   b) 60

   c) 70   d) 100

7. The number of spectral lines allowed in the spectrum for the $3^2D \rightarrow 3^2P$ transition is

   a) 2   b) 4

   c) 3   d) 6

8. In an interference experiment the fringe width is found to be 2 mm at 600 nm. The experiment is repeated in a liquid of refractive index of 4/3, then fringe width is

   a) 1/2 mm   b) 5/2 mm

   c) 3/2 mm   d) 7/2 mm

9. Gravitons have a spin of

   a) 1   b) 1/2

   c) 2   d) 3

10. The basic memory element in a digital circuit consists of a

    a) NAND gate   b) NOR gate

    c) FLIP-FLOP   d) Shift register

11. Esaki diode is also known as

    a) Gun diode   b) Tunnel diode

    c) Laser diode   d) Zener diode

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12. The c/a ratio for an ideal hexagonal closed packed structure is

   a) $\dfrac{2}{\sqrt{3}}$

   b) $\sqrt{8}$

   c) $\sqrt{5}$

   d) $\dfrac{\sqrt{8}}{3}$

13. An electron gains energy so that its mass becomes $2\,m_0$. Its speed is

   a) $\dfrac{\sqrt{3}}{2}\,c$

   b) $\dfrac{3}{4}\,c$

   c) $\dfrac{3}{2}\,c$

   d) $\sqrt{\dfrac{3}{2}}\,c$

14. If the peak output voltage of a full wave rectifier is 10 V, its dc voltage is

   a) 10 V

   b) 7.07 V

   c) 6.36 V

   d) 3.18 V

15. The order of magnitude of the energy gap of a typical superconductor is

   a) 1 MeV

   b) 1 KeV

   c) 1 eV

   d) 1 MeV

16. A plane wave is represented by $A = A_o\, e^{ikz}$, In this equation k represents

   a) angular momentum

   b) wave vector

   c) wavelength

   d) frequency

17. The Boolean expression $B \cdot (A + B) + A \cdot (\vec{B} + A)$ can be realized using maximum number of

   a) 1 AND gate

   b) 2 NAND gates

   c) 1 OR gate

   d) 2 OR gates

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18. If A and B are constant vectors, then $\nabla(\vec{A} \cdot \vec{B} \times \hat{r})$ is

a) $\vec{A} \cdot \vec{B}$ b) $\vec{A} \times \vec{B}$

c) $\hat{r}$ d) Zero

19. Which of the following vectors is orthogonal to the vector $(a\hat{i} + b\hat{j})$

a) $(-b\hat{i} + a\hat{j})$ b) $(-a\hat{i} + b\hat{j})$

c) $(-a\hat{i} - b\hat{j})$ d) $(-b\hat{i} - a\hat{j})$

20. Silicon has diamond structure with unit cell edge (a = 0.542 nm). The interatomic separation is

a) 0.112 nm   b) 0.234 nm

c) 0.383 nm   d) 0.542 nm

21. In an interference pattern, the maximum and minimum intensity values are 25 I_0 and 9 I_0 respectively. The intensities of the interfering beams are

a) 16 I_0 and I_0 b) 5 I_0 and 3 I_0

c) 17 I_0 and 8 I_0 d) 8 I_0 and 2 I_0

22. Vulnerability analysis comes in which part of the disaster management cycle?

a) Mitigation   b) Preparedness

c) Response   d) Recovery

23. The feedback ratio of an amplifier, which on application of a negative feedback changes the voltages gain from –250 to –100, is

a) –0.250   b) –0.025

c) –0.060   d) –0.006

24. Which of the following parameters is related to a superconductor?

a) Attenuation length   b) Penetration depth

c) Skin depth   d) Diffusion length

25. Which of the following is not a magic number?

    a) 2   b) 8

    c) 50   d) 84

26. Velocity of orbital motion of an electron in an atom varies with the atomic number Z as

    a) Z^2 b) $Z^{1/2}$

    c) Z d) $1/Z$

27. Reciprocal lattice to bcc lattice is

    a) fcc   b) bcc

    c) SC   d) Oblique

28. In the diffraction pattern of bcc crystal, which of the following line is absent

    a) $(1\,1\,1)$ b) $(2\,0\,0)$

    c) $(1\,1\,0)$ d) $(3\,0\,1)$

29. In a Raman spectrum under excitation with a laser of wavelength 435.8 nm, the first stokes line is observed at 440 nm. The corresponding Raman shift will be

    a) 219 cm^{-1} b) 319 cm^{-1}

    c) 200 cm^{-1} d) 110 cm^{-1}

30. For a harmonic oscillator, the zero point energy is

    a) $\hbar w$ b) $1/2\,\hbar w$

    c) $3/2\,\hbar w$ d) 0

31. Which of the following equations implies the absence of magnetic monopoles?

    a) $\nabla \cdot \vec{E} = 0$ b) $\nabla \cdot \vec{B} = 0$

    c) $\nabla \times \vec{B} = \mu_0 J$ d) $\nabla \times \vec{E} = 0$

32. The curl of the vector $\vec{A} = z\hat{i} + x\hat{j} + y\hat{k}$ is

a) $\hat{i} + \hat{j} + \hat{k}$

b) $\hat{i} - \hat{j} + \hat{k}$

c) $\hat{i} + \hat{j} - \hat{k}$

d) $-\left(\hat{i} + \hat{j} + \hat{k}\right)$

33. In a He-Ne laser, the laser transition takes place in

a) He only

b) Ne only

c) Ne first then He

d) He first then Ne

34. The spin wave functions are usually referred as

a) Scalars

b) Vectors

c) Spinors

d) Tensors

35. A planet moves around the sun in an elliptical orbit with semi major axis 'a' and time period 'T'. T is proportional to

a) a^2

b) $a^{1/2}$

c) $a^{3/2}$

d) a^3

36. Which one of the following molecules does not show a rotational spectrum?

a) H_2

b) CO

c) HCl

d) HBr

37. Which one of the following particles does not have a spin 1/2

a) Proton

b) Electron

c) Photon

d) Neutrino

38. The target of an X-ray tube is subjected to an excitation voltage V. The wavelength of the emitted X-ray is proportional to

a) $\dfrac{1}{\sqrt{V}}$

b) $\sqrt{V}$

c) $\dfrac{1}{V}$

d) V

39. The probability current density for the wave function $\psi(x) = e^{ikx}$ is

a) $\dfrac{\hbar k}{m}$

b) $\dfrac{\hbar^2 k^2}{m}$

c) $\dfrac{\hbar k}{2m}$

d) $\hbar k$

40. Franck-Condon principle is used to explain

a) Raman spectra

b) IR spectra

c) Rotational spectra

d) Electronic spectra

41. For an LED the energy gap is 1 eV. The emission wavelength of the LED is

a) 1.24 μm

b) 0.124 μm

c) 2.48 μm

d) 0.248 μm

42. Which of the following is not a microprocessor?

a) CISC

b) RISC

c) EPIC

d) NISC

43. The differential form of Gauss's law is

a) $\nabla \cdot \vec{B} = \dfrac{\rho}{\varepsilon_0}$

b) $\nabla \times \vec{B} = \dfrac{\rho}{\varepsilon_0}$

c) $\nabla \times \vec{E} = \dfrac{\rho}{\varepsilon_0}$

d) $\nabla \cdot \vec{E} = \dfrac{\rho}{\varepsilon_0}$

44. If 'T' is the surface tension of soap solution, the amount of work done in blowing a soap bubble from diameter D to 2D is

a) $2\pi D^2 T$

b) $4\pi D^2 T$

c) $6\pi D^2 T$

d) $8\pi D^2 T$

45. Hamilton's equation of motion is

a) Convergent

b) Divergent

c) Variant

d) Invariant

46. In an 8-bit microprocessor how many opcodes are present?

   a) 246   b) 278

   c) 250   d) 256

47. A rod of proper length 'l_0' starts moving with velocity 0.8 c. The length of rod in motion is

   a) $0.5 \, l_0$ b) $0.6 \, l_0$

   c) $0.8 \, l_0$ d) $0.4 \, l_0$

48. Bohr's quantum condition is

   a) $L = \dfrac{nh}{2\pi}$ b) $L = \dfrac{n\hbar}{2\pi}$

   c) $L = \dfrac{2\pi\hbar}{n}$ d) $L = \dfrac{\pi\hbar}{n}$

49. Proton is a

   a) Baryon   b) Boson

   c) Lepton   d) Fermion

50. The gradient of a scalar is always

   a) a scalar   b) a vector

   c) zero   d) constant

51. Spatial quantization and electron spin are confirmed by

   a) Frank-Hertz experiment   b) Stern-Gerlach experiment

   c) Davisson-Germer experiment   d) Michelson-Gale experiment

52. The quantum analogue of the classical expression P for the momentum is

   a) $\dfrac{h}{k}$ b) $\dfrac{\hbar}{k}$

   c) hk d) $\hbar k$

53. According to the uncertainty principle the relation between the spectral width Δv and the excited state lifetime τ is

a) $\Delta v = \dfrac{1}{4\pi\tau}$

b) $\Delta v = \dfrac{2\pi}{\tau}$

c) $\Delta v = \dfrac{1}{2\pi\tau}$

d) $\Delta v = \dfrac{\tau}{2\pi}$

54. The moment of inertia of a body does not depend on its

a) mass

b) axis of rotation

c) angular velocity

d) shape

55. The apex authority of disaster management in India is

a) SDMA

b) CDMA

c) NDMA

d) IDNDR

56. In the nuclear reaction $^{13}C_6 + v_e \rightarrow {}^{13}N_7 + X$, the particle X is

a) an electron

b) an antielectron

c) a muon

d) a pion

57. The minimum number of NAND gates required to construct an OR gate is

a) 2

b) 4

c) 5

d) 3

58. The nature of I-V characteristic of an ideal PN diode is

a) parabolic

b) linear

c) exponential

d) zig-zag

59. Proton has the mass

a) 1637 times of an electron

b) 1737 times of an electron

c) 1837 times of an electron

d) 1937 times of an electron

60. As per modern theory, the atom has a diameter of about
   a) 10^{-4} mm
   b) 10^{-5} mm
   c) 10^{-6} mm
   d) 10^{-7} mm

61. For the evaluation of the electric field due to a collection of charges, which of the following principle is made use of?
   a) Exclusive principle
   b) Superposition principle
   c) Combination principle
   d) Uncertainty principle

62. The limited number of electrons in the 'M' shell is
   a) 2
   b) 8
   c) 18
   d) 32

63. One atomic mass unit (AMU) is equal to
   a) 1.66×10^{-20} g
   b) 1.66×10^{-22} g
   c) 1.66×10^{-24} g
   d) 1.66×10^{-26} g

64. In alpha decay (α-decay) proton number of parent nuclide
   a) increases by 2
   b) increases by 1
   c) decreases by 2
   d) decreases by 4

65. A circuit which implements AND operation is
   a) AND gate
   b) OR gate
   c) NOT gate
   d) NOR gate

66. In OR operation if one of inputs is '1' then output is
   a) 0
   b) 2
   c) 4
   d) 1

67. An electron is trapped in a one dimensional well of width 0.132 nm. The energy of an electron is the n = 10 state is
   a) 2140 eV
   b) 2640 eV
   c) 2610 eV
   d) 2160 eV

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68. The maximum possible acceleration for a simple harmonic oscillator is

a) $\omega^2 x$

b) $\omega\sqrt{\alpha^2 - x^2}$

c) ωx

d) ωx^2

69. The Young's modulus of a wire of length 'L' and radius 'r' is 'Y' Nm^2. If the length is reduced to L/2, and radius r/2, its Young's modulus will be

a) Y/2

b) Y

c) 2Y

d) 4Y

70. In the equation $p = \alpha E$, α is

a) Polarizability

b) Polarization

c) a dimensionless constant

d) Charge per unit area

71. Volume current density J is equivalent to

a) current per unit volume

b) current per unit area

c) current per unit length

d) charge per unit area

72. The value of Poisson's ratio cannot be

a) 0.01

b) 0.1

c) 0.4

d) 0.6

73. For a monatomic gas the adiabatic relation between pressure and volume is

a) $PV = const$

b) $PV^{\frac{5}{3}} = const$

c) $PV^{\frac{7}{5}} = const$

d) $PV^{\frac{2}{3}} = const$

74. The work done by the force $F = 4a_x - 3a_y - 2a_z$ N in giving a 1nC charge a displacement of $5a_x - 2a_y - 5a_z$ m is

a) 6 nJ

b) 15 nJ

c) 20 nJ

d) 10 nJ

75. A 60 kg woman stands on a light, cubical box that is 5.0 cm on each edge. The box sits on the floor. What pressure does the box exerts on the floor?

a) 2.4×10^5 N/m^2

b) 6×10^5 N/m^2

c) 3×10^5 N/m^2

d) 4.8×10^5 N/m^2

76. How many flip flops are there in a flag register of 8085 microprocessor?

a) 4

b) 5

c) 7

d) 10

77. The equation of a simple harmonic motion with amplitude 5 m and time period 0.5 s is

a) $y = 5\sin(4\pi t)$

b) $y = 0.5\sin(2\pi t/5)$

c) $y = 5\sin(2\pi t)$

d) $y = 0.5\sin(4\pi t)$

78. The time period of mass of 1 kg attached to a spring of spring constant of 100 N/m is

a) $0.2\,\pi$

b) π

c) $2\,\pi$

d) $\pi/2$

79. How many address lines are present in 8085 microprocessors?

a) 20

b) 16

c) 24

d) 8

80. A planet has a mass four times and diameter twice that of the earth. What is the value of g on the planet?

a) 19.6 m/s^2

b) 9.8 m/s^2

c) 4.9 m/s^2

d) 14.7 m/s^2

81. The distance between adjacent atomic planes in CaCO$_3$ is 0.3 nm. The smallest angle of Bragg scattering for 0.03 nm X ray is approximately

a) 3°

b) 1.5°

c) 0.3°

d) 6°

82. How many stages are there in the process of disaster management?

    a) 4
    b) 5
    c) 7
    d) 6

83. A physical quantity $A = a^2 b^3 / cd^{1/2}$ is given with the percentage of errors of measurements in a, b, c and d are 1%, 3%, 2% and 2% respectively. Then the percentage of errors in the quantity A is

    a) 12%
    b) 8%
    c) 14%
    d) 16%

84. The surface temperature of stars is determined using

    a) Planck's law
    b) Stefan's law
    c) Wien's law
    d) Kirchoff's law

85. Newton's law of cooling is a special case of

    a) Stefan's law
    b) Planck's law
    c) Wien's law
    d) Boltzman's law

86. Internal energy of an ideal gas depends on

    a) Pressure
    b) Volume
    c) Temperature
    d) Molecular size

87. One mole of gas at temperature T expands isothermally to double its volume. The work done is

    a) $RT \log_e(2)$
    b) $RT \log_e(1/2)$
    c) $RT \log_e(4)$
    d) $RT \log_e(1/4)$

88. A gas is being compressed adiabatically. The specific heat during compression is

    a) zero
    b) infinity
    c) 1
    d) undefined

89. In an adiabatic process, the pressure is increased by 2/3%. If $\gamma = 3/2$, then the volume decreases by nearly

    a) 4/9%   b) 2/3%

    c) 1%   d) 3/2%

90. A carnot engine is working between temperature T_1 and T_2. The efficiency will be maximum for the maximum value of

    a) $\dfrac{T_1 + T_2}{T_1}$ b) $\dfrac{T_1 - T_2}{T_1}$

    c) $\dfrac{T_1 + T_2}{T_2}$ d) $\dfrac{T_1 - T_2}{T_2}$

91. The last electron of an atom has the set of quantum numbers $(3, 2, -2, +1/2)$. Its atomic number is

    a) 19   b) 21

    c) 25   d) 23

92. When the azimuthal quantum number 1 = 1, then the shape of the orbital is

    a) spherical   b) elliptical

    c) dumbbell   d) doughnut

93. Principal quantum number was discovered by

    a) Lande   b) Planck

    c) Bohr   d) Sommerfield

94. If energy is doubled, the wavelength of light radiation will be

    a) doubled   b) halved

    c) same   d) one fourth

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95. A wire loaded with mass 'm' extends by '1'. The work is

a) mgl

b) mgh

c) ½ mgl

d) zero

96. A beam is supported by two knife-edges. The depression at the center is proportional to

a) Y

b) Y^2

c) $1/Y^2$

d) $1/Y$

97. A solid sphere rolls on a horizontal plane. The ratio of its rotational kinetic energy to its total kinetic energy is

a) 1 : 7

b) 2 : 7

c) 3 : 7

d) 4 : 7

98. If the earth shrinks to half its present radius, then the duration of a day and night will be

a) 12 hrs

b) 36 hrs

c) 6 hrs

d) 18 hrs

99. In a differentiator, the feedback element is a

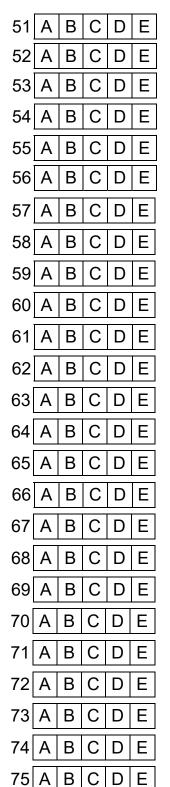a) Resistor

b) Capacitor

c) Zener diode

d) Voltage divider

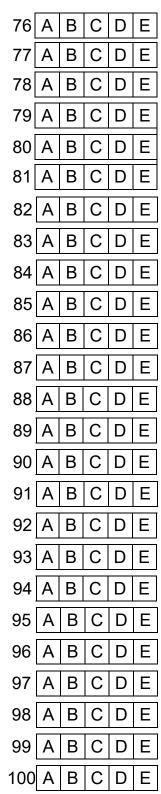100. The Boolean expression $\overline{\overline{AB} + \overline{A}} + AB$ is equivalent to

a) A

b) $\overline{A}$

c) 1

d) Zero

ANSWER SHEET

1	A	B	C	D	E	26	A	B	C	D	E	51	A	B	C	D	E	76	A	B	C	D	E
2	A	B	C	D	E	27	A	B	C	D	E	52	A	B	C	D	E	77	A	B	C	D	E
3	A	B	C	D	E	28	A	B	C	D	E	53	A	B	C	D	E	78	A	B	C	D	E
4	A	B	C	D	E	29	A	B	C	D	E	54	A	B	C	D	E	79	A	B	C	D	E
5	A	B	C	D	E	30	A	B	C	D	E	55	A	B	C	D	E	80	A	B	C	D	E
6	A	B	C	D	E	31	A	B	C	D	E	56	A	B	C	D	E	81	A	B	C	D	E
7	A	B	C	D	E	32	A	B	C	D	E	57	A	B	C	D	E	82	A	B	C	D	E
8	A	B	C	D	E	33	A	B	C	D	E	58	A	B	C	D	E	83	A	B	C	D	E
9	A	B	C	D	E	34	A	B	C	D	E	59	A	B	C	D	E	84	A	B	C	D	E
10	A	B	C	D	E	35	A	B	C	D	E	60	A	B	C	D	E	85	A	B	C	D	E
11	A	B	C	D	E	36	A	B	C	D	E	61	A	B	C	D	E	86	A	B	C	D	E
12	A	B	C	D	E	37	A	B	C	D	E	62	A	B	C	D	E	87	A	B	C	D	E
13	A	B	C	D	E	38	A	B	C	D	E	63	A	B	C	D	E	88	A	B	C	D	E
14	A	B	C	D	E	39	A	B	C	D	E	64	A	B	C	D	E	89	A	B	C	D	E
15	A	B	C	D	E	40	A	B	C	D	E	65	A	B	C	D	E	90	A	B	C	D	E
16	A	B	C	D	E	41	A	B	C	D	E	66	A	B	C	D	E	91	A	B	C	D	E
17	A	B	C	D	E	42	A	B	C	D	E	67	A	B	C	D	E	92	A	B	C	D	E
18	A	B	C	D	E	43	A	B	C	D	E	68	A	B	C	D	E	93	A	B	C	D	E
19	A	B	C	D	E	44	A	B	C	D	E	69	A	B	C	D	E	94	A	B	C	D	E
20	A	B	C	D	E	45	A	B	C	D	E	70	A	B	C	D	E	95	A	B	C	D	E
21	A	B	C	D	E	46	A	B	C	D	E	71	A	B	C	D	E	96	A	B	C	D	E
22	A	B	C	D	E	47	A	B	C	D	E	72	A	B	C	D	E	97	A	B	C	D	E
23	A	B	C	D	E	48	A	B	C	D	E	73	A	B	C	D	E	98	A	B	C	D	E
24	A	B	C	D	E	49	A	B	C	D	E	74	A	B	C	D	E	99	A	B	C	D	E
25	A	B	C	D	E	50	A	B	C	D	E	75	A	B	C	D	E	100	A	B	C	D	E

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ROUGH WORK

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