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CALICUT UNIVERSITY CENTRALIZED ENTRANCE TEST (CU-CET)
APRIL 2025

M.Sc. PHYSICS / M.Sc. RADIATION PHYSICS / M.Sc. PHYSICS (NANOSCIENCE)

Time : Two Hours Maximum : 400 Marks

Each question carries 4 marks.
1 mark will be deducted for each wrong answer.

1. The moment of inertia of a solid sphere about an axis passing through its center is given by :

   (A) $\frac{2}{5} MR^2$. (B) $\frac{1}{2} MR^2$.

   (C) $\frac{3}{5} MR^2$. (D) MR^2.

2. A ball is thrown vertically upward with an initial velocity u. The time taken to reach the highest point is :

   (A) u/g. (B) $2u/g$.

   (C) $\sqrt{2u/g}$. (D) $u^2/2g$

3. A body of mass m moving with velocity v has kinetic energy :

   (A) mv^2. (B) mgh.

   (C) $\frac{1}{2} mv^2$. (D) mgv.

4. The unit of angular momentum in the SI system is :

   (A) kg m/s. (B) kg m^2/s.

   (C) kg m^3/s^2. (D) N m.

5. A force of 10 N is applied to a body of mass 2 kg. The acceleration produced is :

(A) $2\ m/s^2$.

(B) $5\ m/s^2$.

(C) $10\ m/s^2$.

(D) $20\ m/s^2$.

6. The work done by a force is zero when :

(A) The displacement is perpendicular to the force.

(B) The displacement is in the direction of the force.

(C) The displacement is opposite to the force.

(D) The force is large.

7. The dimensional formula of angular momentum is :

(A) ML^2T^{-1}.

(B) MLT^{-1}.

(C) ML^2T^{-2}.

(D) $M^2L^2T^{-1}$.

8. A body moves in a circular path with constant speed. Which of the following statements is true ?

(A) Velocity is constant.

(B) Acceleration is zero.

(C) There is no force acting on the body.

(D) The body has a centripetal acceleration.

9. The force required to keep a body moving in a circular path is called :

(A) Centripetal force.

(B) Centrifugal force.

(C) Inertial force.

(D) Gravitational force.

10. A convex lens of focal length 20 cm is used to form an image of an object placed 40 cm away. The image formed is :

(A) Virtual and erect.

(B) Real and inverted.

(C) Virtual and inverted.

(D) Real and erect.

11. The phenomenon of light bending around obstacles and spreading into the geometrical shadow region is known as :

(A) Reflection.

(B) Refraction.

(C) Diffraction.

(D) Interference.

12. Which of the following optical instruments uses a pair of convex lenses ?

(A) Microscope. (B) Telescope.

(C) Both (A) and (B). (D) None of these.

13. The unit of the refractive index is :

(A) m/s. (B) Unitless.

(C) Hz. (D) m.

14. The speed of light in a medium of refractive index 1.5 is approximately :

(A) 2×10^8 m/s. (B) 3×10^8 m/s.

(C) 4.5×10^8 m/s. (D) 1.5×10^8 m/s.

15. The focal length of a plane mirror is :

(A) Infinite. (B) Zero.

(C) Negative. (D) 25 cm.

16. The unit of electric field is :

(A) V/m. (B) N/C.

(C) Both (A) and (B). (D) Wb/m.

17. The SI unit of magnetic flux is:

(A) Weber. (B) Tesla.

(C) Gauss. (D) Henry.

18. Faraday's law of electromagnetic induction states that the induced emf in a circuit is proportional to :

(A) Rate of change of electric field.

(B) Rate of change of magnetic flux.

(C) Rate of change of current.

(D) Resistance of the circuit.

19. A transformer works on the principle of :

(A) Electrostatic induction. (B) Electromagnetic induction.

(C) Self-induction. (D) Mutual capacitance.

20. The force between two parallel current-carrying wires is :

(A) Attractive if currents are in the same direction.

(B) Repulsive if currents are in the same direction.

(C) Zero always.

(D) None of the above.

21. A concave mirror with focal length 10 cm forms an image at 30 cm from the mirror. The object distance is :

(A) 15 cm. (B) 20 cm.

(C) 30 cm. (D) 40 cm.

22. According to Einstein's special theory of relativity, the speed of light in a vacuum is :

(A) Constant for all observers.

(B) Varies with the observer's motion.

(C) Depends on the source's velocity.

(D) Infinite.

23. The phenomenon where time slows down for a moving observer is called :

(A) Length contraction. (B) Time dilation.

(C) Gravitational redshift. (D) Doppler effect.

24. The Schwarzschild radius is associated with :

(A) White dwarfs. (B) Neutron stars.

(C) Black holes. (D) Galaxies.

25. The general theory of relativity explains :

(A) Motion at constant velocity.

(B) The wave nature of light.

(C) Gravity as the curvature of spacetime.

(D) The uncertainty principle.

26. What is the primary source of energy in stars ?

(A) Chemical reactions. (B) Nuclear fission.

(C) Nuclear fusion. (D) Gravitational collapse.

27. The cosmic microwave background radiation is evidence for :

(A) The steady-state theory. (B) The Big Bang theory.

(C) The existence of black holes. (D) Dark matter.

28. Gravitational waves were first directly detected by :

(A) Hubble Space Telescope. (B) LIGO.

(C) CERN. (D) Kepler Space Observatory.

29. The escape velocity from a celestial body depends on :

(A) Its temperature. (B) Its mass and radius.

(C) Its rotation speed. (D) Its surface composition.

30. The redshift of light from distant galaxies indicates that the universe is :

(A) Contracting. (B) Static.

(C) Expanding. (D) Rotating.

31. The equivalence principle states that :

(A) Mass and energy are equivalent.

(B) Gravity and acceleration are indistinguishable.

(C) All reference frames are equivalent.

(D) The speed of light is variable.

32. The Bohr model of the atom explains :

(A) Electron orbits as fixed energy levels.

(B) Wave nature of electrons.

(C) Quantum entanglement.

(D) Uncertainty principle.

33. The Heisenberg uncertainty principle states that :

(A) We can measure position and momentum precisely.

(B) We cannot measure energy and time simultaneously.

(C) The speed of light is always constant.

(D) Electrons follow definite paths.

34. The Pauli exclusion principle applies to :

(A) Bosons only.
(B) Fermions only.
(C) All particles.
(D) Charged particles only.

35. Which of the following is a state function ?

(A) Work.
(B) Heat.
(C) Internal Energy.
(D) None of the above.

36. The first law of thermodynamics is a statement of :

(A) Conservation of mass.
(B) Conservation of energy.
(C) Conservation of momentum.
(D) None of the above.

37. Which thermodynamic process occurs at constant pressure ?

(A) Isothermal.
(B) Isobaric.
(C) Isochoric.
(D) Adiabatic.

38. The efficiency of a Carnot engine depends on :

(A) The working substance.
(B) The temperatures of the hot and cold reservoirs.
(C) The amount of heat supplied.
(D) The type of fuel used.

39. The specific heat of an ideal gas in an isothermal process is :

(A) Zero.
(B) Infinite.
(C) Equal to the gas constant.
(D) None of the above.

40. Which of the following laws states that energy cannot be created or destroyed ?

(A) Zeroth law.
(B) First law.
(C) Second law.
(D) Third law.

41. Which process is characterized by no heat exchange with surroundings ?

(A) Isothermal.
(B) Isochoric.
(C) Isobaric.
(D) Adiabatic.

42. The Carnot cycle consists of how many processes ?

(A) Two. (B) Three.

(C) Four. (D) Five.

43. The second law of thermodynamics introduces the concept of :

(A) Enthalpy. (B) Internal energy.

(C) Entropy. (D) Work.

44. Which of the following is a characteristic of a crystalline solid ?

(A) Random atomic arrangement. (B) Long-range periodic order.

(C) No definite melting point. (D) Amorphous structure.

45. The packing efficiency of a face-centered cubic (FCC) structure is :

(A) 52 %. (B) 68 %.

(C) 74 %. (D) 100 %.

46. Which type of bonding is predominant in diamond ?

(A) Ionic. (B) Metallic.

(C) Covalent. (D) Van der Waals.

47. What is the main function of a transistor in an electronic circuit ?

(A) To store charge. (B) To amplify signals.

(C) To provide resistance. (D) To generate voltage.

48. The term "phonon" refers to :

(A) A quantum of sound wave. (B) A type of photon.

(C) A nuclear particle. (D) A charged ion.

49. The specific heat of an ideal gas in an isothermal process is :

(A) Zero. (B) Infinite.

(C) Equal to the gas constant. (D) None of the above.

50. Which of the following laws states that energy cannot be created or destroyed ?

(A) Zeroth law. (B) First law.

(C) Second law. (D) Third law.

51. The Debye temperature is associated with :

(A) Electrical conductivity.
(B) Heat capacity of solids.
(C) Magnetic permeability.
(D) Optical transparency.

52. The Fermi energy of a metal determines :

(A) The lowest occupied energy level.
(B) The highest occupied energy level at absolute zero.
(C) The probability of electron transitions.
(D) The strength of metallic bonding

53. Which of the following particles is a lepton ?

(A) Proton.
(B) Neutron.
(C) Electron.
(D) Alpha particle.

54. What is the approximate binding energy per nucleon of an iron nucleus ?

(A) 2 MeV.
(B) 5 MeV.
(C) 8 MeV.
(D) 12 MeV.

55. Which fundamental force is responsible for beta decay ?

(A) Strong nuclear force.
(B) Weak nuclear force.
(C) Electromagnetic force.
(D) Gravitational force.

56. The quark content of a neutron is :

(A) uud.
(B) udd.
(C) ddu.
(D) udu.

57. The energy released in nuclear fission is primarily due to :

(A) Binding energy difference.
(B) Electron transitions.
(C) Proton-proton collisions.
(D) Gravitational effects.

58. What is the charge of a neutrino ?

(A) + 1.
(B) − 1.
(C) 0.
(D) + 2.

59. Which of the following is a boson ?

(A) Electron. (B) Neutron.

(C) Photon (D) Proton

60. Which isotope is commonly used in nuclear reactors as fuel ?

(A) ^{235}U. (B) ^{238}U.

(C) ^{40}K. (D) ^{14}C.

61. What is the antiparticle of an electron called ?

(A) Neutrino. (B) Positron.

(C) Muon. (D) Tau.

62. Which conservation law prohibits proton decay in the Standard Model ?

(A) Baryon number conservation.

(B) Lepton number conservation.

(C) Charge conservation.

(D) Energy conservation.

63. Which of the following particles is affected by the strong nuclear force ?

(A) Photon. (B) Electron.

(C) Neutron. (D) Neutrino.

64. Which quarks make up a proton ?

(A) uud. (B) udd.

(C) ddu. (D) udu.

65. What is the rest mass energy of an electron ?

(A) 0.511 MeV. (B) 1.02 MeV.

(C) 105 MeV. (D) 938 MeV.

66. The Higgs boson gives particles :

(A) Charge. (B) Spin.

(C) Mass. (D) Energy.

67. The energy of a photon is given by :

(A) $E = mc^2$.

(B) $E = hf$.

(C) $E = mv^2$.

(D) $E = p^2/2m$.

68. Which of the following experiments confirmed the particle nature of light ?

(A) Young's double-slit experiment.

(B) Michelson-Morley experiment.

(C) Photoelectric effect.

(D) Davisson-Germer experiment.

69. The Compton effect demonstrates :

(A) The wave nature of light.

(B) The particle nature of electrons.

(C) The wave-particle duality of light.

(D) The existence of the neutron.

70. The rest mass of a photon is :

(A) Zero.

(B) Infinite.

(C) h/c.

(D) mc^2.

71. In the Bohr model of the hydrogen atom, the quantization of angular momentum is given by :

(A) $L = nh$.

(B) $L = n\hbar$.

(C) $L = nh/2\pi$.

(D) $L = mvr$.

72. The uncertainty principle is given by :

(A) $\Delta E \, \Delta t \geq \hbar/2$.

(B) $\Delta x \, \Delta p \geq \hbar/2$.

(C) Both (A) and (B).

(D) None of the above.

73. Which scientist proposed the wave nature of electrons ?

(A) Heisenberg.

(B) Bohr.

(C) De Broglie.

(D) Planck.

74. The wavelength of matter waves associated with a moving particle is given by :

(A) $\lambda = h/mv$. (B) $\lambda = mv/h$.

(C) $\lambda = h/p$. (D) $\lambda = p/h$.

75. In nuclear reactions, the total :

(A) Energy is conserved. (B) Mass is conserved.

(C) Mass-energy is conserved. (D) None of the above.

76. The concept of space-time and the relativity of simultaneity were introduced by :

(A) Newton. (B) Einstein.

(C) Maxwell. (D) Schrödinger.

77. The electric potential at a point due to a point charge Q is given by :

(A) $V = \frac{Q}{4\pi\varepsilon_0 r}$. (B) $V = \frac{4\pi\varepsilon_0 Q}{r}$.

(C) $V = \frac{Qr}{4\pi\varepsilon_0}$. (D) $V = \frac{Q}{r^2}$.

78. Gauss's law states that the total electric flux through a closed surface is proportional to :

(A Charge outside the surface.

(B) Charge inside the surface.

(C) Both inside and outside charges.

(D) The shape of the surface.

79. The capacitance of a parallel plate capacitor depends on :

(A) Plate area and separation. (B) Voltage applied.

(C) Charge stored. (D) None of the above.

80. The SI unit of magnetic field strength is :

(A) Tesla (T). (B) Ampere (A).

(C) Newton per meter (N/m). (D) Coulomb (C).

81. The Biot-Savart law is used to determine :

(A) Electric field due to a charge.

(B) Magnetic field due to a current element.

(C) Magnetic force on a moving charge.

(D) Capacitance of a capacitor.

82. The force per unit length between two parallel current-carrying conductors is given by :

(A) $\frac{\mu_0 I_1 I_2}{2\pi d}$.

(B) $\frac{\mu_0 I_1 I_2}{\pi d}$.

(C) $\frac{\mu_0 I_1 I_2}{4\pi d}$.

(D) $\frac{\mu_0 I_1 I_2}{d}$.

83. The magnetic field inside a long solenoid is :

(A) Proportional to current and number of turns per unit length.

(B) Inversely proportional to current.

(C) Zero.

(D) Independent of current.

84. A charged particle moves perpendicular to a uniform magnetic field. Its path will be :

(A) A straight line.

(B) A parabola.

(C) A circle.

(D) An ellipse.

85. The average kinetic energy of a gas molecule is directly proportional to :

(A) Pressure.

(B) Temperature.

(C) Volume.

(D) Number of molecules.

86. According to the kinetic theory of gases, temperature is a measure of :

(A) The total energy of a gas.

(B) The average kinetic energy per molecule.

(C) The potential energy of a gas.

(D) The momentum of a gas molecule.

87. The root mean square (r.m.s.) speed of gas molecules is given by :

(A) $\sqrt{\frac{3k_BT}{m}}$.

(B) $\sqrt{\frac{k_BT}{m}}$.

(C) $\sqrt{\frac{2k_BT}{m}}$.

(D) $\sqrt{\frac{3m}{k_BT}}$.

88. The degrees of freedom of a diatomic gas (neglecting vibrational motion) are :

(A) 3.

(B) 5.

(C) 6.

(D) 7.

89. The equipartition theorem states that each quadratic degree of freedom contributes how much energy per molecule ?

(A) $\frac{1}{2}k_BT$.

(B) k_BT.

(C) $\frac{3}{2}k_BT$.

(D) $\frac{5}{2}k_BT$.

90. Maxwell's velocity distribution law describes :

(A) The distribution of velocities in a gas.

(B) The motion of solid particles.

(C) The electric field in a conductor.

(D) The pressure of a liquid.

91. The entropy of an ideal gas :

(A) Decreases with increasing volume.

(B) Increases with increasing temperature.

(C) Remains constant during an isothermal expansion.

(D) Is independent of temperature.

92. The partition function is used in statistical mechanics to calculate :

(A) Entropy.
(B) Internal energy.
(C) Free energy.
(D) All of the above.

93. Bose-Einstein condensation occurs in :

(A) Fermions at high temperature.
(B) Bosons at low temperature.
(C) Classical gases.
(D) Metals at room temperature.

94. Which of the following is a unidirectional device ?

(A) Resistor.
(B) Inductor.
(C) Diode.
(D) Capacitor.

95. The output of a NOT gate is :

(A) Always HIGH.
(B) Always LOW.
(C) The same as the input.
(D) The complement of the input.

96. In an NPN transistor, the majority charge carriers in the base are :

(A) Electrons.
(B) Holes.
(C) Both electrons and holes.
(D) None of the above.

97. The unit of capacitance is :

(A) Henry.
(B) Ohm.
(C) Farad.
(D) Tesla.

98. The purpose of a Zener diode in a circuit is to :

(A) Rectify AC signals.
(B) Amplify signals.
(C) Provide voltage regulation.
(D) Generate oscillations.

99. The function of a transformer in an electronic circuit is to :

(A) Convert AC to DC.

(B) Increase or decrease voltage levels.

(C) Store electrical energy.

(D) Regulate current flow

100. The Boolean expression for an AND gate with two inputs A and B is :

(A) $A + B$.

(B) $A \cdot B$.

(C) $A \oplus B$.

(D) $\bar{A} + B$.