Reg. No.......................................

Date of Examination.....................

U.G./P.G. ENTRANCE EXAMINATION, APRIL 2021

PHYSICS/RADIATION PHYSICS

Time : Two Hours

Maximum : 100 Marks

Instructions to Candidates

- Candidates are provided with a Question Booklet and an Optical Marker Reader (OMR) answer sheet to mark the responses.

- Write the Register number and Date of the Examination in the space provided on the top of this booklet.

- Read carefully all the instructions given in the OMR sheet.

- Each correct answer carries 2 marks. For each wrong answer one-third of the mark for that question will be deducted.

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1. In digital computer systems, which number systems is preferred for arithmetic circuits :

   (a) Unsigned binary numbers.

   (b) Sign-magnitude numbers.

   (c) 1's complement binary numbers.

   (d) 2's complement binary numbers.

2. In a Michelson interferometer :

   (a) One concave lens and two plane mirrors are used.

   (b) One half silvered glass plate and two concave mirrors are used.

   (c) One half silvered glass plate and two plane mirrors are used.

   (d) One half silvered glass plate and two convex lens are used.

3. The interference phenomenon is shown by :

   (a) Both longitudinal and transverse waves.

   (b) Longitudinal waves only.

   (c) Transverse waves only.

   (d) None of these.

4. The width of the central bright fringe of the image of Fraunhofer's diffraction experiment with a source wavelength 600 mn. and slit width 0.8 mm. is :

   (a) 1 mm.   (b) 2 mm.

   (c) 3 mm.   (d) 4 mm.

5. In a Fraunhofer's diffraction experiment, the intensity of the central bright fringe when the slit width is decreased :

   (a) Decreases initially then increases.

   (b) Increases initially then decreases.

   (c) Increases.

   (d) Decreases.

6. Snell's law relates :

    (a) Light reflection.   (b) Light transmission.

    (c) Light refraction.   (d) Light Absorption.

7. A polariser is used to :

    (a) Reduce intensity of light.   (b) Produce polarised light.

    (c) Increase intensity of light.   (d) Produce unpolarised light.

8. The transverse nature of light is shown by :

    (a) Polarisation of light.   (b) Dispersion of light.

    (c) Interference of light.   (d) Refraction of light.

9. A rigid diatomic molecule is free to rotate in a fixed plane. The rotational energy eigen values are given by :

    (a) $\dfrac{\hbar m^2}{2I}$.   (b) $\dfrac{\hbar^2 I}{2m}$.

    (c) $\dfrac{2mI}{\hbar^2}$.   (d) $\dfrac{mI}{2\hbar^2}$.

10. If $\psi = A \exp\left(\dfrac{-\alpha x^2}{2}\right)\exp\left(\dfrac{iEt}{\hbar^2}\right)$ is a normalized wave function, the value of A is :

    (a) 1.   (b) 0.

    (c) $\alpha/2$.   (d) $\left(\dfrac{\pi}{a}\right)^{(-1/4)}$

11. Let ϕ_1 and ϕ_2 be orthonormal functions, find the value of n which normalizes the function $f = n\left(\phi_1 + 2i\phi_2\right)$:

    (a) $1 + 2i$.   (b) $1/(1 + 2i)$.

    (c) $1/5$.   (d) $1/\sqrt{5}$.

12. The minimum intensity of light to be detected by human eye is 10^{-10} W/m^2. The number of photons of wavelength 5.6×10^{-7} m. entering the eye with pupil area 10^{-6} m^2. per second for vision will be nearly :

   (a)   100.   (b)   200.

   (c)   300.   (d)   400.

13. The de-Broglie wavelength of a particle accelerated with 150 V potential is 10^{-10} m. If it is accelerated by 600 V, its wavelength (in Å) will be :

   (a)   0.25.   (b)   0.5.

   (c)   1.5.   (d)   2.

14. The degree of degeneracy of the energy level $19\,\hbar^2/(ma^2)$ of a particle in a cubic potential box of side α is :

   (a)   3.   (b)   6.

   (c)   9.   (d)   12.

15. The energy contained in a small volume through which an electromagnetic wave is passing, oscillates with :

   (a)   Zero frequency.

   (b)   The frequency of the wave.

   (c)   Half the frequency of the wave.

   (d)   Double the frequency of the wave.

16. An electromagnetic wave going through vacuum is described by $E = E_0 \sin (kx - wt)$, $B = B_0 \sin (kx - wt)$, then :

   (a) $E_0 k = B_0 w$.   (b) $E_0 B_0 = wk$.

   (c) $E_0 w = B_0 k$.   (d)   None of these.

17. A plane electromagnetic wave is incident on a material surface. The wave delivers momentum p and energy E.

   (a) $p = 0, E \neq 0$.   (b) $p \neq 0, E = 0$.

   (c) $p \neq 0, E \neq 0$.   (d) $p = 0, E = 0$.

18. A free electron is placed in the path of a plane electromagnetic wave. The electron will start moving :

    (a)   Along the electric field.

    (b)   Along the magnetic field.

    (c)   Along the direction of the propagation of the wave.

    (d)   In a plane containing the magnetic field and the direction of propagation.

19. An electric dipole is placed in a uniform electric field. The net electric force on the dipole.

    (a)   Is always zero.

    (b)   Depends on the orientation of the dipole.

    (c)   Can never be zero.

    (d)   Depends on the strength of the dipole.

20. If the moment of inertia of a thin circular disc with respect to the axis passing though the plane of the disc is I, then the moment of inertia about an axis normal to the plane will be :

    (a)   41.   (b)   21.

    (c)   1/2.   (d)   1/4.

21. If the external force acting on a system of particles is zero :

    (a)   Total momentum is a constant.

    (b)   Momenta of individual particles is a constant.

    (c)   Total energy is a constant.

    (d)   Total momentum and energy cannot be a constant.

22. If angular momentum is a constant of motion :

    (a)   Torque is zero.   (b)   Force is conservative.

    (c)   Both (a) and (b).   (d)   None of these.

23. The escape velocity from the surface of earth is 11.2 km/s. The escape velocity of particle projected from a satellite revolving round the earth at a distance of 6000 km. above the surface of earth will be approximately.

    (a)   5 km/s.   (b)   8 km/s.

    (c)   11 km/s.   (d)   14 km/s.

24. The number of degree freedom for a particle moving on the circumference of a circle is :

    (a) 1.   (b) 2.

    (c) 3.   (d) 4..

25. Five Coulombs of charge are placed on a thin-walled conducting shell. Once the charge has come to rest, the electric potential inside the hollow conducting shell is found to be :

    (a) Zero.

    (b) Uniform inside the sphere and equal to the electric potential on the surface of the sphere.

    (c) Smaller than the electric potential outside the sphere.

    (d) Varying as one over r squared.

26. An infinitely long wire carries a current of three amps. The magnetic field outside the wire :

    (a) Points radially away from the wire.

    (b) Points radially inward.

    (c) Circles the wire.

    (d) Is zero.

27. A converging thin lens has a focal length of 27 centimeters. An object is placed 9 centimeters from the lens. Where is the image of this object formed ?

    (a) – 13.5 cm.   (b) – 23.5 cm.

    (c) – 33.5 cm.   (d) – 43.5 cm.

28. When a physical property such as charge exists in discrete "packets" rather than in continuous amounts, the property is said to be :

    (a) Discontinuous.   (b) Abrupt.

    (c) Quantized.   (d) Non-continuous.

29. The Millikan experiment showed that electric charge was :

    (a) Negative.   (b) Quantized.

   (c) Positive.   (d) Unmeasurable.

30. Two radioactive isotopes P and Q have half-lives of 10 minutes and 15 minutes respectively. Freshly prepared samples of each isotope initially contain the same number of atoms. After 30 minutes what is the ratio of number of atoms of P to that of Q $\left(\dfrac{N_P}{N_Q}\right)$?

    (a) 1.

    (b) 2.

    (c) 1.5.

    (d) 0.5.

31. The mass number A must be conserved in a nuclear reaction. This is a special case of a more general conservation rule. Which ?

    (a) Baryon number.

    (b) Charge.

    (c) Energy.

    (d) Mass.

32. Why do we have decay with alpha emission but not with proton emission ?

    (a) The proton is too light.

    (b) The proton has too small charge.

    (c) The alpha-is loosely bound.

    (d) The alpha-particle has high binding energy per nucleon.

33. In the binding energy B (Z, A) formula, the pairing term is proportional to :

    (a) A.

    (b) $A^{-3/4}$.

    (c) $A^{-1/3}$.

    (d) $A^{2/3}$.

34. In the binding energy B (Z, A) formula, the pairing term will be zero in the case of :

    (a) Even-even nuclei.

    (b) Odd-odd nuclei.

    (c) Even-odd nuclei.

    (d) None of these.

35. Fundamental or elementary particles are particles that aren't made up of smaller particles. What is the most common type of fundamental particle in the universe ?

    (a) Atom.

    (b) Meson.

    (c) Neutrino.

    (d) Quark.

36. ———— lines are of longer wavelength than that of exciting radiation responsible for the Raman effect.

    (a) Lymen.

    (b) Anti-Stokes.

    (c) Balmer.

    (d) Stokes.

37. ————— laser is used for the treatment in diabetic retinopathy.

    (a) Ruby.

    (b) Diode laser.

    (c) CO_2 laser.

    (d) Nd : YAG.

38. Carbon dioxide laser was invented by :

    (a) C. V. Raman.

    (b) K. P. Patel.

    (c) Kumar Patel.

    (d) Edison.

39. Transition temperature of mercury is :

    (a) 4.2°C.

    (b) 4.2 K.

    (c) 2.3 K.

    (d) 77 K.

40. Meissner effect tells the superconductors are :

    (a) Dielectric.

    (b) Paramagnetic.

    (c) Ferroelectric.

    (d) Diamagnetic.

41. Which of the following statements are True ?

    A. Bosons does not obey Pauli exclusion principle.

    B. Bosons are in general spin 1 particles.

    (a) Only A.

    (b) Only B.

    (c) Both (A) and (B).

    (d) None.

42. In a first order phase transition, at the transition temperature :

    (a) Entropy and specific volume show discontinuity.

    (b) Entropy and specific volume are continuous.

    (c) Gibbs energy show discontinuity.

    (d) Gibbs energy and entropy show discontinuity.

43. A Carnot engine takes in a thousand kilocalorie of heat from a reservoir at 627° C and exhausts it to a sink at 27°C. What is its efficiency ?

    (a) 100 %.

    (b) 66 %.

    (c) 33 %.

    (d) 25 %.

44. A black body at 27°C surrounds another black body at – 73°C. The net heat transferred from the body at higher temperature in Joules per second per square metre is ($\sigma = 5.67 \times 10^{-8}$ S.I. units).

    (a) 370.

    (b) 220.

    (c) 90.

    (d) 10.

45. In general, the particles for which their wave functions overlap to a negligible extent, will obey.

    (a) Maxwell - Boltzmann Statistics.

    (b) Fermi - Dirac statistics.

    (c) Bose - Einstein statistics.

    (d) None of these.

46. The average energy per degree of freedom for any classical particle in thermal equilibrium system at a temperature T is (k is Boltzmann constant).

    (a) 0.   (b) 1.

    (c) $\frac{3}{2}kT$.   (d) $\frac{1}{2}kT$.

47. When the temperature of a radiating black body increases, the maximum intensity of radiation ?

    (a) Shifts towards the longer wavelength.

    (b) Shifts towards the shorter wavelength.

    (c) Remains unaffected.

    (d) Depends on the ambient temperature.

48. Find the voltage and current through the Zener diode ($R_s = 270\ \Omega$, $V_z = 10\ V$ and $R_L = 1\ k\Omega$).
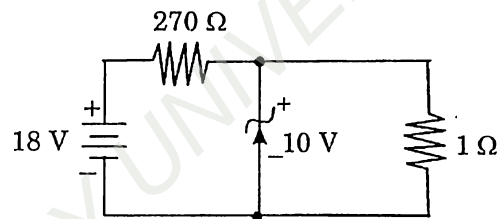
    (a) 18 V and 10 mA.   (b) 10 V and 10 mA.

    (c) 8 V and 1 mA.   (d) 9 V and 19.6 mA.

49. A photo diode is normally :

    (a) Forward biased.   (b) Reverse biased.

    (c) Neither forward nor reverse biased.

    (d) Emitting light.

50. Which of the following has a negative-resistance region ?

    (a) Tunnel diode.   (b) Step-recovery diode.

    (c) Shottkey diode.   (d) Opto-coupler.