M/P ENT. – 07

Total No. of Pages : 12

Seat No.	

M.Phil / Ph.D. Entrance Examination, May - 2019
PHYSICS (Special Drive)

Day and Date : Tuesday, 21 - 05 - 2019 **Total Marks : 100**
Time : 01.00 p.m. to 03.00 p.m.

Instructions :

1) **All questions are compulsory.**
2) **Each question carries 2 mark.**
3) **Answers should be marked in the given OMR answer sheet by darkening the appropriate option.**
4) **Use black pen only for marking the circle. Do not make any stray mark on the Answer Sheet.**
5) **Follow the instructions given on OMR Sheet.**
6) **Rough work should be done on the sheet provided at the end of question paper.**
7) **Only non-programmable calculators are allowed.**

1) An atom with one outer electron having orbital angular momentum l is placed in a weak magnetic field. The number of energy levels into which the higher total angular momentum state splits is

a) $2l + 2$ b) $2l + 1$

c) $2l$ d) $2l - 1$

2) The ground state of sodium atom (^{11}Na) is a $^2S_{½}$ state. The difference in energy levels arising in the presence of a weak magnetic field B. given in terms of Bohr magneton. μ_B is

a) $\mu_B B$ b) $2\mu_B B$

c) $4\mu_B B$ d) $6\mu_B B$

P.T.O.

3) Transition for the sodium D_2 line (589.0 nm) is

a) $^2P_{3/2} \rightarrow ^2S_{1/2}$ b) $^2P_{1/2} \rightarrow ^2S_{1/2}$

c) $^2D_{3/2} \rightarrow ^2P_{1/2}$ d) $^2D_{3/2} \rightarrow ^2P_{3/2}$

4) What is the ground state of a helium atom

a) $^2P_{½}$ b) $^2S_0$

c) $^1S_{½}$ d) $^2S_0$

5) Example of a non-central force is

a) Gravitational force $-\frac{Gm_1m_2}{r^2}\hat{r}$

b) Coulomb force $\frac{z_1z_2}{r^2}\hat{r}$

c) Hooke law $kr\bar{r}$

d) Dipole - dipole interaction $\frac{\bar{p}.\bar{r}}{r^3}$ where $\bar{p}$ is the dipole moment

6) A particle is placed in a region with the potential $V(x) = \frac{1}{2}kx^2 + \frac{\lambda}{3}x^3$ where k, λl > 0.

Then,

a) $x = 0$ and $x = k/\lambda$ are points of stable equilibrium

b) $x = 0$ is a point of stable equilibrium and $x = k/\lambda$ is a point of unstable equilibrium

c) $x = 0$ and $x = k/\lambda$ are points of unstable equilibrium

d) There are no points of the stable or unstable equilibrium

7) A particle of mass m moves in a potential $V(x) = \frac{1}{2}m\omega^2x^2 + \frac{1}{2}m\mu v^2$ where *X* is the position coordinate, v is the speed, and ω and μ are constants. The canonical (conjugate) momentum of the particle is

a) $p = m(1 + \mu)v$ b) $p = mv$

c) $p = m\mu v$ d) $p = m(1 - \mu)v$

8) The Lagrangian of a particle of mass m is

$L = \frac{m}{2}\left[\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{da}{dt}\right)^2\right] - \frac{V}{2}\left(x^2 + y^2\right) + W \sin \omega t$, where V, W and ω are constants. The conserved quantities are

a) Energy and z-component of linear momentum only

b) Energy and z-component of angular momentum only

c) z-component of linear and angular momenta only

d) Energy and z-component of both linear and angular momenta

9) An electron enters a uniform electric field region with its velocity perpendicular to the direction of the field. In the field region, the trajectory of the electron is

a) linear

b) Circular

c) parabolic

d) helical

10) Electric field at large distance r, from the electric dipole is proportional to

a) r^2

b) r^{-2}

c) r^{-3}

d) r^{-4}

11) A circularly polarized monochromatic plane wave is incident on a dielectric interface at Brewster angle. Which one of the following statements is correct?

a) The reflected light is plane polarized in the plane of incidence and the transmitted light is circularly polarized

b) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is plane polarized in the plane of incidence

c) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is elliptically polarized

d) There will be no reflected light and the transmitted light is circularly polarized

12) For the complex function, $f(z)=\dfrac{e^{\sqrt{z}}-e^{-\sqrt{z}}}{\sin\left(\sqrt{z}\right)}$, which of the following statement is correct?

a) z = 0 is branch point
b) z = 0 is a pole of order one
c) z = 0 is a removable singularity
d) z = 0 is an essential singularity

13) Two matrices A and B are said to be similar if $B = P^{-1}AP$ for some invertible matrix P. which of the following statements is not true?

a) Det A = Det B
b) Trace of A = Trace of B
c) A and B have the same eigen vectors
d) A and B have the same eigen values

14) The complex function $f(z) = z$ is singular at

a) $z = \infty$ b) $z = 0$
c) $z = 1$ d) $z = i$

15) The value of the integral $\oint \dfrac{e^2 \sin(z)}{z^2} dz$, where the counter C is the unit circle: $|z - 2| = 1$

a) $2\pi i$ b) $4\pi i$
c) πi d) 0

16) Match the reactions on the left with the associated interactions on the right

(1) $\pi^+ \rightarrow \mu^+ + \nu_\mu$ (i) Strong
(2) $\pi^0 \rightarrow \gamma + \gamma$ (ii) Electromagnetic
(3) $\pi^0 + n \rightarrow \pi^- + p$ (iii) Weak

a) (1,iii), (2,ii), (3,i)
b) (1,i), (2,ii), (3,iii)
c) (1 ,ii), (2,i), (3,iii)
d) (1 ,iii), (2,i), (3,ii)

17) Choose the correct statements from the following

a) Neutron interacts through electromagnetic interaction

b) Electron does not interact through weal interactions

c) Neutrino interacts through weal and electromagnetic interaction

d) Quark interacts through strong interactions but not through weal interaction

18) The isospin (I) and baryon number (B) of the up quark is

a) I = 1, B = 1 b) I =1, B = 1/3

c) I = 1/2, B = 1 d) I = 1/2, B = 1/3

19) Which of the following is violated by a β-decay phenomenon

a) Energy conservation

b) Momentum conservation

c) Angular momentum conservation

d) Parity conservation

20) The value of α for which ψ_2 is orthogonal to ψ_1 is

a) 2 b) 1

c) -1 d) -2

21) The stationary eigenfunction for Hamiltonian of a particle of mass m in one dimensional potential V(x) is given to be:

$\psi(x) = A\exp(-bx^2/2)$.

Where A and b are real positive constants. It follows that:

a) $V(x)$ = Constant b) $V(x) \propto 1/x$

c) $V(x) \propto x^2$ d) $V(x) \propto x^3$

22) If the ϕ dependent part of eigen function of an electron in hydrogen atom is $e^{2i\phi}$. then the minimum principle and minimum angular momentum quantum numbers n and l respectively for this eigenfunction will be

a) $n = 3, l = 2$ b) $n = 2, l = 2$

c) $n = 2, l = 1$ d) $n = 1, l = 2$

23) Consider a system of two non-interacting classical particles which can occupy any of the three energy values E = 0, ε and 2ε having degeneracies $g(E) = 1.\ 2$ and 4 respectively. The mean energy of the system is

a) $\varepsilon \dfrac{4e^{-\varepsilon/kT} + 8e^{-2\varepsilon/kT}}{1 + 2e^{-\varepsilon/kT} + 4e^{-2\varepsilon/kT}}$

b) $\varepsilon \dfrac{2e^{-\varepsilon/kT} + 8e^{-2\varepsilon/kT}}{1 + 2e^{-\varepsilon/kT} + 4e^{-2\varepsilon/kT}}$

c) $\varepsilon \left[\dfrac{2e^{-\varepsilon/kT} + 4e^{-2\varepsilon/kT}}{1 + 2e^{-\varepsilon/kT} + 4e^{-2\varepsilon/kT}} \right]^2$

d) $\varepsilon \dfrac{e^{-\varepsilon/kT} + 2e^{-2\varepsilon/kT}}{1 + e^{-\varepsilon/kT} + e^{-2\varepsilon/kT}}$

24) Thermodynamic variables of the system can be volume V, pressure P, temperature T, number of particles N, internal energy E and chemical potential μ, etc. For a system to be specified by Microcanonical (MC), Canonical (CE) and Grand canonical (GC) ensembles, the parameters required for the respective ensembles are:

a) MC : (N,V.T); CE : (E,V,N); GC : (VT,μ)
b) MC : (E,V,N); CE : (N,V,T); GC : (V,T,μ)
c) MC : (T,V,μ); CE : (N,V,T); GC : (E,V,N)
d) MC : (E,V,N); CE : (V,T,μ); GC : (N,V,T)

25) The wavefunctions of two identical particles in states *n* and *s* are given by $\phi_n(r_1)$ and $\phi_s(r_2)$ respectively. The particles obey Maxwell-Boltzmann statistics. The state of the combined two particle system is expressed as

a) $f_n(r_1) + f_s(r_2)$

b) $\dfrac{1}{\sqrt{2}}[f_n(r_1) f_s(r_2) + f_n(r_2) f_s(r_1)]$

c) $\dfrac{1}{\sqrt{2}}[f_n(r_1) f_s(r_2) - f_n(r_2) f_s(r_1)]$

d) $f_n(r_1) f_s(r_2)$

26) Which of the following is the first step in starting the research process?

a) Searching sources of information to locate problem.
b) Survey of related literature
c) Searching for solutions to the problem
d) Identification of problem

27) What is a Patent?

a) An agreement between the inventor and the Government

b) An agreement to the Government

c) Document of the library

d) An agreement between library and Publisher

28) Article published in research journal are _____

a) Primary sources b) Reference sources

c) Tertiary sources d) Secondary sources

29) What is deemed a good measure of the quality of a journal?

a) The impact factor b) Citations

c) h-index d) i-10 index

30) Testing hypothesis is a

a) inferential statistics b) descriptive statistics

c) data preparation d) data analysis

31) Both the current and potential are varied in _____ mode of electrodeposition.

a) Potentiodynamic b) Galvonostatic

c) Potentiostatic d) None of these

32) Which type of ground wave travels over the earth surface by acquiring direct path through air from transmitting to receiving antennas?

a) Surface wave b) Space wave

c) Both surface & space d) None of the above

33) In thermo gravimetric analysis (TGA), the change in weight of the sample may occur due to

a) Gas desorption b) Decomposition

c) Chemisorption d) All of above

34) In Laue x-ray diffraction method the conditions are:

a) Monochromatic Beam. Variable Angle

b) Monochromatic Beam. Fixed Angle

c) Polychromatic Beam. Variable Angle

d) Polychromatic Beam. Fixed Angle

35) The scanning electron microscope (SEM) has a magnification that ranges from:

a) 10x to 10,000x

b) 100x to 10,000x

c) 1x to 100x

d) 10x to 10,000x

36) XRD intensity depends upon

a) Crystal Structure

b) Atomic positions

c) Occupancies

d) All of above

37) X-rays are used for studying crystal structure of solids because

a) They have very high energy, hence they can penetrate through solids

b) They are electromagnetic radiation, and hence do not interact with matter

c) Their wavelengths are comparable to inter-atomic distances

d) Their high frequency enables rapid analysis

38. The wavenumber of a transition is 1500 cm^{-1}. In what part of the electromagnetic spectrum does this come?

a) Microwave

b) Infrared

c) Ultraviolet-visible

d) Radiowave

39) In spray pyrolysis technique solution is converted into fine droplets according to which principle?

a) Bernoulli's

b) Archimedes

c) Siphon
d) Stokes

40. The important deposition parameters involved in hydrothermal method of thin film deposition are

a) Temperature and pressure
b) Temperature and time
c) Temperature and solvent
d) Pressure and time

41. Which antennas are renowned as patch antennas especially adopted for space craft applications?

a) Aperture
b) Array
c) Lens
d) Microstrip

42) When an electromagnetic wave travels from transmitter to receiver, which factor/s affect/s the propagation level?

a) Curvature of earth
b) Roughness of earth
c) Magnetic field of earth
d) All of the above

43) RF amplifiers are used in radio receivers for

a) improved image frequency rejection
b) improved rejection of adjacent unwanted signals
c) prevention of re-radiation of the local oscillator through the antenna of the receiver
d) all of the above

44) In DTA endothermic peak occurs due to

a) Oxidation
b) Chemisorption
c) Melting
d) Crystallization

45) Which of the following statements is wrong?

a) UV absorption is attributable to electronic transitions.
b) UV spectra provide information about valence electrons.
c) IR absorption is attributable to transitions between rotational energy levels of whole molecules.

d) UV-Vis spectrometers used to estimate band gap energy.

46) Which of the following statements regarding IR spectroscopy is not correct?

a) Infrared radiation is higher in energy than UV radiation.

b) Infrared spectra record the transmission of IR radiation.

c) Molecular vibrations are due to periodic motions of atoms in molecules, and include bond stretching. torsional changes, and bond angle changes.

d) Infrared spectra give information about bonding features and functional groups in molecules.

47) The frequency of a transition is 3.0×10^{15} Hz. What is the energy of this transition?

a) 0.124eV b) 1.240 eV

c) 12.40 eV d) 124.0 eV

48) In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to _____ matrix.

a) Digonal b) Lower triangular

c) Upper triangular d) Singular

49) Newton-Raphson method of solution of numerical equation is not preferred when

a) Graph of A (B) is vertical

b) Graph of $x(y)$ is not parallel

c) The graph of $f(x)$ is nearly horizontal-where it crosses the x-axis.

d) None of these

50) The convergence of _____ numerical method is sensitive to starting volume.

a) False position b) Gauss seidal

c) Newton-Raphson d) Jacobi

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Rough Work

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