Ph.D. Entrance Exam 2022

Course	Ph.D.
Branch	Physics
Subject Name	Physics

SN	Question Text	Option 1	Option 2	Option 3	Option 4
1	An atomic transition line with wavelength 350 nm is observed to be split into three components in a spectrum of light from a sunspot. Adjacent components are separated by 1.7 pm . Determine the strength of the magnetic field in the sunspot	3T	0.03T	3.3T	0.3T
2	An X - ray beam of wavelength 0.16 nm is incident on a set of planes of a certain crystal. The first Bragg reflection is observed for an incidence angle of 0 30 . What is the corresponding inter planar spacing?	0.16 nm	0.67 nm	1.02nm	0.89 nm
3	In a multi-stage R -C coupled amplifier, the coupling capacitor	limits the low frequency response	limits the high frequency response	reduces the amplitude of input signal	blocks d.c. component without affecting the frequency response
4	Which radiation has maximum ionization power?	Alpha	Beta	Neutron	Gamma
5	Two students are working on a math problem. The first student has probability 1/2 of solving it and the second student has probability 3/4 of solving it. What is the probability that at least one of them solves the problem?	3/8	5/8	7/8	9/8
6	Ten glass vases were to be packed one each in 10 boxes marked “Glass”. Twelve brass vases were to be packed one each in 12 boxes marked “Brass”. Four vases and boxes got mixed up. A customer orders 1 glass and 1 brass vase and is sent appropriately marked boxes. The chance that the customer does not get the ordered vases in correctly marked boxes is	4/5	5/6	2/3	1/3
7	A two-digit number is such that if the digit 4 is placed to its right, its value would increase by 490 . Find the original number.	48	54	64	56
8	A cyclist covers a certain distance at a constant speed. If a jogger covers half the distance in double the time as the cyclist, the ratio of the speed of the jogger to that of the cyclist is	1:4	4:1	1:2	2:1
9	Consider black body radiation in thermal equilibrium contained in a two-dimensional box. The dependence of the energy density on the temperature T is	T^3	T	T^2	T^4

10	A negative muon, which has a mass nearly 200 times that of an electron, replaces an electron in a Li atom. The lowest ionization energy for the muonic Li atom is approximately	the same as that of He	the same as that of normal Li	200 times larger than that of normal Li	the same as that of normal Be
11	Stern-Gerlach experiment is important because it gives experimental verification of	quantization of energy of atom	orbital motion of electron	electron spin	Sommerfeld model of atom
12	Which of the following can be used to produce lowest temperature?	Liquefaction of N_2	Liquid He	Adiabatic demagnetization of paramagnetic salts	None of these
13	If a particle is at rest relative to an observer at rest at the centre of a rotating frame of reference	centrifugal and Coriolis forces both act	only centrifugal force acts	only Coriolis force acts	None of these
14	The speed of an electron having kinetic energy 2 MeV will be	2.93×10^8 m/ sec	3×10^8 sec	10^8 m/ sec	1.5×10^8 sec
15	The depletion region is created by	ionization	diffusion	recombination	(a), (b) and (c)
16	The bias condition for a transistor to be used as a linear amplifier is called	forward-reverse	forward-forward	reverse-reverse	collector bias
17	Which of the following is a universal gate?	OR gate	NOR gate	AND gate	NOT gate
18	In Newton's ring experiment, the diameters of the bright rings are proportional to the	natural number	square root of natural numbers	square root of odd numbers	odd numbers
19	To increase the resolving power of a grating total number of lines on the grating is increased such that the grating element becomes 2.5λ. How many orders will be seen on the screen?	First order only	First and second orders only	First, second and third orders only	First, second, third and fourth orders only
20	A rigid body is constrained to move on plane. Number of degrees of freedom for it will be	2	1	5	3
21	The constraints of a rigid body is	conservative and scleronomic	conservative and rheonomic	holonomic and rheonomic	non-holonomic and scleronomic
22	Radiocarbon dating is done by estimating in the specimen	the ratio of amount of ^{14}C to ^{12}C still present	the ratio of amount of ~~^{13}~~C to ^{12}C still present	the amount of radiocarbon still present	the amount of ^{13}C still presen
23	The fission rate of ^{235}U to produce energy of 200MW is	6.25×10^{15}fission/sec	6.25×10^{16}fission/sec	6.25×10^{18}fission/sec	3.12×10^{20} fission/sec
24	The magnetic dipole and electric quadrupole moment data of deuteron imply that the that the nuclear force is	purely central	central and spin dependent	mixture of central and non-central components	velocity dependent
25	Origin of characteristic X -rays is	photoelectric effect	inverse photoelectric effect	electronic transitions within atoms	Compton effect
26	For good conductors the skin depth varies inversely with	ω	ω^2	$\sqrt{\omega}$	ω^4
27	The phenomenon employed in the waveguide operation is	reflection	refraction	total internal reflection	absorption
28	The ratio of maximum to minimum resistance that can be obtained with N number of 3-Ω resistors is	N	N^2	N^3	N^4
29	A narrow beam of X - rays with wavelength 0 $1.5A^0$ is reflected from an ionic crystal with an fcc lattice structure with a density of 3 3.32 gcm^{-3} . The molecular weight is 108 amu (1 amu =1.66×10^{-24}g), The lattice constant is	$6.00A^0$	$4.56A^0$	$4.00A^0$	$2.56A^0$
30	Consider an anti-symmetric tensor P_{ij} with indices i and j running from 1 to 5. The number of independent components of the tensor is	3	10	9	6
31	A 3×3 matrix has elements such that its trace is 11 and its determinant is 36. The eigenvalues of the matrix are all known to be positive integers. The largest eigenvalues of the matrix is	18	12	9	6

32	The eigenvalues of a Hermitian matrix are all	real	imaginary	of modulus one	real and positive
33	A plane electromagnetic wave traveling in free space is incident normally on a glass plate of refractive index 3/2. If there is no absorption by the glass, its reflectivity is	4%	16%	20%	50%
34	For a scalar function ϕ satisfying the Laplace equation, $\nabla\phi$ has	zero curl and non-zero divergence	non-zero curl and zero divergence	zero curl and zero divergence	non-zero curl and non-zero divergence
35	Which one of the following quantities is invariant under Lorentz transformation?	Charge density	Charge	Current	Electric field
36	A point charge is placed between two semi-infinite conducting plates which are inclined at an angle of o 30 with respect to each other. The number of image charges is	15	17	25	55
37	The magnitude of the magnetic dipole moment associated with a square shaped loop carrying a steady current I is m . If this loop is changed to a circular shape with the same current I passing through it, the magnetic dipole moment becomes • pm . The value of p is	5	9	8	7
38	A monochromatic plane wave in free space with electric field amplitude of 1 V m is normally incident on a fully reflecting mirror. The pressure exerted on the mirror is…… 10^{12} Pa . (up to two decimal places) ($\varepsilon_0 = 8.854 \times 10^{12}$/ Fm	9.88	5.66	7.89	11
39	An infinitely long straight wire is carrying a steady current I . The ratio of magnetic energy density at distance r_1 to that at $r_2(=2r_1)$ from the wire is	6	8	7	6
40	The valence electrons do not directly determine the following property of a metal	Electrical conductivity	Thermal conductivity	Shear modulus	Metallic luster
41	The order of magnitude of the energy gap of a typical superconductor is	1 MeV	1 KeV	1 eV	1 meV
42	A metal with body centered cubic (bcc) structure show the first (i.e. smallest angle) diffraction peak at a Bragg angle of $\theta = 30^0$. The wavelength of X-ray used is 2.1 $Å^0$. The volume of the PRIMITIVE unit cell of the metal is	26.2 $(Å^0)^3$	13.1$(Å^0)^3$	9.3 $(Å^0)^3$	4.6 $(Å^0)^3$
43	Which one of the following CANNOT be explained by considering a harmonic approximation for the lattice vibrations in solids?	Deby's T^3 law	Dulong Petit's law	Optical branches in lattices	Thermal expansion
44	The force constant between the nearest neighbour of the lattice is (M is the mass of the atom)	$MA^2/4$	$MA^2/2$	$MA^2/8$	$MA^2/9$
45	Considering the BCS theory of superconductors, which one of the following statements is NOT CORRECT? (h is the Plank's constant and e is the electronic charge)	Presence of energy gap at temperature below the critical temperature	Different critical temperature for isotopes	Quantization of magnetic flux in superconduction ring in the unit of (h/e)	Presence of Meissner effect
46	A solid material is found to have a temperature independent magnetic susceptibility, χ=C . Which of the following statements is correct?	If C is positive, the material is a diamagnet.	If C is positive, the material is a ferromagnet.	If C is negative, the material could be a type I superconductor	If C is positive, the material could be a type I superconductor
47	The relative magnetic permeability of a type-I super conductor is	0	-1	2π	$1/4\pi$

48	A conventional type-I superconductor has a critical temperature of 4.7 K at zero magnetic field and a critical magnetic field of 0.3 Tesla at 0K . The critical field in Tesla at 2K (rounded off to three decimal places) is	5	6	0.246	5
49	Two particles each of rest mass m collide head-on and stick together. Before collision, the speed of each mass was 0.6 times the speed of light in free space. The mass of the final entity is	5m/4	2m	5m/2	25m/8
50	A satellite is moving in a circular orbit around the Earth. If T,V and E are its average kinetic, average potential and total energies, respectively, then which one of the following options is correct?	V=-T;E =0	V=-T/2;E =T/2	V=-3T/2;E =-T/2	