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CPG-EE	-2019 (Physics)	-(SET- Y)	19
A		St. No.	10381
Time: 11/2 Hours	Total Questions: 100	3	Max. Marks : 100
Roll No. (in figures)	(in words)	- Jul	
Candidate's Name		Date of Birth	
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STARTING THE QUESTION PAPER. 1. All questions are compulsory and carry equal marks. The candidates are required to attempt all questions.

2. The candidate must return this question booklet and the OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / misbehaviour will be registered against him ther, in addition to lodging of an FIR with the police. Further the answer-sheet of puch a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to

the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A, B, C and Q code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint it any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand of through email. Thereafter, no complaint in any case will be considered.

5. The candidate must not do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers must not be ticked in the question booklet.

6. Use only black or blue ball point pen of good quality in the OMR Answer-Sheek

7. There will be negative marking. Each correct answer will be awarded one full mark and each incorrect answer will be negatively marked for which the candidate will get 1/4 Mark (0.25 Mark) discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer,

8. Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.

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1.	A body, initially a having a total kine explosion is:	t rest, explodes into tic energy E . The kinds	two pieces of mass netic energy of the p	2M and 3M, respectively, piece of mass 2M after the
	2 . T	(2) E/5	(3) 2E/5	(4) 3 <i>E</i> /5
2.		ordinate has the dim		n, the generalized velocity
	(1) Velocity	(2) Acceleration	(3) Torque	(4) Force
3.		acts on a particle, its		
	(1) Remain constan		(2) Gradually decre	
_	(3) Gradually incre			ned after some time
4.			ntum has its origin in	
			(2) Isotropy of space	
-			(4) Lagrange's equal	
5.				ve their usual meaning):
	$(1) \ddot{\theta} + \frac{g}{l} \sin \theta = 0$	$(2) \ddot{\theta} + \frac{g}{l \sin \theta} = 0$	$(3) \ddot{\theta} - \frac{g}{l} \sin \theta = 0$	$(4) \ddot{\theta} + \frac{l}{g}\sin\theta = 0$
6.	A particle is constra The number of degr	ained to move along rees of freedom of the	the inner surface of a e particle is:	fixed hemispherical bowl.
	(1) One	(2) Two	(3) Three	(4) Four
7.	7. If a linear harmonic oscillator has frequency f, the frequency of oscillation of the kinetic energy of oscillator is:			
	(1) f	(2) $f/2$	(3) 2f	(4) 4f
8.				d thin spherical shell with stal charge on the spherical
	$(1) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{r}$	$(2) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{R}$	$(3) \frac{1}{4\pi\varepsilon_0} \frac{\sigma}{r}$	(4) Zero
9.	The induced electric	ic field in the Maxw	Tell equation $\oint \vec{E} \cdot d\vec{l}$	$=-\frac{d\Phi_B}{dt}$, is called a non-
	conservative field always:	as the line integral of	of the electric field	in electrostatics $\oint \vec{E} \cdot d\vec{l}$ is
	(1) Zero	(2) 2π	$(3) \frac{d\Phi_B}{dt}$	(4) $2\pi \vec{E}$
10.	In electromagnetic magnetic field vector		e, the phase differe	ence between electric and
	(1) Zero	(2) $\pi/2$	(3) π	(4) $3\pi/2$
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magnetic induction \overrightarrow{B} is :

(1) $\hat{x} + \hat{z}$

12.	A paramagnetic substance is placed in a field. The resulting magnetic susceptibility		neous and static magnetic
	(1) Paramagnetic contribution		
	(2) Paramagnetic and diamagnetic contri	ibutions	
	(3) Diamagnetic contribution		
	(4) Paramagnetic, ferromagnetic and dia	magnetic contribution	ons
13.			
	frequency 5.09×10^{14} Hz. Given that di 1.00, the speed of wave propagation and respectively, be equal to:		
	(1) 1.24×10^8 m/s and 589 nm	(2) $3.0 \times 10^8 \text{m/s}$ ar	od 580 nm
	(3) 1.24×10^8 m/s and 244 nm	(4) $3.0 \times 10^{8} \text{m/s} \text{ and}$	10 309 11111
			10 244 nm
14.	T .		
	(1) $V = -xy + \text{constant}$ (3) $V = -(y^2 + x^2) + \text{constant}$	(2) $V = -y + x + co$	nstant
	(3) $V = -(y^2 + x^2) + \text{constant}$	(4) $V = constant$	
15.	In an elastic material the force that tends to hold atoms back to their equilibrium positions, has its origin in :		
	(1) Electrostatic force	(2) Electromagneti	
	(3) Weak force	(4) Gravitational fo	orce
16.	Consider an ideal gas made up of point-like particles in thermal equilibrium at temperature T. The most probable value of energy is:		
	(1) $k_B T/2$ (2) $3k_B T/2$	$(3) k_BT$	$(4) 2k_BT$
17.	Suppose an atomic gas in a container is a colliding with each other and the walls of		
	(1) Inelastic	(2) Elastic	
	(3) Inelastic at extremely low temperatures	` '	ove
18.	For an ideal gas of diatomic molecules average energy per molecule is:		
	(1) $\frac{1}{2}k_BT$ (2) $\frac{3}{2}k_BT$	(2) 21- T	(A) 61 T
	$(1) \frac{1}{2} \kappa_B I \qquad (2) \frac{1}{2} \kappa_B I$	(3) $3\kappa_B I$	(4) $6\kappa_B I$
19.	At what temperature is the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C?		
	(1) 80 K (2) -73 K	(3) 3 K	(4) 20 K
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11. The vector potential in a region is given as $\vec{A}(x, y, z) = -\hat{x}y + \hat{y}2x$. The associated

(2) $-\hat{x} + 2\hat{y}$ (3) $-\hat{x} + 2\hat{y} + \hat{z}$

20.	A cube has a volume of 1000 cm^3 . Its volume as observed by an observer Q moving at a velocity of 0.8c relative to the cube in a direction parallel to one edge is:
	(1) 500 cm^3 (2) 1000 cm^3 (3) 900 cm^3 (4) 600 cm^3
21.	1
	(1) Become double (2) Become more than double
22	(3) Remain unchanged (4) Become slightly less than double
22.	Which of the following is invariant in special theory of relativity? (1) Mass (2) Charge
i.	(3) Speed of light (4) Charge as well as speed of light
23.	A capacitor with capacitance $25 \times 10^{-6} F$ is charged by connecting it to a 300 V dc
_0.	power supply. The capacitor is disconnected from the supply and connected across an
	inductor with $L = 10^{-2} H$. What is the frequency and period of oscillation in the circuit?
	(1) 320 Hz; 3.1 ms (2) 220 Hz; 4.5 ms (3) 50 Hz; 0.02 s (4) 100 Hz; 0.01 s
24.	A 200 Ω resistor and a 5 μ F capacitor are connected in series with an alternating
	voltage source. The voltage across the resistor is $v_R = (1.20 \text{ V}) \cos{(2500 \text{ rad/s})t}$. The
	voltage across the capacitor will be:
	(1) $(0.48 V) \cos [(2500 \text{ rad/s})t + \pi/2 \text{ rad}]$ (2) $(1.20 V) \cos [(2500 \text{ rad/s})t - \pi/2 \text{ rad}]$
	(3) $(1.20 \text{ V}) \cos [(2500 \text{ rad/s})t]$ (4) $(0.48 \text{ V}) \cos [(2500 \text{ rad/s})t - \pi/2 \text{ rad}]$
25.	When a forward bias is applied to a pn junction, the drift current?
	(1) Increases (2) Decreases to zero
	(3) Decreases, but not to zero (4) Remains unchanged
26.	Which of the following is true about Hall effect in a semiconductor substance? The Hall coefficient:
	(I) Changes with doping concentration
	(II) Depends on temperature
	(III) Varies with probe current and magnetic field
	(IV) Independent of probe current and magnetic field
000000000	(1) I, II and III (2) II and III (3) I, II and IV (4) IV and I
27.	
	(1) Signal being viewed
	(2) Primary electrons emitted from the cathode
	(3) Final speed with which the electrons strike the screen
-	(4) Coating material of the display screen
28.	8
	electron pair in germanium (given that the band gap of germanium is 0.65 eV) is : (1) 6×10^{-6} m (2) 1.6×10^{-6} m (3) 1.9×10^{-6} m (4) 1.9×10^{-5} m
a= ~	
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		,	
29.	If the load resistance of a CE amplifier i	ncreases, then its current gain:	
	(1) Decreases	(2) Increases	
	(3) Increases followed by an initial decrease	e (4) Remains unchanged	
30.	A transistor has $\alpha = 0.98$, IB = 100 μ A a	and ICO = 6 μ A. The value of IE will be :	
	(1) 5.3 mA (2) 6 mA	(3) 4.6 mA (4) 9 mA	
31.	The value of M after the following set of	f FORTRAN statements are executed is:	
	M = 0		
ě.	Do 10 I = 1.2		
	Do $20 J = 1.2$		
	M = M + I + J		
	20 Continue		
97	10 Continue		
	Stop		
	End	* *	
	(1) 11 (2) 12	(3) 4 (4) 10	
32.	In FORTRAN language, the state	ment, $p = 1/x * a + 1/y + b - 1/z * * 3 * c$ will	
	compute the expression:		
	(1) $p = \frac{1}{xa} + \frac{1}{y} + b - \frac{1}{z^{3c}}$	(2) $p = \frac{a}{x} + \frac{1}{y} + b - \frac{c}{z^3}$	
	(3) $p = \frac{a}{x} + \frac{1}{y+b} - \frac{c}{z^3}$	(4) $p = \frac{1}{xa} + \frac{1}{y+b} - \frac{1}{z^3c}$	
33.	The change in entropy is zero for:		
	(1) Irreversible processes	(2) Reversible adiabatic processes	
	(3) Reversible isothermal processes	(4) All adiabatic processes	
34.	When changes occur within a closed sy	stem, which of the following is true for change	
	in entropy ΔS of the system ?		
	$(1) \Delta S = 0 \qquad (2) \Delta S < 0$	$(3) \Delta S \ge 0 \qquad (4) \Delta S > 0$	
35.	Let us take two sub-systems A_1 and	d A_2 in general contact. The most genera	
	thermodynamic equilibrium relation for	the change in internal energy is:	
	$(1) dE = TdS - PdV + \mu dN$	(2) $dE = TdQ - PdV + \mu dN$	
	(3) $dE = TdS + PdV + \mu dN$	(4) $dE = TdS + PdV - \mu dN$	
36.	A Carnot engine absorbs 1 MJ of heat f	rom a reservoir at 300°C and exhausts heat to a	
	reservoir at 150°C. The work done by the engine is:		
	(1) $2.6 \times 10^6 \text{J}$ (2) $2.6 \times 10^5 \text{J}$		

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37.	Consider that an amount of heat dQ is added to a substance at temperature T keeping volume constant at V . As a result, its temperature changes by dT , while the intenergy by dE . The heat capacity C of the substance is given by:			s by dT , while the internal
		$(2) \ \frac{1}{T} \frac{dE}{dT}$	1 41	$(4) \ \frac{1}{V} \frac{dQ}{dT}$
38.	The Fourier transfo	$\operatorname{rm} f(q)$ of the functi	$f(x) = e^{-x^2/2}$ is:	
	(1) e^{-q^2}	(2) $e^{-q^2/2}$	(3) e^{q^2}	
39.	, 1	d continuous function p^{px} . The Fourier coef		led in the Fourier series as : sfy the condition:
	$(1) C_p = C_p^*$	(2) $C_{-p} = C_p^*$	(3) $C_{-p} = C_p$	(4) $C_0 = 0$
40.	If $f(q)$ is the Fourier	er transform of $f(x)$,	the Fourier transform	n of $f(ax)$ is:
		(2) $f(q\alpha)$		
41.				ch, then intensity of light at
	(1) $4a^2$	(2) $2a^2$	(3) 2 <i>a</i>	(4) 4 <i>a</i>
42.	If in a Young's dou is covered with the	ble slit experiment b	eing performed with other slit with the blu	white light, one of the slits are filter.
		no interference fring		
	(2) There shall be a	an alternate interfere	nce pattern of red an	d blue
		an interference patter	rn of mixed color of	red and blue
	(4) None of the abo			
43.		of interference fringe		or experiment?
		t straight fringes of		
	A STATE OF THE STA	t straight fringes of a	1	tual Colors a daula aus
				tral fringe a dark one entral fringe a dark one
44.				e speed. As a result:
	(1) Energy carried			by light stays constant
	(3) Frequency of li			by light increases
45.				of a box partitioned by ar
	imaginary wall. The		node of distribution	is the one for which the
	(1) Maximum		(2) Minimum	

(3) Absolute zero

(4) Either maximum or minimum

46. A real gas behaves like an ideal gas if its: (1) Pressure and temperature are both high (2) Pressure and temperature are both low (3) Pressure is high and temperature is low (4) Pressure is low and temperature is high N distinguishable particles in a statistical system are somehow restricted to move in a plane. The dimensionality of its phase space will be: $(1) 4^{N}$ $(2) 6^{N}$ (4) 2N48. Two macroscopic systems, say A₁ and A₂, are allowed to have thermal contact. Obviously, there will be exchange of energy if A₁ and A₂ were at different temperatures. According to the postulates of statistical physics, the condition of equilibrium is (Ω denotes the number of microstates for a system): $(1) \frac{\partial}{\partial E} \ln \Omega_1 = \frac{\partial}{\partial E} \ln \Omega_2$ (2) $\frac{\partial}{\partial F}\Omega_1 = \frac{\partial}{\partial F}\Omega_2$ $(4) \ \frac{\partial}{\partial F}(\Omega_1 + \Omega_2) = 0$ (3) $\frac{\partial}{\partial E}\Omega_1\Omega_2 = 0$ 49. The electronic heat capacity of a metal within the framework of Fermi-Dirac statistics depends on temperature as: (3) $AT^{3/2}$ (4) $AT^{1/2}$ $(1) AT^3$ (2) AT50. The phenomenon of Bose-Einstein condensation may occur for a class of particles which are? (1) Indistinguishable and have half-integral spin (2) Distinguishable and have integral spin (3) Distinguishable and have half-integral spin (4) Indistinguishable and have integral spin 51. The gas of electrons in a metal possesses tremendous internal energy even at absolute zero temperature. The origin of this energy lies in the: (1) Maxwell-Boltzmann Law (2) Negative charge on electrons (3) Pauli exclusion principle (4) Small mass of electrons For a gas of electrons in thermal equilibrium at room temperature, the probability of finding an electron in the single-electron states $\varepsilon_F + \varepsilon$ and $\varepsilon_F - \varepsilon$ is (where ε_F is the

(2) Not equal

The diameter of n^{th} dark ring in Newton's ring arrangement changes from 1.2 to 1.0 cm when air is replaced by a transparent liquid. What is the refractive index of liquid?

(3) 4.10

(4) Equal if ε is negative

(4) 1.50

(2) 1.20

(3) Equal if ε is positive

Fermi energy):

(1) Equal

(1) 1.44

54.	Three plane-waves viz. $y_1 = A_1 \hat{y} \cos(kx - \omega t + \delta_1), y_2 = A_2 \hat{z} \cos(kx - \omega t + \delta_2)$ and
	$y_3 = A_3 \hat{y} \cos(kx - \omega t + \delta_3)$ are superposed pairwise. Which superposition can lead to
	interference ? (here A_1 , A_2 , A_3 , δ_1 , δ_2 , δ_3 are constants)

(1) y_1 and y_2

(2) y_1 and y_3

(3) y_2 and y_3

(4) No interference in any pair

55. In a Young's double slit experiment the intensity at a point where the path difference is $\lambda/6$ (λ being the wavelength of light used) is I. If I_0 denotes the maximum intensity, I/I_0 is equal to:

 $(1) \ 3/4$

(2) 1/2

(3) 3/2

(4) 1/6

Illuminated normally, a diffracting grating produces second order bright images with an 56. angle of 60° between them. The light is monochromatic and has a wavelength of 300 nm. The spacing of the grating in mm is:

 $(1) \ 3.6 \times 10^{-3}$

 $(2) 2.4 \times 10^{-3}$

(3) 2.0×10^{-3} (4) 1.5×10^{-3}

Electromagnetic waves are transverse in nature, is evident by:

(1) Polarization

(2) Interference

(3) Reflection

(4) Diffraction

A beam of transverse waves whose vibrations occur in all directions perpendicular to their direction of motion is:

(1) Polarized

(2) Unpolarized

(3) Resolved

(4) Diffracted

59. The state of polarization of light with the electric field vector $\vec{E} = \hat{x}E_0\cos(kz - \omega t)$ – $\hat{y}E_0\cos(kz-\omega t)$ is:

(1) Linearly polarized along z-direction

(2) Linearly polarized at -45° to x-axis

(3) Circularly polarized

(4) Elliptically polarized with the major axis along x-axis

If the electric field vector in a polarized electromagnetic wave is $\vec{E}(\vec{r},t) = \hat{n}E_0e^{i(\vec{k}\cdot\vec{r}-\omega t)}$ (with \hat{n} being the polarization vector and \vec{k} the propagation vector), its magnetic field vector is given by:

(1) $\frac{1}{c}\hat{k} \times \vec{E}$ (2) $\hat{k} \times \vec{E}$ (3) $\frac{1}{c^2}\hat{k} \times \vec{E}$ (4) $\frac{1}{c}\hat{k} \cdot \vec{E}$

A crystalline solid can be distinguished from a glassy solid on the basis of their:

(1) Distinct physical and chemical properties

(2) X-ray diffraction pattern

(3) Lattice and unit cells

(4) Lattice, basis and unit cells

- 62. Which of the following is true about the Wigner-Seitz unit cell?
 (1) It contains always one lattice point at the center of the cell
 (2) In contains always one atom at the center of the unit cell
 (3) It contains one lattice point, with each corner making a contribution of 1/8
 (4) It contains two lattice points, one at the center and other at one of the eight corners
- **63.** If $\vec{R} = u_1\vec{a}_1 + u_2\vec{a}_2 + u_3\vec{a}_3$ is a vector in direct lattice, while $\vec{G} = v_1\vec{b}_1 + v_2\vec{b}_2 + v_3\vec{b}_3$ is a vector in the corresponding reciprocal lattice, then $\vec{R}.\vec{G}$ has the from :
- (1) $2\pi/(\vec{a}_1.\vec{a}_2 \times \vec{a}_3)$ (2) $2\pi/\text{Integer}$ (3) $2\pi \times \text{integer}$ (4) $2\pi/(\vec{b}_1.\vec{b}_2 \times \vec{b}_3)$ **64.** At low temperature T, the specific heat of insulating crystals varies as:
 - (1) $AT + BT^3$ (2) BT^3
 - (3) Will not change with temperature (4) Aexp(-T)
- 65. Consider a cubical lattice. A lattice plane that bisects the bottom face of the cube diagonally, has Miller indices:
 - (1) (100) (2) (010) (3) (111) (4) (110)

 3. The structure of diamond crystal can be described by:
 - (1) A simple cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$
 - (2) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{2} \frac{1}{2} \frac{1}{2}$
 - (3) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4} \frac{1}{4} \frac{1}{4}$
 - (4) A simple cubic lattice, with carbon atoms positioned at corners and face centers of the cubic cell
- 67. If the first-order diffraction from a set of lattice planes in a crystal occurs at $\theta = 45^{\circ}$, then the second-order diffraction from the same set of planes may occur at θ equal to :
 - (1) $\theta = 60^{\circ}$ (2) $\theta = 90^{\circ}$
- (3) $\theta = 22.5^{\circ}$
- (4) None of the above
- 68. Consider that the structure of a simple cubic solid can be described by three different sets of lattice planes having Miller indices (100), (110) and (111). The inter-planar spacing for these planes has the ratio:
 - (1) $\sqrt{6}:\sqrt{3}:\sqrt{2}$ (2) $\sqrt{2}:\sqrt{3}:\sqrt{6}$ (3) 1:2:3 (4) 3:2:1

- The reciprocal lattice of the reciprocal lattice of simple cubic lattice is: 69.
 - (1) A simple cubic lattice
 - (2) An expanded simple cubic lattice
 - (3) A simple cubic lattice rotated by an angle of 45°
 - (4) A compressed simple cubic lattice
- 70. According to Einstein's model, the average energy of an atomic oscillator in a onedimensional crystalline solid in thermal equilibrium at temperature T is given by:

$$(1) \frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right) + 1\right]}$$

(3) k_BT

$$(4) \frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right) - 1\right]}$$

- 71. Light of wavelength 500 nanometers is incident on sodium with work function 2.28 eV. What is the maximum kinetic energy of the ejected photoelectrons?
 - (1) 0.03 eV
- (2) 0.2 eV
- (3) 1.3 eV
- (4) 2.1 eV
- 72. A particle moving freely in x-direction is described by the wave function $\psi(x, t) = Ce^{i(kx-\omega t)}$. Uncertainty in its momentum is equal to :
 - (1) Zero
- (3) ∞
- 73. Which of the following wave functions can describe a physical state?
 - (1) $\psi(x) = |x|$

- (2) $\psi(x) = \exp(x^2)$ (3) $\psi(x) = \tan(x)$ (4) $\psi(x) = \exp(-x^2)$
- A particle restricted to the x-axis has the wave function $\psi(x) = ax$ between x = 0 and 74. x = 1; $\psi(x) = 0$ elsewere. The probability that the particle can be found between x = 0.45and x = 0.55 is:
 - (1) a^2
- (2) $0.0251a^2$ (3) $0.3025a^2$ (4) $0.2025a^2$
- X-rays of wavelength 10.0 pm are scattered from a target via Compton scattering. The 75. maximum wavelength present in the scattered X-rays is (given that Compton wavelength is 2.426 pm):
 - (1) 14.9 pm

(2) 1.49 pm

(3) 2.426 pm

- (4) 2426 pm
- 76. The wave function describing a de-Broglie wave associated with a material particle of linear momentum p = mv may be represented as : $\psi(x, t) = e^{i(kx - \omega t)}$. The phase velocity v_p of de-Broglie wave is related to the particle velocity v as:
 - (1) $v_p = v$

(2) $v_p = v/2$

(3) $v_p = v + c$

(4) $v_n = \pm v$

Consider a particle described by the time-dependent Schrodinger wave equation:

$$i\hbar \frac{\partial}{\partial t} \psi(x,t) = \left[-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} + V(x,t) \right] \psi(x,t)$$
. If $\psi(x,t)$ is one solution of this equation,

then which of the following statements is true for $\psi^*(x, t)$:

- (1) $\psi^*(x, t)$ is also a solution of the same Schrodinger wave equation.
- (2) $\psi^*(x, t)$ cannot in general be a solution of the same Schrodinger wave equation.
- (3) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is zero.
- (4) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is independent of x.
- 78. Zero-point energy of an oscillator has its origin in:
 - (1) Pauli exclusion principle
 - (2) Experimental non-realization of absolute zero temperature
 - (3) Quantization of energy
 - (4) Heisenberg uncertainty principle
- 79. Quantum mechanically an electron of energy 2.0 eV incident on a barrier 10.0 eV high and 0.50 nm wide has a finite probability of tunneling through it. If electron is replaced by a proton, the tunneling probability:
 - (1) Increases by a factor of 2
- (2) Decreases

(3) Remains unchanged

- (4) Decrease by a factor of 2
- 80. Eigen value of the operator $-\frac{\hbar^2}{2m}\frac{d^2}{dr^2}$ operating on the wave function

$$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{9\pi x}{L}\right)$$
 is given by :

$$(1) \frac{\pi^2 \hbar^2}{2mL^2}$$

$$(2) \quad \frac{9\pi^2\hbar^2}{2mL^2}$$

(3)
$$\frac{81\pi^2\hbar^2}{2mL^2}$$

(2)
$$\frac{9\pi^2\hbar^2}{2mL^2}$$
 (3) $\frac{81\pi^2\hbar^2}{2mL^2}$ (4) $\frac{3\pi^2\hbar^2}{2mL^2}$

81. For j = 5/2 the allowed values of l are :

- (1) 1, 2
- (2) 2, 3
- (3) 3, 4
- (4) 4, 5
- An atom having one electron in its valence shell is placed in a weak magnetic field oriented along the z-axis. The allowed angles of spin angular momentum with z-axis

(1)
$$\cos^{-1}\left(\pm\frac{1}{\sqrt{3}}\right)$$
 (2) $\cos^{-1}\left(\pm\frac{1}{\sqrt{2}}\right)$ (3) $\cos^{-1}\left(\pm\frac{\sqrt{3}}{2}\right)$ (4) $\cos^{-1}\left(\pm\frac{1}{2}\right)$

- The effect of spin-orbit splitting on the ground state level of hydrogen atom is to split it 83. into:
- (1) Two sub-levels (2) Three sub-levels (3) Five sub-levels (4) None of the above CPG-EE-2019/(Physics)-(SET-Y)/(A)

	the state of the s			
84.	The spin angular momentum of an electron can be described as:			
	(1) Electron spinning about an axis passing through its center			
	(2) Electron spinning clockwise or anti-clockwise about an axis passing through its center			
	(3) Electron spinning at speed of light clockwise or anti-clockwise about an axis passing through its center			
	(4) None of the above			
85.	The maximum degeneracy of an atomic energy level with principal quantum number n is:			
	(1) n (2) n^2 (3) $2n^2$ (4) $2n$			
86.	Suppose that an isolated hydrogen atom in its ground state is placed in an external weak electric field (weak field Stark effect). The ground state would split into:			
	(1) Two sub-levels (2) Four sub-levels (3) Three sub-levels (4) None of the above			
87.	An electron is in a magnetic field of strength $B = 100$ Gauss. The magnetic dipole			
	moment (μ) of the electron is initially anti-parallel to the direction of \vec{B} . How much			
	external work must be done to reverse the direction of magnetic moment of the electron?			
	(1) $-2\mu B$ (2) $+2\mu B$ (3) $-\mu B$ (4) $+\mu B$			
88.	The rotational, vibrational and molecular electronic spectra of diatomic molecules lie, respectively, in the :			
	(1) Microwave, infrared and visible-ultraviolet regions			
	(2) Infrared, microwave and visible-ultraviolet regions			
	(3) Visible-ultraviolet, microwave and infrared regions			
	(4) Infrared, visible-ultraviolet and microwave regions			
89.				
	(1) Two (2) Four (3) Three (4) Five			
90.	A certain ruby LASER emits 1.0 J pulses of light whose wavelength is 694 nm. What is the minimum number of Cr^{3+} ions in the ruby?			
	(1) 1.0×10^{22} (2) 3.5×10^{23} (3) Avogadro number (4) 3.5×10^{18}			
91.	The fact that the binding energy per nucleon is roughly a constant over most of the range of stable nuclei is a consequence of the fact that the nuclear force is:			
	(1) Strong (2) Short range			
	(3) Charge-independent (4) Always attractive			
92.	Alpha particles produced during alpha-decay have kinetic energy of the order of:			
	(1) MeV (2) KeV (3) GeV (4) eV			
93.	What limits the size of a stable nucleus?			
	(1) Limited number of nucleons (2) Limited range of the strong nuclear force			
	(3) Large surface to volume ratio (4) None of the above			
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94. Which of the following is *true*?

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I. A neutron can transform into a proton in free space

		II. A proton can transform into a neutron in free space III. A neutron can transform into a proton inside nucleus IV. A proton can transform into a neutron inside nucleus
		(1) I, III and IV (2) I, II, III and IV (3) II, III and IV (4) III and IV
	95.	Tritium has a half-life of 12.5 y against beta decay. What fraction of a sample of tritium will remain un-decayed after 25 y?
		(1) 1/4 (2) 1/2 (3) 1/10 (4) 1/3
	96.	How many neutrons are released in the following nuclear reaction?
		${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{88}_{38}Sr + {}^{136}_{54}Xe + ? {}^{1}_{0}n$
		(1) 11 (2) 12 (3) 10 (4) 14
	97.	When the nuclear reaction takes place, which of the following is true about the reaction? I. The energy is conserved II. The electric charge is conserved III. The mass is conserved IV. The number of nucleons is conserved (1) I, II, III and IV (2) I and II only (3) I, II and III only (4) I, II and IV only
5.5	98.	Which of the following statements is not <i>true</i> about γ-radiation? I. It is produced by unstable nuclei II. It can penetrate several centimeters of lead III. It can ionize gasses IV. It can be deflected by a magnetic field V. It is a short wavelength electromagnetic photon (1) IV and V (2) III and IV (3) IV (4) V
	99.	The photoelectric cross-section depends on Z (target atomic number) and E_{γ} (energy of incident photon) through the expression: (1) $Z^5/E_{\gamma}^{3/2}$ (2) $Z^2/E_{\gamma}^{7/2}$ (3) $Z^5/E_{\gamma}^{7/2}$ (4) Z/E_{γ}
	100.	Positive ions and electrons produced in the Geiger-Mueller tube as a result of interaction of incident radiation with the gas medium are drifted, respectively, towards cathode and anode. On an average: (1) Ion has more kinetic energy, but smaller speed than electron (2) Ion has smaller kinetic energy and speed than electron (3) Ion and electron have equal kinetic energy and speed (4) Ion and electron have equal kinetic energy, but speed of electron is more than that of ion

Total No. of Printed Pages: 13

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CPG-EE-2019 (Physics)-(SE1-Y)
B 10382
Time: 1½ Hours Total Questions: 100 Max. Marks: 100
Roll No. (in figures) (in words)
Candidate's Name Date of Birth
Father's Name Mother's Name
Date of Exam:
(Signature of the Candidate) (Signature of the Invigilator)

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- 1. All questions are *compulsory* and carry equal marks. The candidates are required to attempt all questions.
- 2. The candidate **must return** his question booklet and the OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfairmeans / misbehaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer sheet of such a candidate will not be evaluated.
- 3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
- 4. Question Booklet along-with answer key of all the A, B, C and D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case will be considered.
- 5. The candidate *must not* do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers *must not* be ticked in the question booklet.
- 6. Use only black or blue ball point pen of good quality in the OMR Answer-Sheet.
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- 8. Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.

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		1
1.	1. The vector potential in a region is given as $\overrightarrow{A}(x, y, y,$	$z) = -\hat{x}y + \hat{y}2x$. The associated
	magnetic induction \overrightarrow{B} is :	
	(1) $\hat{x} + \hat{z}$ (2) $-\hat{x} + 2\hat{y}$ (3) $-\hat{x} + 2\hat{y} + \hat{z}$	$-\hat{z}$ (4) $3\hat{z}$
2.	2. A paramagnetic substance is placed in an external ho field. The resulting magnetic susceptibility contains: (1) Paramagnetic contribution	mogeneous and static magnetic
	(2) Paramagnetic and diamagnetic contributions	
	(3) Diamagnetic contribution	
	(4) Paramagnetic, ferromagnetic and diamagnetic contri	ributions
3.		
	frequency 5.09×10^{14} Hz. Given that diamond has pe 1.00, the speed of wave propagation and wavelength of respectively, be equal to:	rmittivity 5.84 and permeability
		n/s and 589 nm
	(1) 1.24×10^8 m/s and 589 nm (2) 3.0×10^8 m (3) 1.24×10^8 m/s and 244 nm (4) 3.0×10^8 m	n/s and 244 nm
4.	→ ^ ^	
		x + constant
	(1) $V = -xy + \text{constant}$ (2) $V = -y + x$ (3) $V = -(y^2 + x^2) + \text{constant}$ (4) $V = \text{const}$	ant
5.		
	positions, has its origin in:	
	(1) Electrostatic force (2) Electrom	0
	(3) Weak force (4) Gravitation	onal force
6.		cles in thermal equilibrium at
	temperature T . The most probable value of energy is:	
	(1) $k_B T/2$ (2) $3k_B T/2$ (3) $k_B T$	$(4) 2k_BT$
7.	7. Suppose an atomic gas in a container is at thermal equipolating with each other and the walls of the container.	
	(1) Inelastic (2) Elastic	
	(3) Inelastic at extremely low temperatures (4) None of	the above
8.	8. For an ideal gas of diatomic molecules in thermal e average energy per molecule is:	
	(1) $\frac{1}{2}k_BT$ (2) $\frac{3}{2}k_BT$ (3) $3k_BT$	$(4) 6k_BT$

9. At what temperature is the r.m.s. velocity of a hydrogen molecule equal to that of an

(3) 3 K

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(1) 80 K

oxygen molecule at 47°C?

(2) -73 K

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(4) 20 K

			L
10.	A cube has a volume of 1000 cm ³ . Its vo a velocity of 0.8c relative to the cube in a	lume as observed by direction parallel to	y an observer Q moving at one edge is:
	(1) 500 cm^3 (2) 1000 cm^3	(3) 900 cm ³	$(4) 600 \text{ cm}^3$
11.			
	range of stable nuclei is a consequence of	the fact that the nuc	clear force is:
	243	(2) Short range	
	(3) Charge-independent	(4) Always attractiv	ve
12.	Alpha particles produced during alpha-de	cay have kinetic end	ergy of the order of:
		(3) GeV	(4) eV
13.	What limits the size of a stable nucleus?		
	(1) Limited number of nucleons	(2) Limited range of	of the strong nuclear force
	121V E	(4) None of the abo	
14.			
	I. A neutron can transform into a proton	in free space	,
	II. A proton can transform into a neutron	•	
	III. A neutron can transform into a proton		
	IV. A proton can transform into a neutron		
	(1) I, III and IV (2) I, II, III and IV		
15.	Tritium has a half-life of 12.5 y agains tritium will remain un-decayed after 25 y	st beta decay. Wha?	t fraction of a sample of
	(1) 1/4 (2) 1/2	(3) 1/10	(4) 1/3
16.	How many neutrons are released in the fo	llowing nuclear read	ction?
		$\frac{88}{38}Sr + \frac{136}{54}Xe + ? \frac{1}{0}n$	
		54 0	(4) 14
4-	201 800	(3) 10	(4) 14
17.	p	ich of the following	is true about the reaction?
	I. The energy is conservedII. The electric charge is conserved		
	III. The mass is conserved		
	IV. The number of nucleons is conserved		
	(1) I, II, III and IV (2) I and II only	(3) I, II and III only	(4) I, II and IV only
18.	Which of the following statements is not t		
	I. It is produced by unstable nuclei		
	II. It can penetrate several centimeters of	flead	
	III. It can ionize gasses		w.
	IV. It can be deflected by a magnetic field		
	V. It is a short wavelength electromagnet (1) IV and V (2) III and IV		(4) 37
CDC 1		(3) IV	(4) V
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19.	The photoelectric cross-section depends on Z (target atomic number) and E_{γ} (energy of incident photon) through the expression :		
	(1) $Z^5/E_{\gamma}^{3/2}$	(2) $Z^2/E_{\gamma}^{7/2}$	
	(3) $Z^5/E_{\gamma}^{7/2}$	(4) Z/E_{γ}	
20.	interaction of incident radiation with the cathode and anode. On an average: (1) Ion has more kinetic energy, but smaller kinetic energy and sign (3) Ion and electron have equal kinetic energy.	peed than electron energy and speed	
21.	The second secon	(2) 0.2 eV	
22.	(3) 1.3 eV A particle moving freely in x-directly $\psi(x, t) = Ce^{i(kx-\omega t)}$. Uncertainty in its m	(4) 2.1 eV ection is described by the wave function omentum is equal to:	
23.	(1) Zero (2) \hbar Which of the following wave functions (1) $\psi(x) = x $	(3) ∞ (4) $\hbar/2$ can describe a physical state? (2) $\psi(x) = \exp(x^2)$	
24.		(4) $\psi(x) = \exp(-x^2)$ ne wave function $\psi(x) = ax$ between $x = 0$ and y that the particle can be found between $x = 0.45$	
25.	(1) a^2 (2) $0.0251 a^2$ X-rays of wavelength 10.0 pm are scatt	(3) $0.3025 a^2$ (4) $0.2025 a^2$ ered from a target via Compton scattering. The excattered X-rays is (given that Compton	
	(1) 14.9 pm (3) 2.426 pm	(2) 1.49 pm (4) 2426 pm	
26.		glie wave associated with a material particle of ented as : $\psi(x, t) = e^{i(kx - \omega t)}$. The phase velocity article velocity v as : (2) $v_p = v/2$ (4) $v_p = \pm v$	

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Consider a particle described by the time-dependent Schrodinger wave equation :

$$i\hbar \frac{\partial}{\partial t} \psi(x,t) = \left[-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} + V(x,t) \right] \psi(x,t)$$
. If $\psi(x,t)$ is one solution of this equation,

then which of the following statements is true for $\psi^*(x, t)$:

- (1) $\psi^*(x, t)$ is also a solution of the same Schrodinger wave equation.
- (2) $\psi^*(x, t)$ cannot in general be a solution of the same Schrodinger wave equation.
- (3) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is zero.
- (4) ψ *(x, t) can be a solution of the same Schrodinger wave equation provided that V(x, t) is independent of x.
- **28.** Zero-point energy of an oscillator has its origin in :
 - (1) Pauli exclusion principle
 - (2) Experimental non-realization of absolute zero temperature
 - (3) Quantization of energy
 - (4) Heisenberg uncertainty principle
- 29. Quantum mechanically an electron of energy 2.0 eV incident on a barrier 10.0 eV high and 0.50 nm wide has a finite probability of tunneling through it. If electron is replaced by a proton, the tunneling probability:
 - (1) Increases by a factor of 2
- (2) Decreases

(3) Remains unchanged

- (4) Decrease by a factor of 2
- **30.** Eigen value of the operator $-\frac{\hbar^2}{2m}\frac{d^2}{dr^2}$ operating on the wave function

$$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{9\pi x}{L}\right)$$
 is given by :

- (1) $\frac{\pi^2 \hbar^2}{2mI^2}$ (2) $\frac{9\pi^2 \hbar^2}{2mI^2}$ (3) $\frac{81\pi^2 \hbar^2}{2mI^2}$ (4) $\frac{3\pi^2 \hbar^2}{2mI^2}$
- The gas of electrons in a metal possesses tremendous internal energy even at absolute zero temperature. The origin of this energy lies in the:
 - (1) Maxwell-Boltzmann Law
- (2) Negative charge on electrons
- (3) Pauli exclusion principle
- (4) Small mass of electrons
- For a gas of electrons in thermal equilibrium at room temperature, the probability of finding an electron in the single-electron states $\varepsilon_F^{}+\varepsilon_F^{}$ and $\varepsilon_F^{}-\varepsilon_F^{}$ is (where $\varepsilon_F^{}$ is the Fermi energy):
 - (1) Equal

- (2) Not equal
- (3) Equal if ε is positive
- (4) Equal if ε is negative

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					5
33.	when air is replaced	l by a transparent liqu	uid. V	What is the refrac	hanges from 1.2 to 1.0 cm ctive index of liquid?
	(1) 1.44	(2) 1.20	(3)	4.10	(4) 1.50
34.	Three plane-waves	$s viz. y_1 = A_1 \ \hat{y} c c$	os(kx	$(-\omega t + \delta_1), y_2 =$	$A_2 \hat{z} \cos(kx - \omega t + \delta_2)$ and
	$y_3 = A_3 \hat{y} \cos(kx - \omega)$	$ot + \delta_3$) are superpos	ed p	airwise. Which	superposition can lead to
	interference? (here	$A_1, A_2, A_3, \delta_1, \delta_2, \delta_3$	are c	onstants)	n n
	(1) y_1 and y_2		(2)	y_1 and y_3	
	(3) y_2 and y_3		(4)	No interference	in any pair
35.	_				where the path difference is the maximum intensity, I/I_0
	(1) 3/4	(2) 1/2	(3)	3/2	(4) 1/6
36.	Illuminated normally, a diffracting grating produces second order bright images with an angle of 60° between them. The light is monochromatic and has a wavelength of 300 nm. The spacing of the grating in mm is:				
3.53	(1) 3.6×10^{-3}	(2) 2.4×10^{-3}	(3)	2.0×10^{-3}	(4) 1.5×10^{-3}
37.	Electromagnetic wa	aves are transverse in	natu	re, is evident by	·:
	(1) Polarization	(2) Interference	(3)	Reflection	(4) Diffraction
38.	A beam of transver their direction of m		ratio	ns occur in all	directions perpendicular to
	(1) Polarized	(2) Unpolarized	(3)	Resolved	(4) Diffracted
39.	The state of polariz	zation of light with	the e	electric field vec	$\cot \vec{E} = \hat{x}E_0 \cos(kz - \omega t) -$
	$\hat{y}E_0\cos(kz-\omega t)$ is	3:			
4	(1) Linearly polariz	zed along z-direction	ĺ		
	(2) Linearly polariz	zed at -45° to x-axis			
	(3) Circularly pola	rized			
	(4) Elliptically pol	arized with the major	r axis	along x-axis	
40.	If the electric field	vector in a polarized	d ele	ctromagnetic wa	we is $\vec{E}(\vec{r},t) = \hat{n}E_0e^{i(\vec{k}\cdot\vec{r}-\omega t)}$
	(with \hat{n} being the p	polarization vector as	$nd \vec{k}$	the propagation	vector), its magnetic field
	vector is given by:				n
,	$(1) \ \frac{1}{c}\hat{k} \times \overrightarrow{E}$		(2)	$\hat{k} \times \overrightarrow{E}$	
	$(3) \ \frac{1}{c^2} \hat{k} \times \vec{E}$		(4)	$\frac{1}{c}\hat{k}.\overrightarrow{E}$, ,

41.	The value of M after the following set of	of FORTRAN statements are executed is:
	M = 0	
	Do $10 I = 1.2$	
	Do $20 J = 1.2$	
	M = M + I + J	
	20 Continue	
	10 Continue	
	Stop	
	End	
	(1) 11 (2) 12	(3) 4 (4) 10
42.	In FORTRAN language, the state	ement, $p = 1/x * a + 1/y + b - 1/z * * 3 * c$ will
	compute the expression:	
	(1) $p = \frac{1}{xa} + \frac{1}{y} + b - \frac{1}{z^{3c}}$	(2) $n = a + 1 + b + c$
	$xa y z^{3c}$	(2) $p = \frac{a}{x} + \frac{1}{y} + b - \frac{c}{z^3}$
	(3) $n = \frac{a}{1} + 1 + c$	(1) $=$ 1 $=$ 1
	(3) $p = \frac{a}{x} + \frac{1}{y+b} - \frac{c}{z^3}$	(4) $p = \frac{1}{xa} + \frac{1}{y+b} - \frac{1}{z^3c}$
43.	The change in entropy is zero for:	
	(1) Irreversible processes	(2) Reversible adiabatic processes
	(3) Reversible isothermal processes	(4) All adiabatic processes
44.	When changes occur within a closed sy	stem, which of the following is true for change
	in entropy ΔS of the system?	
	(1) $\Delta S = 0$ (2) $\Delta S < 0$	$(3) \Delta S \ge 0 \qquad (4) \Delta S > 0$
45.	Let us take two sub-systems A_1 and	d A_2 in general contact. The most general
	thermodynamic equilibrium relation for	
	$(1) dE = TdS - PdV + \mu dN$	(2) $dE = TdQ - PdV + \mu dN$
	(3) $dE = TdS + PdV + \mu dN$	$(4) dE = TdS + PdV - \mu dN$
46.		from a reservoir at 300°C and exhausts heat to a
	reservoir at 150°C. The work done by the	ne engine is :
	(1) $2.6 \times 10^6 \text{J}$ (2) $2.6 \times 10^5 \text{J}$	(3) $1 \times 10^6 \text{J}$ (4) $1.6 \times 10^5 \text{J}$
47.	Consider that an amount of heat dQ is a	dded to a substance at temperature T keeping its
	volume constant at V . As a result, its energy by dE . The heat capacity C of the	temperature changes by dT , while the internal e substance is given by :
		1 10
	$(1) \frac{dE}{dT} \qquad (2) \frac{1}{T} \frac{dE}{dT}$	$(3) \frac{1}{T} \frac{dQ}{dT} \qquad (4) \frac{1}{V} \frac{dQ}{dT}$

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48.	The Fourier transfo	$\operatorname{rm} f(q)$ of the fund	$extion f(x) = e^{-x^2/2} is$:	
A .	(1) e^{-q^2}	(2) $e^{-q^2/2}$	(3) e^{q^2}	(4) $e^{q^2/2}$	
49.	A real, periodic and	d continuous functi	on $n(x)$ can be expan	ided in the Fourier series as:	
			efficient C_p must sat		
	$(1) C_p = C_p^*$	(2) $C_{-p} = C_p^*$	$(3) C_{-p} = C_p$	(4) $C_0 = 0$	
50.	If $f(q)$ is the Fourier	er transform of $f(x)$, the Fourier transfor	$m ext{ of } f(ax) ext{ is :}$	
	(1) $f(q/\alpha)$	(2) $f(q\alpha)$	(3) $\alpha^{-1} f(q/\alpha)$	(4) $\alpha f(q/\alpha)$	
51.	If the speed of a pa	rticle moving at 0.4	le is doubled, its mor	mentum will:	
	(1) Become double		(2) Become more		
. 50	(3) Remain unchar			tly less than double	
52.	(1) Mass	ving is invariant in	special theory of rela	ativity?	
	(3) Speed of light		(2) Charge	ell as speed of light	
53.		canacitance 25×10	-6 F is charged by c	onnecting it to a 300 V dc	
00.	power supply. The	capacitor is discor	nnected from the sup	ply and connected across an	
	inductor with $L=1$	$0^{-2}H$. What is the	frequency and period	of oscillation in the circuit?	
				(4) 100 Hz; 0.01 s	
54.					
	(2) $(1.20 V) \cos [(2 V)]$		-		
	(3) $(1.20 V) \cos [(2.0 V)]$	7000 V 1000 000 000 000 000 000 000 000 000 0			
	(4) (0.48 V) cos [(2	$2500 \text{ rad/s} t - \pi/2 \text{ r}$	ad]		
55.	When a forward bia	as is applied to a pr	junction, the drift cu	irrent?	
	(1) Increases	11 1	(2) Decreases to		
	(3) Decreases, but	not to zero	(4) Remains uncl	hanged	
56.	Which of the follo Hall coefficient:	wing is true about		niconductor substance? The	
	(I) Changes with o	loping concentration	n		
	(II) Depends on ter	nperature			
	(III) Varies with pr				
	(IV) Independent o		-		
	(1) I, II and III	(2) II and III	(3) I, II and IV	(4) IV and I	
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57.	The color of the bright spot on the screen of a CRO is the characteristic of the:				
	(1) Signal being viewed(2) Primary electrons emitted from the cathode				
	(3) Final speed with which the electrons strike the screen				
	(4) Coating material of the display screen				
58.					
	electron pair in germanium (given that the b	oand gap of german	nium is 0.65 eV) is :		
	(1) $6 \times 10^{-6} \mathrm{m}$ (2) $1.6 \times 10^{-6} \mathrm{m}$ (3)				
59.					
) Increases	and		
60	(3) Increases followed by an initial decrease (4				
60.	A transistor has $\alpha = 0.98$, IB = 100 μ A and (1) 5.3 mA (2) 6 mA (3)				
61.					
01.	maxima is:	riciciec is a cacii	, then intensity of light at		
	(1) $4a^2$ (2) $2a^2$ (3)	3) 2 <i>a</i>	(4) 4 <i>a</i>		
62.	If in a Young's double slit experiment being	g performed with v	white light, one of the slits		
	is covered with the red filter, while the other	er slit with the blue	filter.		
	(1) There shall be no interference fringes				
	(2) There shall be an alternate interference		The state of the s		
	(3) There shall be an interference pattern o(4) None of the above	of mixed color of re	ed and blue		
60		the I levidle mimor	avnariment?		
63.	What is the shape of interference fringes in the Lloyd's mirror experiment?(1) Dark and bright straight fringes of equal width				
	(2) Dark and bright straight fringes of uned				
341	(3) Dark and bright straight fringes of equa	-	al fringe a dark one		
	(4) Dark and bright straight fringes of unec				
64.	When light travels from rare to denser med	lium, it loses some	speed. As a result:		
	(1) Energy carried by light decreases (2)				
	.,	4) Energy carried l			
65.					
	imaginary wall. The most probable mod randomness (i.e. the degree of non-predicta		is the one for which the		
		2) Minimum			
		4) Either maximur	n or minimum		
66.	A real gas behaves like an ideal gas if its:				
	(1) Pressure and temperature are both high (2	2) Pressure and ter	mperature are both low		
	(3) Pressure is high and temperature is low (4)	4) Pressure is low	and temperature is high		
CPG-	CPG-EE-2019/(Physics)-(SET-Y)/(B)				

67.	N distinguishable particles in a statistic	cal system are somehow restricted to move in a
	plane. The dimensionality of its phase s $(1) 4^{N} \qquad (2) 6^{N}$	
68.		and A_2 , are allowed to have thermal contact.
	Obviously, there will be exchange	of energy if A_1 and A_2 were at different
	temperatures. According to the post	plates of statistical physics, the condition of
	equilibrium is (Ω denotes the number of	f microstates for a system):
	$(1) \frac{\partial}{\partial E} \ln \Omega_1 = \frac{\partial}{\partial E} \ln \Omega_2$	$(2) \ \frac{\partial}{\partial E} \Omega_1 = \frac{\partial}{\partial E} \Omega_2$
	$(3) \ \frac{\partial}{\partial E} \Omega_1 \Omega_2 = 0$	$(4) \ \frac{\partial}{\partial E}(\Omega_1 + \Omega_2) = 0$
69.	The electronic heat capacity of a metal	within the framework of Fermi-Dirac statistics
	depends on temperature as:	
	$(1) AT^3 \qquad (2) AT$	$(3) AT^{3/2} (4) AT^{1/2}$
70.	The phenomenon of Bose-Einstein co	ndensation may occur for a class of particles
	which are ?(1) Indistinguishable and have half-interest	aral anin
	(2) Distinguishable and have integral sp	
	(3) Distinguishable and have half-integ	ral spin
	(4) Indistinguishable and have integral	spin
71.	A crystalline solid can be distinguished	from a glassy solid on the basis of their:
	(1) Distinct physical and chemical prop	erties
	(2) X-ray diffraction pattern(3) Lattice and unit cells	* ,
	(4) Lattice, basis and unit cells	
72.	Which of the following is true about the	Wigner-Seitz unit cell ?
	(1) It contains always one lattice point	at the center of the cell
	(2) In contains always one atom at the	
	(3) It contains one lattice point, with ea	ch corner making a contribution of 1/8
		the center and other at one of the eight corners
73.		direct lattice, while $\vec{G} = v_1 \vec{b}_1 + v_2 \vec{b}_2 + v_3 \vec{b}_3$ is a
	vector in the corresponding reciprocal la	attice, then $\overrightarrow{R}.\overrightarrow{G}$ has the from :
	(1) $2\pi/(\vec{a}_1.\vec{a}_2 \times \vec{a}_3)$ (2) $2\pi/\text{Integer}$	(3) $2\pi \times \text{integer}$ (4) $2\pi/(\vec{b}_1 \cdot \vec{b}_2 \times \vec{b}_3)$
74.	At low temperature T , the specific heat	of insulating crystals varies as :
	$(1) AT + BT^3$	(2) BT^{3}
	(3) Will not change with temperature	(4) $\operatorname{Aexp}(-T)$
CPG-I	EE-2019/(Physics)-(SET-Y)/(B)	P. T. O.

diagonally, has Miller indices:

positioned at 000 and $\frac{1}{2} \frac{1}{2} \frac{1}{2}$

000 and $\frac{1}{4} \frac{1}{4} \frac{1}{4}$

(2) (010)

The structure of diamond crystal can be described by:

(1)(100)

	positioned at 00	00 and $\frac{1}{4} \frac{1}{4} \frac{1}{4}$	GC.	
	(4) A simple cubic the cubic cell	lattice, with carbon	atoms positioned at	corners and face centers of
77.				a crystal occurs at $\theta = 45^{\circ}$, s may occur at θ equal to :
	(1) $\theta = 60^{\circ}$	(2) $\theta = 90^{\circ}$	(3) $\theta = 22.5^{\circ}$	(4) None of the above
78.		es having Miller in		described by three different and (111). The inter-planar
	(1) $\sqrt{6}:\sqrt{3}:\sqrt{2}$	(2) $\sqrt{2}:\sqrt{3}:\sqrt{6}$	(3) 1:2:3	(4) 3:2:1
79.	The reciprocal latti	ce of the reciprocal l	attice of simple cubi	c lattice is:
	(1) A simple cubic	lattice		
	(2) An expanded s	imple cubic lattice		
	(3) A simple cubic	lattice rotated by an	angle of 45°	
	(4) A compressed	simple cubic lattice		
80.	According to Eins dimensional crysta	tein's model, the avilline solid in thermal	erage energy of an lequilibrium at temp	atomic oscillator in a one- perature T is given by:
	$(1) \frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right) + 1\right]}$	$ (2) \frac{k_B T}{2} $	(3) k_BT	$(4) \frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right) - 1\right]}$
81.	A body, initially a having a total kine explosion is:	at rest, explodes into etic energy E . The k	two pieces of mas inetic energy of the	is $2M$ and $3M$, respectively piece of mass $2M$ after the
	(1) E/3	(2) E/5	(3) $2E/5$	(4) 3 <i>E</i> /5
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Consider a cubical lattice. A lattice plane that bisects the bottom face of the cube

(1) A simple cubic lattice and a basis of two carbon atoms, with atoms positioned at

(2) A face centered cubic lattice and a basis of two carbon atoms, with atoms

(3) A face centered cubic lattice and a basis of two carbon atoms, with atoms

(3) (111)

(4) (110)

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82.	If a generalized co will have the dimer	ordinate has the dim	nension of momentu	m, the generalized velocity	
	(1) Velocity	(2) Acceleration	(3) Torque	(4) Force	
83.	If a constant force a	acts on a particle, its	acceleration will:		
	(1) Remain constant	nt	(2) Gradually decr	rease ined after some time	
	(3) Gradually incre	ease	(4) Become undef	ined after some time	
84.	The law of conserv	ation of linear mome	ntum has its origin in	n:	
	(1) Translational S	ymmetry of space	(2) Isotropy of spa	ice	
85.		e of space			
05.	agrange's equ	ation for simple pend	dulum is (symbols ha	ave their usual meaning):	
		$(2) \ddot{\theta} + \frac{g}{l \sin \theta} = 0$		0	
86.	A particle is constra	ained to move along	the inner surface of	a fixed hemispherical bowl.	
	(1) One	rees of freedom of th	e particle is:	(A) F	
87.	` ,	(2) Two		(4) Four	
07.	kinetic energy of os	scillator is:	equency J , the frequency	ency of oscillation of the	
	(1) f	(2) $f/2$	(3) 2f	(4) 4f	
88.					
	3. The electric potential at point r inside a uniformly charged thin spherical shell we surface charge density σ and radius R is equal to (q) is the total charge on the spherical shell we have R in equal to R is equal to R is equal to R is the total charge on the spherical shell we have R in equal to R is equal to R .				
	shell):				
	$(1) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{r}$	$(2) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{R}$	(3) $\frac{1}{4\pi\epsilon_0}\frac{\sigma}{r}$	(4) Zero	
00		0 -	0		
89.				$=-\frac{d\Phi_B}{dt}$, is called a non-	
	conservative field as the line integral of the electric field in electrostatics $\oint \vec{E} \cdot d\vec{l}$ is				
	always:				
	(1) Zero	(2) 2π	(3) $\frac{d\Phi_B}{dt}$	(4) $2\pi \vec{E}$	
90.	In electromagnetic	wave in free space	e, the phase differe	ence between electric and	
	magnetic field vector	ore F and Pic.			
	Bracker xxexa veet	ors E and B is.			
			(3) π	(4) $3\pi/2$	
91.		(2) $\pi/2$ wed values of l are:	(3) π	(4) $3\pi/2$	
91.		(2) $\pi/2$ wed values of l are:			
	(1) Zero For $j = 5/2$ the allow (1) 1, 2	(2) $\pi/2$ wed values of l are: (2) 2, 3	(3) 3, 4	(4) 4, 5	
91. 92.	(1) Zero For $j = 5/2$ the allow (1) 1, 2 An atom having or	(2) $\pi/2$ wed values of l are: (2) 2, 3 ne electron in its val	(3) 3, 4 ence shell is placed	(4) 4, 5 lin a weak magnetic field	
	(1) Zero For $j = 5/2$ the allow (1) 1, 2 An atom having or	(2) $\pi/2$ wed values of l are: (2) 2, 3 ne electron in its val	(3) 3, 4 ence shell is placed	(4) 4, 5	
	(1) Zero For $j = 5/2$ the allow (1) 1, 2 An atom having or oriented along the are:	(2) $\pi/2$ wed values of l are: (2) 2, 3 ne electron in its val	(3) 3, 4 ence shell is placed angles of spin angu	(4) 4, 5 l in a weak magnetic lar momentum with	

93.

	mico .				
	(1) Two sub-levels	(2) Three sub-levels			
	(3) Five sub-levels	(4) None of the above			
94.	The spin angular momentum of an electronic e	on can be described as:			
	(1) Electron spinning about an axis passing through its center				
	(2) Electron spinning clockwise or anti-clo	ockwise about an axis passing through its center			
	(3) Electron spinning at speed of light passing through its center	t clockwise or anti-clockwise about an axis			
	(4) None of the above				
95.	The maximum degeneracy of an atomic en	ergy level with principal quantum number n is:			
	(1) n	$(2) n^2$			
	(3) $2n^2$	(4) 2 <i>n</i>			
96.	weak electric field (weak field Stark effe				
		(3) Three sub-levels (4) None of the above			
97.	moment $(\vec{\mu})$ of the electron is initially	trength $B = 100$ Gauss. The magnetic dipole anti-parallel to the direction of \vec{B} . How much			
		direction of magnetic moment of the electron?			
	(1) $-2\mu B$ (2) $+2\mu B$				
98.	The rotational, vibrational and molecular respectively, in the:	r electronic spectra of diatomic molecules lie,			
	(1) Microwave, infrared and visible-ultr	aviolet regions			
	(2) Infrared, microwave and visible-ultr	aviolet regions			
	(3) Visible-ultraviolet, microwave and i	nfrared regions			
	(4) Infrared, visible-ultraviolet and micr	rowave regions			
99.	For laser action to occur, what is the medium should have?	minimum number of energy levels the lasing			
	(1) Two	(2) Four			
	(3) Three	(4) Five			
100.		s of light whose wavelength is 694 nm. What is ruby?			
	(1) 1.0×10^{22}	(2) 3.5×10^{23}			
	(3) Avogadro number	$(4) 3.5 \times 10^{18}$			
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The effect of spin-orbit splitting on the ground state level of hydrogen atom is to split it

Total No. of Printed Pages: 13 (DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO) CPG-EE-2019 (Physics)-(SET-Y) Sr. No. Max. Marks: 100 Total Questions: 100 Time: 11/2 Hours __ (in words) _ Roll No. (in figures) _ Date of Birth Candidate's Name -Mother's Name Father's Name — Date of Exam: ----(Signature of the Invigilator) (Signature of the Candidate) CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER. 1. All questions are compulsory and carry equal marks. The candidates are required to attempt all questions. 2. The candidate must return this question booklet and the OMR Answer-Sheet to the Invigilator

concerned before leaving the Examination Hall failing which a case of use of unfairmeans / misbehaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that/a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A, B, C and D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if and with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case will be considered.

5. The candidate must not do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers must not be ticked in the question booklet.

6. Use only black or live ball point pen of good quality in the OMR Answer-Sheet.

7. There/will be pegative marking. Each correct answer will be awarded one full mark and each incorrect answer will be negatively marked for which the candidate will get 1/4 Mark (0.25 Mark) discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

8. Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30

minutes after starting of the examination.

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 $(3) \ \frac{\partial}{\partial E} \Omega_1 \Omega_2 = 0$

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1.	If amplitudes of two waves producing maxima is:	g interference is '	a' each, then intensity of light a	at
	(1) $4a^2$ (2) $2a^2$	(3) 2a	(4) 4 <i>a</i>	
2.	If in a Young's double slit experiment is covered with the red filter, while the	t being performed		ts
	(1) There shall be no interference frim	nges		
	(2) There shall be an alternate interfe	rence pattern of r	ed and blue	
	(3) There shall be an interference pat	tern of mixed col	or of red and blue	
	(4) None of the above			
3.	What is the shape of interference fring	ges in the Lloyd's	mirror experiment?	
	(1) Dark and bright straight fringes o	of equal width		
	(2) Dark and bright straight fringes of	f unequal width		
	(3) Dark and bright straight fringes of	of equal width wit	h central fringe a dark one	
	(4) Dark and bright straight fringes of	of unequal width v	with central fringe a dark one	
4.	When light travels from rare to dense	r medium, it lose	s some speed. As a result:	
	(1) Energy carried by light decreases	(2) Energy c	arried by light stays constant	
	(3) Frequency of light reduces	(4) Energy of	arried by light increases	×
5.	Consider the distribution of N mole imaginary wall. The most probable randomness (i.e. the degree of non-probable content of the degree of the degree of non-probable content of the degree	mode of distrib		
	(1) Maximum	(2) Minimu	n	
	(3) Absolute zero	(4) Either m	aximum or minimum	
6.	A real gas behaves like an ideal gas i	f its:		
	(1) Pressure and temperature are both h	nigh (2) Pressure	and temperature are both low	
	(3) Pressure is high and temperature is	low (4) Pressure	is low and temperature is high	
7.	N distinguishable particles in a statis		somehow restricted to move in	ı a
	plane. The dimensionality of its phas		(4) 037	
	$(1) 4^{N} (2) 6^{N}$	(3) 4N	(4) 2N	
8.				
	Obviously, there will be exchange			
	temperatures. According to the po- equilibrium is (Ω denotes the number			01
	$(1) \frac{\partial}{\partial E} \ln \Omega_1 = \frac{\partial}{\partial E} \ln \Omega_2$	$(2) \ \frac{\partial}{\partial E} \Omega_1 =$	$=\frac{\partial}{\partial E}\Omega_2$	

 $(4) \ \frac{\partial}{\partial E}(\Omega_1 + \Omega_2) = 0$

9.	The electronic heat capacity of depends on temperature as:	a metal within	n the framewor	k of Fermi-Dirac stat	tistics
	$(1) AT^3 (2) AT$	(3)	$AT^{3/2}$	(4) $AT^{1/2}$	
10.	The phenomenon of Bose-Eins which are?	tein condensa	ation may occu	or for a class of par	ticles
	(1) Indistinguishable and have l	nalf-integral sp	oin		
	(2) Distinguishable and have in				
	(3) Distinguishable and have ha		n		
11.	(4) Indistinguishable and have i		11 1 2		
11.	If the speed of a particle moving (1) Become double		Become more the		
	(3) Remain unchanged			less than double	
12.	Which of the following is invari				
	(1) Mass	5 555 555	Charge		
10	(3) Speed of light			as speed of light	
13.	A capacitor with capacitance 2 power supply. The capacitor is				
	power supply. The capacitor is disconnected from the supply and connected across are inductor with $L = 10^{-2} H$. What is the frequency and period of oscillation in the circuit?				
	(1) 320 Hz; 3.1 ms		220 Hz; 4.5 ms		
	(3) 50 Hz; 0.02 s		100 Hz; 0.01 s		
14.	A 200 Ω resistor and a 5 μF voltage source. The voltage acr voltage across the capacitor will	oss the resisto	connected in or is $v_R = (1.20)$	series with an altern V) cos (2500 rad/s) t	nating . The
	(1) $(0.48 V) \cos [(2500 \text{ rad/s})t +$		$(1.20 V) \cos [(2$	$500 \text{ rad/s} t - \pi/2 \text{ rad}$	ĺ
	(3) $(1.20 V) \cos [(2500 \text{ rad/s})t]$			$500 \text{ rad/}s)t - \pi/2 \text{ rad}$	
15.	When a forward bias is applied	o a pn junctio	n, the drift curr	ent?	
	(1) Increases	(2) 1	Decreases to ze	ro	
	(3) Decreases, but not to zero	(4)]	Remains unchar	nged	
16.	Which of the following is true Hall coefficient:	about Hall ef	fect in a semic	onductor substance	? The
	(I) Changes with doping concer	ntration			
	(II) Depends on temperature				
	(III) Varies with probe current a				
	(IV) Independent of probe curre (1) I, II and III (2) II and I			(4) IV on J I	
		11 (3) 1	I, II and IV	(4) IV and I	
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17.	The color of the bright spot on the screen	of a CRO is the char	racteristic of the:			
	(1) Signal being viewed	.1 1				
	(2) Primary electrons emitted from the cathode					
	(3) Final speed with which the electrons s					
esson to grov	(4) Coating material of the display screen					
18.	The maximum wavelength of electrom					
	electron pair in germanium (given that the					
	(1) 6×10^{-6} m (2) 1.6×10^{-6} m					
19.	If the load resistance of a CE amplifier in		ent gain:			
		(2) Increases				
	(3) Increases followed by an initial decrease					
20.	A transistor has $\alpha = 0.98$, IB = 100 μ A are					
		(3) 4.6 mA	(4) 9 mA			
21.	A body, initially at rest, explodes into t					
	having a total kinetic energy E . The kinetic	etic energy of the p	iece of mass 2M after the			
	explosion is:	(2) 0.5/5	(4) 2 5/5			
		(3) 2E/5	(4) 3E/5			
22.		nsion of momentum	n, the generalized velocity			
	will have the dimension of:	(2) Torque	(4) Force			
	(1) Velocity (2) Acceleration		(4) 10100			
23.			2000			
	(1) Remain constant	(2) Gradually decre				
0.4		(4) Become undefin				
24.						
	(1) Translational symmetry of space(3) Time invariance of space	(2) Isotropy of space(4) Lagrange's equal	,			
25		, , , ,				
25.						
	(1) $\ddot{\theta} + \frac{g}{l}\sin\theta = 0$ (2) $\ddot{\theta} + \frac{g}{l\sin\theta} = 0$	$(3) \ddot{\theta} - \frac{g}{l} \sin \theta = 0$	$(4) \ddot{\theta} + \frac{\iota}{g} \sin \theta = 0$			
26.			fixed hemispherical bowl.			
	The number of degrees of freedom of the					
	(1) One (2) Two	(3) Three				
27.	If a linear harmonic oscillator has free kinetic energy of oscillator is:	quency f , the frequ	ency of oscillation of the			
	(1) f (2) $f/2$	(3) 2 <i>f</i>	(4) 4 <i>f</i>			
CDC	FF_2010/(Physics)_(SFT_V)/(C)		Р. Т. О			

				•	
28.	The electric potential at point r inside a uniformly charged thin spherical shell with surface charge density σ and radius R is equal to (q) is the total charge on the spherical shell):				
	$(1) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{r}$	$(2) \ \frac{1}{4\pi\varepsilon_0} \frac{q}{R}$	$(3) \ \frac{1}{4\pi\varepsilon_0} \frac{\sigma}{r}$	(4) Zero	
29.	The induced electric field in the Maxwell equation $\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$, is called a non-				
	conservative field as the line integral of the electric field in electrostatics $\oint \vec{E} \cdot d\vec{l}$ is always:				
	(1) Zero	(2) 2π	$(3) \frac{d\Phi_B}{dt}$	$(4) \ \ 2\pi \vec{E}$	
30.	In electromagnetic magnetic field vector	\rightarrow \rightarrow	e, the phase differe	ence between electric and	
	(1) Zero	(2) $\pi/2$	(3) π	(4) $3\pi/2$	
31.	range of stable nucl (1) Strong	ei is a consequence of	of the fact that the nu		
32.			8 8	ergy of the order of:	
			(3) GeV		
33.	What limits the size			(4) 60	
00.				of the strong nuclear force	
			(4) None of the abo		
34.	Which of the follow		(+) None of the abo	5 vc	
		ransform into a proto	on in free space		
	II. A proton can transform into a neutron in free space				
	III. A neutron can transform into a proton inside nucleus				
	IV. A proton can tra	ansform into a neutro	on inside nucleus		
	(1) I, III and IV	(2) I, II, III and IV	(3) II, III and IV	(4) III and IV	
35.	Tritium has a half-life of 12.5 y against beta decay. What fraction of a sample of tritium will remain un-decayed after 25 y?				
	(1) 1/4	(2) 1/2	(3) 1/10	(4) 1/3	
36.	How many neutrons	s are released in the	following nuclear rea	ction?	
			$\frac{88}{20}$ Sr + $\frac{136}{20}$ Xe + $\frac{1}{2}$ In		

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(2) 12

(1) 11

2	5				
37.	 I. The energy is conserved II. The electric charge is conserved III. The mass is conserved IV. The number of nucleons is conserved (1) I, II, III and IV (2) I and II only (3) I, II and III only (4) I, II and IV only 				
38.	 Which of the following statements is not <i>true</i> about γ-radiation? I. It is produced by unstable nuclei II. It can penetrate several centimeters of lead III. It can ionize gasses IV. It can be deflected by a magnetic field V. It is a short wavelength electromagnetic photon (1) IV and V (2) III and IV (3) IV (4) V 				
39.	The photoelectric cross-section depends on Z (target atomic number) and E_{γ} (energy of incident photon) through the expression: (1) $Z^5/E_{\gamma}^{3/2}$ (2) $Z^2/E_{\gamma}^{7/2}$ (3) $Z^5/E_{\gamma}^{7/2}$ (4) Z/E_{γ}				
40.	Positive ions and electrons produced in the Geiger-Mueller tube as a result of interaction of incident radiation with the gas medium are drifted, respectively, towards cathode and anode. On an average: (1) Ion has more kinetic energy, but smaller speed than electron (2) Ion has smaller kinetic energy and speed than electron (3) Ion and electron have equal kinetic energy and speed (4) Ion and electron have equal kinetic energy, but speed of electron is more than that of ion				
41	 A crystalline solid can be distinguished from a glassy solid on the basis of their: (1) Distinct physical and chemical properties (2) X-ray diffraction pattern (3) Lattice and unit cells (4) Lattice, basis and unit cells 				
42	Which of the following is true about the Wigner-Seitz unit cell? (1) It contains always one lattice point at the center of the cell (2) In contains always one atom at the center of the unit cell (3) It contains one lattice point, with each corner making a contribution of 1/8 (4) It contains two lattice points, one at the center and other at one of the eight corners				
43	1 2 3				
	vector in the corresponding reciprocal lattice, then $\overrightarrow{R}.\overrightarrow{G}$ has the from :				
	(1) $2\pi/(\vec{a}_1.\vec{a}_2 \times \vec{a}_3)$ (2) $2\pi/\text{Integer}$ (3) $2\pi \times \text{integer}$ (4) $2\pi/(\vec{b}_1.\vec{b}_2 \times \vec{b}_3)$				
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44.	At low temperature T, the specific heat of insulating crystals varies as:			
	$(1) AT + BT^3 \qquad (2) BT^3$			
	(3) Will not change with temperature (4) $Aexp(-T)$			
45.	Consider a cubical lattice. A lattice plane that bisects the bottom face of the cubidiagonally, has Miller indices:			
	(1) (100) (2) (010) (3) (111) (4) (110)			
46.	The structure of diamond crystal can be described by:			
	(1) A simple cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$			
	(2) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{2} \frac{1}{2} \frac{1}{2}$			
	(3) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$			
	(4) A simple cubic lattice, with carbon atoms positioned at corners and face centers of the cubic cell			
47.	If the first-order diffraction from a set of lattice planes in a crystal occurs at $\theta = 45^{\circ}$ then the second-order diffraction from the same set of planes may occur at θ equal to :			
	(1) $\theta = 60^{\circ}$ (2) $\theta = 90^{\circ}$ (3) $\theta = 22.5^{\circ}$ (4) None of the above			
48.	Consider that the structure of a simple cubic solid can be described by three differences sets of lattice planes having Miller indices (100), (110) and (111). The inter-plane spacing for these planes has the ratio:			
	(1) $\sqrt{6}:\sqrt{3}:\sqrt{2}$ (2) $\sqrt{2}:\sqrt{3}:\sqrt{6}$ (3) 1:2:3 (4) 3:2:1			
49.	The reciprocal lattice of the reciprocal lattice of simple cubic lattice is: (1) A simple cubic lattice (2) An expanded simple cubic lattice (3) A simple cubic lattice rotated by an angle of 45°			
	(4) A compressed simple cubic lattice			
50.	According to Einstein's model, the average energy of an atomic oscillator in a one dimensional crystalline solid in thermal equilibrium at temperature T is given by :			
	(1) $\frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right)+1\right]}$ (2) $\frac{k_BT}{2}$ (3) k_BT (4) $\frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right)-1\right]}$			

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The value of M after the following set of FORTRAN statements are executed is:

M = 0

Do 10 I = 1.2

Do 20 J = 1.2

M = M + I + J

20 Continue

10 Continue

Stop

End

- (1) 11
- (2) 12
- (3) 4
- (4) 10

52. In FORTRAN language, the statement, p = 1/x * a + 1/y + b - 1/z * * 3 * c will compute the expression:

- (1) $p = \frac{1}{xa} + \frac{1}{v} + b \frac{1}{z^{3c}}$
- (2) $p = \frac{a}{x} + \frac{1}{y} + b \frac{c}{z^3}$

(3) $p = \frac{a}{x} + \frac{1}{y+b} - \frac{c}{z^3}$

(4) $p = \frac{1}{xa} + \frac{1}{v+h} - \frac{1}{z^3c}$

53. The change in entropy is zero for:

- (1) Irreversible processes
- (2) Reversible adiabatic processes
- (3) Reversible isothermal processes
- (4) All adiabatic processes

When changes occur within a closed system, which of the following is true for change in entropy ΔS of the system?

- (1) $\Delta S = 0$
- (2) $\Delta S < 0$
- (3) $\Delta S \ge 0$
- (4) $\Delta S > 0$

55. Let us take two sub-systems A_1 and A_2 in general contact. The most general thermodynamic equilibrium relation for the change in internal energy is:

- (1) $dE = TdS PdV + \mu dN$
- (2) $dE = TdQ PdV + \mu dN$
- (3) $dE = TdS + PdV + \mu dN$
- (4) $dE = TdS + PdV \mu dN$

A Carnot engine absorbs 1 MJ of heat from a reservoir at 300°C and exhausts heat to a 56. reservoir at 150°C. The work done by the engine is:

- (1) $2.6 \times 10^6 \text{J}$
- (2) $2.6 \times 10^5 \text{J}$
- (3) $1 \times 10^6 J$
- $(4) 1.6 \times 10^{5} J$

Consider that an amount of heat dQ is added to a substance at temperature T keeping its volume constant at V. As a result, its temperature changes by dT, while the internal energy by dE. The heat capacity C of the substance is given by:

- (1) $\frac{dE}{dT}$
- (2) $\frac{1}{T}\frac{dE}{dT}$ (3) $\frac{1}{T}\frac{dQ}{dT}$ (4) $\frac{1}{V}\frac{dQ}{dT}$

58.	The Fourier transform $f(q)$ of the function	on $f(x) = e^{-x^2/2}$ is:			
50.	(1) e^{-q^2} (2) $e^{-q^2/2}$	(3) e^{q^2} (4) $e^{q^2/2}$			
59.		n(x) can be expanded in the Fourier series as:			
55.	$n(x) = \sum_{p=-\infty}^{\infty} C_p e^{ipx}$. The Fourier coefficient C_p must satisfy the condition:				
	r	A STATE OF THE STA			
	$(1) C_p = C_p^*$	$(2) C_{-p} = C_p^*$			
	$(3) C_{-p} = C_p$	(4) $C_0 = 0$			
60.	If $f(q)$ is the Fourier transform of $f(x)$, the Fourier transform of $f(ax)$ is:				
	(1) $f(q/\alpha)$	(2) $f(q\alpha)$			
	(3) $\alpha^{-1}f(q/\alpha)$	(4) $\alpha f(q/\alpha)$			
61.	Light of wavelength 500 nanometers	s is incident on sodium with work function			
	2.28 eV. What is the maximum kinetic	energy of the ejected photoelectrons?			
	(1) 0.03 eV	(2) 0.2 eV			
•	(3) 1.3 eV	(4) 2.1 eV			
62.	A particle moving freely in x-direction is described by the wave function				
	$\psi(x, t) = Ce^{i(kx-\omega t)}$. Uncertainty in its n	(1) 1/0			
	(1) Zero (2) ħ				
63.	Which of the following wave functions	(2) $\psi(x) = \exp(x^2)$			
	$(1) \ \psi(x) = x $	(4) $\psi(x) = \exp(-x^2)$			
0.4	(3) $\psi(x) = \tan(x)$				
64.	A particle restricted to the x-axis has the wave function $\psi(x) = ax$ between $x = 0$ and $x = 1$; $\psi(x) = 0$ elsewere. The probability that the particle can be found between $x = 0.45$				
	and $x = 0.55$ is:	cy chart the parties			
	(1) a^2	(2) $0.0251 a^2$			
	(3) $0.3025 a^2$	(4) $0.2025 a^2$			
65.	X-rays of wavelength 10.0 pm are sca	ttered from a target via Compton scattering. The			
	maximum wavelength present in the scattered X-rays is (given that Compton				
	wavelength is 2.426 pm):	(2) 1.49 pm			
	(1) 14.9 pm (3) 2.426 pm	(4) 2426 pm			
66.	The wave function describing a de-Br	roglie wave associated with a material particle of			
00.	linear momentum $p = mv$ may be repre	esented as : $\psi(x, t) = e^{i(kx - \omega t)}$. The phase velocity			
	v_p of de-Broglie wave is related to the	particle velocity v as:			
	$(1) v_p = v$	(2) $v_p = v/2$			
	$(3) v_p = v + c$	$(4) v_p = \pm v$			
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Consider a particle described by the time-dependent Schrodinger wave equation :

$$i\hbar \frac{\partial}{\partial t} \psi(x,t) = \left[-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} + V(x,t) \right] \psi(x,t). \text{ If } \psi(x,t) \text{ is one solution of this equation,}$$

then which of the following statements is true for $\psi^*(x, t)$:

- (1) $\psi^*(x, t)$ is also a solution of the same Schrodinger wave equation.
- (2) $\psi^*(x, t)$ cannot in general be a solution of the same Schrodinger wave equation.
- (3) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is zero.
- (4) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is independent of x.
- Zero-point energy of an oscillator has its origin in:
 - (1) Pauli exclusion principle
 - (2) Experimental non-realization of absolute zero temperature
 - (3) Quantization of energy
 - (4) Heisenberg uncertainty principle
- Quantum mechanically an electron of energy 2.0 eV incident on a barrier 10.0 eV high 69. and 0.50 nm wide has a finite probability of tunneling through it. If electron is replaced by a proton, the tunneling probability:
 - (1) Increases by a factor of 2
- (2) Decreases
- (3) Remains unchanged

- (3) Remains unchanged (4) Decrease by a factor of 2 **70.** Eigen value of the operator $-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}$ operating on the wave function

$$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{9\pi x}{L}\right)$$
 is given by :

$$(1) \frac{\pi^2 \hbar^2}{2mL^2}$$

C

(2)
$$\frac{9\pi^2\hbar^2}{2mI^2}$$

(1)
$$\frac{\pi^2 \hbar^2}{2mL^2}$$
 (2) $\frac{9\pi^2 \hbar^2}{2mL^2}$ (3) $\frac{81\pi^2 \hbar^2}{2mL^2}$ (4) $\frac{3\pi^2 \hbar^2}{2mL^2}$

$$(4) \quad \frac{3\pi^2\hbar^2}{2mL^2}$$

- **71.** For j = 5/2 the allowed values of l are :
 - (1) 1, 2
- (2) 2, 3
- (3) 3, 4
- (4) 4, 5
- An atom having one electron in its valence shell is placed in a weak magnetic field oriented along the z-axis. The allowed angles of spin angular momentum with z-axis
- (1) $\cos^{-1}\left(\pm\frac{1}{\sqrt{3}}\right)$ (2) $\cos^{-1}\left(\pm\frac{1}{\sqrt{2}}\right)$ (3) $\cos^{-1}\left(\pm\frac{\sqrt{3}}{2}\right)$ (4) $\cos^{-1}\left(\pm\frac{1}{2}\right)$
- The effect of spin-orbit splitting on the ground state level of hydrogen atom is to split it 73. into:
 - (1) Two sub-levels (2) Three sub-levels (3) Five sub-levels (4) None of the above
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	74.	The spin angular momentum of an electron can be described as:					
		(1) Electron spinning about an axis passing through its center					
		(2) Electron spinning clockwise or anti-clockwise about an axis passing through its center					
		(3) Electron spinning at speed of light clockwise or anti-clockwise about an axis passing through its center					
		(4) None of the above					
	75.	The maximum degeneracy of an atomic energy level with principal quantum number n is:					
		(1) n (2) n^2 (3) $2n^2$ (4) $2n$					
	76.	Suppose that an isolated hydrogen atom in its ground state is placed in an external weak electric field (weak field Stark effect). The ground state would split into:					
		(1) Two sub-levels (2) Four sub-levels (3) Three sub-levels (4) None of the above					
	77.	An electron is in a magnetic field of strength $B = 100$ Gauss. The magnetic dipole					
		moment (μ) of the electron is initially anti-parallel to the direction of B. How much					
		external work must be done to reverse the direction of magnetic moment of the electron?					
		(1) $-2\mu B$ (2) $+2\mu B$ (3) $-\mu B$ (4) $+\mu B$					
	78.	The rotational, vibrational and molecular electronic spectra of diatomic molecules lie, respectively, in the :					
		(1) Microwave, infrared and visible-ultraviolet regions					
		(2) Infrared, microwave and visible-ultraviolet regions					
		(3) Visible-ultraviolet, microwave and infrared regions					
		(4) Infrared, visible-ultraviolet and microwave regions					
	79.	For laser action to occur, what is the minimum number of energy levels the lasing medium should have?					
		(1) Two (2) Four (3) Three (4) Five					
	80.	the minimum number of Cr^{3+} ions in the ruby?					
		(1) 1.0×10^{22} (2) 3.5×10^{23} (3) Avogadro number (4) 3.5×10^{18}					
	81.	$\frac{1}{1}$					
		magnetic induction \overrightarrow{B} is:					
		(1) $\hat{x} + \hat{z}$ (2) $-\hat{x} + 2\hat{y}$ (3) $-\hat{x} + 2\hat{y} + \hat{z}$ (4) $3\hat{z}$					
	82.	A paramagnetic substance is placed in an external homogeneous and static magnetic					
		field. The resulting magnetic susceptibility contains:					
		(1) Paramagnetic contribution(2) Paramagnetic and diamagnetic contributions					
		(3) Diamagnetic contribution					
		(4) Paramagnetic, ferromagnetic and diamagnetic contributions					
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83.	Suppose that you	hold a diamond	up to a street lamp	which emits yellow light of	
	frequency $5.09 \times$	10 Hz. Given that wave propagation	it diamond has perr	nittivity 5.84 and permeability vellow light in diamond would,	
	(1) $1.24 \times 10^8 \text{m/s}$				
	(2) $3.0 \times 10^8 \text{m/s}$ a				
	(3) $1.24 \times 10^8 \text{m/s}$	and 244 nm			
	(4) 3.0×10^8 m/s a	and 244 nm			
84.	84. The potential field of an electric field $\vec{E} = (y\hat{i} + x\hat{j})$ is:				
	(1) V = -xy + con	stant	(2) $V = -y + x - y +$	+ constant	
	(3) $V = -(y^2 + x^2)$	+ constant	(4) $V = \text{constan}$	nt	
85.	In an elastic mat positions, has its c	erial the force tha	t tends to hold ato	ms back to their equilibrium	
	(1) Electrostatic f	orce	(2) Electromag	netic force	
	(3) Weak force		(4) Gravitation	al force	
86.	Consider an idea temperature <i>T</i> . The	l gas made up o e most probable val	f point-like particlue of energy is:	es in thermal equilibrium at	
	$(1) k_B T/2$	(2) $3k_BT/2$	(3) k_BT	$(4) 2k_BT$	
87.	colliding with each	gas in a container other and the walls	is at thermal equilibrof the container. The	orium. Atoms are continuously e nature of these collisions is:	
	(1) Inelastic		(2) Elastic		
00	(3) Inelastic at extremely low temperatures (4) None of the above For an ideal gas of diatomic molecules in thermal equilibrium at temperature T , the				
88.	average energy per	r molecule is:	iles in thermal equi	dibrium at temperature T , the	
	$(1) \ \frac{1}{2} k_B T$	$(2) \ \frac{3}{2} k_B T$	$(3) 3k_BT$	$(4) 6k_BT$	
89.	At what temperatu oxygen molecule a	are is the r.m.s. vel at 47°C?	ocity of a hydroger	molecule equal to that of an	
	(1) 80 K	(2) -73 K	(3) 3 K	(4) 20 K	
90.	A cube has a volum	me of 1000 cm ³ . Its	volume as observe	d by an observer O moving at	
	a velocity of 0.8c r	elative to the cube	in a direction paralle	el to one edge is :	
	(1) 500 cm ³		$(3) 900 \text{ cm}^3$	$(4) 600 \text{ cm}^3$	
91.	The gas of electron zero temperature.	ns in a metal posse The origin of this er	esses tremendous intergy lies in the :	ternal energy even at absolute	
	(1) Maxwell-Boltz			arge on electrons	
	(3) Pauli exclusion		(4) Small mass		
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92.	For a gas of electron	ons in thermal equili	brium at room temper on states $\varepsilon_r + \varepsilon$ and ε_r	$\varepsilon_F - \varepsilon$ is (where ε_F is the
	Fermi energy):	in the single clear	in States of	r
	(1) Equal		(2) Not equal	
	(3) Equal if ε is positive (3).	sitive	(4) Equal if ε is neg	ative
93.	The diameter of nth	dark ring in Newton	's ring arrangement c	hanges from 1.2 to 1.0 cm
33.	when air is replaced	by a transparent liqu	aid. What is the refrac	ctive index of liquid?
	(1) 1 44	(2) 1.20	(3) 4.10	(4) 1.50
94.	Three plane-waves	$\hat{y}_1 = A_1 \hat{y}_2$	$os(kx - \omega t + \delta_1), y_2 =$	$A_2 \hat{z} \cos(kx - \omega t + \delta_2)$ and
	$y_3 = A_3 \hat{y} \cos(kx - \alpha)$	$\delta(t + \delta_3)$ are superpos	ed pairwise. Which	superposition can lead to
	interference? (here	$A_1,A_2,A_3,\delta_1,\delta_2,\delta_3$	are constants)	
	(1) y_1 and y_2		(2) y_1 and y_3	
	(3) v_2 and v_2		(4) No interference	
95.	In a Young's doubl	e slit experiment the	intensity at a point w	where the path difference is
	$\lambda/6$ (λ being the wa	evelength of light use	ed) is I . If I_0 denotes t	he maximum intensity, I/I_0
	is equal to:			
	(1) 3/4		(3) 3/2	(4) 1/6
96.	Illuminated normal	ly, a diffracting grati	ing produces second of	order bright images with an
	angle of 60° between	en them. The light is	monochromatic and h	as a wavelength of 300 nm.
	The spacing of the $\frac{-3}{3}$	grating in mm is:	(3) 2.0×10^{-3}	$(4) 15 \times 10^{-3}$
	$(1) 3.6 \times 10^{-5}$	(2) 2.4×10	$(3) 2.0 \times 10$	(4) 1.3 × 10
97.			n nature, is evident by (3) Reflection	(4) Diffraction
	(1) Polarization	(2) Interference		20 1/20
98.	A beam of transve	erse waves whose vi	brations occur in all	directions perpendicular to
	their direction of n (1) Polarized	(2) Unpolarized	(3) Resolved	(4) Diffracted
99.				$\cot \vec{E} = \hat{x}E_0\cos(kz - \omega t) -$
	$\hat{y}E_0\cos(kz-\omega t)$			
		ized along z-directio	n	
		ized at -45° to x-axis		
	(3) Circularly pol	arized		R
	(4) Elliptically po	larized with the major	or axis along x-axis	
100	If the electric field	d vector in a polarize	ed electromagnetic w	rave is $\vec{E}(\vec{r},t) = \hat{n}E_0e^{i(\vec{k}.\vec{r}-\omega t)}$
	(with \hat{n} being the	polarization vector	and \vec{k} the propagation	n vector), its magnetic fiel
	vector is given by			
	(1) $\frac{1}{-}\hat{k} \times \vec{E}$	(2) $\hat{k} \times \vec{E}$	(3) $\frac{1}{2}\hat{k}\times\vec{E}$	$(4) \frac{1}{-}\hat{k}.\vec{E}$

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Total No. of Printed Pages: 13
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Time : 1½ Hours	Total Questions : 100	Max. Marks . 100
Roll No. (in figures)	(in words)	
Candidate's Name ————————————————————————————————————	Date of Bi	th———
Date of Exam :		
(Signature of the Candidate)	(Signatu	re of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are *compulsory* and carry equal marks. The candidates are required to attempt all questions.

2. The candidate *must return* this question booklet and the OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfairmeans / misbehaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A/B, C and D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examination by hand or through email. Thereafter, no complaint in any case will be considered.

5. The candidate *must not* do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers *must not* be ticked in the question booklet.

6. Use only black or blue pall point pen of good quality in the OMR Answer-Sheet.

7. There will be negative marking. Each correct answer will be awarded one full mark and each incorrect answer will be negatively marked for which the candidate will get ¼ Mark (0.25 Mark) discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

8. Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30

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CPG-EE-2019(Physics) (SET-Y)/(D)

						19
1.		_	anometers is incide			function
	2.28 eV. Wh	at is the maximum	n kinetic energy of t	he ejected photo	electrons?	
	(1) 0.03 eV	(2) 0.2 e ⁻¹	V (3) 1.3 e	eV (4)	2.1 eV	
2.	A particle	moving freely	in x-direction is	described by	the wave	function
	$\psi(x, t) = Ce^{t}$	$i(kx-\omega t)$. Uncertain	ty in its momentum	is equal to:		
	(1) Zero	(2) ħ	(3) ∞	(4)	$\hbar/2$	

3. Which of the following wave functions can describe a physical state?

(1)
$$\psi(x) = |x|$$
 (2) $\psi(x) = \exp(x^2)$ (3) $\psi(x) = \tan(x)$ (4) $\psi(x) = \exp(-x^2)$

4. A particle restricted to the x-axis has the wave function $\psi(x) = ax$ between x = 0 and x = 1; $\psi(x) = 0$ elsewere. The probability that the particle can be found between x = 0.45 and x = 0.55 is:

(1)
$$a^2$$
 (2) $0.0251 a^2$ (3) $0.3025 a^2$ (4) $0.2025 a^2$

5. X-rays of wavelength 10.0 pm are scattered from a target via Compton scattering. The maximum wavelength present in the scattered X-rays is (given that Compton wavelength is 2.426 pm):

linear momentum p = mv may be represented as : $\psi(x, t) = e^{i(kx - \omega t)}$. The phase velocity v_p of de-Broglie wave is related to the particle velocity v as :

(1)
$$v_p = v$$

(2) $v_p = v/2$
(3) $v_p = v + c$
(4) $v_p = \pm v$

7. Consider a particle described by the time-dependent Schrodinger wave equation :

$$i\hbar \frac{\partial}{\partial t} \psi(x,t) = \left[-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} + V(x,t) \right] \psi(x,t)$$
. If $\psi(x,t)$ is one solution of this equation,

then which of the following statements is true for $\psi^*(x, t)$:

- (1) $\psi^*(x, t)$ is also a solution of the same Schrodinger wave equation.
- (2) $\psi^*(x, t)$ cannot in general be a solution of the same Schrodinger wave equation.
- (3) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is zero.
- (4) $\psi^*(x, t)$ can be a solution of the same Schrodinger wave equation provided that V(x, t) is independent of x.
- **8.** Zero-point energy of an oscillator has its origin in :
 - (1) Pauli exclusion principle
 - (2) Experimental non-realization of absolute zero temperature
 - (3) Quantization of energy
 - (4) Heisenberg uncertainty principle

9.	Quantum mechanically an electron of energy 2.0 eV incident on a barrier 10.0 eV high and 0.50 nm wide has a finite probability of tunneling through it. If electron is replaced by a proton, the tunneling probability :
	(1) Increases by a factor of 2 (2) Decreases
	(3) Remains unchanged (4) Decrease by a factor of 2
10.	Eigen value of the operator $-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}$ operating on the wave function
	$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{9\pi x}{L}\right) \text{ is given by :}$
	(1) $\frac{\pi^2 \hbar^2}{2mL^2}$ (2) $\frac{9\pi^2 \hbar^2}{2mL^2}$ (3) $\frac{81\pi^2 \hbar^2}{2mL^2}$ (4) $\frac{3\pi^2 \hbar^2}{2mL^2}$
11.	The gas of electrons in a metal possesses tremendous internal energy even at absolute zero temperature. The origin of this energy lies in the :
	(1) Maxwell-Boltzmann Law (2) Negative charge on electrons
	(3) Pauli exclusion principle (4) Small mass of electrons
12.	For a gas of electrons in thermal equilibrium at room temperature, the probability of finding an electron in the single-electron states $\varepsilon_F + \varepsilon$ and $\varepsilon_F - \varepsilon$ is (where ε_F is the Fermi energy):
	(1) Equal (2) Not equal
	(3) Equal if ε is positive (4) Equal if ε is negative
13.	The diameter of n^{th} dark ring in Newton's ring arrangement changes from 1.2 to 1.0 cm when air is replaced by a transparent liquid. What is the refractive index of liquid?
	(1) 1.44 (2) 1.20 (3) 4.10 (4) 1.50
14.	Three plane-waves viz. $y_1 = A_1 \hat{y} \cos(kx - \omega t + \delta_1), y_2 = A_2 \hat{z} \cos(kx - \omega t + \delta_2)$ and
	$y_3 = A_3 \hat{y} \cos(kx - \omega t + \delta_3)$ are superposed pairwise. Which superposition can lead to
	interference ? (here A_1 , A_2 , A_3 , δ_1 , δ_2 , δ_3 are constants)
	(1) y_1 and y_2 (2) y_1 and y_3
	(3) y_2 and y_3 (4) No interference in any pair
15.	In a Young's double slit experiment the intensity at a point where the path difference is $\lambda/6$ (λ being the wavelength of light used) is I . If I_0 denotes the maximum intensity, I/I_0 is equal to :
	(1) 3/4 (2) 1/2 (3) 3/2 (4) 1/6
16.	Illuminated normally, a diffracting grating produces second order bright images with an angle of 60° between them. The light is monochromatic and has a wavelength of 300 nm. The spacing of the grating in mm is:
	(1) 3.6×10^{-3} (2) 2.4×10^{-3} (3) 2.0×10^{-3} (4) 1.5×10^{-3}

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17.	Electromagnetic wa	aves are transverse in	n nature, is evident	by:	
	(1) Polarization	(2) Interference	(3) Reflection	(4) Diffraction	
18.	A beam of transve their direction of m		brations occur in a	ll directions perpendicu	lar to
	(1) Polarized	(2) Unpolarized	(3) Resolved	(4) Diffracted	
10	The state of polori	zation of light with	the electric field r	$ \xrightarrow{F} \hat{F} = \hat$	(a t)

- 19. The state of polarization of light with the electric field vector $E = \hat{x}E_0 \cos(kz \omega t) \hat{y}E_0 \cos(kz \omega t)$ is:
 - (1) Linearly polarized along z-direction
 - (2) Linearly polarized at -45° to x-axis
 - (3) Circularly polarized
 - (4) Elliptically polarized with the major axis along x-axis
- **20.** If the electric field vector in a polarized electromagnetic wave is $\vec{E}(\vec{r},t) = \hat{n}E_0e^{i(\vec{k}\cdot\vec{r}-\omega t)}$ (with \hat{n} being the polarization vector and \vec{k} the propagation vector), its magnetic field vector is given by :
 - (1) $\frac{1}{c}\hat{k} \times \vec{E}$ (2) $\hat{k} \times \vec{E}$ (3) $\frac{1}{c^2}\hat{k} \times \vec{E}$ (4) $\frac{1}{c}\hat{k} \cdot \vec{E}$
- 21. The value of M after the following set of FORTRAN statements are executed is:

M = 0

Do 10 I = 1.2Do 20 J = 1.2

M = M + I + J

20 Continue

10 Continue

Stop

End (1) 11

(2) 12

(3) 4

(4) 10

- **22.** In FORTRAN language, the statement, p = 1/x * a + 1/y + b 1/z * * 3 * c will compute the expression :
 - (1) $p = \frac{1}{xa} + \frac{1}{y} + b \frac{1}{z^{3c}}$
- (2) $p = \frac{a}{x} + \frac{1}{y} + b \frac{c}{z^3}$

(3) $p = \frac{a}{x} + \frac{1}{y+b} - \frac{c}{z^3}$

- (4) $p = \frac{1}{xa} + \frac{1}{y+b} \frac{1}{z^3c}$
- **23.** The change in entropy is zero for :
 - (1) Irreversible processes
- (2) Reversible adiabatic processes
- (3) Reversible isothermal processes
- (4) All adiabatic processes

in entropy ΔS of the system?

(1) $dE = TdS - PdV + \mu dN$

(2) $\Delta S < 0$

(1) $\Delta S = 0$

	(3) dE = TdS + Pd	$V + \mu dN$	(4) dE = TdS + Pa	$V - \mu dN$
26.		osorbs 1 MJ of heat the three		00°C and exhausts heat to a
	(1) $2.6 \times 10^6 \text{J}$	(2) $2.6 \times 10^5 \text{J}$	(3) $1 \times 10^6 \text{J}$	(4) $1.6 \times 10^5 \text{J}$
27.	Consider that an an volume constant at	nount of heat dQ is a t V . As a result, its	dded to a substance a	at temperature T keeping its s by dT , while the internal
	$(1) \ \frac{dE}{dT}$		$(2) \ \frac{1}{T} \frac{dE}{dT}$	
	$(3) \frac{1}{T} \frac{dQ}{dT}$		$(4) \ \frac{1}{V} \frac{dQ}{dT}$	e e
28.	The Fourier transfo	$\operatorname{rm} f(q)$ of the function	ion $f(x) = e^{-x^2/2}$ is:	
			(3) e^{q^2}	(4) $e^{q^2/2}$
29.				ed in the Fourier series as:
			Efficient C_p must satisfy	
	$(1) C_p = C_p^*$	(2) $C_{-p} = C_p^*$	(3) $C_{-p} = C_p$	(4) $C_0 = 0$
30.	If $f(q)$ is the Fourier	er transform of $f(x)$,	the Fourier transform	of $f(ax)$ is:
			(3) $\alpha^{-1} f(q/\alpha)$	
31.	The vector potenti	al in a region is g	given as $\overrightarrow{A}(x, y, z) =$	$-\hat{x}y + \hat{y}2x$. The associated
	magnetic induction	→		
	(1) $\hat{x} + \hat{z}$	$(2) -\hat{x} + 2\hat{y}$	(3) $-\hat{x} + 2\hat{y} + \hat{z}$	(4) $3\hat{z}$
32.	field. The resulting (1) Paramagnetic c	magnetic susceptibi	lity contains:	eneous and static magnetic
	(3) Diamagnetic co	ontribution		

(4) Paramagnetic, ferromagnetic and diamagnetic contributions

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24. When changes occur within a closed system, which of the following is true for change

25. Let us take two sub-systems A_1 and A_2 in general contact. The most general

thermodynamic equilibrium relation for the change in internal energy is :

(3) $\Delta S \ge 0$

(2) $dE = TdQ - PdV + \mu dN$

(4) $\Delta S > 0$

33.	Suppose that you hold a diamond up to frequency 5.09×10^{14} Hz. Given that di 1.00, the speed of wave propagation and respectively, be equal to:	amond has permittiv	rity 5.84 and permeability	
	(1) 1.24×10^8 m/s and 589 nm (3) 1.24×10^8 m/s and 244 nm	(2) 3.0×10^8 m/s and (4) 3.0×10^8 m/s and	d 589 nm d 244 nm	
34.	The potential field of an electric field \vec{E} :	~ ~		
		TOTAL TOTAL IN	nstant	
	(1) $V = -xy + \text{constant}$ (3) $V = -(y^2 + x^2) + \text{constant}$	(4) $V = \text{constant}$		
35.	In an elastic material the force that te			
	positions, has its origin in:			
	(1) Electrostatic force	(2) Electromagnetic		
	(3) Weak force	(4) Gravitational fo		
36.	Consider an ideal gas made up of personal consideration and		n thermal equilibrium at	
	temperature T . The most probable value (1) $k_BT/2$ (2) $3k_BT/2$	•	$(A) \supset k T$	
	(1) KB1/2 (2) SKB1/2	$(3) \kappa_{B1}$	(4) 2kg1	
37.	Suppose an atomic gas in a container is a	The second secon	processes and the second of th	
	colliding with each other and the walls of t		ure of these collisions is:	
	(1) Inelastic	(2) Elastic		
38.	(3) Inelastic at extremely low temperatures (4) None of the above For an ideal gas of diatomic molecules in thermal equilibrium at temperature T , the			
50.	average energy per molecule is:	iii tilerinai equilibr	ium at temperature 1, me	
		(2) 21 T	(4) (1 T	
	(1) $\frac{1}{2}k_BT$ (2) $\frac{3}{2}k_BT$	(3) $3k_BI$	(4) $6k_BI$	
39.	At what temperature is the r.m.s. veloci	ty of a hydrogen mo	olecule equal to that of an	
	oxygen molecule at 47°C? (1) 80 K (2) -73 K	(2) 2 V	(4) 20 V	
40.	A cube has a volume of 1000 cm^3 . Its vo	(3) 3 K	(4) 20 K	
40.	a velocity of 0.8c relative to the cube in a			
ė	(1) 500 cm^3 (2) 1000 cm^3		(4) 600 cm^3	
41.	The fact that the binding energy per nu			
	range of stable nuclei is a consequence of			
	(1) Strong	(2) Short range		
	(3) Charge-independent	(4) Always attractive		
42.	Alpha particles produced during alpha-de	17.	ergy of the order of:	
	(1) MeV (2) KeV	(3) GeV	(4) eV	
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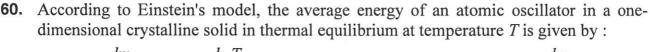
43. What limits the size of a stable nucleus?

	(1) Limited number of nucleons(3) Large surface to volume ratio	(2) Limited range of(4) None of the about	of the strong nuclear force			
44.	Which of the following is <i>true</i> ?	(4) None of the abc	ove			
	I. A neutron can transform into a proton					
	II. A proton can transform into a neutron III. A neutron can transform into a proton	-				
	IV. A proton can transform into a neutro	n inside nucleus	*			
	(1) I, III and IV (2) I, II, III and IV					
45.	Tritium has a half-life of 12.5 y again tritium will remain un-decayed after 25 y	st beta decay. Wha?	t fraction of a sample of			
		(3) 1/10	(4) 1/3			
46.	How many neutrons are released in the fo		ction?			
	$_{92}^{235}U + _{0}^{1}n \rightarrow$	${}_{38}^{88}Sr + {}_{54}^{136}Xe + ?{}_{0}^{1}n$				
	(1) 11 (2) 12	(3) 10	(4) 14			
47.	piece, iii	nich of the following	is true about the reaction?			
	I. The energy is conservedII. The electric charge is conserved					
	III. The mass is conserved					
	IV. The number of nucleons is conserved					
	(1) I, II, III and IV (2) I and II only					
48.	Which of the following statements is not <i>true</i> about γ -radiation?					
	I. It is produced by unstable nucleiII. It can penetrate several centimeters of	of lead				
	III. It can ionize gasses					
	IV. It can be deflected by a magnetic fiel					
	V. It is a short wavelength electromagne		. (4) 17			
49.	(1) IV and V (2) III and IV The photoelectric cross-section depends		(4) V			
	incident photon) through the expression:	on Z (target atomic)	number) and E_{γ} (energy of			
	(1) $Z^5/E_{\gamma}^{3/2}$ (2) $Z^2/E_{\gamma}^{7/2}$	(3) $Z^5/E_{\gamma}^{7/2}$	(4) Z/E_{γ}			
50.	Positive ions and electrons produced interaction of incident radiation with the	in the Geiger-Mue gas medium are dri	eller tube as a result of fted, respectively, towards			
*	cathode and anode. On an average: (1) Ion has more kinetic energy, but smaller speed than electron (2) Ion has smaller kinetic energy and speed than electron					
	(3) Ion and electron have equal kinetic energy and electron have equal kinetic energy and electron have equal kinetic energy.	nergy and speed	tron is more than that of ion			
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- 51. A crystalline solid can be distinguished from a glassy solid on the basis of their:
 - (1) Distinct physical and chemical properties
 - (2) X-ray diffraction pattern
 - (3) Lattice and unit cells
 - (4) Lattice, basis and unit cells
- **52.** Which of the following is true about the Wigner-Seitz unit cell?
 - (1) It contains always one lattice point at the center of the cell
 - (2) In contains always one atom at the center of the unit cell
 - (3) It contains one lattice point, with each corner making a contribution of 1/8
 - (4) It contains two lattice points, one at the center and other at one of the eight corners
- 53. If $\vec{R} = u_1\vec{a}_1 + u_2\vec{a}_2 + u_3\vec{a}_3$ is a vector in direct lattice, while $\vec{G} = v_1\vec{b}_1 + v_2\vec{b}_2 + v_3\vec{b}_3$ is a vector in the corresponding reciprocal lattice, then $\vec{R}.\vec{G}$ has the from :
 - (1) $2\pi/(\vec{a}_1.\vec{a}_2 \times \vec{a}_3)$ (2) $2\pi/\text{Integer}$ (3) $2\pi \times \text{integer}$ (4) $2\pi/(\vec{b}_1.\vec{b}_2 \times \vec{b}_3)$
- **54.** At low temperature T, the specific heat of insulating crystals varies as:
 - (1) $AT + BT^3$

- (2) BT^{3}
- (3) Will not change with temperature
- (4) $A\exp(-T)$
- 55. Consider a cubical lattice. A lattice plane that bisects the bottom face of the cube diagonally, has Miller indices:
 - (1) (100)
- (2) (010)
- (3) (111)
- (4) (110)
- The structure of diamond crystal can be described by:
 - (1) A simple cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4} \frac{1}{4} \frac{1}{4}$
 - (2) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{2} \frac{1}{2} \frac{1}{2}$
 - (3) A face centered cubic lattice and a basis of two carbon atoms, with atoms positioned at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$
 - (4) A simple cubic lattice, with carbon atoms positioned at corners and face centers of the cubic cell
- 57. If the first-order diffraction from a set of lattice planes in a crystal occurs at $\theta = 45^{\circ}$, then the second-order diffraction from the same set of planes may occur at θ equal to :
 - (1) $\theta = 60^{\circ}$
- (2) $\theta = 90^{\circ}$
- (3) $\theta = 22.5^{\circ}$ (4) None of the above

	$oldsymbol{\Gamma}$
58.	Consider that the structure of a simple cubic solid can be described by three different sets of lattice planes having Miller indices (100), (110) and (111). The inter-planar spacing for these planes has the ratio:
	(1) $\sqrt{6}:\sqrt{3}:\sqrt{2}$ (2) $\sqrt{2}:\sqrt{3}:\sqrt{6}$ (3) 1:2:3 (4) 3:2:1
59.	The reciprocal lattice of the reciprocal lattice of simple cubic lattice is:
	(1) A simple cubic lattice
	(2) An expanded simple cubic lattice
	(3) A simple cubic lattice rotated by an angle of 45°
	(4) A compressed simple cubic lattice



(1)
$$\frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right)+1\right]}$$
 (2)
$$\frac{k_BT}{2}$$
 (3)
$$k_BT$$
 (4)
$$\frac{hv}{\left[\exp\left(\frac{hv}{k_BT}\right)-1\right]}$$

- **61.** For j = 5/2 the allowed values of l are :
 - (1) 1, 2(2) 2, 3(3) 3, 4 (4) 4, 5
- An atom having one electron in its valence shell is placed in a weak magnetic field oriented along the z-axis. The allowed angles of spin angular momentum with z-axis are:

(1)
$$\cos^{-1}\left(\pm\frac{1}{\sqrt{3}}\right)$$
 (2) $\cos^{-1}\left(\pm\frac{1}{\sqrt{2}}\right)$ (3) $\cos^{-1}\left(\pm\frac{\sqrt{3}}{2}\right)$ (4) $\cos^{-1}\left(\pm\frac{1}{2}\right)$

- 63. The effect of spin-orbit splitting on the ground state level of hydrogen atom is to split it into:
 - (1) Two sub-levels (2) Three sub-levels (3) Five sub-levels (4) None of the above
- The spin angular momentum of an electron can be described as:
 - (1) Electron spinning about an axis passing through its center
 - (2) Electron spinning clockwise or anti-clockwise about an axis passing through its center
 - (3) Electron spinning at speed of light clockwise or anti-clockwise about an axis passing through its center
 - (4) None of the above
- The maximum degeneracy of an atomic energy level with principal quantum number n is:
 - (3) $2n^2$
- 66. Suppose that an isolated hydrogen atom in its ground state is placed in an external weak electric field (weak field Stark effect). The ground state would split into:
- (1) Two sub-levels (2) Four sub-levels (3) Three sub-levels (4) None of the above CPG-EE-2019/(Physics)-(SET-Y)/(D)

67.	An electron is in a magnetic field of strength $B = 100$ Gauss. The magnetic dipole moment $(\vec{\mu})$ of the electron is initially anti-parallel to the direction of \vec{B} . How much external work must be done to reverse the direction of magnetic moment of the electron?				
	(1) $-2\mu B$ (2) $+2\mu B$ (3) $-\mu B$ (4) $+\mu B$				
68.	The rotational, vibrational and molecular electronic spectra of diatomic molecules lie, respectively, in the :				
	(1) Microwave, infrared and visible-ultraviolet regions				
	(2) Infrared, microwave and visible-ultraviolet regions				
	(3) Visible-ultraviolet, microwave and infrared regions				
	(4) Infrared, visible-ultraviolet and microwave regions				
69.	For laser action to occur, what is the minimum number of energy levels the lasing medium should have?				
	(1) Two (2) Four (3) Three (4) Five				
70.	A certain ruby LASER emits 1.0 J pulses of light whose wavelength is 694 nm. What is				
	the minimum number of Cr^{3+} ions in the ruby?				
	(1) 1.0×10^{22} (2) 3.5×10^{23} (3) Avogadro number (4) 3.5×10^{18}				
71.	If amplitudes of two waves producing interference is 'a' each, then intensity of light at maxima is:				
	(1) $4a^2$ (2) $2a^2$ (3) $2a$ (4) $4a$				
72.	If in a Young's double slit experiment being performed with white light, one of the slits is covered with the red filter, while the other slit with the blue filter.				
	(1) There shall be no interference fringes				
	(2) There shall be an alternate interference pattern of red and blue				
	(3) There shall be an interference pattern of mixed color of red and blue				
	(4) None of the above				
73.	What is the shape of interference fringes in the Lloyd's mirror experiment?				
	(1) Dark and bright straight fringes of equal width				
	(2) Dark and bright straight fringes of unequal width				
	(3) Dark and bright straight fringes of equal width with central fringe a dark one				
	(4) Dark and bright straight fringes of unequal width with central fringe a dark one				
74.	When light travels from rare to denser medium, it loses some speed. As a result:				
	(1) Energy carried by light decreases				
	(2) Energy carried by light stays constant				
	(3) Frequency of light reduces				

(4) Energy carried by light increases

/	Э.		ode of distribution is the one for which the ctability) is:
		(1) Maximum	(2) Minimum
		(3) Absolute zero	(4) Either maximum or minimum
7	76.	A real gas behaves like an ideal gas if its	: -
		(1) Pressure and temperature are both high	(2) Pressure and temperature are both low
		(3) Pressure is high and temperature is low	(4) Pressure is low and temperature is high
7	77.	plane. The dimensionality of its phase sp	
		(1) 4^N (2) 6^N	(3) 4N (4) 2N
7	78.		d A_2 , are allowed to have thermal contact.
			of energy if A_1 and A_2 were at different
		temperatures. According to the postule equilibrium is (Ω denotes the number of	lates of statistical physics, the condition of microstates for a system):
		$(1) \frac{\partial}{\partial E} \ln \Omega_1 = \frac{\partial}{\partial E} \ln \Omega_2$	$(2) \ \frac{\partial}{\partial E} \Omega_1 = \frac{\partial}{\partial E} \Omega_2$
		$(3) \ \frac{\partial}{\partial E} \Omega_1 \Omega_2 = 0$	$(4) \ \frac{\partial}{\partial E}(\Omega_1 + \Omega_2) = 0$
7	79.	The electronic heat capacity of a metal depends on temperature as:	within the framework of Fermi-Dirac statistics
		$(1) AT^3 \qquad (2) AT$	$(3) AT^{3/2} (4) AT^{1/2}$
8	30.		ndensation may occur for a class of particles
		(1) Indistinguishable and have half-inte	gral spin
		(2) Distinguishable and have integral sp	in
		(3) Distinguishable and have half-integration	ral spin
		(4) Indistinguishable and have integral	spin
8	31.	If the speed of a particle moving at 0.4c	is doubled, its momentum will:
		(1) Become double	
		(2) Become more than double	
		(3) Remain unchanged(4) Become slightly less than double	·
8	82.	Which of the following is invariant in sp	pecial theory of relativity?
		(1) Mass	(2) Charge
		(3) Speed of light	(4) Charge as well as speed of light

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				1
83.				necting it to a 300 V dc y and connected across an
	inductor with $L = 10$	^{-2}H . What is the fre		foscillation in the circuit?
84.		voltage across the r		series with an alternating <i>V</i>) cos (2500 rad/s)t. The
	(1) (0.48 V) cos [(25	$00 \text{ rad/s} t + \pi/2 \text{ rad}$	(2) $(1.20 V) \cos [(2 V)]$	$500 \text{ rad/}s)t - \pi/2 \text{ rad}$
				$500 \operatorname{rad/s} t - \pi/2 \operatorname{rad}$
85.	When a forward bias			
	(1) Increases	. 11	(2) Decreases to ze	
	(3) Decreases, but n	ot to zero	(4) Remains unchar	
86.	Which of the follow Hall coefficient:	ving is true about H	, ,	conductor substance? The
	(I) Changes with do	ping concentration		
	(II) Depends on tem	perature		
	(III) Varies with pro	be current and magn	etic field	
	(IV) Independent of	probe current and m	agnetic field	
	(1) I, II and III	(2) II and III	(3) I, II and IV	(4) IV and I
87.	The color of the brig	tht spot on the screen	n of a CRO is the cha	racteristic of the:
	(1) Signal being vie	wed		
	(2) Primary electron	ns emitted from the c	athode	
	(3) Final speed with	which the electrons	strike the screen	
	(4) Coating materia	l of the display scree	en	
88.				which can create a hole- nium is 0.65 eV) is:
	(1) 6×10^{-6} m	(2) 1.6×10^{-6} m	(3) 1.9×10^{-6} m	(4) 1.9×10^{-5} m
89.	If the load resistance	e of a CE amplifier in	ncreases, then its cur	rent gain:
	(1) Decreases		(2) Increases	
	(3) Increases followe	d by an initial decrease	e (4) Remains uncha	nged
90.	A transistor has $\alpha =$	0.98 , IB = $100 \mu A$ a	and ICO = $6 \mu A$. The	value of IE will be:
D.	(1) 5.3 mA	(2) 6 mA	(3) 4.6 mA	(4) 9 mA
91.				2M and 3M, respectively, piece of mass 2M after the
	explosion is: (1) $E/3$	(2) E/5	(3) 2 <i>E</i> /5	(4) 3 <i>E</i> /5

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will have the dimension of:

	(1) Velocity (2) Acceleration	(3) Torque	(4) Force
93.	If a constant force acts on a particle, its a	acceleration will:	
	(1) Remain constant	(2) Gradually decre	ease
	(3) Gradually increase	(4) Become undefi	ned after some time
94.	The law of conservation of linear mome		and the second s
	(1) Translational symmetry of space		
	(3) Time invariance of space		
95.	The Lagrange's equation for simple pend	lulum is (symbols ha	ve their usual meaning):
	$(1) \ddot{\theta} + \frac{g}{l}\sin\theta = 0$	$(2) \ddot{\theta} + \frac{g}{l\sin\theta} = 0$	
	$(3) \ddot{\theta} - \frac{g}{l}\sin\theta = 0$	$(4) \ddot{\theta} + \frac{l}{g}\sin\theta = 0$	
96.	A particle is constrained to move along to The number of degrees of freedom of the		fixed hemispherical bowl.
	(1) One (2) Two	(3) Three	(4) Four
97.	If a linear harmonic oscillator has fre kinetic energy of oscillator is:	quency f, the frequency	ency of oscillation of the
	(1) f (2) $f/2$	(3) 2 <i>f</i>	$(4) \ 4f$
98.	The electric potential at point r inside surface charge density σ and radius R is shell):		
	(1) $\frac{1}{4\pi\varepsilon_0} \frac{q}{r}$ (2) $\frac{1}{4\pi\varepsilon_0} \frac{q}{R}$	$(3) \ \frac{1}{4\pi\varepsilon_0} \frac{\sigma}{r}$	(4) Zero
99.	The induced electric field in the Maxw	rell equation $\oint \vec{E} \cdot d\vec{l}$	$=-\frac{d\Phi_B}{dt}$, is called a non-
	conservative field as the line integral of	of the electric field	in electrostatics $\oint \vec{E} \cdot d\vec{l}$ is
	always:		•
	(1) Zero	(2) 2π	
	$(3) \frac{d\Phi_B}{dt}$	$(4) \ \ 2\pi \vec{E}$	
100.	In electromagnetic wave in free space	e, the phase differe	ence between electric and
	magnetic field vectors \overrightarrow{E} and \overrightarrow{B} is:		
	(1) Zero	(2) $\pi/2$	
	(3) π	(4) $3\pi/2$	
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92. If a generalized coordinate has the dimension of momentum, the generalized velocity

0	centralized ent	rance Exam 20	19 Answer Key of Ph	ysics
Question				
No.	A	В	С	D
1	4	4 -	1	2 ~
2	4	2-	1	1 -
3	2	3 -	3	4,
4	1	1-	2	21
5	1	2 -	1	1,
6	2	1 -	4	2 ′
7	3	2-	3	21
8	2	3-	1	4/
9	1 .	4,	2	2/
10	1	4/	4	3/
11	4	2-	2	
12	2	1/	4	3 -
13	3	2.4		21
14	1	11	1	1-
15	2	1/	4	2 +
16	1		4	1-
17	2	2	3	2 ^
18	3	4/	4	1/
19		3 /.	3	2/
	4	3^	1	21
20	4	4~	1	1/
	. 2	2-	4	2 ~
22	4	1-	4	2 -
23	1	4 /	2	2-
24	4	2 ~	-1	3 4
25	4	1 -	1	1 -
26	3	2 -	2	21
27	4	2 -	3	1.
28	3	4 /	2	2 1
29	1	2 -	1	2
30	1	3^	1	3,
31	2	3 -	2	4 0
32	2	2 .*	1	2 /
33	2	11	2	3 /
34	3	2/	1	
35	1	1.	1	1 ->
36	2	2,	2	2 /
37	1	1-	4	1.
38	2	2 /	3	2 -
39	2	2/	3	3 ~
40	3	1_		4 -
41	1		4	4 -
42	1	2	2	2 -1
43	3	2 -	1	1/
44		2-	3	2 /
	2	3 -1	2	1-
45	1	1 /	4	1 /
46	4	2 1	3	2 1
47	3	1/	4	4 /
48	1	2 1	1	3 -
49	2	2 -	1	3 -
50	4	3 /	4	4 -

Checked from original key & jumble chart

Blan Gujian 5/7/19 19 10/05/21/9

Question	centralized er	trance Exam 2019	Answer Key of Phy	ysics
No.				
	A	В	С	D
51	3	2 -	2	2 ~
52	2	4 -	2	1 -
53	1	1 -	2	3 -
54	2	4 -+	3	2 1
55	1	4 -	1	4 -1
56	2	3	2	3 *
57	1	4 -	1	4_
58	2	3 -	2	1-
59	2	1-	2	1_
60	1	1-	3	4 4
61	2	1~	2	2-7
62	1	1'	1	14
63	3	3-	4	4-
64	2	21	2	41
65	4	1,	1	3/
66	3	4 -	2	4/
67	4	3,	2	
68	1	1,	4	1/
69	1	2,	2	1,-
70	4	4 ^	3	3/
71	2	2-	2	4/
72	1	1-	1	1,
73	4 .	3 -		1-
74	2	2 -	4	3 ^
75	1	41	4	2 4
76	2	3-	3	1/
77	2	4 4	4	4 ~
78	4		1	3 /
79	2	1 -	1	1~
80	3	1 ′	3	21
81		4 /	4	4/
82	2	4.	4	2 -
	1	4,	2	4 -
83	4	2.	3	1 -
84	4	1 ,	1	4 /
85	3	1.	2	4 -
86	4	2 /	1	3 -
87	1	3 -	2	4 /
88	1	2 -	3	3 +
89	3	1 -	4	1 -
90	4	1 -	4	1-
91	2	2-	3	4-
92	1	1/	2	4 -
93	2	4 -	1	2 ,-
94	1	4-	2	1-
95	1	3-,	1	1.
96	2	4 ~	2	2 7
97	4	1-	1	3 -
98	3	1-	2	2 /
99	3	3/	2	1,
100	4	4/	1	1-

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