

Test Booklet No. \_\_\_\_\_

This booklet consists of 100 questions and 12 printed pages.

RGUPET/\_\_\_\_/\_\_\_

Series

NIL
-----

**RGUPET 2023  
Ph.D. in PHYSICS**

**Full Marks: 100**

**Time: 3 Hours**

--	--	--	--	--	--	--	--

Roll No.

Day and Date of Examination : \_\_\_\_\_

Signature of Invigilator(s) : \_\_\_\_\_

Signature of Candidate : \_\_\_\_\_

*General Instructions:*

***PLEASE READ ALL THE INSTRUCTIONS CAREFULLY BEFORE MAKING ANY ENTRY.***

1. DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO.
2. Candidate must write his/her Roll Number on the space provided.
3. This Test Booklet contains 100 Multiple Choice Questions (MCQs) from the concerned subject. Each question carries 1 mark.
4. Please check the Test Booklet to verify that the total pages and total number of questions contained in the test booklet are the same as those printed on the top of the first page. Also check whether the questions are in sequential order or not.
5. Candidates are not permitted to enter into the examination hall 15 minutes after the commencement of the entrance test or leave the examination hall before 30 minutes of end of examination.
6. Making any identification mark in the OMR Answer Sheet or writing Roll Number anywhere other than the specified places will lead to disqualification of the candidate.
7. Candidates shall maintain silence inside and outside the examination hall. If candidate(s) is/are found violating the instructions mentioned herein or announced in the examination hall, they will be summarily disqualified from the entrance test.
8. In case of any dispute, the decision of the Entrance Test Committee, RGU shall be final and binding.
9. The OMR Answer Sheet consists of two copies, the Original copy and the Student's copy.

### SPACE FOR ROUGH WORK

1	Which one of the following is a requisite quality of Good Researcher				d	Scientific temper
	a) Age	b) Money	c) Time	d)Scientific temper		
2	Survey is a				b	Fact finding study
	a)Descriptive study	b) Fact finding study	c)Analytical study	d)Systematic study		
3	Fundamental Research is otherwise called				d	Pure Research
	a)Action Research	b)Survey	c)Pilot study	d)Pure Research		
4	Good Research is always				d	Systematic
	a)Slow	b) Fast	c) Narrow	d) Systematic		
5	The last stage of research is				a	report writing
	a) report writing	b) data analysis	c) collection of data	d) literature review		
6	Thesis is also known as				b	Dissertation
	a) Monograph	b) Dissertation	c) Research report	d) Book		
7	Which one of the following is an indication of the quality of a research journal?				a	Impact factor
	a)Impact factor	b) h-index	c) i-10 index	d) g-index		
8	Gaussian distribution is also known as				b	normal distribution
	a)binomial distribution	b)normal distribution	c)Bernoulli distribution	d)binomial probability distribution		
9	Least Square Method uses				b	Linear regression
	a)Linear polynomial	b)Linear regression	c)Linear sequence	d) Double polynomial		
10	If $(-3)^{m+1} \times (-3)^5 = (-3)^7$ , then the value of m is				c	1
	a) 5	b) 7	c) 1	d) 3		

11	The mode and mean is given by 7 and 8, respectively. Then the median is				d	23/3
	a) 1/13	b) 3/13	c) 23/13	d) 23/3		
12	The probability of event equal to zero is called				c	Impossible event
	a) Unsure event	b) Sure Event	c) Impossible event	d) Independent event		
13	Plagiarism is				a	a fraudulent practice
	a) a fraudulent practice	b) a good practice	c) a well-accepted practice	d) honesty towards ethics		
14	A common test in research demands much priority on: i) Reliability ii) Useability and iii) Objectivity				d)	i, ii & iii
	(a) i & ii	b) ii & iii	c) i & iii	d) i, ii & iii		
15	An appropriate source to find out descriptive information is.....				c)	Encyclopaedia
	a) Bibliography	b) Directory	c) Encyclopaedia	d) Dictionary		
16	One of the following search engine is exclusively meant for scientific information:				c)	SCIRUS
	a) Google	b) Yahoo	c) SCIRUS	d) Altavista		
17	A theory:				a)	Is an accumulated body of knowledge
	a) Is an accumulated body of knowledge	b) Includes inconsequential ideas	c) Is independent of research methodology	d) Should be viewed uncritically		
18	Failure of acknowledge the borrowed material is called				d)	Plagiarism
	a) Acknowledgement	b) Footnote	c) Index	d) Plagiarism		
19	A systematic literature review is:				b)	A replicable, scientific and transparent process
	a) One which starts in your own library, then goes to on-line databases and, finally, to the internet	b) A replicable, scientific and transparent process	c) One which gives equal attention to the principal contributors to the area	d) A responsible, professional process of time-management for research		

20	HCF of two numbers is 121 and their LCM is 12. If one of the numbers is 11, the other number is				b	132
	a) 123	b) 132	c) 145	d) 12		
21	Inside a right rectangle of 7m by 24m, the maximum length (in meters) of a stick that can be placed is				a	25
	a) 25	b) 15	c) 35	d) 31		
22	The mean of 10 observations is 5. If each observation is increased by 2, the new mean is				b	5.2
	a) 5	b) 5.2	c) 7	d) 7.5		
23	In three numbers, the first number is double than second, and the second is three times than third. If the average of all the numbers is 10, then the first number is				d	18
	a) 9	b) 16	c) 40	d) 18		
24	A man sold two watches for Rs. 900 each. On one of them, he lost 10% and on the other, he gained 10%. His total gain or loss percent in the transaction is				d	1%less
	a) 2% gain	b) 2% less	c) 1% gain	d) 1%less		
25	Choose the odd word in the group				d	oil
	a) curd	b) cheese	c) butter	d) oil		
26	Sort out the odd one out of the four meaningful words:				d	meat
	a) banana	b) grape	c) mango	d) meat		
27	A man stands at 10 m away from a mirror and comes closer towards the mirror upto 2m from the mirror. Now the distance between the man and his image will be				d	16
	a) 14	b) 20	c) 24	d) 16		
28	The mirror image of the word: <b>MOU</b> is				b	<b>UOM</b>
	a) <b>MOU</b>	b) <b>UOM</b>	c) <b>WOU</b>	d) <b>MUO</b>		
29	What will be the next sequence: aB bB cD dD .....				d	eF
	a)fG	b) gH	c) eG	d) eF		
30	"Rocket Boys" is an Indian-Hindi-language biographical streaming television series on SonyLIV based on the life story of two great Indian scientists. The two scientists are				b	H.J. Bhabha and V. Sarabhai
	a) Abdul Kalam and H.J. Bhabha	b) H.J. Bhabha and V. Sarabhai	c) V. Sarabhai and Abdul Kalam	d) K. Kasturirangan and Abdul Kalam		
31	What comes in the sequence: 20, 30, 45, 65, .....				c	90
	a) 80	b)85	c)90	d)95		

32	A collection of related web pages that can be accessed electronically is called				d	WebSite
	a) Links	b) Hyper links	c) Home page	d) WebSite		
33	In a certain code “-“ means “x”, “x” means “+”, “+” means “:-“ and “:-“ means “-“. Then $60 \times 20 + 5 - 5 :- 20$ equals				a	6
	a) 6	b) -26	c) 36	d) -6		
34	Each word of a Research should be				a	Justifiable
	a) Justifiable	b) Full of wisdom	c) Enjoyable	d) Entertaining		
35	a) Philosophical researches	b) Experimental researches	c) Action researches	d) Fundamental researches	c	
36	'Ganga Action Plan' – is an Action Research Plan of				d	A definite socio-economic order
	a) A definite non- social order	b) A definite non-economic order	c) A definite socio-economic order	d) A definite non socio-economic order		
37	Published information in a particular subject area is discussed in				c	Literature Review
	a) Journals	b) Research Proposal	c) Literature Review	d) Bioethics		
38	Which one of the following is/are not the characteristic of research				d	Non-systematic
	a) Systemic	b) Logical	c) Empirical	d) Non-systematic		
39	Which of the following is a characteristic of qualitative research				d	Inductive process
	a) Deductive process	b) Control over the context	c) Fixed research design	d) Inductive process		
40	A short summary of Technical Report is called				b	Research abstract
	a) Article	b) Research abstract	c) Publication	d) Guide		
41	Interpretation should be				a	Subjective
	a) Subjective	b) Objective	c) Integrity	d) Differentiative		
	Concept is of two types					

42	a) Abstract and Coherent	b) Concrete and Coherent	c) Abstract and concrete	d) Only Concrete	c	Abstract and concrete
43	Source of data collected and compiled by others is called				b	Secondary data
	a) Primary data	b) Secondary data	c) Primary and Secondary	d) Recitative Data		
44	Information in the research is				d	Organized data
	a) Raw data	b) Processed data	c) Input data	d) Organized data		
45	Essence of both basic and applied research lies in				b	Scientific method
	a) Market orientation	b) Scientific method	c) Performance monitoring research	d) Costing methods		

## DIMAIN

46	P-type extrinsic semiconductors are formed by adding impurities with valency?				c	3
	a) 5	b) 4	c) 3	d) both 3 and 4		
47	The probability of occupancy of electrons above Fermi level at $T=0^{\circ}\text{K}$ is				a	0 %
	a) 0 %	b) 25 %	c) 50 %	d) 100%		
48	The free electron theory could not explain which of the following properties?				c	Magnetic
	a) Electrical	b) Thermal	c) Magnetic	d) Electrical and magnetic		
49	What is the effect of very high temperature on N-type semiconductors?				a	It turns into intrinsic semiconductor or
	a) It turns into intrinsic semiconductor	b) It turns more N-type	c) It turns P-type	d) It turns metallic		

50	Water is denser than ice due to				d	hydrogen bonding interactions
	a) induced dipole induced dipole interactions	b) dipole-induced dipole interactions	c) dipole-dipole interactions	d) hydrogen bonding interactions		
51	The colour in solid alkali metal halides appears due to				b	F-centres defect
	a) Interstitial defects	b) F-centre defect	c) Frenkel defect	d) Schottky defect		
52	Which one of the following exhibits the most well defined X-ray diffraction pattern?				b	A single crystal material
	a) A polycrystalline material	b) A single crystal material	c) An amorphous material	d) A plastic deformed material		
53	The ratio of intensity of magnetization to the magnetization force is known as				b	Susceptibility
	a) Flux density	b) Susceptibility	c) Relative permeability	d) Field intensity		
54	Which of the following law defines electromagnetic based phenomena?				a	Lorentz force
	a) Lorentz force	b) Newton's law	c) Ohm's law	d) Dalton's law		
55	Which one of the following does not rely on electromagnets?				d	Photodiodes
	a) Hard disk drives	b) Video cassette recorders	c) DVD	d) Photodiodes		
56	A stationary charge produces an electric field, whereas a moving charge produces				c	both magnetic and electric field
	a) only magnetic field	b) restricted electric field	c) both magnetic and electric field	d) restricted magnetic field		
57	Poynting's theorem is analogous to				a	work-energy theorem
	a) work-energy theorem	b) energy conservation law	c) Ampere's law	d) Ampere's law with Maxwell's correction		

58	Eddy current can be minimized				d	by using thin laminated sheets
	a) by using thick copper sheets	b) by setting up a strong magnetic field	c) by using insulated thick sheets	d) by using thin laminated sheets		
59	For direct current, the resistance offered by a capacitor is				b	infinity
	a) greater than unity	b) infinity	c) zero	d) unity		
60	The Biot-savart's law is a general modification of				c	Ampere's law
	a) Kirchoff's law	b) Lenz's law	c) Ampere's law	d) Faraday's laws		
61	If $f[s]$ is a Laplace transform of $F[t]$ , then the Laplace transform of $e^{a^2 t} F[t]$ equals				b	$f[-a^2 + s]$
	a) $f[a^2 + s^2]$	b) $f[-a^2 + s]$	c) $f[a^2 - s]$	d) $f[-a^2 + s^2]$		
62	The solution of the differential equation: $y'[x] - 2y[x] = 3x, y[0] = 0$ will be given by				a	$\frac{3}{4}(-1 + e^{2x})$
	a) $\frac{3}{4}(-1 + e^{2x})$	b) $\frac{3}{4}(1 + e^{2x} + 2x)$	c) $\frac{3}{4}(-1 - e^{2x} + 2x)$	d) $\frac{3}{4}(1 + e^{2x} - 2x)$		
63	A mass of 1 kg starts from rest at 4 m in an attractive force field given by $F = -\frac{1}{x^3}$ . The time taken to reach the origin will be				b	4 s
	a) 3 s	b) 4 s	c) 5 s	d) 2 s		
64	A particle of mass $m$ is constrained by a one dimensional force along x-axis only as $F = (-kx + bx^3)$ where $k$ and $b$ are positive constants. The maximum potential will be				c	$\frac{k^2}{4b}$
	a) $\frac{k^2}{2b}$	b) $\frac{k^2}{3b}$	c) $\frac{k^2}{4b}$	d) $\frac{k^2}{b}$		
65	The potential for the isotropic central force: $F = \frac{V_0}{r^2} (1 + \frac{r}{\lambda}) e^{-\frac{r}{\lambda}}$ is				d	$\frac{V_0}{r} e^{-\frac{r}{\lambda}}$
	a) $\frac{V_0}{r^3} e^{-\frac{r}{\lambda}}$	b) $\frac{V_0}{r^2} e^{-\frac{r}{\lambda}}$	c) $V_0 e^{-\frac{r}{\lambda}}$	d) $\frac{V_0}{r} e^{-\frac{r}{\lambda}}$		
66	The value of $m$ and $n$ for which $Q = \sqrt{2q} e^m \cos p, P = \sqrt{2q} e^n \sin p$ will be the canonical transformation are given by				c	(1,-1)
	a) (1,1)	b) (-1,1)	c) (1,-1)	d) (-1,-1)		
67	A passenger in a supersonic jet liner tosses a coin vertically upwards the coin will fall				c	right in his hand

	a) behind him	b) before him	c) right in his hand	d) he cannot toss the coin		
68	A particle along a circular path under the influence of an attractive central force is directed towards a point on the circle. The force will be inversely proportional to				a	the cube of the radial distance
	a) the cube of the radial distance	b) the square of the radial distance	c) the radial distance	d) the fifth of the radial distance		
69	The trajectory of a falling particle in the absence of friction in the shortest time will be given by the equation of a				b	cycloid
	a) sphere	b) cycloid	c) sigmoid	d) catenary		
70	The values of $(x, \tan(x))$ for $0.10 \leq x \leq 0.30$ are $(0.10, 0.1003)$ , $(0.15, 0.1511)$ , $(0.20, 0.2027)$ , $(0.25, 0.2553)$ and $(0.30, 0.3093)$ . $\tan(0.12)$ will be				b	0.1205
	a) 0.0205	b) 0.1205	c) 0.2662	d) 0.3662		
71	The value of the gamma integral $\int_0^{\infty} e^{-x} x^{\frac{7}{2}} dx$ is				b	$\frac{3\sqrt{\pi}}{4}$
	a) $\frac{\sqrt{\pi}}{2}$	b) $\frac{3\sqrt{\pi}}{4}$	c) $\frac{15\sqrt{\pi}}{8}$	d) $\sqrt{\pi}$		
72	Residue of $\frac{(z - \cos[z])}{(z - \frac{\pi}{2})^3}$ at its singular point is				a	0
	a) 0	b) 1	c) $2\pi$	d) $\pi$		
73	Fourier Series of $\{f(x) = x^2, -\pi < x < \pi, \text{ otherwise, } 0\}$ upto second order is				c	$\frac{\pi^2}{3} - 4\cos[x]$
	a) $\frac{\pi^2}{3} + 4\cos[4x]$	b) $\frac{\pi^2}{3} + 4\cos[4x] +$	c) $\frac{\pi^2}{3} - 4\cos[x] +$	d) $\frac{\pi^2}{3} + 4\cos[4x]$		
74	Which of the following atoms cannot exhibit Bose-Einstein condensation, even in principle?				a	${}^1\text{H}_1$
	a) ${}^1\text{H}_1$	b) ${}^2\text{He}_4$	c) ${}^{23}\text{Na}_{11}$	d) ${}^{40}\text{K}_{19}$		
75	Consider a linear collection of N independent spin $\frac{1}{2}$ particles, each at a fixed location. The entropy of this system is (k is the Boltzmann constant)				d	$Nk \ln(2)$
	a) Zero	b) Nk	c) $\frac{1}{2} Nk$	d) $Nk \ln(2)$		

76	At a certain temperature T, the average speed of nitrogen molecules in air is found to be 400 m/s. The most probable and the root mean square speeds of the molecules are, respectively				c	152 m/s , 301 m/s
	a) 355 m/s, 434 m/s	b) 820 m/s, 917 m/s	c) 152 m/s , 301 m/s	d) 422 m/s, 600 m/s		
77	For a Fermi gas of N particles in three dimensions at T = 0 K, the Fermi energy, $E_F$ is proportional to				a	$N^{2/3}$
	a) $N^{2/3}$	b) $N^{3/2}$	c) $N^3$	d) $N^2$		
78	If the equation of state for a gas with internal energy U is $pV = \frac{1}{3} U$ , then the equation for an adiabatic process is				c	$pV^{4/3} = \text{constant}$
	a) $pV^{1/3} = \text{constant}$	b) $pV^{2/3} = \text{constant}$	c) $pV^{4/3} = \text{constant}$	d) $pV^{3/5} = \text{constant}$		
79	If Planck's constant is zero, then the total energy contained in a box filled with radiation of all frequencies at temperature T would be (k is the boltzmann constant and T is non zero)				b	Infinite
	a) Zero	b) Infinite	c) $\frac{3}{2} kT$	d) kT		
80	The dimension of phase space of ten rigid diatomic molecules is				d	100
	a) 5	b) 10	c) 50	d) 100		
81	In a classical micro-canonical ensemble for a system of N non-interacting particles, the fundamental volume in phase space which is regarded as "equivalent to one micro-state" is				a	$h^{3N}$
	a) $h^{3N}$	b) $h^{2N}$	c) $h^N$	d) h		
82	According to the quark model, the $K^+$ meson is composed of the following quarks				c	$u\bar{s}$
	a) $uud$	b) $u\bar{c}$	c) $u\bar{s}$	d) $s\bar{u}$		
83	Typical energies released in a nuclear fission and a nuclear fusion reactions are respectively				d	200 MeV and 10 MeV
	a) 50 MeV and	b) 200 MeV and 1000 MeV	c) 1000 MeV and 50 MeV	d) 20 0 M eV		

	1000 MeV			and 10 MeV		
84	Which one of the following disintegration series of the heavy elements will give $^{209}\text{Bi}$ as a stable nucleus?				b	Neptunium series
	a) Thorium series	b) Neptunium series	c) Uranium series	d) Actinium series		
85	Suppose that a neutron at rest in free space decays into a proton and an electron. This process would violate				d	Conservation of angular momentum
	a) Conservation of charge	b) Conservation of energy	c) Conservation of linear momentum	d) Conservation of angular momentum		
86	The average number of photons in equilibrium inside the cavity is proportional to				c	$T^3$
	a) $T$	b) $T^2$	c) $T^3$	d) $T^4$		
87	Dead time is more in				a	Scintillation counters
	a) Scintillation counters	b) Proportional counters	c) Geiger counters	d) Semiconductors		
88	In Fermi theory of $\beta$ -decay, the number of final states of electrons corresponding to momenta between $p$ and $p+dp$ is				c	Proportional to $p^2 dp$
	a) Independent of $p$	b) Proportional to $p dp$	c) Proportional to $p^2 dp$	d) Proportional to		

				$p^3$ $dp$		
89	A thermal neutron having speed $v$ impinges on a $^{235}\text{U}$ nucleus. The reaction cross-section is proportional to				a	$v^{-1}$
	a) $v^{-1}$	b) $v$	c) $v^{1/2}$	d) $v^{-1/2}$		
90	Let $ 0\rangle$ and $ 1\rangle$ denote the normalized Eigen-states corresponding to the ground and first excited states of a one-dimensional harmonic oscillator. The uncertainty $\Delta p$ in the state $\frac{1}{\sqrt{2}}( 0\rangle +  1\rangle)$ is				c)	$\sqrt{\hbar m \omega}$
	a) $\sqrt{2\hbar m \omega}$	b) $\sqrt{\frac{\hbar m \omega}{2}}$	c) $\sqrt{\hbar m \omega}$	d) None of these		
91	If the wave properties of a particle are difficult to observe, it is probably due to the particle's				b)	Large mass
	a) Small size	b) Large mass	c) Low momentum	d) High charge		
92	Planck's Constant has the same unit as				a)	Angular momentum
	a) Angular momentum	b) The Hamiltonian	c) Frequency	d) de Broglie wavelength		
93	If the operators $A$ and $B$ satisfy the commutation relation $[A, B] = I$ , where $I$ is the identity operator, then				a)	$[e^A, B] = e^A$
	a) $[e^A, B] = e^A$	b) $[e^A, B] = [e^B, A]$	c) $[e^A, B] = [e^{-B}, A]$	d) $[e^A, B] = I$		
94	A particle in one dimension moves under the influence of a potential $V(x) = ax^6$ , where $a$ is a real constant. For large $n$ the quantized energy level $E_n$ depends on $n$ as				d)	$E_n \sim n^{3/2}$
	a) $E_n \sim n^3$	b) $E_n \sim n^{4/3}$	c) $E_n \sim n^{6/5}$	d) $E_n \sim n^{3/2}$		
95	An ideal crystal diode behaves as a perfect ..... in forward biasing.				a)	conductor
	a) conductor	b) insulator	c) resistance material	d) none of the above		
96	What is the Hexadecimal equivalent of the binary number $(111110101010100100101)_2$				a)	7D5525
	a) 7D5525	b) 7D5225	c) 7D2525	d) None of above		

97	What is the binary equivalent of the decimal number 13.671875?				b)	1101.10101 1
	a)1101.1010 01	b)1101.1010 11	c)1101.1010110110 11	d)1101.1010110 11001		
98	An ideal OP-AMP is an				c)	Voltage controlled voltage source
	a)ideal Current controlled Current source	b)Current controlled voltage source	c)Voltage controlled voltage source	d)voltage controlled current source		
99	An op-amp based voltage follower				b)	is useful for converting a high impedance source into a low impedance source.
	a)is useful for converting a low impedance source into a high impedance source.	b)is useful for converting a high impedance source into a low impedance source.	c)has infinitely high closed loop output impedance	d)has infinitely high closed loop gain		
100	Which of the following gate can be used as a parity checker?				c)	a XOR Gate
	a) an OR Gate	b) a NOR Gate	c)a XOR Gate	d) an AND Gate		