Test Booklet No. _____________

This booklet consists of 150 questions and 17 printed pages.

RGUPET/2024/__/_

RGUPET 2024
Common Entrance Test, 2024
DOCTOR OF PHILOSOPHY IN MATHEMATICS

Full Marks: 150 **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 150 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 after the commencement of the entrance test or leave the examination hall within two hour.
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 candidates 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 shall be final and binding.
9. The OMR Answer Sheet consists of two copies, the Original copy and the Student's copy.

1	If you________ a piece of string in front of a kitten, it will play with it.				**<u>Answer</u>**
	a) sway	b) dangle	c) tangle	d) dip	**b**
2	The Jasmine gives _________ its fragrance at night.				
	a) up	b)out	c)off	d) in	**c**
3	A decision on which one cannot go back is called				
	a)invulnerable	b)incorrigible	c)irrevocable	d)infrangible	**c**
4	A disease which spreads by contact is called				
	a) infectious	b) mortal	c) contiguous	d) contagious	**d**
5	The idiom "*To read between the lines*" means				
	a) to suspect.	b) to read carefully	c) to understand the hidden meaning of writer.	d) to do useless things.	**c**
6	A person who has no money to pay off debts is called___				
	a) insolvent	b) beggar	c) debtor	d) pauper	**a**
7	The United Nations University is situated in				
	a) United States of America	b) Japan	c) Russia	d)France	**b**
8	Which of the following sector is not covered in the Make in India programme?				
	a) Automobiles	b) Defense	c)Media and Entertainment	d) Education	**d**
9	Arunachal Pradesh is paired to which state under Ek Bharat Shrestha Bharat programme?				
	a) Assam	b) Himachal Pradesh	c) Uttar Pradesh	d) Punjab	**c**
10	The largest island in the world is				
	a) Greenland	b) Majuli	c)Andaman and Nicobar	d) Hawaii	**a**
11	The name of first Indian satellite launched in space is				
	a) Rohini	b)Aryabhatta	c) Bhaskara	d) Chandrayan-I	**b**
12	The T20 Cricket World Cup 2024 will be hosted by the countries-				
	a) England and United States of America	b) Australia and West Indies	c) West Indies and United States of America	d) New Zealand and England.	**c**
13	The number of seats for which the General Election of Lok Sabha 2024 is conducted-				
	a) 543	b) 456	c) 562	d) 620	**a**
14	Which of the following has conferred with the Bharat Ratna 2024?				
	a) Mahendra Singh Dhoni	b) Ramnath Kovind	c) Lal Krishna Advani	d) Dr. Manmohan Singh	**c**
15	The theme of India's National Science Day 2024 is				
	a) Science for Nation Building	b) Women in Science	c) Global Science for	d) Indigenous Technologies	**d**

			Global Wellbeing	for Viksit Bharat	
16	Coordinate geometry is invented by				
	a) Archimedes	b) Rene Descartes	c) Leonhard Euler	d) Galileo Galilei	**b**
17	Among the clusters of letters, three of them are similar in certain way and one is different. Which is the odd one?				
	a) GEL	b) CAH	c) OMR	d) KIP	c
18	In certain Code language, 'PEARL' is written as 'OIZVK' and 'GIRL' is written as 'OIRT'. How will 'BIRD' be written as				
	a) PIRU	b) WIRY	c) WIRU	d)DIRE	b
19	Eight friends A, B, C, D, E, F, G and H are sitting in a circle facing the center. A is sitting between F and C. E is sitting to third to the right of A and second to the left of B. G is sitting between B and C. If D is not sitting opposite to A. Then, who is sitting fourth to the right of G?				
	a) E	b) D	c) F	d) H	b
20	Find the odd one from the following?				
	a) 3762	b) 6282	c) 5462	d) 4752	c
21	The purpose of random assignment in an experimental research design is				
	a) To ensure that the sample is representative of the population.	b) To minimize the effects of bias and confounding variables.	c) To increase the likelihood of obtaining statistically significant results.	d) To simplify the data analysis process.	b
22	Which of the following is NOT a type of research design?				
	a) Experimental.	b) Descriptive.	c) Qualitative.	d) Predictive.	d
23	What is the primary purpose of a research proposal in the context of research design? A. To outline the budget for the research project. B. To describe the research methodology and design. C. To summarize the findings of the research study. D. To provide a list of references used in the research study.				
	a) A	b) B	c) C	d) D	b
24	Which of the following is an example of a qualitative research method?				
	a) Survey	b) Experiment	c) Case study	d) Correlational study	c
25	Which research design involves selecting participants based on specific criteria and comparing them on various measures?				
	a) Experimental design.	b) Quasi-experimental design.	c) Correlational design.	d) Matched-pairs design.	d
26	Which research design involves observing and recording behaviour in its natural environment without manipulating it?				
	a) Experimental design	b) Survey design	c) Observational design	d) Correlational design	c
27	Which of the following is/are NOT a type of quantitative research design? A. Experimental design.				

	B. Correlational design. C. Grounded theory design. D. Quasi-experimental design.				
	a) A and B	b)B and C	c) B only	d) C only	d
28	What is the main advantage of using a longitudinal design in research?				
	a) It allows for the comparison of different groups at one point in time.	b) It provides data on how variables change over time.	c) It requires less time and resources compared to other designs.	d) It minimizes the risk of bias in the selection of participants.	b
29	Which type of research design is commonly used to explore relationships between variables without manipulation?				
	a) Experimental design	b) Correlational design	c) Longitudinal design	d) Descriptive design	b
30	What is the primary purpose of a quasi-experimental design?				
	a) To establish cause-and-effect relationships.	b) To explore the relationship between variables.	c) To generalize findings to a larger population.	d) To study phenomena that cannot be manipulated.	d
31	If the function defined by $f(t) = \begin{cases} \frac{\lambda}{\sqrt{t}}, & 0 < t < 4 \\ 0, otherwise \end{cases}$ is a probability density function, then the values of λ and P(t>1) are:				
	a) 0.25 and 0	b) 0.5 and 1	c) 0.25 and 0.5	d)1 and 0.2	c
32	Match the items 1st column with the items of 2nd column and indicate the code of correct matching: List-I / List-II: **A**.The parameters of the distribution are n and p — i. Hypergeometric distribution **B**. The mean and variance of the distribution coincide — ii. Binomial distribution **C**.The mean and S.D. of the distribution determine the central location and spread respectably — iii. Poisson distribution **D**.When N and n approaches to infinity, standard normal distribution is a limiting case of — iv.Normal distribution				
	a)A→(iv), B→(iii), C→(i), D→(ii)	b)A→(ii), B→(iii), C→(iv), D→(i)	c)A→(iii), B→(ii), C→(iv), D→(i)	d) None of the above	b
33	Consider the following statements: A. Goodness of fit of a probability distribution is tested by $\chi^2 -$ test . B. $\bar{X}$ is not a sufficient estimator of the mean μ of a normal population with the known variance σ^2. C. Normal distribution is a particular case of χ^2- distribution. D. Mean and variance of a Gamma distribution are identical. Choose the correct option(s).				

	a) B and D are true	b) A,B,C and D are true	c) Only A is true	d) A, C and D are true	d
34	Consider the Markov chain { X_n: n ≥ 0} of finite state space S and stationary transition probability matrix. If the chain is not irreducible, then the Markov chain				
	a) admits infinitely many stationary distributions	b) admits unique stationary distribution	c) may not admit stationary distribution	d) cannot admit exactly two stationary distributions	a
35	If A and B are two independent events such that $P(A^c \cap B) = \frac{2}{15}$ and $P(A \cap B^c) = \frac{1}{6}$, then A. $P(A)=\frac{2}{5}$ and $P(B)=\frac{4}{5}$ B. $P(A)=\frac{1}{5}$ and $P(B)=\frac{1}{6}$ C. $P(A)=\frac{5}{6}$ and $P(B)=\frac{4}{5}$ D. $P(A)=\frac{1}{7}$ and $P(B)=\frac{4}{5}$				
	a) A and B are true	b) B and C are true	c) A, B and C are true	d) only D is true	b
36	Suppose that 100 tires made by a certain manufacturer lasted on the average 21819 miles with a standard deviation of 1295 miles. In testing the null hypothesis μ = 22000 miles against the alternative hypothesis μ< 22000 miles at the 0.05 level of significance, A. Null hypothesis can be rejected B. Null hypothesis cannot be rejected C. Z=1.40 D. Z= -1.40 Select the correct alternative.				(c)
	a) Only A is true	(b) A and C are true	c) B and D are true	d) None of the above	
37	95% confidence limits for a correlation coefficient which is computed to be 0.60 from a sample of size 28 is				
	a)0.29236 and 0.7951	b) 0.18236 and 0.8896	c) 0.45782 and 0. 5578	d)0.09236 and 0.4951	(a)
38	Which of the following is against research ethics? A. Fabrication of data B. Misrepresent Data C. Deceive granting agencies, or the public D. Self Plagarism.				
	a) Only A and B	b) Only A and C	c) Only A, B and D	d) All of A, B, C, and D	d
39	The act of publishing the same data and results in more than one journal or publication refers to which of the following professional issues:				
	a) Partial publication	b) Duplicate publication	c) Full publication	d) Common publication.	b
40	Ethical norms in research do not involve guidelines for:				
	a) Thesis format	b) Copyright	c) Patenting policy	d) Data sharing policies	a
41	Find the odd one out from the following:				
	a) iThunticate	b) Urkund	c) Turnitin	d) Cmap Tools	d

42	Copying the work of other authors in whole pieces is called as				
	a) Self plagiarism	b) Indirect plagiarism	c) Direct plagiarism	d) Patch writing	d
43	Identify the threats to the internal validity of an investigation A. History B. Instrumentation C. Maturation Choose the correct answer from the options given below:				
	a) A and B only	b) B and C only	c) A and C only	d) A, B and C	d
44	UGC-CARE has been set up for promoting A. Quality research B. Academic integrity C. Publication ethics D. Inclusion and access E. International collaborative research Choose the correct option from those given below:				
	a) Only A, B, C and E	b) Only B, C and D	c) Only B, C and E	d) Only A, B and C	d
45	Research ethics does not include				
	a) Honesty	b) Integrity	c) Subjectivity	d) Objectivity	c
46	Which one of the following is not used for checking plagiarism?				
	a) Turnitin	b)Urkund	c)drillbit	d. Latex	d
47	Which method is most commonly associated with a lack of informed consent?				
	a) Qualitative content analysis	b) In-depth interviewing	c) Covert observation	d) Structured interviewing	c
48	Which of the following factors make the compliance of research ethics difficult?				
	a) Societal norms	b) Respect for confidentiality	c) Lack of Checks	d) Self-check	c
49	Which among the following is an open-source software for data analysis?				
	a)MATLAB	b)MATHEMATICA	c)SPSS	d)R	(d)
50	Which of the following is not a method of collecting primary data?				(b)
	a)Indirect Interview	b) National Publications	c)Questionnaire method	d)Direct Interview	
51	The matrix $\begin{bmatrix} 2+3i & 1 \\ i & 1+2i \end{bmatrix}$ is				
	a) Hermitian	b) Normal	c) Skew-Hermitian	d) Unitary	b
52	The rank and nullity of a linear operator T on $\mathbb{R}^3$ defined by $T(x,y,z) = (2x, 4x-y, 2x+3y-z)$ are, respectively,				
	a) 2 and 1	b) 1 and 2	c) 0 and 3	d) 3 and 0	d
53	Which of the following is linearly dependent? A. u= $(1,2)$ and $v=(3,-5)$. B. u= $(1,2,-3)$ and $v=(4,5,-6)$. C. u= $(1,-3)$ and $v=(-2,6)$. D. u= $(1,2,5), v=(2,5,1)$ and $w=(1,5,2)$.				
	a) A, B and C.	b) B and D.	c) C only	d) D only	c
54	Let A and B are two similar matrices, then				

	a) A and B may represent different linear transformations .	b) A and B are invertible.	c) A and B have same characteristic polynomial.	d) Trace of A may not be equal to trace of B.	c
55	Consider the standard inner product on $\mathbb{R}^2$. If $< a, c >= -1$ and $< b, c >= 3$ where $a = (1,2),\ b = (-1,1)$, then c is				
	a) $(-\frac{7}{3}, \frac{2}{3})$	b) $(\frac{7}{3}, \frac{2}{3})$	c) $(-\frac{9}{3}, \frac{2}{3})$	d) $(\frac{9}{3}, \frac{2}{3})$	a
56	Let E and F are two projections on a vector space V over a field K, with $char(K) \neq 2$. Then $E + F$ is a projection *iff*				
	a) $EF \neq FE = \hat{0}$	b) $EF = \hat{0} \neq FE$	c) $EF = FE = \hat{0}$	d) $EF = FE \neq \hat{0}$	c
57	The inverse of the linear operator T on $\mathbb{R}^3$ defined by $T(x, y, z) = (2x, 4x - y, 2x + 3y - z)$ is				
	a) $T^{-1}(x, y, z) = (x, 2x - y, x - y - z)$	b) $T^{-1}(x, y, z) = (\frac{1}{2}x, 2x - y, 7x - 3y - z)$	c) $T^{-1}(x, y, z) = (\frac{1}{2}x, 2x - \frac{1}{2}y, x + \frac{3}{2}y - \frac{1}{2}z)$	d) does not exist.	b
58	Which of the following is false for a nilpotent operator $T: V \to V$ of index k? A. T has a block matrix representation with Jordan nilpotent blocks as diagonal entries. B. At least one Jordan Nilpotent block is of order k. C. There cannot be two Jordan Nilpotent block of order k. D. All the Jordan Nilpotent blocks must be of order k.				
	a) A, B, C and D	b) A, B and D	c) A, C and D	d) A only.	c
59	The vectors (x, y) and $(-y, x)$ with respect to standard inner product space is				
	a) Orthonormal	b) Continuous	c) Orthonormal and continuous	d) Orthogonal	d
60	Quadratic form $q(x, y) = ax^2 + bxy + cy^2$ is positive definite if and only if				
	a) $a > 0$ and $b^2 - 4ac < 0$.	b) $a > 0$ and $b^2 - 4ac > 0$.	c) $a < 0$ and $b^2 - 4ac > 0$.	d) $a < 0$ and $b^2 - 4ac < 0$.	A
61	Let U and V are finite dimensional vector spaces with $dim\ U = n$ and $dim\ V = m$, then the dimension of the vector space $dim\ L(U, V)$ of all linear transformations from U to V is				
	a) $n + m$	b) n/m	c) $n - m$	d) nm	d
62	Consider the following statements and choose the correct option. A) Rolle's theorem does not hold if f is continuous in (a, b) only. B) $f'(x) \neq a$, for all x in $(a, b]$.				
	a) Both A and B are true and B is the correct explanation for A.	b) Both A and B are true and B is not a correct explanation for A.	c) A is true but B is false.	d) A is false but B is true.	a

<table>
<tr><td>63</td><td colspan="4">Which of the following statement is true for the series $\sum\left(\frac{n+1}{n+2}\right)^n x^n,\ x > 0$?
A. converges if $x > 1$ and diverges for $x \leq 1$.
B. converges for every $x > 0$.
C. converges if $x < 1$ and diverges for $x \geq 1$.
D. diverges for every $x > 0$.</td><td></td></tr>
<tr><td></td><td>a) A</td><td>b) B</td><td>c) C</td><td>d) D</td><td>c</td></tr>
<tr><td>64</td><td colspan="4">What is abscissa of the point at which the tangent to the curve $y = e^x$ is parallel to the chord joining the extremities of the curve in the interval [0,1]?</td><td></td></tr>
<tr><td></td><td>a) $ln\ 1/e$</td><td>b) $ln\ (e-1)$</td><td>c) $1/e$</td><td>d) $1/2$</td><td>b</td></tr>
<tr><td>65</td><td colspan="4">For the given sequence $<(-1)^n\left(1+\frac{1}{n}\right)>$, which one of the following statements is correct?</td><td></td></tr>
<tr><td></td><td>a) Limit superior = limit inferior.</td><td>b) Neither limit superior nor limit inferior exists.</td><td>c) Limit superior = 1 and limit inferior = 0.</td><td>d) Limit superior = 1 and limit inferior = -1.</td><td>d</td></tr>
<tr><td>66</td><td colspan="4">Which of the following sequences is uniformly convergent in $[0, k]$ where $k < \infty$ and $x \in \mathbb{R}^+$?
A. $f_n(x) = \frac{x}{1+nx^2}$.
B. $f_n(x) = \frac{x}{n+x}$.
C. $f_n(x) = nxe^{-nx^2}$.
D. $f_n(x) = e^{-nx}$</td><td></td></tr>
<tr><td></td><td>a) D only</td><td>b) C and D.</td><td>c) C only.</td><td>d) B, C and D</td><td>a</td></tr>
<tr><td>67</td><td colspan="4">Which of the following is true for the function $f(x,y) = \begin{cases} \frac{xy(x^2-y^2)}{x^2+y^2}, & for\ (x,y) \neq (0,0) \\ 0, & for\ (x,y) = (0,0) \end{cases}$?</td><td></td></tr>
<tr><td></td><td>a) $f_{xy} = f_{yx}$ at origin.</td><td>b) $f_{xy} \neq f_{yx}$ at origin.</td><td>c) $f_{xy} > f_{yx}$ at origin.</td><td>d) $f_{xy} < f_{yx}$at origin.</td><td>b</td></tr>
<tr><td>68</td><td colspan="4">A metric space satisfies Bolzano-Weierstrass property, then</td><td></td></tr>
<tr><td></td><td>a) X is not compact.</td><td>b) X is not sequentially compact.</td><td>c) Every infinite sequence in X has at least one cluster point.</td><td>d) An infinite sequence in X may not have any cluster point.</td><td>c</td></tr>
<tr><td>69</td><td colspan="4">If f is a uniformly continuous mapping of metric space X into metric space Y, then which of the statement(s) is/are correct?
A. (x_n) is Cauchy sequence in X implies (fx_n) is Cauchy sequence in Y.
B. (x_n) is sequence in X implies (fx_n) is Cauchy sequence in Y.
C. (x_n) is Cauchy sequence in X does not imply (fx_n) is Cauchy sequence in Y.
D. (x_n) is convergent sequence in X imply (fx_n) is Cauchy sequence in Y.</td><td></td></tr>
<tr><td></td><td>a) A only</td><td>b) B only</td><td>c) A and B</td><td>d) A and D.</td><td>d</td></tr>
<tr><td>70</td><td colspan="4">Which of the following statement is true for the function $f = \frac{Sin(x)}{x}$?
A. f is Riemann integrable over$[0, \infty[$ but $|f|$ is not.
B. f is not Riemann integrable over$[0, \infty[$ but $|f|$ is.</td><td>a</td></tr>
</table>

	C. f is Lebesgue integrable over$[0,\infty[$ but $\|f\|$ is not. D. f is not Lebesgue integrable over$[0,\infty[$ but $\|f\|$ is.				
	a)A only.	b) A and C.	c) B and D.	d) C only	a
71	Which of the following is true for the function $f(x) = x^2$? A. f is uniformly continuous on $\mathbb{R}$. B. f is not uniformly continuous on $[0, a], a \in \mathbb{R}^+$. C. f is uniformly continuous on $]0, a], a \in \mathbb{R}^+$. D. f is uniformly continuous on every closed and finite interval.				
	a) A only	b) C only.	c) A and C.	d) D only	d
72	Which of the following statements is/are false? A. f is of bounded variation on $[a, b]$ implies f' is bounded on $[a, b]$. B. Continuous functions are necessarily of bounded variation. C. Bounded monotonic functions are of bounded variation. D. A function of bounded variation may not be bounded.				
	a) A and C	b) A, B and C	c) A, B and D	d) A, C and D	c
73	Which of the following statements is/areTrue? A. Borel sets are measurable. B. Uncountable sets are not measurable. C. A set containing one member is measurable. D. Cantor sets are measurable.				
	a) A only.	b) A, B and C.	c) A, Band D.	d) A, C and D.	d
74	If two non-empty subsets A and B of a topological space (X, T) are separated, then				**<u>Answer</u>**
	a) $A \cap \overline{B} = \phi$ and $B \cap \overline{A} = \phi$	b) $A \cap \overline{B} \neq \phi$ and $B \cap \overline{A} \neq \phi$	c) $A \cap \overline{B} \neq \phi$	d) $B \cap \overline{A} = \phi$ and $A \cap \overline{B} \neq \phi$	**a**
75	Let $X = \{a, b, c\}$ and $T = \{X, \phi, \{a\}, \{a, b\}\}$. Then (X, T) is				
	a) Not a topological space	b) compact	c) Hausdorff	d) not compact but Hausdorff	**b**
76	The property of a topological space such that every subspace of the space has that property is called				
	a) hereditary property	b) topological property	c) relative property	d) isometry property	**a**
77	If X_α is a Hausdorff apace, then $\prod X_\alpha$ is a Hausdorff space				
	a) in box topology but not in product topogy	b) in product topology but not in box topology.	c) in both box and product topologies	d) neither in box nor on product topologies	**c**
78	The remainder obtained when 16^{2016} is divided by 9 is				
	a) 7	b) 5	c) 3	d) 1	**d**
79	Let T_1 and T_2 be two topologies defined on a set X with bases B_1 and B_2, respectively. Then T_1 is said to be finer than T_2 if				
	a) $B_1 = B_2$ always.	b) every member of B_1 can be expressed as a union of members of B_2.	c) every member of B_2 can be expressed as a union of members of B_1.	d) every member of B_1 can be expressed as a union of members of B_2 and vice-versa.	**c**

80	Topological space is a T_3-space if				
	a) it is normal	b) it is normal and T_1-space	c) it is regular	d) it is regular and T_1-space	**d**
81	Tychonoff's theorem is related to which of the following properties of topological space?				
	a) completeness	b)connectednes s	c) embedding	d) compactness	**d**
82	The number of roots, counting multiplicities, of the equation $2z^5 - 6z^2 + z + 1 = 0$ in the region $1 \leq z \leq 2$ is				
	a) 5	b) 4	c) 3	d) 1	**c**
83	If $f(z) = \tan \pi z$ and C is the circle $\|z\| = \pi$, then the value of $\int_C \left(\frac{f'(z)}{f(z)}\right) dz$ is				
	a) πi	b) $-\pi i$	c) $-2\pi i$	d) $2\pi i$	**d**
84	Every transfromation of the form $w = f(\bar{z})$ is				
	a) isogonal	b) conformal	c) both isogonal and conformal	d) neither conformal nor isogonal	**a**
85	The Jacobian of the transformation $f(z) = \sqrt{3}\, e^{\frac{i\pi}{4}} z + 2 - i$ is				
	a) $\sqrt{3}/4$	b) $\sqrt{3}$	c) $-1/4$	d) 3	**d**
86	If C is the circle $\|z\| = 1$, then the value of $\int_C \frac{z^2+1}{z(2z+1)} dz$ is				
	a) $-\pi i$	b) $-\pi i/2$	c) $2\pi i$	d) $-2\pi i/3$	**b**
87	Consider the function $f, g: \mathbb{C} \to \mathbb{C}$ be defined by $f(z) = e^z$ and $g(z) = e^{iz}$. Let $D = \{z \in \mathbb{C}: Re(z) \in [-\pi, \pi]\}$. Then				
	a) f is bounded on D.	b) g is bounded on D.	c) both f and g are bounded on D.	d) both f and g are unbounded on D.	**a**
88	Let $f(z) = f(x) = \begin{cases} (\sin z)/z, & z \neq 0 \\ 1, & z = 0 \end{cases}$. Then Maclaurin series expansion of $f(z)$ is				
	a) $\sum_{n=0}^{\infty} \frac{(-1)^n z^{2n}}{(2n+1)!}$	b) $\sum_{n=0}^{\infty} \frac{(-1)^n z^{2n+1}}{(2n+1)!}$	c) $\sum_{n=0}^{\infty} \frac{z^{2n+1}}{(2n+1)!}$	d) $\sum_{n=0}^{\infty} \frac{(-1)^n z^{2n}}{(2n)!}$	**a**
89	The region of convergence of the series $\sum_{n=0}^{\infty} (n!)\, z^n$				
	a) $0 < \|z\| < 1$	b) $\|z\| = 1$	c) $\|z\| > 0$	d) converges only at $z = 0$	**d**
90	If a function $f(z)$ is continuous in a simply connected domain D and $\int_C f(z)dz = 0$ for every closed contour C in D, then				
	a) $f(z)$ is a constant.	b) $f(z)$ is analytic in D.	c) $f(z)$ is not analytic in D.	d) $f(z)$ is an entire fucntion.	**b**
91	A bilinear transformation $f(z) = z/(2 - z)$ is				
	a) elliptic	b)hyperbolic	c)parabolic	d)both parabolic and hyperbolic	**b**
92	Let $< z_n >$ and $< w_n >$ be two sequences of complex numbers such that $\lim_{n\to\infty} z_n = a$ and $\lim_{n\to\infty} w_n = b$. Then $\lim_{n\to\infty} (z_1 w_1 + z_2 w_2 + \cdots + z_n w_n)/n$ is equal to				
	a) $a + b$	b) $ab - a - b$	c) ab	d) $a + b - ab$	**c**
93	Which of the following functions are analytic everywhere?				

	a) ze^z	b) $(\overline{z}+2i)^2 - 1$	c) $\frac{z+1}{z+4}$	d) $(z+i)/(\overline{z}-i)$	**a**
94	The radius of convergence of the power series $\sum_{n=0}^{\infty} 2^{\sqrt{n}} z^n$ is				
	a) ∞	b) 1	c) $1/\sqrt{2}$	d) 0	**b**
95	If the power series $\sum a_n z^n$ converges for $z = z_0 \neq 0$, then				
	a) $\sum a_n z^n$ converges uniformly for $\lvert z\rvert > \lvert z_0\rvert$.	b) $\sum a_n z^n$ converges uniformly for $\lvert z\rvert < \lvert z_0\rvert$.	c) $\sum a_n z^n$ converges absolutely for $\lvert z\rvert > \lvert z_0\rvert$.	d) $\sum a_n z^n$ converges absolutely for $\lvert z\rvert < \lvert z_0\rvert$.	**d**
96	If G be a group of order 49, then				
	a) G is abelian.	b) G is cyclic.	c) G is non-abelian	d) G is cyclic but non-abelian.	**a**
97	Let G be the group of all 2×2 non-singular matrices over reals. Then the centre of G is				
	a) the identity matrix of order 2×2.	b) the zero matrix of order 2×2.	c) a diagonal matrix of order 2×2.	d) a singular matrix of order 2×2.	**c**
98	Let p be a prime. Then a subgroup H of a group G is a $p - Sylow$ subgroup of G if for some positive integer n,				
	a) p^n and p^{n+1} divide order of G.	b) p^n divides order G but p^{n+1} does not divide order of G.	c) both p^n and p^{n+1} does not divide order of G.	d) p^n does not divides order G but p^{n+1} divides order of G.	**b**
99	The ring $R = \{a + b\sqrt{2} : a, b$ are integers$\}$ is				
	a) an integral domian but not a field.	b) not an integral domian but a field.	c) both integral domain and field.	d) niether field not integral domain.	**a**
100	Let G bea group and order of an element x in G be n. Then for any positive integer k, order of x^k is				
	a) n^k	b) nk	c) $n/\gcd(n,k)$	d) $n/\mathrm{lcm}(n,k)$	**c**
101	Let G be a cyclic group of order 8. Then the number of generators of G are				
	a) 1	b) 2	c) 3	d) 4	**d**
102	The number of prime ideal of $\mathbb{Z}_{10^5}$ is				
	a) 2	b) 5	c) 10	d) 50	**a**
103	The number of group homomorphism from $\mathbb{Z}_{10}$ to $\mathbb{Z}_{20}$ is				
	a) 0	b) 1	c) 5	d) 10	**d**
104	The order and degree of the differential equation $\frac{d^2}{dx^2}\left(\frac{d^2y}{dx^2}\right)^{-\frac{3}{2}} = 0$ is				
	a) 1, 4	b) 4, 1	c) 4, 4	d) 1, 1	b
105	Conider the following statements: A: The Solution of ordinary differential equation of order n have n arbitrary functions. B: The Solution of partial differential equation of order n have n arbitrary functions.				

	a) A is true, B is false	b) A is false, B is true	c) Both A and B are true	d) Both A and B are false	b
106	For the differential equation $xy' - y = 0$ which of the following function is not an integrating factor				
	a) $\frac{1}{x^2}$	b) $\frac{1}{y^2}$	c) $\frac{1}{xy}$	d) $\frac{1}{x+y}$	d
107	Consider the PDE $4xyz = pq + 2px^2y + 2qxy^2$ A) It can be reduced to Clairaut form by some suitable transformation. B) $z = ax + by + ab$ is complete integral. C) $z = -x^2y^2$ is singular solution. Choose the correct statement				
	a) Only A and B are correct.	b) Only B and C are correct.	c) A and C are correct.	d) A, B and C are correct.	c
108	The initial value problem $y'(t) = \frac{2}{t}y + t^2e^t, 1 \le t \le 2, y(1) = 0$ has:				
	a) unique solution	b) Infinite number of solutions	c) No solution	d) 2 solutions	a
109	The solution of $\frac{dy}{dx} = \frac{(1-x)}{y}$ represents				
	a) a family of circle centre at (1,0)	b) a family of circle centre at (0,0)	c) a family of circle centre at $(-1,0)$	a) a family of straight line with slope -1	a
110	The set of real numbers λ for which the boundary value problem $\frac{d^2y}{dx^2} + \lambda y = 0, y(0) = 0, y(\pi) = 0$ has non-trivial solution is				Answer option (c)
	a) $(-\infty, 0)$	b) $\{\sqrt{n} \mid n$ is a positive nteger$\}$	c) $\{n^2 \mid n$ is apositive integer$\}$	d) $\mathbb{R}$	
111	The general solution of $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is of the form				
	a) $u = f(x + iy) + g(x - iy)$	b) $u = f(x + iy) + g(x - y)$	c) $u = cf(x - iy)$	d) $u = g(x + y)$	a
112	Classify the PDE: $$2u_{xx} + 4u_{xy} + 3u_{yy} = 2$$				
	a) elliptic at all points	b) elliptic at finite points only	c) hyperbolic at all points	d) hyperbolic at finite points only	a
113	Consider the IVP: $\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0, u(0, y) = 4e^{-2y}$. Then the value of $u(1,1)$ is:				
	a) $4e^{-2}$	b) $4e^2$	c) $2e^{-4}$	d) $4e^4$	b
114	Let $u(x, t)$be the solution of the IVP:$u_{tt} - u_{xx} = 0$ Subject to: $u(x, 0) = x^3, u_t(x, 0) = sinx$. Then $u(\pi, \pi)$ is				Answer option (a)
	a) $4\pi^3$	b) π^3	c) 0	d) 4	Answer: $4\pi^3$

<table>
<tr><td>115</td><td colspan="4">The IVP $\frac{dy}{dx} = y^{\frac{1}{3}}; y(0) = 1$ then how many solutions does the IVP has?</td><td></td></tr>
<tr><td></td><td>a) unique solution</td><td>b) Infinitely many solutions</td><td>c) 2</td><td>d) 0</td><td>a</td></tr>
<tr><td>116</td><td colspan="4">The rate of convergence of Secant method is</td><td></td></tr>
<tr><td></td><td>a) 1</td><td>b) 1.6</td><td>c) 2</td><td>d) None</td><td>b</td></tr>
<tr><td>117</td><td colspan="4">Iterative formula to find $\sqrt[k]{N}$ is</td><td></td></tr>
<tr><td></td><td>a) $x_{n+1} = \frac{1}{2}\left(x_n + \frac{k}{Nx_n}\right)$</td><td>b)$x_{n+1} = \frac{1}{2}\left(x_n + \frac{kN}{x_n}\right)$</td><td>c) $\frac{1}{k}\left[(k-1)x_n + \frac{N}{x_n^{k-1}}\right]$</td><td>d) $\frac{1}{k}\left[(k-1)x_n - \frac{N}{x_n^{k-1}}\right]$</td><td>c</td></tr>
<tr><td>118</td><td colspan="4">Values of k for which the system of equations:
$$(3k-8)x + 3y + 3z = 0,$$ $$3x + (3k-8)y + 3z = 0,$$ $$3x + 3y + (3k-8) = 0$$
has a non-trivial solution.</td><td></td></tr>
<tr><td></td><td>a) 2/3 only</td><td>b) 11/3 only</td><td>c) 4/3 and 2/3 only</td><td>d) 2/3 and 11/3 only</td><td>d</td></tr>
<tr><td>119</td><td colspan="4">An iterative scheme is given by
$$x_{n+1} = \frac{1}{5}\left(16 - \frac{12}{x_n}\right), n \in \mathbb{N} \cup \{0\}$$
such a scheme, with suitable x_0, will</td><td></td></tr>
<tr><td></td><td>a) not converge</td><td>b) converge to 1.6</td><td>c) converge to 1.8</td><td>d) converge to 2</td><td>d</td></tr>
<tr><td>120</td><td colspan="4">Euler method for solving initial value problem $\frac{dy}{dx} = f(x,y),\ y(x_0) = 0$ is</td><td></td></tr>
<tr><td></td><td>a) $y_{n+1} = y_n + hf(x_n, y_n)$</td><td>b) $y_{n+1} = y_n + hf(x_{n+1}, y_{n+1})$</td><td>c) $y_{n+1} = y_{n-1} + 2hf(x_n, y_n)$</td><td>d) $y_{n+1} = (1+h)f(x_{n+1}, y_{n+1})$</td><td>a</td></tr>
<tr><td>121</td><td colspan="4">Match the following:<table>
<tr><td>Method</td><td>Number of subinterval to be taken</td></tr>
<tr><td>A. Simpson one third rule</td><td>i. multiple of 6</td></tr>
<tr><td>B. Simpson three eighth rule</td><td>ii. even</td></tr>
<tr><td>C. Weddle's rule</td><td>iii. multiple of 3</td></tr>
<tr><td>D. Boole's rule</td><td>iv. multiple of 4</td></tr>
</table></td><td></td></tr>
<tr><td></td><td>a) A-i, B-ii, C-iii, D-iv</td><td>b) A-ii, B-iii, C-i, D-iv</td><td>c) A-iii, B-ii, C-i, D-iv</td><td>d) A-ii, B-iii, C-iv, D-i</td><td>b</td></tr>
<tr><td>122</td><td colspan="4">In Simpson's one-third rule the curve $y = f(x)$ is assumed to be a</td><td></td></tr>
<tr><td></td><td>a) circle</td><td>b) parabola</td><td>c) hyperbola</td><td>d) ellipse</td><td>b</td></tr>
<tr><td>123</td><td colspan="4">If the matrix A is diagonally dominant matrix, the Jacobian iteration scheme</td><td></td></tr>
<tr><td></td><td>a) converges for any initial starting vector</td><td>b) converges for any non-negative initial starting vector</td><td>c) converges for certain initial starting vector</td><td>d) can't say</td><td>a</td></tr>
<tr><td>124</td><td colspan="4">If Δ and ∇ are the forward and the backward difference operators respectively, then $\Delta - \nabla$ is equal to</td><td></td></tr>
<tr><td></td><td>a) $-\nabla\Delta$</td><td>b) $\nabla\Delta$</td><td>c) $\nabla + \Delta$</td><td>d) $\frac{\Delta}{\nabla}$</td><td>c</td></tr>
</table>

<table>
<tr><td>125</td><td colspan="4">The value of $f(3)$ from the following table using the Lagrange's formula is
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>$f(x)$</td><td>1</td><td>14</td><td>15</td><td>5</td><td>6</td><td>9</td></tr>
</table></td><td></td></tr>
<tr><td></td><td>a) 10</td><td>b) 10.5</td><td>c) 11</td><td>d) 11.5</td><td>a</td></tr>
<tr><td rowspan="2">126</td><td colspan="4">The extremal of the functional $\int_0^1 (y^2 + x^2 y')dx$, $y(0) = 0, y(1) = 1$ is given by</td><td rowspan="2">(a)</td></tr>
<tr><td>a) $y(x) = x$</td><td>b) $y = x^2$</td><td>c)$y(x) = \sinh x/\sinh 1$</td><td>d) $y(x) = x\sinh x/\sinh 1$</td></tr>
<tr><td rowspan="2">127</td><td colspan="4">The Euler's equation for the extremals of the functional $\int_a^b \left(y^2 - yy' + y'^2\right)dx$ is given by</td><td rowspan="2">(b)</td></tr>
<tr><td>a)$y'' = 0$</td><td>b) $y'' - y = 0$</td><td>c) $y'' + y = 0$</td><td>d) $y' + y = 0$</td></tr>
<tr><td rowspan="2">128</td><td colspan="4">The extremal of the functional $\int_a^b y\sqrt{\left(1 + y'^2\right)}dx$ is a</td><td rowspan="2">(d)</td></tr>
<tr><td>a) circle</td><td>b) ellipse</td><td>c) hyperbola</td><td>d) catenary</td></tr>
<tr><td rowspan="2">129</td><td colspan="4">D' Alembert's principle can be written (with standard notations) as</td><td rowspan="2">(a)</td></tr>
<tr><td>a) $\sum_i \left(\vec{F}_i^a - \vec{P}_i\right).\ \delta\vec{r}_i = 0$</td><td>b) $\sum_i \left(\vec{F}_i^a - \vec{P}_i\right).\vec{r}_i = 0$</td><td>c) $\sum_i \left(\vec{F}_i^a - \vec{P}_i\right).\ \delta\vec{r} = 0$</td><td>d) $\sum_i \left(\vec{F}_i^a - \vec{P}_i\right) = 0$</td></tr>
<tr><td rowspan="2">130</td><td colspan="4">The Hamiltonian $H(p_i, q_i, t)$ can be constructed from the Lagrangian$L$ using the formula</td><td rowspan="2">(d)</td></tr>
<tr><td>a) $H(p_i, q_i, t) = \sum_i p_i q_i$</td><td>b) $H(p_i, q_i, t) = \sum_i p_i \dot{q}_i$</td><td>c) $H(p_i, q_i, t) = \mathrm{L} + \frac{\mathrm{d}}{\mathrm{dt}}\sum_i p_i \dot{q}_i$</td><td>d) $H(p_i, q_i, t) = \sum_i p_i \dot{q}_i - L$</td></tr>
<tr><td rowspan="2">131</td><td colspan="4">The Hamiltonian of a rotating body is given by $H = (p_\theta^2/2I) + (1/2)I\theta^2$, where θ is angle of rotation, p_θ is conjugate momentum and I is the moment of inertia. The required equation of motion is given by</td><td rowspan="2">(b)</td></tr>
<tr><td>a) $\ddot{\theta} - \theta = 0$</td><td>b) $\ddot{\theta} + \theta = 0$</td><td>c) $\ddot{\theta} - m\theta = 0$</td><td>d)$\ddot{\theta} = 0$</td></tr>
<tr><td rowspan="2">132</td><td colspan="4">The c −discriminant of the family of curve $y(c - x) - c^2 = 0$ is given by</td><td rowspan="2">(a)</td></tr>
<tr><td>a)$y(y - 4x) = 0$</td><td>b)$y(y + 4x) = 0$</td><td>c) $y(y - 2x) = 0$</td><td>d) $y(y + 2x) = 0$</td></tr>
<tr><td rowspan="2">133</td><td colspan="4">Th curve of given length which minimizes the curved surface area of solid generated by the revolution of given curve about $x -$ axis is</td><td rowspan="2">(d)</td></tr>
<tr><td>a) Ellipse</td><td>b) Circle</td><td>c) cone</td><td>d) Catenary</td></tr>
<tr><td rowspan="2">134</td><td colspan="4">The solution of the integral equation $y(x) - \sin x - 2\int_0^x \cos(x - t)\, y(t)dt = 0$ is</td><td rowspan="2">(a)</td></tr>
<tr><td>a) $y = xe^x$</td><td>b) $y = xe^{-x}$</td><td>c) $y = x^2e^x$</td><td>d) $y = x^2e^{-x}$</td></tr>
<tr><td>135</td><td colspan="4">The solution of the integral equation $y(x) - \frac{\pi^2}{4}\int_0^1 \mathrm{K}(x,t)\, y(t)dt = \frac{x}{2}$, where $K(x,t) = \begin{cases} x(2-t)/2, & 0 \le x \le t \\ t(2-x)/2, & t \le x \le 1 \end{cases}$ is</td><td></td></tr>
</table>

	a) $y(x) = \sin(\pi x/2)$	b) $y(x) = \cos(\pi x/2)$	c) $y(x) = \frac{\pi^2}{4}\sin(\pi x/2)$	d) $(x) = \frac{\pi^2}{4}cos(\pi x/2)$	(a)
136	The value of λ for which the integral equation $y(x) = \lambda\int_0^1(2xt - 4x^2)y(t)dt$ has a non-trivial solution, are given by the roots of the equation				
	a) $\lambda^2 - 6\lambda + 9 = 0$	b) $\lambda^2 + 6\lambda + 9 = 0$	c) $\lambda^2 + 4\lambda + 9 = 0$	d) $\lambda^2 - 4\lambda + 9 = 0$	(b)
137	The integral equation $y(x) = \lambda\int_0^{2\pi}\sin(x+t)\,y(t)dt$ has				
	a) two solutions for any value of λ	b) infinitely many solutions for two values of λ	c) unique solution for every value of λ	d) infinitely many solutions for only one value of λ	(b)
138	The resolvent kernel $R(x,t;\lambda)$ for the Fredholm integral equation having kernel $K(x,t) = e^{x+t}, a = 0, b = 1$ is given by				
	a) $R(x,t;\lambda) = \frac{2e^{x+t}}{2+\lambda(e^2-1)}$	b) $R(x,t;\lambda) = \frac{2e^{x+t}}{2-\lambda(e^2-1)}$	c) $R(x,t;\lambda) = \frac{2e^{x+t}}{\lambda(e^2-1)}$	d) $R(x,t;\lambda) = \frac{e^{x+t}}{\lambda(e^2-1)}$	(b)
139	The resolvent kernel $R(x,t;\lambda)$ of the integral equation $y(x) = e^x - \frac{e}{2} + \frac{1}{2} + \frac{1}{2}\int_0^1 y(t)dt$ is given by				
	a) $R(x,t;\lambda) = 1$	b) $R(x,t;\lambda) = -1$	c) $R(x,t;\lambda) = 2$	d) $R(x,t;\lambda) = -2$	(c)
140	The resolvent kernel $R(x,t;\lambda)$ for the Volterra integral equation having kernel $K(x,t) = e^{x^2-t^2}$ is given by				
	a) $R(x,t;\lambda) = e^{x^2-t^2}e^{\lambda(x+t)}$	b) $R(x,t;\lambda) = e^{x^2-t^2}e^{\lambda(x-t)}$	c) $R(x,t;\lambda) = e^{x^2-t^2}$	d) $R(x,t;\lambda) = e^{x^2-t^2}e^{\lambda(x^2+t)}$	(b)
141	One coin is chosen at random from a bag containing (m+1) coins of which one is two headed and others are unbiased. Then the chosen coin was tossed once. If $\frac{7}{12}$ is the probability that the toss result is head, then which of the following will be the value of m:				
	a)10	b)15	c) 6	d) 5	d
142	Match the items of 1st column with the items of 2nd column and indicate the code of correct matching.				

A. If X_1, X_2, …….. are independent and identically distributed N(0,1) random variables and $Y_n = X_1^4 + X_2^4 + \cdots \ldots\ldots X_n^4$. then $P(3n \le Y_n \le 5n)$ will converge to	i. less than $\frac{1}{2}$
B. Suppose X follows Binomial(10,0.5) and Y follows Binomial(11,0.5) with X and Y are independent, then P(X<Y) equals	ii. $\frac{1}{12}$
C. If X_1, X_2, …….. X_{10} is a random sample from Uniform(0,1) and $X_{(1)}, X_{(2)}$, …….. $X_{(10)}$ denotes the corresponding order statistics, then $E(X_{(2)},)$ equals to	iii. $\frac{2}{11}$

	D. If arrival rate is 100 customers per day and service rate is 400 customers per day for a M/M/1 queue model, then the expected number of customers in the system at certain day is			iv. $\frac{1}{2}$	
	a) A→(i), B→(iv), C→(iii) D→(ii)	b) A→(iv) , B→(i), C→(iii) D→(ii)	c)A→(i), B→(iv), C→(ii) D→(iii)	d)A→(i), B→(ii), C→(iv) D→(iii)	b
143	Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason/Justification (R). **Assertion (A):** If U and V are two independent random variables with E(U)=E(V)=0 and Var(U)=Var(V)=5. If X=U+V, then $(P(\|X\| > \sigma) \leq \frac{10}{\sigma^2}$ and Var(X)=E(X^2) = 10 **Justification(R):** The Chebyshev's inequality is $(P(\|X-\mu\| > k) \leq \frac{Var(X)}{k^2}$ In the light of the above statements choose the correct answer from the options given below:				
	a)A is true but R is false	b) R is true but A is false	c) Both A and R are true and R is the correct explanation of A.	d) Both A and R are false	c
144	In a pure birth model, if λ is an arrival rate, $P_0(t)$ denotes the probability of 0 arrivals, then which of the following is true?				
	a)$P_0'(t) = -\frac{\lambda}{P_0(t)}$	$b)\ P_0'(t) = -\lambda P_0(t)$	c)$P_0'(t) = P_0(t)$	d)$P_0'(t) = \lambda$	(b)
145	Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason/Justification (R). **Assertion** (A): If H(t) is cumulative hazard function of non-negative continuous r.v., then H(0) = 0 and H(t) is non-decreasing function of 't' with $\lim_{t\to\infty} H(t) = \infty$ **Justification** (R): Cumulative hazard function satisfy H(t) ≥ 0, H(t) is increasing or decreasing or constant and H(t) tends to ∞ as 't' tends to ∞. In the light of the above statements choose the correct answer from the options given below:				(d)
	a) A is true but R is false	b) R is true but A is false	c) Both A and R are false	d) Both A and R are true and R is the correct explanation for A.	Both A and R are true and R is the correct explanation for A.
146	Which of the following statements are true? A. Uniform distribution is a special case of beta distribution of 1st kind. B. Moment generating function of binomial distribution is $(q+pe^t)^n$ C. Ratio of two standard normal variate follows standard Cauchy distribution.				

	D. If $X \sim \gamma(\lambda, \mu) and\ Y \sim \gamma(\lambda, \nu)\ then\ \frac{X}{Y} \sim \gamma(\mu, \nu)$				
	a) A and B	b) A, B and C	c) A, C and D	d) A,B,C and D	(d)
147	Mean and variance of Uniform distribution U(a,b) are				
	a) $\frac{b+a}{2}\ and\ \frac{(a-b)^2}{12}$	b) $\frac{b-a}{2}\ and\ \frac{(a-b)^2}{12}$	c) $\frac{b+a}{2}\ and\ \frac{(a+b)^2}{12}$	d) $\frac{b-a}{2}\ and\ \frac{(a+b)^2}{12}$	a
148	The joint probability density function of a bivariate random variable is defined by $f(x,y) = \begin{cases} e^{-(2x+3y)}, 0 < x < y < \infty \\ 0, otherwise \end{cases}$, Then $P(3X < Y)$ equals to				
	a) $\frac{7}{10}$	b)$\frac{2}{11}$	c)$\frac{1}{33}$	d)$\frac{5}{33}$	c
149	Necessary condition for the equation $M(x,y)dx + N(x,y)dy = 0$, to be exact is				
	a) $\frac{\partial N}{\partial y} = \frac{\partial M}{\partial x}$	b) $\frac{\partial N}{\partial y} = -\frac{\partial M}{\partial x}$	c) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$	d) $\frac{\partial M}{\partial y} = -\frac{\partial N}{\partial x}$	c
150	Newton Raphson method is useful in cases of				
	a) smaller values of $f'(x)$	b) larger values of $f'(x)$	c) for any values of $f'(x)$	d) None	b