Seat	
No	

## Total No. of Pages: 12

## M.Phil./Ph.D. Entrance Examination, September - 2019 MATHEMATICS

Day and Date : Thursday, 19 - 09 - 2019				Total Marks : 100		
Γin	ne:1.	00 p.m. to	3.00 p.m.			
Instructions:		ns: 1)	All questions a	re compulsory	•	
		2)	<b>Each question</b>			
		3)	Answers shou darkening the			the given OMR answer sheet by
		4)	_	point pen only	for r	marking the circle. Do not make any
		5)	Follow the inst			
		6)		_		sheet provided at the end of question
		7)	Only non progr	rammable calc	culate	ors are allowed.
1)	Res	earch ethic	cs include			
	A)	Integrity		]	B)	Subjectivity
	C)	Punctual	ity	]	D)	Smartness
2)	Wh	ich of the f	following is an	example of s	cier	ntific knowledge?
	A)	the author	ority of the proj	phet or great	maı	n
	B)	social tra	aditions and cu	stoms		
	C)	laborator	ry and field exp	eriments		
	D)	religious	scriptures or n	notes		
3)	The	readymad	le and readily a	vailable data	is c	alled
	A)	Primary		]	B)	Secondary
	C)	Personal		]	D)	Organizational
4)	Con	ncepts repr	esent various	degrees of		
	A)	Formulat	tion	]	B)	Calculation
	C)	Abstract	ion	]	D)	Specifications

5) The academic purpose of research is to have							
	A)	Information	B)	Firsthand knowledge			
	C)	Knowledge & information	D)	Construction of models			
6)	In de	ecimal number system a binary fract	tion (	$0.101)_2 =$			
	A)	0.625	B)	0.725			
	C)	0.635	D)	0.620			
7)	Wha	at are the five key objectives of scien	nce?				
	A)	questions, answers, prediction, explanation, summary					
	B)	influence, prediction, questions, exploration, answers					
	C)	exploration, description, explanation, prediction, influence					
	D)	prediction, summary, conclusion, e	explar	nation, description			
8) Anil travelled westward 5 km, turned left and travelled 3 km, turned ri travelled 9 km. He then travelled north 3 km. How far is he from the point?			_				
	A)	5 km	B)	3 km			
	C)	6 km	D)	14 km			
9)	Whi	ch of the following is NOT the char	acter	istic of a research?			
	A)	Research is problem oriented					
	B)	Research is not passive					
	C)	Research is not a process					
	D)	Research is systematic					

10)	Seco	Second step in problem formulation is				
	A)	Statement of the problem				
	B)	Understanding the nature of the problem				
	C) Survey					
	D)	Discussions				
11)		ne minute hand of a clock has mover hand moved?	ed 30	00°, how many degrees has the		
	A)	25°	B)	150°		
	C)	50°	D)	300°		
12)	The average of 3 consecutive even numbers is 18, find the largest of these numbers.					
	A)	15	B)	16		
	C)	20	D)	26		
13)	Whi	Which of the following is an example of professional writing?				
	A)	From equations (2) and (3), we get	the	desired result.		
	B) From Equations (2) and (3), we get the desired result.			desired result.		
	C) From equations (2), (3), we get the desired result.			red result.		
	D)	From Equations (2) and (3), we ge	t, the	desired result.		
14)	Whi	ch of the following is an example of	prof	essional writing?		
	A)	State and prove Open Mapping the	eoren	1.		
	B)	State and prove Open mapping the	oren	1.		
	C)	State and prove open mapping the	orem			
	D) State and Prove Open Mapping Theorem.					

- 15) Similarity checks for plagiarism shall exclude
  - A) All references, bibliography, table of content, preface and acknowledgements
  - B) All quoted work either falling under public domain or reproduced with all necessary permission and/or attribution
  - C) All generic terms, laws, standard symbols and standard equations
  - D) All of the above
- 16) Which of the following is an example of professional writing?
  - A) Consequently  $R_{ij} = 0$  characterizes the empty space.
  - B) Consequently,  $R_{ii} = 0$  characterizes the empty space.
  - C) Consequently,  $R_{ii} = 0$ , characterizes the empty space.
  - D) Consequently,  $R_{ij} = 0$  Characterizes the empty space.
- 17) Which of the following is an example of professional writing?
  - A) This completes the proof of my Inequalities (5.2) and (5.4).
  - B) This completes the proof of our Inequalities (5.2) and (5.4).
  - C) This completes the proof of our inequalities (5.2) and (5.4).
  - D) This completes the proof of my inequalities (5.2) and (5.4).
- 18) Which of the following is an example of professional writing?
  - A) Section 3 establishes the converse of theorem 2.
  - B) We establish the converse of Theorem 2 in Section 3.
  - C) We establish the converse of Theorem 2 in section 3.
  - D) Section 3 establishes the converse of Theorem 2.

19)	The	itemize environment in Latex gives	us a	
	A)	bullet - list	B)	numbered - list
	C)	tabular data	D)	mathematical formula
20)	The	expression $x^{mn}$ is obtained using La	atex o	command
	A)	x^mn	B)	\$x^mn\$
	C)	$x^{mn}$	D)	\$x^(mn)\$
21)	The	expression $\sqrt[4]{5}$ is obtained using L	atex	command
	A)	\$\sqrt[5]{4}\$	B)	\$\sqrt [4]{5}\$
	C)	\$\sqrt{5}{4}\$	D)	\$\sqrt[4][5]\$
22)	The	Latex command used to type bold	font-	style is
	A)	\textbf	B)	\bold
	C)	\boldf	D)	\textbold
23)	The	boolean $a <> b$ in Scilab is true if		
	A)	a < b	B)	$b \le a$
	C)	either $a < b$ or $b < a$	D)	a = b
24)		Scilab function is used to obliber.	tain a	an imaginary part of a complex
	A)	imag	B)	im
	C)	Im	D)	imagin
25)	The	command 3:2:6 in Scilab produce		
	A)	3 4 5 6	B)	3 6
	C)	3 3	D)	3 5

- 26) The sequence  $\{2x^n\}_{n=1}^{\infty}$  of functions converges uniformly on interval \_\_\_\_\_
  - A) [0, 2]

B) [0, 0.9]

C) (0, 1)

- D) [0, 1]
- 27) Consider the two statements for  $f: \mathbb{R}^m \to \mathbb{R}^n$ ,  $c \in \mathbb{R}^m$ :
  - (a) f is differentiable at c.
  - (b) Jacobian of f exists at c.

Then

A)  $(a) \Rightarrow (b)$ 

B)  $(b) \Rightarrow (a)$ 

C)  $(a) \Leftrightarrow (b)$ 

- D) neither (a)  $\Rightarrow$  (b), nor (b)  $\Rightarrow$  (a)
- 28) Let H be a Hilbert space and let S be a non-empty subset of H. Which of the following statement is incorrect?
  - A) neither  $S^{\perp} \subseteq S^{\perp \perp \perp}$  nor  $S^{\perp \perp \perp} \subseteq S^{\perp}$  B)  $S^{\perp} \subseteq S^{\perp \perp \perp}$
  - C)  $S \subseteq S^{\perp \perp}$

- D)  $S^{\perp\perp\perp} \subseteq S^{\perp}$
- 29) Let  $\{e_1, \dots, e_n\}$  be a finite orthonormal set in Hilbert space H. Then for any  $x \in H$ 
  - A)  $\left(x \sum_{i=1}^{n} \langle x, e_i \rangle e_i\right) \in \left\{e_j\right\}^{\perp}$  for each j
  - B)  $\left(x \sum_{i=1}^{n} \langle x, e_i \rangle e_i\right) \in \{0\}$
  - C)  $\left(x \sum_{i=1}^{n} \langle x, e_i \rangle e_i\right) \in \left\{e_j\right\}$  for each j
  - D)  $\left(x \sum_{i=1}^{n} \langle x, e_i \rangle e_i\right) \in \left\{e_j\right\}^{\perp \perp}$  for each j

- 30) Two linearly independent solutions of y'' + (3i-1)y' 3iy = 0 are
  - A)  $e^x, e^{ix}$

B)  $\sin x, \cos x$ 

C)  $e^x, e^{-3ix}$ 

- D)  $e^{ix}, e^{3ix}$
- 31) Lipschitz constant for the function

 $f(x,y) = x^2 \cos^2 y + y \sin^2 x$  on S:  $|x| \le 1, |y| < \infty$  is

A) 2

B) 3

C)  $\frac{1}{3}$ 

- D)  $\frac{1}{2}$
- 32) Let Q denotes the set of rational numbers, and f is measurable function on Q.

Then  $\int_{Q} f =$ 

A) 0

B) 1

C) ∞

- D)  $\pm 1$
- 33) For each n (n = 1,2,...) define  $f_n : \mathbb{R} \to \{0,1\}$  by  $f_n(x) = \begin{cases} 0 \text{ if } x < n \\ 1 \text{ if } x \ge n \end{cases}$ .

Let  $f_n \to f$  on  $\mathbb{R}$ . Then  $\int_{\mathbb{R}} f =$ 

A) <sup>1</sup>∞

B) 1

C) 2

- D) 0
- 34) Let  $f(z) = \frac{z^2}{(z-1)(z-2)^2}$ . Then Res(f;2) =
  - A)

B) -1

C) 0

D) –2

35)	Let $f(z) = -\frac{1}{2}$	$\frac{1}{\sin\left(\frac{\pi}{z}\right)}, z \in \mathbb{C}$ . Then $z = 0$ is
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- A) pole of f
- B) isolated singularity of f
- C) non-isolated singularity of f
- D) essential singularity of f

36)	The usual	topological	space	$(\mathbb{R}, au_{_{u}})$	) is not

A) compact

B) connected

C) first axiom space

D) second axiom space

37)	A topological space $(X, \tau)$ is $T_1$ space if and only if every finite subset of X is
	always

A) open

- B) closed
- C) open but not closed
- D) both open and closed

38) The complete graph  $K_3$  has \_\_\_\_\_ different spanning trees.

A) 3

B) 9

C) 6

D) 2

39) The total number of edges in complete bipartite graph  $K_4$  are \_\_\_\_\_

A) 12

B) 9

C) 6

D) 7

- 40) The cardinality of the centre of  $D_{12}$  is \_\_\_\_\_
  - A) 1

B) 2

C) 3

- D) 12
- 41) In the group U(15), the order of 7 is \_\_\_\_\_
  - A) 1

B) 2

C) 3

D) 4

- 42)  $\left| G\left( \frac{\mathbb{Q}\left(2^{\frac{1}{3}}\right)}{\mathbb{Q}} \right) \right| = \underline{\qquad}$ 
  - A) 1

B) 3

C) 2

- D) 8
- 43)  $\left[\mathbb{Q}\left(2^{\frac{1}{3}},\omega,\sqrt{3i}\right):\mathbb{Q}\right] = \underline{\qquad}$  (where  $\omega$  is cube root of unity)
  - A) 2

B) 4

C) 6

- D) 8
- 44) If V is a vector space of all 2×2 matrices over the field F, then dimension of V is
  - A) 2

B) 3

C) 4

D) 1

- 45) If M is 7×5 matrix of rank 3 and N is 5×7 matrix of rank 5, then rank (MN) is
  - A) 5

B) 3

C) 2

- D) 7
- 46) Lobatto integration method with n = 2 is
  - A) Simpsons rule with step length 1
  - B) Simpsons rule with step length ½
  - C) Trapezoidal rule with step length 2
  - D) None of these
- 47) In Jacobi method for symmetric matrices, if  $a_{ik}$  is the numerically largest element of matrix A then  $\theta =$ 
  - A)  $\frac{1}{2} \tan^{-1} \left( \frac{2a_{ik}}{a_{ii} a_{kk}} \right)$
  - B)  $\tan^{-1}\left(\frac{2a_{ik}}{a_{ii}-a_{kk}}\right)$
  - C)  $\frac{1}{2} \tan^{-1} \left( \frac{a_{ik}}{a_{ii} a_{kk}} \right)$
  - D)  $\frac{1}{2} \tan^{-1} \left( \frac{2a_{ik}}{a_{ii} + a_{kk}} \right)$

- 48) The arc of minimum length connecting two points on a given surface is \_\_\_\_\_
  - A) Catenary

B) Great circle

C) Geodesic

- D) Brachistocrone
- 49) A coordinate q is said to be ignorable coordinate if \_\_\_\_\_
  - A) Lagrangian is independent of  $\dot{q}$
  - B) Lagrangian is independent of q
  - C) Hamiltonian is independent of p
  - D) Hamiltonian is independent of t
- 50) The second order partial differential equation  $Au_{xx} + Bu_{xy} + Cu_{yy} + F(x, y, u) = 0$  is parabolic if
  - A)  $B^2 4AC > 0$

B)  $B^2 - 4AC < 0$ 

C)  $B^2 - 4AC = 0$ 

D) F(x, y, u) = 0



## **M/P ENT - 21**

## Rough Work