

22

QUESTION PAPER
SERIES CODE
C

Registration No. :

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Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2017

MASTER OF COMPUTER APPLICATIONS

[Field of Study Code : MCAM (224)]

Time Allowed : 3 hours

Maximum Marks : 100

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

- (i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.
- (ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
- (iii) All questions are compulsory.
- (iv) Answer all the 100 questions in the Answer Sheet provided for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against the corresponding circle. Any overwriting or alteration will be treated as wrong answer.
- (v) Each correct answer carries 1 mark. **There will be negative marking and 0.25 mark will be deducted for each wrong answer.**
- (vi) Answer written by the candidates inside the Question Paper will not be evaluated.
- (vii) Pages at the end have been provided for Rough Work.
- (viii) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

- 1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
- 2. Please darken the whole Circle.
- 3. Darken ONLY ONE CIRCLE for each question as shown in the example below :

Wrong	Wrong	Wrong	Wrong	Correct
<input type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)	<input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input type="radio"/> (a) <input checked="" type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)

- 4. Once marked, no change in the answer is allowed.
- 5. Please do not make any stray marks on the Answer Sheet.
- 6. Please do not do any rough work on the Answer Sheet.
- 7. Mark your answer only in the appropriate space against the number corresponding to the question.
- 8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

1. Evaluate

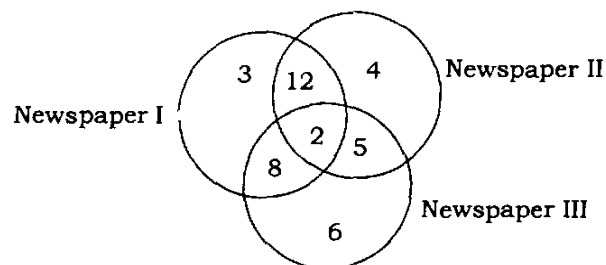
$$\left(e^{-\lambda} \sum_{i=0}^{\infty} i \frac{\lambda^i}{i!} \right)$$

- (a) e^λ
- (b) λ
- (c) λe^λ
- (d) None of the above

2. Suppose a is a rational number and b is an irrational number. Then $a + b$ will become

- (a) integer
- (b) rational
- (c) irrational
- (d) complex

3. Consider the Venn diagram below :



The number in the Venn diagram indicates the number of persons reading the newspapers. The diagram is drawn after surveying 50 persons. In a population of 10000, how many can be expected to read at least two newspapers?

- (a) 5000
 - (b) 5400
 - (c) 4400
 - (d) 4000
4. Let $X = \{a, b, c\}$ and $Y = \{1, 2, 3, 4\}$ be sets. How many one-to-one functions are there from X to Y ?
- (a) 14
 - (b) 17
 - (c) 20
 - (d) None of the above

5. Among the following sequences

(i) $\lim_{n \rightarrow \infty} \left(\frac{2^n}{n!} \right)$

(ii) $\lim_{n \rightarrow \infty} \left(\frac{\sin x}{n} \right)$

(iii) $\lim_{n \rightarrow \infty} ((-1)^n n^2)$

find the converging sequences

- (a) Only (i) and (ii)
- (b) Only (i) and (iii)
- (c) Only (ii) and (iii)
- (d) All converge

6. In the series

6 4 1 2 2 8 7 4 2 1 5 3 8 6 2 1 7 1 4 1 3 2 8 6

How many pairs of alternate numbers have a difference of 2?

- (a) Five
- (b) Four
- (c) Three
- (d) Two

7. Let A, B, C be square matrices. Assume that

$$AB = I \text{ and } BC = I$$

where, I is the identity matrix. Then, the matrix A should be equal to

- (a) B
- (b) C
- (c) the zero matrix
- (d) the identity matrix

8. The points $(a, b + c)$, $(b, c + a)$ and $(c, a + b)$

- (a) are vertices of an equilateral triangle
- (b) are vertices of a right angled triangle
- (c) lie on a circle
- (d) None of the above

9. If a line OP through the origin O makes angles α , 45° and 60° with X -, Y - and Z -axis respectively, then the value of $\cos\alpha$ is

- (a) $1/2$
- (b) $\sqrt{3}/2$
- (c) $1/\sqrt{2}$
- (d) 1

10. Find the value of the trigonometric sum

$$\tan 203^\circ + \tan 22^\circ + \tan 203^\circ \tan 22^\circ$$

- (a) -1
- (b) 0
- (c) 1
- (d) None of the above

11. How many elements are in the power set of the power set of the empty set?

- (a) 0
- (b) 1
- (c) 2
- (d) None of the above

12. Consider the following limits :

(i) $\lim_{x \rightarrow 0} f(x)$, where $f(x) = \begin{cases} x & \text{when } x \text{ is rational} \\ 0 & \text{when } x \text{ is irrational} \end{cases}$

(ii) $\lim_{x \rightarrow 0} x \sin(1/x)$

(iii) $\lim_{x \rightarrow 0} \left(x + \frac{x}{|x|} \right)$

Then

- (a) all of them do not exist
- (b) exactly two of them do not exist
- (c) exactly one of them does not exist
- (d) all of them exist

13. If $-$ means $+$, $+$ means \times , \times means $-$, and \div means $+$, then which one of the following equations is incorrect?

(a) $52 + 4 + 5 \times 8 - 2 = 36$

(b) $36 \times 4 - 12 + 5 + 3 = 2$

(c) $45 \times 5 + 15 + 8 - 4 = 19$

(d) $36 - 3 \times 12 + 4 + 6 = 54$

14. The value of 573_8 is equal to

(a) 319_{10}

(b) 359_{10}

(c) 389_{10}

(d) 379_{10}

15. Let $T: R^3 \rightarrow R^3$ be a transformation defined by
for (v_1, v_2, v_3) in R^3

$$T(v_1, v_2, v_3) = (v_2, v_3, v_1)$$

Then $T^{100}(v_1, v_2, v_3)$ is equal to

- (a) (v_1, v_2, v_3)
(b) (v_2, v_3, v_1)
(c) (v_3, v_1, v_2)
(d) None of the above
16. Let a_1, a_2, \dots be the sequence of numbers defined by

$$a_1 = 1, a_2 = 0$$

and

$$a_n = 4a_{n-1} - 4a_{n-2} \text{ for } n > 2$$

Then a_{10} will become

- (a) -4096
(b) -4224
(c) 4672
(d) 4360
17. A man, a woman, a boy, a girl, a dog and a cat are walking down a long road one after the other. In how many ways can this happen if only the dog is between the man and the boy?
- (a) 40
(b) 42
(c) 46
(d) None of the above
18. In a row of boys, Aryan is eighth from the right and Nileshe is twelfth from the left. When Aryan and Nileshe interchange positions, Nileshe becomes twenty-first from the left. Which will be Aryan's position from the right?
- (a) Seventeenth
(b) Nineteenth
(c) Twenty-first
(d) Thirtieth

$$\begin{bmatrix} \omega & 1 & \omega \end{bmatrix}$$

where $\omega(\neq 1)$ is a cubic root of unity. Then, the matrix A^2 will become

- (a) zero matrix
- (b) identity matrix

(c) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

- (d) None of the above

20. What is the probability of picking either a spade or a queen from a well-shuffled pack of playing cards?

- (a) $4/13$
- (b) $11/52$
- (c) $7/26$
- (d) $22/52$

21. The value of the integral

$$\int_{-\infty}^{\infty} \exp[-(x-7)^2 / 32] dx$$

is equal to

- (a) $2\sqrt{\pi}$
- (b) $4\sqrt{2\pi}$
- (c) $7\sqrt{2}$
- (d) None of the above

22. How many natural numbers are lying between 20000 and 60000, the sum of the digits being even?

- (a) 19998
- (b) 19999
- (c) 39998
- (d) 39999

23. The probability density function (pdf) of a continuous random variable X is

$$f(x) = \begin{cases} |x|, & |x| \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

The variance of X is

- (a) 1
2
- (b) 1
- (c) 2
- (d) 0
24. Which one of the following numeral groups is odd one out?
- (a) 12-144
- (b) 15-180
- (c) 18-198
- (d) 21-252
25. Let u and v be differentiable functions of the variables x , y and z . Show that a necessary and sufficient condition that u and v are functionally related by the equation $F(u, v) = 0$ is
- (a) $\nabla u \times \nabla v = 0$
- (b) $\nabla u \cdot \nabla v = 0$
- (c) Both (a) and (b) should be satisfied
- (d) None of the above
26. If every alternate letter starting from B of the given alphabet is written in small letters, and rest all in capital letters, how will the month of September be written?
- (a) SepteMbeR
- (b) SEptEMbEr
- (c) SEptembER
- (d) sePTeMbeR

27. A fair coin is flipped until head appears for the first time. If this occurs on the k th trial, the player gets 2^k amount. The expected gain from this game is

- (a) 0
- (b) 2
- (c) ∞
- (d) None of the above

28. Find the number of solutions to the equation

$$x_1 + x_2 + x_3 + x_4 = 13$$

so that x_1, x_2, x_3, x_4 are non-negative integers

- (a) 560
- (b) 520
- (c) 490
- (d) 356

29. For any two integers a, b , when a divides b we denote it by $a|b$. For integers a, b, c and d consider the following statements :

- (i) If $a|b$ and $c|b$, then $a \times c|b$
- (ii) If $a|b$ and $c|d$, then $a \times c|b \times d$
- (iii) If $a|b$ and $c|\left(\frac{b}{a}\right)$, then $c|b$ and $a|\left(\frac{b}{c}\right)$

Among them, identify the true statements.

- (a) Only (i) and (ii)
- (b) Only (i) and (iii)
- (c) Only (ii) and (iii)
- (d) (i), (ii) and (iii)

30. Suppose $f : A \rightarrow B$ and $g : B \rightarrow C$ are functions where A, B, C are non-empty sets. Let $g \circ f$ denote the composite function such that $(g \circ f)(x) = g(f(x))$. If $g \circ f$ is one-to-one and f is onto, then

- (a) g is one-to-one
- (b) g is onto
- (c) g is both one-to-one and onto
- (d) None of the above

31. Consider the four matrices given below :

$$\begin{bmatrix} 1 & 1 & 3 \\ 0 & 4 & 6 \\ 1 & 5 & 9 \end{bmatrix}, \begin{bmatrix} 2 & 0 & -3 \\ 3 & 1 & 2 \\ -4 & 0 & 6 \end{bmatrix}, \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 2 \\ 1 & 3 & 2 \end{bmatrix}$$

Find the number of matrices whose determinant is zero.

- (a) 1
- (b) 2
- (c) 3
- (d) 4

32. The result of adding the binary numbers

$$11011 \text{ and } 10011$$

will be

- (a) 110010
- (b) 101100
- (c) 101010
- (d) 101110

33. Let A, B, C be sets. Identify the number of true statements from below :

- (i) $A \cup B = A \cup C \Rightarrow B = C$
- (ii) $A \cup B \subseteq A \cap B \Rightarrow A = B$
- (iii) $A \cap B = A \cap C \Rightarrow B = C$

- (a) 0
- (b) 1
- (c) 2
- (d) 3

34. Let $\{x_n\}$ be the sequence, defined by

$$x_1 = 1, x_2 = 2 \text{ and } x_n = \frac{1}{2}(x_{n-2} + x_{n-1}) \text{ for } n > 2$$

It is given that $\lim_{n \rightarrow \infty} x_n = x$.

Then

- (a) $1 < x < 2$
- (b) $x > 2$
- (c) $x = \infty$
- (d) $x < 0$

35. Define the function $f : Z \rightarrow Z$ by

$$f(x) = 3x^3 - x$$

where Z denotes the set of integers. Then f is

- (a) injective
- (b) surjective
- (c) bijective
- (d) None of the above

36. Let ' \sim ' be an equivalence relation on the Euclidian plane R^2 defined by
for $(x_1, y_1), (x_2, y_2)$ in R^2

$$(x_1, y_1) \sim (x_2, y_2) \text{ if and only if } x_1^2 - y_1^2 = x_2^2 - y_2^2$$

Then the equivalence class of the point $(0, 0)$ will be

- (a) a pair of straight lines
- (b) a parabola
- (c) an ellipse
- (d) a hyperbola

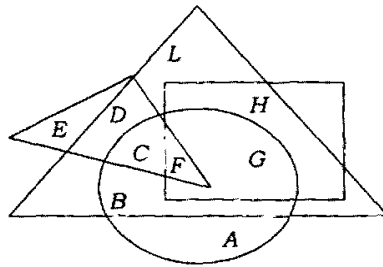
37. Among the following statements, identify the number of the true statements :

- (i) If all diagonal entries of a square matrix A are zero, then A is singular.
 - (ii) If U is an invertible upper triangular matrix, then $(U^{-1})^T$ is a lower triangular matrix.
 - (iii) If A, B are invertible matrices, then $(A + B)$ is always invertible.
- (a) 0
 - (b) 1
 - (c) 2
 - (d) 3

38. Let $f: R \rightarrow (1, \infty)$ be the function defined by $f(x) = 3^{2x} + 1$, where R is the set of real numbers. Then, the function $g: (1, \infty) \rightarrow R$ be the inverse of f when

- (a) $g(x) = \log_3(x - 1)$
- (b) $g(x) = 2\log_3(x - 1)$
- (c) $g(x) = 3\log_2(x - 1)$
- (d) None of the above

39. In the following figure, the smaller triangle represents the teachers; the big triangle, the politicians; the circle, the graduates and the rectangle, the members of parliament :



Who among the following are graduates or teachers but not politicians?

- (a) B, G
 - (b) G, H
 - (c) E, F
 - (d) A, E
40. How many integers between 1 and 300 (inclusive) are divisible by 3 and by 5 but not by 7?
- (a) 16
 - (b) 20
 - (c) 22
 - (d) 18

41. In a group of 100 people, several will have their birthdays in the same month. At least how many must have their birthdays in the same month?

- (a) 7
- (b) 9
- (c) 11
- (d) None of the above

42. Let z and w be two non-zero complex numbers such that

$$|z| = |w| \text{ and } \arg(z) + \arg(w) = \pi$$

If \bar{w} is the complex conjugate of w , then z will be equal to

- (a) w
- (b) \bar{w}
- (c) $-w$
- (d) $-\bar{w}$

43. A coin is tossed four times. How many times would you expect it falls heads?

- (a) 4
- (b) 3
- (c) 2
- (d) 1

44. Let z be a complex number such that $|z| = 1$. Let

$$w = \frac{z-1}{z+1} \text{ (where } z \neq -1)$$

Then the real part of the complex number w is equal to

- (a) 0
- (b) 1
- (c) $\sqrt{2}$
- (d) None of the above

45. Consider the following limits :

(i) $\lim_{x \rightarrow 0} \frac{1}{x}$

(ii) $\lim_{x \rightarrow 0} \sin(1/x)$

(iii) $\lim_{x \rightarrow 0} \frac{x}{|x|}$

Then, the limits of

- (a) all of them do not exist
- (b) exactly two of them do not exist
- (c) exactly one of them does not exist
- (d) all of them exist

46. Let a, b be real numbers. Consider the inequalities :

(i) $\left(\frac{1}{2}(a+b)\right)^2 \leq \frac{1}{2}(a^2 + b^2)$

(ii) $a < b \Rightarrow a < \sqrt{ab} < b$

(iii) $ab > 0 \Leftrightarrow |a+b| = |a| + |b|$

Among them, the correct statements are

- (a) only (i) and (ii)
- (b) only (i) and (iii)
- (c) only (ii) and (iii)
- (d) None of the above

47. For $k = 1, 2, 3, 4$, let

$$z_k = \cos\left(\frac{k\pi}{10}\right) + i \sin\left(\frac{k\pi}{10}\right)$$

be complex numbers. Then the product $z_1 z_2 z_3 z_4$ will be

- (a) 1
- (b) -1
- (c) 0
- (d) None of the above

48. Let the complex numbers z_1 , z_2 and z_3 be vertices of a parallelogram $ABCD$. Then, its fourth vertex is

- (a) $z_1 + z_2 + z_3$
- (b) $z_1 + z_2 - z_3$
- (c) $z_1 - z_2 + z_3$
- (d) None of the above

49. A bus starts from city X . The number of women in the bus is half of the number of men. In city Y , as 10 men leave the bus and 5 women enter, the number of men and women in the bus is equal. From city X , how many passengers started the journey?

- (a) 15
- (b) 24
- (c) 36
- (d) 45

50. Let a point undergoes the following three transformations successively :

- (i) Reflection about the line $y = x$
- (ii) Translation through a distance of 2 units along the positive direction of the x -axis
- (iii) Rotation through the angle 90° about the origin in the anticlockwise direction

What is the final position if the given point is $(4, 1)$?

- (a) $\left(\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$
- (b) $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$
- (c) $(-\sqrt{2}, 7\sqrt{2})$
- (d) $(\sqrt{2}, 7\sqrt{2})$

51. Find the median of the data given in the table :

Income (in \$)	1000	1100	1200	1300	1400	1500
No. of persons	14	26	21	18	28	15

- (a) 1300
(b) 1250
(c) 1200
(d) None of the above
52. Determine the set
- $$B = \left\{ x \in R : \frac{2x+1}{x+2} < 1 \right\}$$
- where, R is the set of real numbers
- (a) $B = (-2, 1)$
(b) $B = (1, 2)$
(c) $B = (-\infty, -1) \cup \left(\frac{1}{2}, \infty\right)$
(d) None of the above
53. The odds against A solving the problem is 4 is to 3 and the odds in favour of B solving the problem is 7 is to 5. What is the probability that the problem will not be solved?
- (a) $\frac{4}{21}$
(b) $\frac{16}{21}$
(c) $\frac{63}{84}$
(d) $\frac{69}{84}$
54. Let $\{f_n\}$ be the Fibonacci sequence of numbers defined by

$$f_1 = 1, f_2 = 1 \text{ and } f_n = f_{n-1} + f_{n-2} \text{ for } n > 2$$

It is defined that

$$x_n = \frac{f_n}{f_{n+1}} \text{ for } n \geq 1$$

Then, the sequence $\{x_n\}$

- (a) diverges
(b) converges to $\frac{1}{2}(-1 + \sqrt{5})$
(c) converges to $\frac{1}{2}(1 + \sqrt{5})$
(d) None of the above

55. Let a, b be integers. A necessary and sufficient condition for $(a^2 - b^2)$ to be an odd number is
- (a) both a, b are even
 - (b) both a, b are odd
 - (c) a even and b odd or a odd and b even
 - (d) None of the above
56. The following system of linear equations
- $$\begin{aligned}2x + 3y - z &= 5 \\x - 2y + 3z &= 7 \\x + 5y - 4z &= 0\end{aligned}$$
- has
- (a) a unique solution
 - (b) no solution
 - (c) infinitely many solutions
 - (d) None of the above
57. The variance of the first n natural numbers is
- (a) $n^2/4$
 - (b) $(n^2 + 1)/8$
 - (c) $(n^2 - 1)/12$
 - (d) None of the above
58. The number of 2×2 matrices whose entries are 1's and -1's will be equal to
- (a) 8
 - (b) 16
 - (c) 32
 - (d) None of the above

59. In a certain language, MACHINE is coded as LBBIHOD. Which one of the following words will be coded as SLTMFNB?

- (a) RKSLEMA
- (b) TKULGMC
- (c) RMSNEOA
- (d) TMUNGMC

60. Find the rank of the matrix

$$\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 \\ 2 & 0 & 0 & 6 \end{bmatrix}$$

- (a) 1
- (b) 2
- (c) 3
- (d) None of the above

61. When Gauri was born, her mother was 25 years older than her sister and her father was 32 years older than her brother. If Gauri's brother is 6 years older than her and her mother is 3 years younger than her father, how old was Gauri's sister when Gauri was born?

- (a) 10 years
- (b) 8 years
- (c) 7 years
- (d) 5 years

62. The first four moments of a distribution about the value 4 of the variable are -1.5, 17, -30 and 108. The variance is

- (a) 21.0
- (b) 19.5
- (c) 14.75
- (d) None of the above

63. If

$$6\cos 2\theta + 2\cos^2(\theta/2) + 2\sin^2\theta = 0, \quad 0 < \theta < \pi/2$$

then the value of θ is equal to

- (a) $\pi/3$
- (b) $\pi/4$
- (c) $\pi/6$
- (d) None of the above

64. The three words, Historian : Scholar : Researcher are related in some way. Which one of the following options exhibit the same relationship?

- (a) Professor : Lecturer : Teacher
- (b) Story : History : Book
- (c) Morning : Day : Night
- (d) Novel : Book : Epic

65. The vectors $2\hat{i} + \hat{j} - 2\hat{k}$, $\hat{i} + \hat{j} + 3\hat{k}$ and $x\hat{i} + \hat{j}$ are coplanar when x is equal to

- (a) $8/13$
- (b) $5/8$
- (c) $13/8$
- (d) $8/5$

66. Find the determinant of the skew-symmetric matrix A defined by

$$A = \begin{pmatrix} \sin x & -\sin(x - \pi/4) & \tan(x - \pi/4) \\ \sin(x - \pi/4) & 0 & \log(x/y) \\ -\tan(x - \pi/4) & \log(y/x) & \tan x \end{pmatrix}$$

- (a) $\sin x + \tan x$
- (b) 1
- (c) 0
- (d) None of the above

67. An anti-aircraft gun can take a maximum of three shots at an enemy plane moving away from it. The probabilities of hitting the plane in the first, second and third shot are 0.3, 0.2 and 0.1 respectively. The probability that gun hits the plane is

- (a) 0.423
- (b) 0.481
- (c) 0.496
- (d) None of the above

68. Let X be a random variable such that $E\{|X|\} < \infty$. Then

$$E\{|X - c|\}$$

is minimized if we choose c is equal to

- (a) the variance of X
- (b) $E\{X\}$
- (c) the median of X
- (d) None of the above

69. Priya walked 10 meters in front and 10 meters to her right. Then every time turning to her left, she walked 5, 15 and 15 meters respectively. How far is she from her starting point?

- (a) 55 meters
- (b) 35 meters
- (c) 25 meters
- (d) 5 meters

70. If x is real, then the maximum value of

$$\frac{3x^2 + 9x + 17}{3x^2 + 9x + 7}$$

is

- (a) 40
- (b) 48
- (c) 51
- (d) None of the above

71. The number of equivalence relations on the set

$$S = \{a, b, c\}$$

is

- (a) 6
- (b) 8
- (c) 9
- (d) None of the above

72. Complete the series

$$2, 5, 9, 19, 37, \underline{\hspace{2cm}}.$$

- (a) 76
- (b) 75
- (c) 74
- (d) 72

73. Let a, b, c be real numbers. Consider the following equalities :

(i) $\max\{a, b\} = \frac{1}{2}(a + b + |a - b|)$

(ii) $\min\{a, b\} = \frac{1}{2}(a + b - |a - b|)$

(iii) $\min\{a, b, c\} = \min\{\min\{a, b\}, c\}$

Among these, identify the number of correct statements

- (a) 0
- (b) 1
- (c) 2
- (d) 3

74. Statements :

All trolleys are pulleys.
Some pulleys are chains.
All chains are bells.

Conclusions :

- (i) Some bells are trolleys.
- (ii) No bell is trolley.
- (iii) Some pulleys are bells.
- (iv) All chains are pulleys.

From the statements given above which of the conclusions logically follow?

- (a) Either (i) or (ii)
- (b) Only (iii) and (iv)
- (c) Either (i) and (iii), or (ii) and (iv)
- (d) Either (i) or (ii), and (iii)

75. Among the following series defined as

(i) $\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$

(ii) $\sum_{n=1}^{\infty} \frac{1}{n \ln n}$

(iii) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$

Identify the converging series

- (a) Only (i) and (ii)
- (b) Only (i) and (iii)
- (c) Only (ii) and (iii)
- (d) None of the above

76. Given that $(4373)^2 + 1 = 2(9561, 565)$. Write the number (9561, 565) as the sum of two squares

- (a) $(2185)^2 + (2184)^2$
- (b) $(2180)^2 + (2183)^2$
- (c) $(2188)^2 + (2189)^2$
- (d) $(2185)^2 + (2187)^2$

77. Let

$$A = \frac{1}{2} \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

and $C = AB$ be 2×2 matrices. Then C^k will be equal to

(a) $\begin{bmatrix} 1 & 0 \\ 0 & (-1)^k \end{bmatrix}$

(b) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} (-1)^k & 0 \\ 0 & 0 \end{bmatrix}$

(d) None of the above

78. Let \hat{a} , \hat{b} , \hat{c} be vectors such that

$$\hat{a} + \hat{b} + \hat{c} = \hat{0} \quad \text{and} \quad |\hat{a}| = 3, |\hat{b}| = 5, |\hat{c}| = 7$$

Then the angle between \hat{a} and \hat{b} is

(a) $\pi/6$

(b) $\pi/3$

(c) $2\pi/3$

(d) $5\pi/3$

79. An object is moving in the clockwise direction around the unit circle $x^2 + y^2 = 1$. As it passes through the point $(1/2, \sqrt{3}/2)$, its y -coordinate is decreasing at the rate of 3 units per second. The rate at which the x -coordinate changes at this point is

(a) $\sqrt{3}$

(b) $2\sqrt{3}$

(c) 3

(d) $3\sqrt{3}$

80. Let $\mathcal{R} = \{(1, 1), (2, 2), (3, 3), (2, 1), (1, 2), (2, 3), (3, 1)\}$ be a binary relation on the set $S = \{1, 2, 3\}$. Then the relation \mathcal{R} is

- (a) reflexive
- (b) symmetric
- (c) transitive
- (d) equivalence

81. Find all the eigenvalues of the matrix

$$\begin{bmatrix} 1/2 & 1/2 \\ 1/2 & 1/2 \end{bmatrix}$$

- (a) 1, -1
- (b) 0, -1
- (c) 1, 0
- (d) 0, 0

82. Find the greatest common divisor of 1800 and 756.

- (a) 36
- (b) 32
- (c) 24
- (d) None of the above

83. Consider the Fibonacci function $F: N \rightarrow N$, where N is the set of natural numbers defined by

$$\begin{aligned} 1 &\rightarrow F(1) = F_1 = 1 \\ 2 &\rightarrow F(2) = F_2 = 1 \end{aligned}$$

and

$$n \rightarrow F(n) = F_n = F_{n-1} + F_{n-2} \quad \text{for } n > 2$$

Then the Fibonacci function is

- (a) one-to-one
- (b) onto
- (c) both one-to-one and onto
- (d) None of the above

- 84.** The stripes measuring 1 ml in a 1 litre cylindrical kitchen measuring jug is 1 mm wide, if the radius is with an error of no more than 1%. What is the radius of the cylinder?
- (a) 50 mm
 - (b) 60 mm
 - (c) 75 mm
 - (d) 100 mm
- 85.** In a cricket match, five batsmen *A, B, C, D* and *E* scored an average of 36 runs. *D* scored 5 more than *E*, *E* scored 8 fewer than *A*, *B* scored as much as the combined score of *D* and *E*, and *B* and *C* together scored 107. How many runs did *E* score?
- (a) 62
 - (b) 45
 - (c) 28
 - (d) 20
- 86.** How many numbers in the range 1000 – 9999 do not have any repeated digits?
- (a) 4653
 - (b) 4435
 - (c) 4365
 - (d) 4536
- 87.** A student must answer exactly eight questions out of ten on a final examination. In how many ways can she choose the questions to answer if she must answer at least three of the last five questions and at most four of the first five?
- (a) 30
 - (b) 32
 - (c) 35
 - (d) 38

88. Among the following statements, identify the true statement(s) :

- (i) Any subgroup of a cyclic group is cyclic.
 - (ii) Let $(H, *)$ be a subgroup of a group $(G, *)$. Let $N = \{x | x \in G, xHx^{-1} = H\}$, where x^{-1} is the inverse of the element x . Then $(N, *)$ is a subgroup of $(G, *)$.
 - (iii) Let $(G, *)$ be a group. Let $H = \{x \in G | x * y = y * x \text{ for all } y \in G\}$. Then $(H, *)$ is a subgroup of $(G, *)$.
- (a) Only (i) and (ii) are true
 - (b) Only (i) and (iii) are true
 - (c) Only (ii) and (iii) are true
 - (d) All of the above are true

89. Find the following sum :

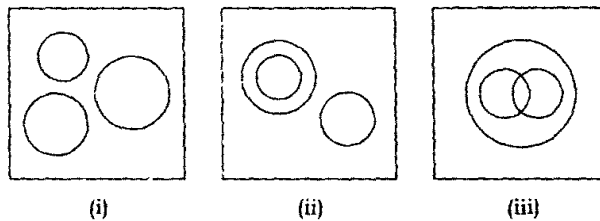
$$\sum_{x=0}^n \binom{M}{x} \binom{N-M}{n-x}$$

- (a) $\binom{M}{N}$
- (b) $\binom{N}{M}$
- (c) $\binom{N}{n}$
- (d) None of the above

90. Which Venn diagrams best illustrate the relationship among the given two sets of items?

Set 1 : Yak, Zebra, Bear

Set 2 : Sun, Moon, Stars



- (a) Only (i) and (iii)
- (b) Only (ii) and (iii)
- (c) Only (i) and (ii)
- (d) Only (i)

91. Let the equation of two circles be given as

$$x^2 + y^2 + 2g_1x + 2f_1y = 0 \text{ and } x^2 + y^2 + 2g_2x + 2f_2y = 0$$

If they touch each other, then

(a) $f_1^2 + g_1^2 = f_2^2 + g_2^2$

(b) $f_2g_1 = f_1g_2$

(c) $f_1f_2 = g_1g_2$

(d) $f_1^2 + g_2^2 = f_2^2 + g_1^2$

92. Among the five groups of letters given below, two are different from the remaining three groups of letters :

(i) LEVEL

(ii) FRETFUL

(iii) DRUID

(iv) UELOPE

(v) CALORIC

Which one of the given is true?

(a) Only (i) and (ii)

(b) Only (ii) and (iii)

(c) Only (ii) and (iv)

(d) Only (iv) and (v)

93. If $ca \equiv cb \pmod{n}$ and $\gcd(c, n) = d$, then

(a) $a \equiv b \pmod{n/d}$

(b) $a \equiv b \pmod{n}$

(c) $a \equiv b \pmod{d/n}$

(d) $a \equiv b \pmod{nd}$

94. The total work done in moving a particle in a force field given by

$$\mathbf{F} = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$$

along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$ is

- (a) 101
- (b) 202
- (c) 303
- (d) 330

95. Find the root of the equation

$$\frac{1}{x+1} + \frac{1}{x+5} = \frac{1}{x+2} + \frac{1}{x+4}$$

- (a) -2
- (b) -1/2
- (c) 1/3
- (d) -3

96. For any positive integer $n > 1$, the canonical form for the number n is

- (a) $n = p_1^{k_1} p_2^{k_2} \dots p_r^{k_r}$, where p_i 's are primes and k_i 's are positive integers
- (b) $n = p_1 p_2 \dots p_r$, where p_i 's are primes
- (c) $n = 2p + 1$, where p is a prime
- (d) None of the above

97. In a certain code, 15789 is written as EGKPT and 2346 is written as ALUR. How is 23549 written in that code?

- (a) ALGUT
- (b) ALEUT
- (c) ALGTU
- (d) ALGRT

98. The vectors \mathbf{X} , \mathbf{Y} , \mathbf{Z} issue from a common point and have their heads in a plane. The vector perpendicular to this plane is

- (a) $(\mathbf{X} \times \mathbf{Y} \times \mathbf{Z})$
- (b) $(\mathbf{X} \times \mathbf{Y}) + (\mathbf{Z} \times \mathbf{X})$
- (c) $(\mathbf{X} \times \mathbf{Y}) \times (\mathbf{Y} \times \mathbf{Z}) \times (\mathbf{Z} \times \mathbf{X})$
- (d) $(\mathbf{X} \times \mathbf{Y}) + (\mathbf{Y} \times \mathbf{Z}) + (\mathbf{Z} \times \mathbf{X})$

99. Let z be a complex number such that $|z|=1$ and $z \neq \pm 1$. Then all the values of

$$\frac{z}{1-z^2}$$

are

- (a) on the X -axis
- (b) on the Y -axis
- (c) not on the X -axis but on a line parallel to the X -axis
- (d) None of the above

100. Six fruits—an apple, an orange, a guava, a banana, a papaya and a kiwi are placed in two rows, three fruits in each of the rows. Consider the following information :

- (i) Papaya is not at the end of any row.
- (ii) Banana is second to the left of kiwi.
- (iii) Guava, placed next to papaya is diagonally opposite to banana.
- (iv) Orange is beside kiwi.

Which one of the following statements is true regarding the fruit arrangement?

- (a) Apple and orange are placed diagonally opposite to each other.
- (b) Apple, guava and papaya are placed in the same row.
- (c) Banana is placed opposite to guava.
- (d) None of the above is true.

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

/22-C

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