22
QUESTION PAPER SERIES CODE
A

ENTRANCE EXAMINATION, 2010

MASTER OF COMPUTER APPLICATIONS

[Field of Study Code : MCAM (225)]

Time Allowed : 3 hours

Maximum Marks : 480
Weightage : 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 120 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 **4** marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Simple Calculators and Log Tables may be used.

(viii) Pages at the end have been provided for Rough Work.

(ix) 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 example below :

Wrong	Wrong	Wrong	Wrong	Correct
● ⓑ ⓒ ●	ⓐ̸ ⓑ ⓒ ⓓ	ⓐ̸ ⓑ ⓒ ⓓ̸	⊙ ⓑ ⓒ ●	ⓐ ⓑ ⓒ ●

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. Given $f(x)$ is differentiable and $f'(4) = 5$, find

$$\lim_{x \to 2} \frac{f(4) - f(x^2)}{x - 2}$$

(a) ∞

(b) 0

(c) 5

(d) -20

2. $\lim_{x \to 0} \frac{1}{1 + e^{1/x}}$ is

(a) 0

(b) 1

(c) $\frac{1}{2}$

(d) Does not exist

3. The fourth power of $\sqrt{1 + \sqrt{1 + \sqrt{1}}}$ is

(a) $3 + 2\sqrt{3}$

(b) $3 + 2\sqrt{2}$

(c) $\frac{7 + 3\sqrt{5}}{2}$

(d) None of these

4. At what time between 3 and 4 o'clock are the hands of a clock together?

(a) $49\frac{1}{11}$ minutes past 3

(b) $16\frac{4}{11}$ minutes past 3

(c) $10\frac{10}{11}$ minutes past 3

(d) $43\frac{7}{11}$ minutes past 3

5. How many numbers from 1 to 1000 are not divisible by 2, 3 and 5?

(a) 266

(b) 500

(c) 333

(d) None of these

6. Express $(4312)_5$ as a number in base 10.

(a) 502

(b) 512

(c) 562

(d) 582

7. A and B can reap a field in 8 days, B and C in 12 days and C and A in 16 days. How long will they take to reap the field, if they work together?

(a) $\frac{77}{13}$ days

(b) $\frac{88}{13}$ days

(c) $\frac{96}{13}$ days

(d) 11 days

8. If α is a repeated root of $px^2 + qx + r = 0$, then

$$\lim_{x \to \alpha} \frac{\tan(px^2 + qx + r)}{(x - \alpha)^2}$$

is

(a) 0

(b) r

(c) p

(d) $\frac{\pi}{2}$

9. A triangle has two of its vertices at $P(1, 0)$ and $Q(0, 1)$. The third vertex $R(x, y)$ moves along the line $y = x$. Let A represent the area of the triangle. Find $\frac{dA}{dx}$.

(a) 0

(b) 1

(c) $\frac{1}{2}$

(d) $\frac{1}{4}$

10. If $0 < st < 1$, then which of the following can be true?

(a) $s < -1$ and $t > 0$

(b) $s < -1$ and $t < -1$

(c) $s > 1$ and $t > 1$

(d) $s > -1$ and $t < -1$

11. A certain cake recipe states that the cake should be baked in a pan of 8 cm diameter. If you want to make a cake of same depth but 12 cm in diameter, by what factor should you multiply the recipe ingredients?

(a) $2\frac{1}{4}$

(b) $2\frac{1}{2}$

(c) $1\frac{1}{4}$

(d) $1\frac{1}{3}$

12. X is normally distributed with mean -2 and variance 4, i.e., $X \sim N(-2, 4)$. Find $E[e^X]$.

(a) 1

(b) e^4

(c) e^2

(d) e^{-2}

13. For what value of x is $S = (x-1)^2 + (x-2)^2 + (x-5)^2 + (x-7)^2$ minimum?

(a) 4

(b) 6

(c) 7

(d) None of these

14. The density ρ of a uniform cylinder is determined by measuring its mass m, length l and diameter d. Calculate the approximate fractional error in ρ from the following data :

$$m = 47 \cdot 36 \pm 0 \cdot 01 \text{ g}, \; l = 15 \cdot 28 \pm 0 \cdot 05 \text{ mm}, \; d = 21 \cdot 37 \pm 0 \cdot 04 \text{ mm}$$

(a) 0·01%

(b) 0·08%

(c) 0·50%

(d) 1·50%

15. $X_1, X_2, \cdots, X_n$ are independent random variables with respective means $\mu_1, \mu_2, \cdots, \mu_n$ and variances $\sigma_1^2, \sigma_2^2, \cdots, \sigma_n^2$. Obtain $\mathrm{Var}(a_1X_1 + a_2X_2 + \cdots + a_nX_n)$.

(a) $\sigma_1^2 + \sigma_2^2 + \cdots + \sigma_n^2$

(b) $\sigma_1^2 \sigma_2^2 \cdots \sigma_n^2$

(c) $a_1^2\sigma_1^2 + a_2^2\sigma_2^2 + \cdots + a_n^2\sigma_n^2$

(d) $(a_1 a_2 \cdots a_n)$

16. X is a random variable with mean M and standard deviation σ. For small deviations compared to M, compute $E[\sqrt{X}]$.

(a) $M^{\frac{1}{2}}$

(b) $M^{\frac{1}{2}}\left(1-\frac{\sigma^2}{8M^2}\right)$

(c) $M^{\frac{1}{2}}\left(1-\frac{\sigma^2}{M^2}\right)$

(d) $M\left(1+\frac{\sigma^2}{M^2}\right)$

17. The incomes of A and B are in the ratio 3 : 2 and the expenditures in the ratio 5 : 3. If each of them saves Rs 1,000, find their incomes.

(a) Rs 3,000; Rs 2,000

(b) Rs 6,000; Rs 4,000

(c) Rs 12,000; Rs 8,000

(d) None of these

18. In a singles tennis tournament that has 125 entrants, a player is eliminated whenever she loses a match. How many matches are played in the entire tournament?

(a) 62

(b) 63

(c) 124

(d) 246

19. How many four-digit numbers have only even digits?

(a) 96

(b) 128

(c) 500

(d) 625

20. There are 27 students in a college debate team. Find the probability that at least 3 of them have their birthdays in the same month.

(a) $\frac{1}{27}$

(b) $\left(\frac{1}{27}\right)^3$

(c) $\frac{9}{27}$

(d) 1

21. Which of the operations is/are applicable on semaphore?

(a) UP and DOWN

(b) INTERRUPT

(c) BUSY WAITING

(d) SEND and RECEIVE

22. The time taken to move the arm trom one track to another for R/W operation is called

(a) seek time

(b) rotational time

(c) latency time

(d) transmission time

23. Consider a relation R(P, Q, R) with set of functional dependencies $F = \{P \rightarrow QR, Q \rightarrow PR, R \rightarrow PQ\}$. The minimal cover of F is

(a) $\{P \rightarrow R, Q \rightarrow P, R \rightarrow Q\}$

(b) $\{P \rightarrow R, Q \rightarrow P, R \rightarrow P\}$

(c) $\{P \rightarrow Q, Q \rightarrow P, R \rightarrow Q\}$

(d) $\{P \rightarrow R, Q \rightarrow R, R \rightarrow Q\}$

24. Consider a relation R(P, Q, R, S, T) with set of functional dependencies $F = \{P \rightarrow Q, QR \rightarrow T, ST \rightarrow P\}$. The highest normal form for R is

(a) 2NF

(b) 3NF

(c) BCNF

(d) 4NF

25. Which of the following is a conflict serializable schedule?

(a) $R_1(X)$, $R_2(X)$, $W_1(X)$, $R_1(Y)$, $W_2(X)$, $W_1(Y)$

(b) $R_1(X)$, $R_2(X)$, $W_2(X)$, $W_1(X)$, $R_1(Y)$, $W_1(Y)$

(c) $R_1(X)$, $R_2(Y)$, $W_1(X)$, $R_1(Y)$, $W_1(Y)$, $W_2(Y)$

(d) $R_1(X)$, $W_1(X)$, $R_1(Y)$, $R_2(X)$, $W_1(Y)$, $W_2(X)$

where $R_T(A)$ refers to read operation on data A by transaction T and $W_T(A)$ refers to write operation on data A by transaction T.

26. The address lines required for 512 K word memory are

(a) 10

(b) 19

(c) 20

(d) None of these

27. Suppose the numbers a, b, c are in AP and $|a|, |b|, |c| < 1$. If

$$x = 1 + a + a^2 + \cdots \infty, \; y = 1 + b + b^2 + \cdots \infty, \; z = 1 + c + c^2 + \cdots \infty$$

then x, y, z are in

(a) AP

(b) GP

(c) HP

(d) None of these

28. The number of rectangles that one can find on a chessboard is

(a) 1082

(b) 1296

(c) 1128

(d) 1632

29. Let A be an orthogonal matrix. Consider the following statements :

I. The transpose of A is orthogonal.

II. The inverse of A is orthogonal.

III. aA is orthogonal, where a is any non-zero real number.

The number of true statements is

(a) 0

(b) 1

(c) 2

(d) 3

30. The greatest value of the positive integer n so that the sum to n terms of the series $1 + \frac{1}{2} + \frac{1}{2^2} + \cdots$ is less than $\left(2 - \frac{1}{1000}\right)$, is

(a) 5

(b) 7

(c) 8

(d) 10

31. The number of solutions of the system of equations

$$1 + x + x^2 + \cdots + x^{23} = 0$$
$$1 + x + x^2 + \cdots + x^{19} = 0$$

equals

(a) 3

(b) 4

(c) 19

(d) 23

32. A man of weight W is in an elevator of weight W. The elevator accelerates vertically up at a rate k and at a certain instant has a speed V. What is the apparent weight of the man?

(a) $W\left(1 - \frac{k}{g}\right)$

(b) $W\left(1 + \frac{k}{g}\right)$

(c) $2WV$

(d) Zero

33. Octal equivalent of the hexadecimal number B2F16 is

(a) 2627426

(b) 2625426

(c) 2826426

(d) 5457426

34. If a file of size $n = 1000$ takes on an average 4 ms for searching an item using binary search algorithm, then approximately how much time on an average would it take to search an item in a file of size $n = 1000000000000$?

(a) 1600 ms

(b) 16000 ms

(c) 160 ms

(d) 16 ms

35. Assume that a lower triangular matrix $A[0 \cdots n-1,\ 0 \cdots n-1]$ is stored in a linear array $B[0 \cdots \frac{1}{2} * n(n+1) - 1]$ in row by row order. For $n = 100$, if $A[0,\ 0]$ is stored in $B[0]$, where is $A[50,\ 40]$ stored?

(a) 1275

(b) 1300

(c) 1312

(d) 1315

36. The probability that a number chosen at random from the primes between 100 and 199 is odd, is

(a) 0

(b) 1

(c) $\frac{1}{2}$

(d) 0·6

37. Three identical balls fit exactly into a cylindrical can : the radius of the balls equals the radius of the can and the balls just touch the bottom and the top of the can. What fraction of the volume of can is taken up by the balls?

(a) $\frac{1}{2}$

(b) $\frac{2}{3}$

(c) $\frac{3}{4}$

(d) 1

38. In quadrilateral *WXYZ*, the measure of angle *Z* is 10 more than twice the average of the measures of the other three angles. What is the measure of angle *Z*?

(a) 100

(b) 120

(c) 150

(d) 170

39. What is the arithmetic mean of 3^{30}, 3^{60}, 3^{90}?

(a) 3^{60}

(b) 3^{177}

(c) $3^{10}+3^{20}+3^{30}$

(d) None of these

40. If the sum of all the positive even integers less than 1000 is *A*, what is the sum of all the positive odd integers less than 1000?

(a) $A+500$

(b) $A+1$

(c) $\frac{A}{2}$

(d) $A-499$

41. Calculate $\int_1^2 \frac{\sin(\ln x)}{x} dx$,

(a) $1 - \sin 2$

(b) $1 - \cos(\ln 2)$

(c) $1 + \cos(\ln 2)$

(d) $1 + \ln 2$

42. There are three critical points of the function $g(x, y) = x^4 + 2x^2 y + 2y^2 + 4$. Identify the point which is not critical.

(a) $\left(\frac{1}{\sqrt{2}}, \frac{1}{4}\right)$

(b) $\left(0, -\frac{1}{4}\right)$

(c) $\left(\frac{1}{\sqrt{2}}, -\frac{1}{2}\right)$

(d) $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{2}\right)$

43. Find the area enclosed by the lines $t = 1$, $t = 2$, t-axis and the graph of the function $f(t) = e^t$.

(a) e^{2t}

(b) e

(c) $e^2 - e$

(d) e^2

44. Given the function $f(x, y) = 2y^3 x + 5y^4 - (y^{\frac{3}{4}} - 2x^{\frac{3}{4}})^4 x$, then $x\frac{\partial f}{\partial x} + y\frac{\partial f}{\partial y}$ equals

(a) xy

(b) $x^4 y^4$

(c) xyf

(d) $4f$

45. Suppose that $f(x) = \frac{1}{x}$, $g(x) = x^{3/2}$, $h(x) = x^2 + 2x + 3$. Compute $fgh(x)$ at $x = 2$.

(a) 11^3

(b) $11^{-3/2}$

(c) $11^{3/2}$

(d) None of these

46. Let a_i, $q_i > 0$, $i = 1, 2, \cdots, n$; $\sum_{i=1}^{n} q_i = 1$. Then $\lim_{x \to 0} \ln(\sum q_i a_i^x)^{\frac{1}{x}}$ equals

(a) $\ln(a_1 a_2 \cdots a_n)$

(b) $(q_1 + q_2 + \cdots + q_n)$

(c) $\sum_{i=1}^{n} q_i \ln a_i$

(d) Does not exist

47. Evaluate $\int_0^u \int_0^v \exp[\max(v^2 x^2, u^2 y^2)] \, dy \, dx$.

(a) $\dfrac{e^{u^2 v^2} - 1}{uv}$

(b) $\dfrac{e^{u^2 v^2}}{uv}$

(c) e^{uv}

(d) $\dfrac{uv}{e}$

48. Compute $\int_0^\infty x^{-\frac{1}{2}} e^{-x} dx$.

(a) e^{-1}

(b) $\sqrt{\pi}$

(c) $\sqrt{\pi / e}$

(d) ∞

49. Suppose that the lifetime X (in years) of a machine has an exponential distribution with parameter $\lambda = \frac{1}{3}$. What is the probability that a three-year-old machine will still work at the end of three additional years?

(a) $e^{-6} + e^{-3}$

(b) $e^{-3} - e^{-6}$

(c) e^{-1}

(d) $e^{-1/3}$

50. Let X be a non-negative continuous random variable. Then $E(X) = \int_0^\infty x f_X(x) dx$ in terms of c.d.f. $F_X(x)$ can be expressed as

(a) $\int_0^\infty F_X(x) dx$

(b) $\int_0^\infty (1 - F_X(x)) dx$

(c) $F_X(\infty) - F_X(0)$

(d) $\int_0^\infty \dfrac{F_X(x)}{x} dx$

51. License plates are made up of three letters followed by four digits. We assume that letters I and O are never used and that no license plates end with 0000. How many distinct license plates can there be?

(a) $\binom{24}{3}\binom{10}{4}-1$

(b) $\binom{24}{3}\left[\binom{10}{4}-1\right]$

(c) $(24\times24\times24)10^4$

(d) $(24\times24\times24)(10^4-1)$

52. An amount of Rs 1,000 is invested and attracts interest at a rate equivalent 10% per annum. Find the total after one year, if the interest is compounded monthly.

(a) $1000(1+0\cdot1)^{12}$

(b) $1000(1+1\cdot2)$

(c) $1000\left(1+\frac{0\cdot1}{12}\right)^{12}$

(d) $1000\times0\cdot1\times12$

53. Determine the set $G\cap L$, where

$$G=\{(x,\ y)\mid y=x^2-5x+6\}$$
$$L=\{(x,\ y)\mid y=2x-6\}$$

$G\cap L$ consists of

(a) (4, 2), (3, 0)

(b) (2, 3)

(c) (2, 6), (3, 0)

(d) (4, 2), (6, 2)

54. The population of a country doubled every 10 years from 1960 to 1990. What was the percent increase in population during this time?

(a) 200%

(b) 300%

(c) 60%

(d) 70%

55. 8 is $\frac{1}{3}$% of what number?

(a) 24

(b) 240

(c) 2·4

(d) 2400

56. Consider the identity $(1+x+x^2)^{25} = a_0 + a_1 x + a_2 x^2 + \cdots + a_{50} x^{50}$. We find $2(a_0 + a_2 + a_4 + \cdots)$ equals

(a) 3^{25}

(b) $3^{25} + 1$

(c) 3^{26}

(d) $3^{26} - 1$

57. The value of $f(0)$, for which $f(x) = \dfrac{512(\sqrt{x+4} - 2)}{\sin 2x}$ is continuous, is

(a) 51

(b) 59

(c) 61

(d) None of these

58. If A is the area of a triangle whose vertices are (1, 2, 3), (−2, 1, −4), (3, 4, −2), then the value of $4A^2$ is

(a) $\dfrac{\sqrt{1218}}{2}$

(b) 1128

(c) 1218

(d) 2418

59. If $f(x) = (1+x)^n$, then the value of $f(0) + f'(0) + \dfrac{f''(0)}{2!} + \cdots + \dfrac{f^n(0)}{n!}$ is

(a) n

(b) 2^{n-1}

(c) 2^{n+1}

(d) 2^n

60. The curve which passes through the point (2, 0) and the slope of the tangent at any point (x, y) is $x^2 - 2x$ for all values of x, is

(a) $y = x^3$

(b) $y = \dfrac{x^3}{3} - x^2$

(c) $y = \dfrac{x^3}{3} - x^2 + \dfrac{4}{3}$

(d) $y = \dfrac{x^3}{3} - x^2 - \dfrac{4}{3}$

61. A straight line passes through (2, − 6) and the point of intersection of the lines $5x-2y+14=0$ and $2y=8-7x$. Any straight line concurrent with the given lines is $(5x-2y+14)+\lambda(2y-8+7x)=0$. The value of λ is

(a) 6

(b) 36

(c) 17

(d) 16

62. The Laplace transform of a real-valued function $f(t)$ is defined as $\bar{f}(s)=\int_0^\infty e^{-st}f(t)\,dt$. If $f(t)$ is a piecewise continuous function of exponential order α (i.e., $|f(t)|< Me^{\alpha t}$) the transform $\bar{f}(s)$ is defined for $\mathrm{Re}\, s>\alpha$. If $\bar{f}(s)=\frac{1}{s+1}+\frac{1}{s+2}$, then $f(t)$ is given by

(a) $t+t^2$

(b) $e^{-t}+2t$

(c) $e^{-t}+e^{-2t}$

(d) $\sin t+\sin 2t$

63. Given a 10×10 matrix. Each element of the matrix is a Boolean variable. How many different matrices can be formed?

(a) 2^{100}

(b) 100^2

(c) 2^{10}

(d) 10^2

64. Let $S\equiv x^2+y^2+2gx+2fy+c=0$ be the equation of a circle and $P\equiv ax+by+c'=0$ be the equation of a straight line. Then the equation $S+\lambda P=0$ represents

(a) circle

(b) ellipse

(c) hyperbola

(d) pair of straight lines

65. The ratio of the outer and the inner perimeters of a circular path is 23 : 22. If the path is 5 metres wide, the diameter of the inner circle is

(a) 55 m

(b) 65 m

(c) 215 m

(d) 220 m

66. Four circular cardboard pieces, each of radius 7 cm, are placed in such a way that each piece touches two other pieces. The area of the space enclosed by the four pieces is

(a) $22\ \text{cm}^2$

(b) $42\ \text{cm}^2$

(c) $84\ \text{cm}^2$

(d) $102\ \text{cm}^2$

67. The value of $e^{0 \cdot 001}$ correct up to one decimal place is

(a) 1·1

(b) 2·7

(c) 1·0

(d) None of these

68. Mr. *A*, Miss *B*, Mr. *C* and Miss *D* are sitting around a table and discussing their trades.

(i) Mr. *A* sits opposite to cook.

(ii) Miss *B* sits right to the barber.

(iii) Miss *D* sits opposite to Mr. *C*.

(iv) The washerman is on the left of the tailor.

What are the trades of *A* and *B*?

(a) Incomplete information

(b) Tailor and cook

(c) Washerman and cook

(d) Barber and cook

69. It is given that $f''(x) = -f(x)$, $f'(x) = g(x)$ and $h(x) = [f(x)]^2 + [g(x)]^2$. If $h(\frac{1}{2}) = 8$, then $h(\frac{3}{2})$ is equal to

(a) 0

(b) 2

(c) 4

(d) 8

70. Six roads lead to a country. They may be indicated by letters *X*, *Y*, *Z* and digits 1, 2, 3. When there is storm, *Y* is blocked. When there are floods, *X*, 1 and 2 will be affected. When road 1 is blocked, *Z* also is blocked. At a time when there are floods and a storm also blows, which road(s) can be used?

(a) Only *Y*

(b) Only *Z*

(c) Only 3

(d) *Z* and 2

71. Six persons *A*, *B*, *C*, *D*, *E* and *F* are standing in a circle. *B* is between *F* and *C*; *A* is between *E* and *D*; *F* is to the left of *D*. Who is between *A* and *F*?

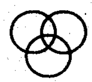
(a) *B*

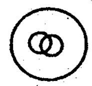
(b) *C*

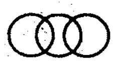
(c) *D*

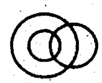
(d) *E*

72. Which one of the following diagrams correctly represents the relationship among the classes—Tennis fans, Cricket players and Students?

(a) 

(b) 

(c) 

(d) 

73. If sky is called sea, sea is called water, water is called air, air is called cloud and cloud is called river, then what do we drink when thirsty?

(a) River

(b) Sky

(c) Water

(d) Air

74. Grain : Stock :: Stick : ?

(a) Heap

(b) String

(c) Bundle

(d) Collection

75. What terms will fill the blank spaces?

Z, X, V, T, R, ——, ——

(a) M, N

(b) N, M

(c) P, N

(d) O, K

76. In a certain code, PAPER is written as SCTGW. How is MOTHER written in that code?

(a) ORVLGW

(b) PQRSXY

(c) PQVJGT

(d) None of these

77. A point moves in such a manner that the sum of its distances from fixed points $(-3, 0)$ and $(3, 0)$ is 6. Then the locus of the moving point must be

(a) an ellipse

(b) a parabola

(c) a line segment joining the fixed points

(d) a circle

78. Find the centre of mass for three weights located at points $(1, 3)$, $(2, -2)$ and $(3, 2)$, the weights being 5 kg, 6 kg and 2 kg respectively.

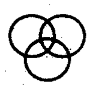
(a) $(23, 7)$

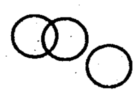
(b) $(\frac{23}{13}, \frac{7}{13})$

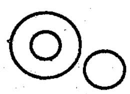
(c) $(\frac{6}{13}, \frac{8}{13})$

(d) $(6, 3)$

79. Select from the given diagrams the one that illustrates the relationship among the given three classes—Judge, Thief and Criminal.

(a) 

(b) 

(c) 

(d) 

80. In an (8×8) matrix whose elements are $a_{ij} = (-1)^{i+j}$, how many positive terms are there?

(a) 64

(b) 32

(c) 48

(d) 16

81. Which of these systems has no solution?

(a) $\begin{cases} 2x_1 - x_2 = 3 \\ x_1 + x_2 = 1 \end{cases}$

(b) $\begin{cases} 2x_1 - x_2 = 3 \\ 4x_1 - 2x_2 = 6 \end{cases}$

(c) $\begin{cases} x_1 + x_2 = 3 \\ 2x_1 - 2x_2 = 6 \end{cases}$

(d) $\begin{cases} 2x_1 - x_2 = 3 \\ 4x_1 - 2x_2 = 5 \end{cases}$

82. For what value of α is the vector $(2, 11, -3)$ in the span of the set $\{(2, 5, -3), (4, 8, \alpha)\}$?

(a) 4

(b) -6

(c) -8

(d) 2

83. Let A be (4×3) matrix whose columns form a linearly independent set. Which conclusion is justified?

(a) The equation $AX = b$ is consistent for every b in $\mathbb{R}^4$

(b) The set of rows in A is linearly dependent

(c) The equation $AX = 0$ has a non-trivial solution

(d) There is a matrix B such that $AB = I_4$

84. Let $\frac{1}{x^2 - 1} = \frac{A}{x+1} + \frac{B}{x-1}$. Find A and B.

(a) $-\frac{1}{2}, \frac{1}{2}$

(b) $\frac{1}{2}, -\frac{1}{2}$

(c) $-1, 1$

(d) $-1, -2$

85. Which of the these transformations is linear? In each case $X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$.

(a) $T(X) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

(b) $T(X) = \begin{bmatrix} x_1 - x_2 \\ x_1 / x_2 \end{bmatrix}$

(c) $T(X) = \begin{bmatrix} x_1 x_2 \\ x_1 + x_2 \end{bmatrix}$

(d) $T(X) = \begin{bmatrix} 3x_1^2 \\ 4x_2^2 \end{bmatrix}$

86. What is the range of the function f that maps $\mathbb{R}$ to $\mathbb{R}^2$ by means of the formula $f(t) = \begin{bmatrix} \sin t \\ \cos t \end{bmatrix}$?

(a) A circle (circumference only)

(b) $\mathbb{R}^2$

(c) The set of all points (x, y) satisfying $-1 \le x \le 1$ and $-1 \le y \le 1$

(d) A disk consisting of a circle together with all the points enclosed by the circle

87. Given an array of n elements. Each element can take three values -1, 0, 1. How many different arrays can be formed?

(a) $\binom{n}{3}$

(b) n^3

(c) 3^n

(d) $\left[\binom{n}{1}\right]^3$

88. The number of roots of $x^{2 \cdot 1} + x^{3 \cdot 01} + x^{4 \cdot 001} = 1$ is

(a) infinite

(b) two

(c) 3001

(d) 4001

89. The value of the sum $\sum_{n=1}^{13} (i^n + i^{n+1})$, $i = \sqrt{-1}$ is

(a) i

(b) $i - 1$

(c) $1 - i$

(d) 0

90. What is the area of a regular hexagon inscribed in a circle of radius of 10 cm?

(a) 180 cm^2

(b) $150\sqrt{3} \text{ cm}^2$

(c) $(150/\sqrt{3}) \text{ cm}^2$

(d) $180\sqrt{3} \text{ cm}^2$

91. For what value of x is $S = |x-1| + |x-3| + |x-8| + |x-9| + |x-20|$ minimum?

(a) 7

(b) 6·8

(c) 8

(d) None of these

92. The Fibonacci sequence is governed by the difference equation $y_n = y_{n-1} + y_{n-2}$ with initial condition $y_0 = 0$, $y_1 = 1$. The general solution is $y_n = A\left(\frac{1+\sqrt{5}}{2}\right)^n + B\left(\frac{1-\sqrt{5}}{2}\right)^n$

Determine A and B.

(a) $-1, 1$

(b) $-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$

(c) $\frac{1}{\sqrt{5}}, \frac{1}{\sqrt{5}}$

(d) $\frac{1}{\sqrt{5}}, -\frac{1}{\sqrt{5}}$

93. Find z^4, if $z = 1+\sqrt{3}i$, $i = \sqrt{-1}$.

(a) $4\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}$

(b) $4\left(\cos\frac{4\pi}{3} + i\sin\frac{2\pi}{3}\right)$

(c) $16\left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right)$

(d) $-16\left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right)$

94. $\sinh ix$ equals

(a) $\cosh x$

(b) $i\sin x$

(c) $\cos x$

(d) 1

95. $S = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$ equals

(a) $\frac{\pi^2}{6}$

(b) $\frac{\pi}{2}$

(c) 4

(d) ∞

96. The arc length of the parabola $y(x) = \frac{1}{2}x^2$ from $x = 0$ to $x = 1$ is given by

(a) $\ln(\sqrt{2}-1)$

(b) $\frac{1}{2}(\sqrt{2} - \ln(\sqrt{2}-1))$

(c) $\frac{\ln(\sqrt{2}+1)}{2}$

(d) $\frac{\ln\sqrt{2}}{2}$

97. The divergence of a vector field $\underline{u}$ is the dot product of del operator ∇ and $\underline{u}$, i.e.

$$\text{div } \underline{u} = \nabla \cdot \underline{u} = \frac{\partial u_1}{\partial x} + \frac{\partial u_2}{\partial y} + \frac{\partial u_3}{\partial z}$$

and the curl is the cross product of the del operator and the vector field $\underline{u}$, i.e.

$$\text{curl } \underline{u} = \nabla \times \underline{u} = \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ u_1 & u_2 & u_3 \end{vmatrix}$$

Then $\nabla \cdot (\nabla \times \underline{u})$ is

(a) $\nabla(\nabla \cdot \underline{u}) - \nabla^2 \underline{u}$

(b) 0

(c) $\nabla^2 \underline{u}$

(d) 3

98. For $-1 \le x \le 1$, the infinite power series $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} - \cdots$ converges to

(a) e^x

(b) $\sin x$

(c) $\ln x$

(d) $\ln(1+x)$

99. For cylindrical polar coordinates (r, ϕ, z), we have $x = r\cos\phi$, $y = r\sin\phi$, $z = z$. The Jacobian $J = \frac{\partial(x, y, z)}{\partial(r, \phi, z)}$ is

(a) r

(b) ϕ

(c) $r^2 \sin\phi \cos\phi$

(d) z

100. For large x, Stirling's asymptotic formula for $x!$ gives

(a) $e^{x \ln x}$

(b) $\sqrt{2\pi x}\, e^{x \ln x}$

(c) $\sqrt{2\pi x}\, e^{x \ln x - x}$

(d) $e^x \sqrt{x}$

101. $g(n) = O(f(n))$ denotes

(a) $g(n)$ has order at least $f(n)$

(b) $g(n)$ has the same order as $f(n)$

(c) $g(n)$ has order at most $f(n)$

(d) None of these

102. The object-oriented paradigm includes which of the following properties?

I. Encapsulation

II. Inheritance

III. Recursion

(a) I only

(b) I, II and III

(c) II only

(d) I and II only

103. Which of the following is the name of the data structure in a compiler that is responsible for managing information about variables and their attributes?

(a) Parse table

(b) Symbol table

(c) Attribute grammar

(d) Semantic stack

104. Which of the following statements about Ethernets is typically false?

(a) Ethernets use circuit switching to send messages

(b) Ethernets use buses with multiple masters

(c) Networks connected by Ethernets are limited in length to a few hundred metres

(d) Packets sent on Ethernets are limited in size

105. In the Internet Protocol (IP) suite of protocols, which of the following best describes the purpose of the Address Resolution Protocol?

(a) To determine the appropriate route for a datagram

(b) To translate Web addresses to host name

(c) To determine the hardware address of a given host name

(d) To determine the hardware address of a given IP address

106. Let k be an integer greater than 1. Which of the following represents the order of growth of the expression $\sum_{i=1}^{n} k^i$ as a function of n?

(a) $O(k^n)$

(b) $O(k^{n \log n})$

(c) $O(k^{n+k})$

(d) $O(k^n \log n)$

107. Consider the following program :

```
#include (stdio.h)
main( )
  {
        int i = 0, x = 0;
          do {
                if (i% 5 == 0) {
                              x++;
                              printf ("%d", x);
                            }
                          ++i;
              } while (i < 25);
        printf ("\nx = %d", x);
  }
```

The above program would produce output as

(a) 12345
x = 5

(b) 01234
x = 4

(c) 23456
x = 6

(d) None of these

108. Consider the following function :

```
int fun (int n)
{
  if (n ==1) return (1);
  else return (fun (n/2) + 1)
}
```

The value of fun (4000) is

(a) 10

(b) 9

(c) 12

(d) None of these

109. X is binomially distributed with parameters n and p. Then $E[(X-np)+(X-np)^2]$ equals

(a) np

(b) n^2p^2

(c) $n(n-1)p^2$

(d) $np(1-p)$

110. Let random variable X have m.g.f. $M(t)=\exp[3t+t^2]$. What is $E[X^2]$?

(a) 6

(b) 3

(c) 10

(d) 11

111. A uniform density function over an interval of unit length is such that $P\left(\frac{1}{4} < X < \frac{1}{2}\right) = \frac{1}{4}$. What is the left-hand end point of that interval of unit length?

(a) Cannot be determined

(b) 0

(c) $\frac{1}{8}$

(d) $\frac{1}{4}$

112. A company agrees to accept the highest of four sealed bids on a property. The four bids are regarded as four independent random variables with common cumulative distribution function $F(x) = \frac{1}{2}(1 + \sin \pi x)$, $\frac{3}{2} \le x \le \frac{5}{2}$. Which of the following represents the expected value of the accepted bid?

(a) $\int_{3/2}^{5/2} x \cos \pi x \, dx$

(b) $\frac{\pi}{4} \int_{3/2}^{5/2} x \cos \pi x (1 + \sin \pi x)^3 \, dx$

(c) $\frac{1}{16} \int_{3/2}^{5/2} x (1 + \sin \pi x)^4 \, dx$

(d) $\pi \int_{3/2}^{5/2} x \cos \pi x \, dx$

113. The integrating factor of the differential equation $\frac{dy}{dx}(x \log x) + y = 2 \log x$ is given by

(a) $\log \log x$

(b) x

(c) e^x

(d) $\log x$

114. For solving $\frac{dy}{dx} = (4x + y + 1)$, suitable substitution is

(a) $y = Vx$

(b) $y + 4x + 1 = V$

(c) $y = 4x + V$

(d) $y = 4x + V^2$

115. For a given data, the line of regression y on x is $y = 0 \cdot 4 + 1 \cdot 3x$ and x on y is $x = -0 \cdot 1 + 0 \cdot 7y$. Find $\bar{x}$ and $\bar{y}$.

(a) $0 \cdot 4, -0 \cdot 1$

(b) 3, 2

(c) 2, 3

(d) 3, 3

116. Let $X_1, X_2, \cdots, X_n$ be a random sample from exponential distribution with p.d.f.

$$f(x, \theta) = \frac{1}{\theta}\exp[-x/\theta], \quad x \geq 0, \theta \geq 0$$

The maximum likelihood estimator for θ is

(a) $\frac{1}{\overline{X}}$

(b) $(X_1 X_2 \cdots X_n)^{-1/n}$

(c) $\frac{\Sigma X_i}{n}$

(d) $(X_1 X_2 \cdots X_n)^{1/n}$

117. An Olympic diver of mass m begins his descent from a 10 metres high diving board with zero initial velocity. Calculate the velocity on impact with water.

(a) 14 m/s

(b) 28 m/s

(c) 9·8 m/s

(d) $\sqrt{20}$ m/s

118. Two coins are available, one unbiased and the other two-headed. Choose a coin at random and toss it once; assume that the unbiased coin is chosen with probability $\frac{3}{4}$. Given that the result is head, find the probability that the two-headed coin was chosen.

(a) $\frac{1}{5}$

(b) $\frac{2}{5}$

(c) $\frac{3}{8}$

(d) $\frac{3}{16}$

119. The maximum value of $z = 6x + 8y$ subject to constraints $2x + y \leq 30$, $x + 2y \leq 24$ and $x \geq 0$, $y \geq 0$ is

(a) 80

(b) 112

(c) 180

(d) 120

120. A particle executes random walk on a set of integers. Starting from origin, it takes a right step with probability p and a left step with probability $q = 1 - p$. Steps are independent and each step is of unit length. The probability that after 200 steps, particle is at 75 is

(a) p^{75}

(b) $p^{75}q^{125}$

(c) $\binom{200}{75}p^{75}q^{125}$

(d) 0