UPSC: NDA & NA Exam (II), 2013
Held on: 11th, August

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : B–OEBB–M–NBS

Test Booklet Series

Serial No.

045256

D

TEST BOOKLET

MATHEMATICS

Time Allowed : Two Hours and Thirty Minutes

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/ discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item is printed both in **Hindi** and **English**. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. ***All*** items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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ध्यान दें : अनुदेशों का हिन्दी रूपान्तर इस पुस्तिका के पिछले पृष्ठ पर छपा है।

1. What is the seventh term of the sequence 0, 3, 8, 15, 24, ···?

(a) 63

(b) 48

(c) 35

(d) 33

2. What is $\tan 15^\circ$ equal to?

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

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

(c) $1-\sqrt{3}$

(d) $1+\sqrt{3}$

3. Consider the following :

1. $\tan\left(\frac{\pi}{6}\right)$
2. $\tan\left(\frac{3\pi}{4}\right)$
3. $\tan\left(\frac{5\pi}{4}\right)$
4. $\tan\left(\frac{2\pi}{3}\right)$

What is the correct order?

(a) $1<4<2<3$

(b) $4<2<1<3$

(c) $4<2<3<1$

(d) $1<4<3<2$

4. If $\cos x = \frac{1}{3}$, then what is

$$\sin x \cdot \cot x \cdot \operatorname{cosec} x \cdot \tan x$$

equal to?

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

(c) 2 (d) 1

5. What is $\log_{81} 243$ equal to?

(a) 0·75

(b) 1·25

(c) 1·5

(d) 3

6. If the three vertices of the parallelogram $ABCD$ are $A(1, a)$, $B(3, a)$, $C(2, b)$, then D is equal to

(a) $(3, b)$

(b) $(6, b)$

(c) $(4, b)$

(d) $(5, b)$

7. The value of k for which the lines $2x+3y+a=0$ and $5x+ky+a=0$ represent family of parallel lines is

(a) 3

(b) 4·5

(c) 7·5

(d) 15

8. What is the equation of the line which passes through $(4, -5)$ and is perpendicular to $3x+4y+5=0$?

(a) $4x-3y-31=0$

(b) $3x-4y-41=0$

(c) $4x+3y-1=0$

(d) $3x+4y+8=0$

9. The foci of the hyperbola

$$4x^2 - 9y^2 - 1 = 0$$

are

(a) $(\pm\sqrt{13}, 0)$

(b) $\left(\pm\frac{\sqrt{13}}{6}, 0\right)$

(c) $\left(0, \pm\frac{\sqrt{13}}{6}\right)$

(d) None of the above

10. For what value of k are the two straight lines $3x + 4y = 1$ and $4x + 3y + 2k = 0$ equidistant from the point (1, 1)?

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

(b) 2

(c) -2

(d) $-\frac{1}{2}$

11. A point P moves such that its distances from (1, 2) and (-2, 3) are equal. Then the locus of P is

(a) straight line

(b) parabola

(c) ellipse

(d) hyperbola

12. The equation of the locus of a point which is equidistant from the axes is

(a) $y = 2x$

(b) $x = 2y$

(c) $y = \pm x$

(d) $2y + x = 0$

13. What angle does the line segment joining (5, 2) and (6, -15) subtend at (0, 0)?

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

(b) $\frac{\pi}{4}$

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

(d) $\frac{3\pi}{4}$

14. The length of latus rectum of the ellipse $4x^2 + 9y^2 = 36$ is

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

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

(c) 6

(d) 12

15. What is the equation to the straight line passing through (5, -2) and (-4, 7)?

(a) $5x - 2y = 4$

(b) $-4x + 7y = 9$

(c) $x + y = 3$

(d) $x - y = -1$

16. What is $\sin^2 20^\circ + \sin^2 70^\circ$ equal to?

(a) 1

(b) 0

(c) -1

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

17. What is the value of the determinant

$$\begin{vmatrix} 1 & bc & a(b+c) \\ 1 & ca & b(c+a) \\ 1 & ab & c(a+b) \end{vmatrix} ?$$

(a) 0

(b) abc

(c) $ab + bc + ca$

(d) $abc(a + b + c)$

18. Consider the following :

1. $A \cup (B \cap C) = (A \cap B) \cup (A \cap C)$
2. $A \cap (B \cup C) = (A \cup B) \cap (A \cup C)$

Which of the above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

19. Let n be a positive integer and $(1 + x)^n = a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n$

What is $a_0 + a_1 + a_2 + \cdots + a_n$ equal to?

(a) 1

(b) 2^n

(c) 2^{n-1}

(d) 2^{n+1}

20. If α, β are the roots of the equation $ax^2 + bx + b = 0$, then what is the value of $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} + \sqrt{\frac{b}{a}}$?

(a) -1

(b) 0

(c) 1

(d) 2

21. A number in binary system is 110001. It is equal to which one of the following numbers in decimal system?

(a) 45

(b) 46

(c) 48

(d) 49

22. The roots of the equation

$$x^2 - 8x + 16 = 0$$

(a) are imaginary

(b) are distinct and real

(c) are equal and real

(d) cannot be ascertained

23. What is $\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{1}{3}\right)$ equal to?

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

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

24. What is $(1-\sin^2\theta)(1+\tan^2\theta)$ equal to?

(a) $\sin^2\theta$

(b) $\cos^2\theta$

(c) $\tan^2\theta$

(d) 1

25. How many terms are there in the expansion of $(1+2x+x^2)^{10}$?

(a) 11 (b) 20

(c) 21 (d) 30

26. The sum of the first five terms and the sum of the first ten terms of an AP are same. Which one of the following is the correct statement?

(a) The first term must be negative

(b) The common difference must be negative

(c) Either the first term or the common difference is negative but not both

(d) Both the first term and the common difference are negative

27. If $A = \{1, 3, 5, 7\}$, then what is the cardinality of the power set $P(A)$?

(a) 8

(b) 15

(c) 16

(d) 17

28. What is the difference in the roots of the equation $x^2 - 10x + 9 = 0$?

(a) 2

(b) 3

(c) 5

(d) 8

29. If $8x - 9y = 20$ and $7x - 10y = 9$, then what is $2x - y$ equal to?

(a) 10

(b) 11

(c) 12

(d) 13

30. The quadratic equation

$$x^2 + bx + 4 = 0$$

will have real roots if

(a) $b \leq -4$ only

(b) $b \geq 4$ only

(c) $-4 < b < 4$

(d) $b \leq -4$, $b \geq 4$

31. What is the positive square root of $7+4\sqrt{3}$?

(a) $\sqrt{3}-1$

(b) $\sqrt{3}+1$

(c) $\sqrt{3}-2$

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

32. If $A=\{1, 2\}$, $B=\{2, 3\}$ and $C=\{3, 4\}$, then what is the cardinality of $(A\times B)\cap(A\times C)$?

(a) 8

(b) 6

(c) 2

(d) 1

33. If α, β are the roots of the equation $x^2+x+2=0$, then what is

$$\frac{\alpha^{10}+\beta^{10}}{\alpha^{-10}+\beta^{-10}}$$

equal to?

(a) 4096

(b) 2048

(c) 1024

(d) 512

34. If a and b are rational and b is not perfect square, then the quadratic equation with rational coefficients whose one root is $3a+\sqrt{b}$ is

(a) $x^2-6ax+9a^2-b=0$

(b) $3ax^2+x-\sqrt{b}=0$

(c) $x^2+3ax+\sqrt{b}=0$

(d) $\sqrt{b}x^2+x-3a=0$

35. If A is a finite set having n elements, then the number of relations which can be defined in A is

(a) 2^n

(b) n^2

(c) 2^{n^2}

(d) n^n

36. If the positive integers a, b, c, d are in AP, then the numbers abc, abd, acd, bcd are in

(a) HP

(b) AP

(c) GP

(d) None of the above

37. Which one of the following is an example of non-empty set?

(a) Set of all even prime numbers

(b) $\{x : x^2-2=0$ and x is rational$\}$

(c) $\{x : x$ is a natural number, $x<8$ and simultaneously $x>12\}$

(d) $\{x : x$ is a point common to any two parallel lines$\}$

38. What is one of the square roots of $3+4i$, where $i=\sqrt{-1}$?

(a) $2+i$

(b) $2-i$

(c) $-2+i$

(d) $-3-i$

39. The number 83 is written in the binary system as

(a) 100110

(b) 101101

(c) 1010011

(d) 110110

40. The relation R in the set Z of integers given by $R = \{(a, b) : a - b \text{ is divisible by } 5\}$ is

(a) reflexive

(b) reflexive but not symmetric

(c) symmetric and transitive

(d) an equivalence relation

41. What is $\sum_{r=0}^{n} C(n, r)$ equal to?

(a) $2^n - 1$

(b) n

(c) $n!$

(d) 2^n

42. What is $0{\cdot}9 + 0{\cdot}09 + 0{\cdot}009 + \cdots$ equal to?

(a) 1

(b) 1·01

(c) 1·001

(d) 1·1

43. How many real roots does the quadratic equation

$$f(x) = x^2 + 3|x| + 2 = 0$$

have?

(a) One

(b) Two

(c) Four

(d) No real root

44. In a group of 50 people, two tests were conducted, one for diabetes and one for blood pressure. 30 people were diagnosed with diabetes and 40 people were diagnosed with high blood pressure. What is the minimum number of people who were having diabetes and high blood pressure?

(a) 0

(b) 10

(c) 20

(d) 30

45. Consider the following statements :

1. The product of two non-zero matrices can never be identity matrix.
2. The product of two non-zero matrices can never be zero matrix.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

46. What is the area of the parabola $x^2 = y$ bounded by the line $y = 1$?

(a) $\frac{1}{3}$ square unit

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

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

(d) 2 square units

47. What is the area bounded by $y = \tan x$, $y = 0$ and $x = \frac{\pi}{4}$?

(a) ln 2 square units

(b) $\frac{\ln 2}{2}$ square units

(c) 2(ln 2) square units

(d) None of the above

48. What is $\int (x\cos x + \sin x)\,dx$ equal to?

(a) $x\sin x + c$

(b) $x\cos x + c$

(c) $-x\sin x + c$

(d) $-x\cos x + c$

where c is an arbitrary constant.

49. What is $\int_0^2 e^{\ln x}dx$ equal to?

(a) 1

(b) 2

(c) 4

(d) None of the above

50. If the angle between the vectors $\hat{i} - m\hat{j}$ and $\hat{j} + \hat{k}$ is $\frac{\pi}{3}$, then what is the value of m?

(a) 0

(b) 2

(c) −2

(d) None of the above

51. What is the vector perpendicular to both the vectors $\hat{i} - \hat{j}$ and $\hat{i}$?

(a) $\hat{i}$

(b) $-\hat{j}$

(c) $\hat{j}$

(d) $\hat{k}$

52. The position vectors of the points A and B are respectively $3\hat{i} - 5\hat{j} + 2\hat{k}$ and $\hat{i} + \hat{j} - \hat{k}$. What is the length of AB?

(a) 11

(b) 9

(c) 7

(d) 6

53. The vectors $\hat{i} - 2x\hat{j} - 3y\hat{k}$ and $\hat{i} + 3x\hat{j} + 2y\hat{k}$ are orthogonal to each other. Then the locus of the point (x, y) is

(a) hyperbola

(b) ellipse

(c) parabola

(d) circle

54. What is the value of p for which the vector $p(2\hat{i} - \hat{j} + 2\hat{k})$ is of 3 units length?

(a) 1

(b) 2

(c) 3

(d) 6

55. If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are three vectors such that $\vec{a} + t\vec{b}$ is perpendicular to $\vec{c}$, then what is t equal to?

(a) 8 (b) 6

(c) 4 (d) 2

56. The mean of 20 observations is 15. On checking, it was found that two observations were wrongly copied as 3 and 6. If wrong observations are replaced by correct values 8 and 4, then the correct mean is

(a) 15

(b) 15·15

(c) 15·35

(d) 16

57. The arithmetic mean of the squares of the first n natural numbers is

(a) $\frac{n(n+1)(2n+1)}{6}$

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

(c) $\frac{(n+1)(2n+1)}{6}$

(d) $\frac{(n+1)(2n+1)}{3}$

58. Consider the following statements :

1. Both the regression coefficients have same sign.
2. If one of the regression coefficients is greater than unity, the other must be less than unity.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

59. Which one of the following measures is determined only after the construction of cumulative frequency distribution?

(a) Arithmetic mean

(b) Mode

(c) Median

(d) Geometric mean

60. Coefficient of correlation is the measure of

(a) central tendency

(b) dispersion

(c) both central tendency and dispersion

(d) neither central tendency nor dispersion

61. What is $\lim_{x \to 0} \frac{1-\cos x}{x}$ equal to?

(a) 0

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

(c) 1

(d) 2

62. What is $\lim_{x \to 0} \frac{\cos x}{\pi - x}$ equal to?

(a) 0

(b) π

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

(d) 1

63. What is $\lim_{x \to 0} \frac{\sin 2x + 4x}{2x + \sin 4x}$ equal to?

(a) 0

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

(c) 1

(d) 2

64. The maximum value of the function $f(x) = x^3 + 2x^2 - 4x + 6$ exists at

(a) $x = -2$

(b) $x = 1$

(c) $x = 2$

(d) $x = -1$

65. The minimum value of the function $f(x) = |x - 4|$ exists at

(a) $x = 0$ (b) $x = 2$

(c) $x = 4$ (d) $x = -4$

66. What is $\int_1^2 \ln x \, dx$ equal to?

(a) $\ln 2$

(b) 1

(c) $\ln\left(\frac{4}{e}\right)$

(d) $\ln\left(\frac{e}{4}\right)$

67. What is $\int \frac{dx}{\sqrt{4 + x^2}}$ equal to?

(a) $\ln\left|\sqrt{4 + x^2} + x\right| + c$

(b) $\ln\left|\sqrt{4 + x^2} - x\right| + c$

(c) $\sin^{-1}\left(\frac{x}{2}\right) + c$

(d) None of the above

where c is an arbitrary constant.

68. What is the order of the differential equation

$$\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} - \sin^2 y = 0 ?$$

(a) 1

(b) 2

(c) 3

(d) Undefined

69. $y = 2\cos x + 3\sin x$ satisfies which of the following differential equations?

1. $\frac{d^2y}{dx^2} + y = 0$

2. $\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} = 0$

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

70. The differential equation of all circles whose centres are at the origin is

(a) $\frac{dy}{dx} = \frac{y}{x}$

(b) $\frac{dy}{dx} = \frac{x}{y}$

(c) $\frac{dy}{dx} = -\frac{x}{y}$

(d) None of the above

71. What is $\int \sin^2 x\,dx + \int \cos^2 x\,dx$ equal to?

(a) $x + c$

(b) $\frac{x^2}{2} + c$

(c) $x^2 + c$

(d) None of the above

where c is an arbitrary constant.

72. What is $\int e^{e^x} e^x dx$ equal to?

(a) $e^{e^x} + c$

(b) $2e^{e^x} + c$

(c) $e^{e^x} e^x + c$

(d) $2e^{e^x} e^x + c$

where c is an arbitrary constant.

73. What is the area bounded by the lines $x = 0$, $y = 0$ and $x + y + 2 = 0$?

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

(b) 1 square unit

(c) 2 square units

(d) 4 square units

74. What is the derivative of $\sin(\sin x)$?

(a) $\cos(\cos x)$

(b) $\cos(\sin x)$

(c) $\cos(\sin x)\cos x$

(d) $\cos(\cos x)\cos x$

75. What is the derivative of $|x - 1|$ at $x = 2$?

(a) -1

(b) 0

(c) 1

(d) Derivative does not exist

76. If three events A, B, C are mutually exclusive, then which one of the following is correct?

(a) $P(A \cup B \cup C) = 0$

(b) $P(A \cup B \cup C) = 1$

(c) $P(A \cap B \cap C) = 0$

(d) $P(A \cap B \cap C) = 1$

77. What is the variance of the first 11 natural numbers?

(a) 10

(b) 11

(c) 12

(d) 13

78. If A and B are independent events such that $P(A) = \frac{1}{5}$, $P(A \cup B) = \frac{7}{10}$, then what is $P(\overline{B})$ equal to?

(a) $\frac{2}{7}$

(b) $\frac{3}{7}$

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

(d) $\frac{7}{9}$

79. In a binomial distribution, the occurrence and the non-occurrence of an event are equally likely and the mean is 6. The number of trials required is

(a) 15

(b) 12

(c) 10

(d) 6

80. A die is tossed twice. What is the probability of getting a sum of 10?

(a) $\frac{1}{18}$

(b) $\frac{1}{6}$

(c) $\frac{1}{12}$

(d) $\frac{5}{12}$

81. Three dice are thrown. What is the probability of getting a triplet?

(a) $\frac{1}{6}$

(b) $\frac{1}{18}$

(c) $\frac{1}{36}$

(d) $\frac{1}{72}$

82. Consider the following statements :

1. If A and B are exhaustive events, then their union is the sample space.
2. If A and B are exhaustive events, then their intersection must be an empty event.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

83. Consider the following statements :

1. The algebraic sum of the deviations of a set of n values from its arithmetic mean is zero.
2. In the case of frequency distribution, mode is the value of the variable which corresponds to maximum frequency.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

84. Which one of the following may be the parameter of a binomial distribution?

(a) $np = 2,\ npq = 4$
(b) $n = 4,\ p = \frac{3}{2}$
(c) $n = 8,\ p = 1$
(d) $np = 10,\ npq = 8$

85. What is the number of outcomes when a coin is tossed and then a die is rolled only in case a head is shown on the coin?

(a) 6
(b) 7
(c) 8
(d) None of the above

86. If $P(A) = \frac{2}{3}$, $P(B) = \frac{2}{5}$ and $P(A \cup B) - P(A \cap B) = \frac{2}{5}$, then what is $P(A \cap B)$ equal to?

(a) $\frac{3}{5}$
(b) $\frac{5}{11}$
(c) $\frac{1}{3}$
(d) None of the above

87. What is the probability that there are 5 Mondays in the month of February 2016?

(a) 0
(b) $\frac{1}{7}$
(c) $\frac{2}{7}$
(d) None of the above

88. Consider the following statements :

1. Pie diagrams are suitable for categorical data.
2. The arc length of a sector of a pie diagram is proportional to the value of the component represented by the sector.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

89. In a relay race, there are six teams *A*, *B*, *C*, *D*, *E* and *F*. What is the probability that *A*, *B*, *C* finish first, second, third respectively?

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

(b) $\frac{1}{12}$

(c) $\frac{1}{60}$

(d) $\frac{1}{120}$

90. The variance of 20 observations is 5. If each observation is multiplied by 2, then what is the new variance of the resulting observations?

(a) 5

(b) 10

(c) 20

(d) 40

91. What is the angle between the lines $x + y = 1$ and $x - y = 1$?

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

(b) $\frac{\pi}{4}$

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

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

92. The axis of the parabola $y^2 + 2x = 0$ is

(a) $x = 0$

(b) $y = 0$

(c) $x = 2$

(d) $y = 2$

93. The radius of the circle

$$x^2 + y^2 + x + c = 0$$

passing through the origin is

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

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

(c) 1

(d) 2

94. The centroid of the triangle with vertices (2, 3), (−2, −5) and (3, 5) is at

(a) (1, 1)

(b) (2, −1)

(c) (1, −1)

(d) (1, 2)

95. The equation of the line, the reciprocals of whose intercepts on the axes are m and n, is given by

(a) $nx + my = mn$

(b) $mx + ny = 1$

(c) $mx + ny = mn$

(d) $mx - ny = 1$

96. If θ is the acute angle between the diagonals of a cube, then which one of the following is correct?

(a) $\theta = 30°$

(b) $\theta = 45°$

(c) $2\cos\theta = 1$

(d) $3\cos\theta = 1$

97. What is the equation of the sphere with unit radius having centre at the origin?

(a) $x^2 + y^2 + z^2 = 0$

(b) $x^2 + y^2 + z^2 = 1$

(c) $x^2 + y^2 + z^2 = 2$

(d) $x^2 + y^2 + z^2 = 3$

98. What is the sum of the squares of direction cosines of x-axis?

(a) 0 (b) $\frac{1}{3}$

(c) 1 (d) 3

99. What is the distance of the line $2x + y + 2z = 3$ from the origin?

(a) 1 unit

(b) 1·5 units

(c) 2 units

(d) 2·5 units

100. If the projections of a straight line segment on the coordinate axes are 2, 3, 6, then the length of the segment is

(a) 5 units

(b) 7 units

(c) 11 units

(d) 49 units

101. Consider the following functions :

1. $f(x) = e^x$, where $x > 0$
2. $g(x) = |x - 3|$

Which of the above functions is/are continuous?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

102. What is the derivative of x^3 with respect to x^2 ?

(a) $3x^2$

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

(c) x

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

103. What is $\lim_{x \to 2} \frac{2-x}{x^3-8}$ equal to?

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

(b) $-\frac{1}{8}$

(c) $\frac{1}{12}$

(d) $-\frac{1}{12}$

104. A function $f : \mathbb{R} \to \mathbb{R}$ is defined as $f(x) = x^2$ for $x \geq 0$ and $f(x) = -x$ for $x < 0$.

Consider the following statements in respect of the above function :

1. The function is continuous at $x = 0$.
2. The function is differentiable at $x = 0$.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

105. If $f(x) = 2x^2 + 3x - 5$, then what is $f'(0) + 3f'(-1)$ equal to?

(a) -1

(b) 0

(c) 1

(d) 2

106. Consider the following statements :

1. The matrix

$$\begin{pmatrix} 1 & 2 & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$$

is singular.

2. The matrix

$$\begin{pmatrix} c & 2c & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$$

is non-singular.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

107. The cofactor of the element 4 in the determinant

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 5 & 8 & 9 \end{vmatrix}$$

is

(a) 2

(b) 4

(c) 6

(d) -6

108. If A is a square matrix of order 3 with $|A| \neq 0$, then which one of the following is correct?

(a) $|\text{adj}\, A| = |A|$

(b) $|\text{adj}\, A| = |A|^2$

(c) $|\text{adj}\, A| = |A|^3$

(d) $|\text{adj}\, A|^2 = |A|$

109. Let $A = \{a, b, c, d\}$ and $B = \{x, y, z\}$. What is the number of elements in $A \times B$?

(a) 6 (b) 7

(c) 12 (d) 64

110. If $C(28, 2r) = C(28, 2r - 4)$, then what is r equal to?

(a) 7

(b) 8

(c) 12

(d) 16

111. If A is a subset of B, then which one of the following is correct?

(a) $A^c \subseteq B^c$

(b) $B^c \subseteq A^c$

(c) $A^c = B^c$

(d) $A \subseteq A \cap B$

112. If

$$A = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}, \quad B = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}, \quad C = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$$

where $i = \sqrt{-1}$, then which one of the following is correct?

(a) $AB = -C$

(b) $AB = C$

(c) $A^2 = B^2 = C^2 = I$, where I is the identity matrix

(d) $BA \neq C$

113. Let f be a function from the set of natural numbers to the set of even natural numbers given by $f(x) = 2x$. Then f is

(a) one to one but not onto

(b) onto but not one-one

(c) both one-one and onto

(d) neither one-one nor onto

114. If $2A = \begin{pmatrix} 2 & 1 \\ 3 & 2 \end{pmatrix}$, then what is A^{-1} equal to?

(a) $\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$

(b) $\frac{1}{2}\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$

(c) $\frac{1}{4}\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$

(d) None of the above

115. If

$$\begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix} \times \begin{pmatrix} 5 & -2 \\ -3 & 1 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 17 & \lambda \end{pmatrix}$$

then what is λ equal to?

(a) 7 (b) −7

(c) 9 (d) −9

116. What is the angle (in circular measure) between the hour hand and the minute hand of a clock when the time is half past 4?

(a) $\frac{\pi}{3}$

(b) $\frac{\pi}{4}$

(c) $\frac{\pi}{6}$

(d) None of the above

117. The angles of elevation of the top of a tower from two places situated at distances 21 m and x m from the base of the tower are 45° and 60° respectively. What is the value of x?

(a) $7\sqrt{3}$

(b) $7-\sqrt{3}$

(c) $7+\sqrt{3}$

(d) 14

118. What is $\frac{\cot 54^\circ}{\tan 36^\circ} + \frac{\tan 20^\circ}{\cot 70^\circ}$ equal to?

(a) 0

(b) 1

(c) 2

(d) 3

119. A person standing on the bank of a river observes that the angle subtended by a tree on the opposite of bank is 60°. When he retires 40 m from the bank, he finds the angle to be 30°. What is the breadth of the river?

(a) 60 m

(b) 40 m

(c) 30 m

(d) 20 m

120. If the angles of a triangle are 30° and 45° and the included side is $(\sqrt{3}+1)$, then what is the area of the triangle?

(a) $\frac{\sqrt{3}+1}{2}$

(b) $2(\sqrt{3}+1)$

(c) $\frac{\sqrt{3}+1}{3}$

(d) $\frac{\sqrt{3}-1}{2}$