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परीक्षण पुस्तिका अनुक्रम

क्रम संख्या

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परीक्षण पुस्तिका
गणित

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समय : दो घण्टे और तीस मिनट

पूर्णांक : 300

अनुदेश

1. परीक्षा प्रारम्भ होने के तुरन्त बाद, आप इस परीक्षण पुस्तिका की पड़ताल अवश्य कर लें कि इसमें कोई बिना छपा, फटा या छूटा हुआ पृष्ठ अथवा प्रश्नांश आदि न हो। यदि ऐसा है, तो इसे सही परीक्षण पुस्तिका से बदल लें।
2. कृपया ध्यान रखें कि OMR उत्तर-पत्रक में, उचित स्थान पर, रोल नम्बर और परीक्षण पुस्तिका अनुक्रम A, B, C या D को, ध्यान से एवं बिना किसी चूक या विसंगति के भरने और कूटबद्ध करने की जिम्मेदारी उम्मीदवार की है। किसी भी प्रकार की चूक/विसंगति की स्थिति में उत्तर-पत्रक निरस्त कर दिया जाएगा।
3. इस परीक्षण पुस्तिका पर साथ में दिए गए कोष्ठक में आपको अपना अनुक्रमांक लिखना है। परीक्षण पुस्तिका पर और कुछ न लिखें।
4. इस परीक्षण पुस्तिका में 120 प्रश्नांश (प्रश्न) दिए गए हैं। प्रत्येक प्रश्नांश हिन्दी और अंग्रेजी दोनों में छपा है। प्रत्येक प्रश्नांश में चार प्रत्युत्तर (उत्तर) दिए गए हैं। इनमें से एक प्रत्युत्तर को चुन लें, जिसे आप उत्तर-पत्रक पर अंकित करना चाहते हैं। यदि आपको ऐसा लगे कि एक से अधिक प्रत्युत्तर सही हैं, तो उस प्रत्युत्तर को अंकित करें जो आपको सर्वोत्तम लगे। प्रत्येक प्रश्नांश के लिए केवल एक ही प्रत्युत्तर चुनना है।
5. आपको अपने सभी प्रत्युत्तर अलग से दिए गए उत्तर-पत्रक पर ही अंकित करने हैं। उत्तर-पत्रक में दिए गए निर्देश देखें।
6. सभी प्रश्नांशों के अंक समान हैं।
7. इससे पहले कि आप परीक्षण पुस्तिका के विभिन्न प्रश्नांशों के प्रत्युत्तर उत्तर-पत्रक पर अंकित करना शुरू करें, आपको प्रवेश प्रमाण-पत्र के साथ प्रेषित अनुदेशों के अनुसार कुछ विवरण उत्तर-पत्रक में देने हैं।
8. आप अपने सभी प्रत्युत्तरों को उत्तर-पत्रक में भरने के बाद तथा परीक्षा के समापन पर केवल उत्तर-पत्रक अधीक्षक को सौंप दें। आपको अपने साथ परीक्षण पुस्तिका ले जाने की अनुमति है।
9. कच्चे काम के लिए पत्रक परीक्षण पुस्तिका के अन्त में संलग्न हैं।
10. गलत उत्तरों के लिए दण्ड :
वस्तुनिष्ठ प्रश्न-पत्रों में उम्मीदवार द्वारा दिए गए गलत उत्तरों के लिए दण्ड दिया जाएगा।
 - (i) प्रत्येक प्रश्न के लिए चार वैकल्पिक उत्तर हैं। उम्मीदवार द्वारा प्रत्येक प्रश्न के लिए दिए गए एक गलत उत्तर के लिए प्रश्न हेतु नियत किए गए अंकों का एक-तिहाई दण्ड के रूप में काटा जाएगा।
 - (ii) यदि कोई उम्मीदवार एक से अधिक उत्तर देता है, तो इसे गलत उत्तर माना जाएगा, यद्यपि दिए गए उत्तरों में से एक उत्तर सही होता है, फिर भी उस प्रश्न के लिए उपर्युक्तानुसार ही उसी तरह का दण्ड दिया जाएगा।
 - (iii) यदि उम्मीदवार द्वारा कोई प्रश्न हल नहीं किया जाता है, अर्थात् उम्मीदवार द्वारा उत्तर नहीं दिया जाता है, तो उस प्रश्न के लिए कोई दण्ड नहीं दिया जाएगा।

जब तक आपको यह परीक्षण पुस्तिका खोलने को न कहा जाए तब तक न खोलें

Note : English version of the instructions is printed on the back cover of this Booklet.

1. If $\Delta_1 = \begin{vmatrix} 1 & p & q \\ 1 & q & r \\ 1 & r & p \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} 1 & 1 & 1 \\ q & r & p \\ r & p & q \end{vmatrix}$

where $p \neq q \neq r$, then $\Delta_1 + \Delta_2$ is

- (a) 0
- (b) always positive
- (c) always negative
- (d) positive if p, q, r are positive else negative

2. If $(a-b)(b-c)(c-a) = 2$ and $abc = 6$, then what is the value of

$$\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} ?$$

- (a) 3
- (b) 12
- (c) 14
- (d) 15

3. Under which of the following conditions does the determinant

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} \text{ vanish ?}$$

- 1. $a + b + c = 0$
- 2. $a^3 + b^3 + c^3 = 3abc$
- 3. $a^2 + b^2 + c^2 - ab - bc - ca = 0$

Select the correct answer using the code given below :

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

4. Consider the following in respect of the matrices :

$$A = [m \ n], B = [-n \ -m] \text{ and } C = \begin{bmatrix} m \\ -m \end{bmatrix}$$

- 1. $CA = CB$
- 2. $AC = BC$
- 3. $C(A + B) = CA + CB$

Which of the above statements is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) 2 and 3
- (d) 1 and 2

5. If $A = \begin{bmatrix} 2 \sin \theta & \cos \theta & 0 \\ -2 \cos \theta & \sin \theta & 0 \\ -1 & 1 & 1 \end{bmatrix}$, then

what is $A(\text{adj}A)$ equal to ?

- (a) Null matrix
- (b) $-I$
- (c) I
- (d) $2I$

where I is the identity matrix.

6. For what value of k is the matrix

$$\begin{bmatrix} 2 \cos 2\theta & 2 \cos 2\theta & 6 \\ 1 - 2 \sin^2 \theta & 2 \cos^2 \theta - 1 & 3 \\ k & 2k & 1 \end{bmatrix}$$

singular ?

- (a) 0 only
- (b) 1 only
- (c) 2 only
- (d) Any real value

7. Let A be a non-singular matrix and $B = \text{adj}A$. Which of the following statements is/are correct ?

1. $AB = BA$
2. AB is a scalar matrix
3. AB can be a null matrix

Select the correct answer using the code given below :

- (a) 1 only
- (b) 1 and 2 only
- (c) 2 only
- (d) 1, 2 and 3

8. Consider the following statements in respect of square matrices A and B of same order :

1. If AB is a null matrix, then at least one of A and B is a null matrix.
2. If AB is an identity matrix, then $BA = AB$.

Which of the above statements is/are correct ?

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

9. If A is the identity matrix of order 3 and B is its transpose, then what is the value of the determinant of the matrix $C = A + B$?

- (a) 1
- (b) 2
- (c) 4
- (d) 8

10. Let A and B be non-singular matrices of the same order such that $AB = A$ and $BA = B$. Which of the following statements is/are correct ?

1. $A^2 = A$
2. $AB^2 = A^2B$

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

11. How many terms are there in the

expansion of $\left(1 + \frac{2}{x}\right)^9 \left(1 - \frac{2}{x}\right)^9$?

- (a) 9
- (b) 10
- (c) 19
- (d) 20

12. Consider the following statements in respect of the expansion of $(x + y)^{10}$:

1. Among all the coefficients of the terms, the coefficient of the 6th term has the highest value
2. The coefficient of the 3rd term is equal to coefficient of the 9th term

Which of the above statements is/are correct ?

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

13. If $C(3n, 2n) = C(3n, 2n-7)$, then what is the value of $C(n, n-5)$?

(a) 42

(b) 35

(c) 28

(d) 21

14. What is the value of

$$C(51, 21) - C(51, 22) + C(51, 23) - C(51, 24) + C(51, 25) - C(51, 26) + C(51, 27) - C(51, 28) + C(51, 29) - C(51, 30) ?$$

(a) $C(51, 25)$

(b) $C(51, 27)$

(c) $C(51, 51) - C(51, 0)$

(d) $C(51, 25) - C(51, 27)$

15. How many odd numbers between 300 and 400 are there in which none of the digits is repeated?

(a) 32

(b) 36

(c) 40

(d) 45

16. How many permutations are there of the letters of the word 'TIGER' in which the vowels should not occupy the even positions?

(a) 72

(b) 36

(c) 18

(d) 12

17. Let α and β be the roots of the equation $x^2 + px + q = 0$. If α^3 and β^3 are the roots of the equation $x^2 + mx + n = 0$, then what is the value of $m + n$?

(a) $p^3 + q^3 + pq$

(b) $p^3 + q^3 - pq$

(c) $p^3 + q^3 + 3pq$

(d) $p^3 + q^3 - 3pq$

18. Let α and β be the roots of the equation $x^2 - ax - bx + ab - c = 0$. What is the quadratic equation whose roots are a and b ?

(a) $x^2 - \alpha x - \beta x + \alpha\beta + c = 0$

(b) $x^2 - \alpha x - \beta x + \alpha\beta - c = 0$

(c) $x^2 + \alpha x + \beta x + \alpha\beta + c = 0$

(d) $x^2 + \alpha x + \beta x + \alpha\beta - c = 0$

19. If the roots of the equation $x^2 - ax - bx - cx + bc + ca = 0$ are equal, then which one of the following is correct?

(a) $a + b + c = 0$

(b) $a - b + c = 0$

(c) $a + b - c = 0$

(d) $-a + b + c = 0$

20. Let α and β ($\alpha > \beta$) be the roots of the equation $x^2 - 8x + q = 0$. If $\alpha^2 - \beta^2 = 16$, then what is the value of q ?

- (a) -15
- (b) -10
- (c) 10
- (d) 15

21. What is the maximum value of n such that 5^n divides $(30! + 35!)$, where n is a natural number?

- (a) 4
- (b) 6
- (c) 7
- (d) 8

22. What is the value of $2(2 \times 1) + 3(3 \times 2 \times 1) + 4(4 \times 3 \times 2 \times 1) + 5(5 \times 4 \times 3 \times 2 \times 1) + \dots + 9(9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 2$?

- (a) $11!$
- (b) $10!$
- (c) $10 + 10!$
- (d) $11 + 10!$

23. If $A = \{\{1, 2, 3\}\}$, then how many elements are there in the power set of A ?

- (a) 1
- (b) 2
- (c) 4
- (d) 8

24. If a, b, c are in GP where $a > 0, b > 0, c > 0$, then which of the following are correct?

1. a^2, b^2, c^2 are in GP
2. $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in GP
3. $\sqrt{a}, \sqrt{b}, \sqrt{c}$ are in GP

Select the correct answer using the code given below :

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

25. If $\frac{a+b}{2}, b, \frac{b+c}{2}$ are in HP, then which one of the following is correct?

- (a) a, b, c are in AP
- (b) a, b, c are in GP
- (c) $a + b, b + c, c + a$ are in GP
- (d) $a + b, b + c, c + a$ are in AP

26. What is value of $\cot^2 15^\circ + \tan^2 15^\circ$?

- (a) 12
- (b) 14
- (c) $8\sqrt{3}$
- (d) 4

27. In a triangle ABC ,

$$\sin A - \cos B - \cos C = 0.$$

What is angle B equal to ?

- (a) $\frac{\pi}{6}$
- (b) $\frac{\pi}{4}$
- (c) $\frac{\pi}{3}$
- (d) $\frac{\pi}{2}$

28. If $\alpha + \beta = \frac{\pi}{4}$ and $2\tan\alpha = 1$, then what is $\tan 2\beta$ equal to ?

- (a) $\frac{1}{3}$
- (b) $\frac{2}{3}$
- (c) $\frac{3}{4}$
- (d) $\frac{3}{5}$

29. If $\tan(45^\circ + \theta) = 1 + \sin 2\theta$, where $-\frac{\pi}{4} < \theta < \frac{\pi}{4}$, then what is the value of $\cos 2\theta$?

- (a) 0
- (b) $\frac{1}{2}$
- (c) 1
- (d) 2

30. Let $\sin 2\theta = \cos 3\theta$, where θ is acute angle. What is the value of $1 + 4\sin\theta$?

(given that $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$)

- (a) $\sqrt{3}$
- (b) 2
- (c) $\sqrt{5}$
- (d) 3

31. If $\tan\theta = -\frac{5}{12}$, then what can be the value of $\sin\theta$?

- (a) $\frac{5}{13}$ but cannot be $-\frac{5}{13}$
- (b) $-\frac{5}{13}$ but cannot be $\frac{5}{13}$
- (c) $\frac{5}{13}$ or $-\frac{5}{13}$
- (d) None of the above

32. What is the value of

$$\cos^4 \frac{7\pi}{8} + \cos^4 \frac{5\pi}{8} ?$$

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

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

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

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

33. What is $\sin^2\left(\frac{\pi}{4} + \theta\right) - \sin^2\left(\frac{\pi}{4} - \theta\right)$ equal to ?

(a) $\sin 2\theta$

(b) $\cos 2\theta$

(c) $2\sin\theta$

(d) $2\cos\theta$

34. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height h . At a point on the plane the angles of elevation of the bottom and top of the flagstaff are θ and 2θ respectively. What is the height of the tower ?

(a) $h\cos\theta$

(b) $h\sin\theta$

(c) $h\cos 2\theta$

(d) $h\sin 2\theta$

35. The shadow of a tower becomes x metre longer, when the angle of elevation of sun changes from 60° to θ . If the height of the tower is $\sqrt{3}x$ metre, then which one of the following is correct ?

(a) $0 < \theta < 30^\circ$

(b) $30^\circ < \theta < 45^\circ$

(c) $45^\circ < \theta < 60^\circ$

(d) $60^\circ < \theta < 90^\circ$

36. If $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{x}{3}\right) = \frac{\pi}{4}$, where $0 < x < 6$, then what is x equal to ?

(a) 1

(b) 2

(c) 3

(d) 5

37. If $3\sin^{-1}x + \cos^{-1}x = \pi$, then what is x equal to ?

(a) 0

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

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

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

38. If $\tan\alpha + \tan\beta = 1 - \tan\alpha.\tan\beta$, where $\tan\alpha.\tan\beta \neq 1$, then which of the following is one of the values of $(\alpha + \beta)$?

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

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

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

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

39. If $(1 + \tan\theta)(1 + \tan9\theta) = 2$, then what is the value of $\tan(10\theta)$?

(a) 0

(b) 1

(c) 2

(d) Infinite

40. What is the value of $\sin 0^\circ + \sin 10^\circ + \sin 20^\circ + \sin 30^\circ + \dots + \sin 360^\circ$?

(a) -1

(b) 0

(c) 1

(d) 2

41. Consider all the subsets of the set $A = \{1, 2, 3, 4\}$. How many of them are supersets of the set $\{4\}$?

(a) 6

(b) 7

(c) 8

(d) 9

42. Consider the following statements in respect of two non-empty sets A and B :

1. $x \notin (A \cup B) \Rightarrow x \notin A$ or $x \notin B$

2. $x \notin (A \cap B) \Rightarrow x \notin A$ and $x \notin B$

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

43. Consider the following statements in respect of two non-empty sets A and B :

1. $A \cup B = A \cap B$ iff $A = B$

2. $A \Delta B = \emptyset$ iff $A = B$

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

44. Consider the following statements in respect of the relation R in the set \mathbb{N} of natural numbers defined by xRy if $x^2 - 5xy + 4y^2 = 0$:

1. R is reflexive
2. R is symmetric
3. R is transitive

Which of the above statements is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) 1 and 2 only
- (d) 1, 2 and 3

45. Consider the following statements in respect of any relation R on a set A :

1. If R is reflexive, then R^{-1} is also reflexive
2. If R is symmetric, then R^{-1} is also symmetric
3. If R is transitive, then R^{-1} is also transitive

Which of the above statements are correct ?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

46. What is the principal argument of $\frac{1}{1+i}$ where $i = \sqrt{-1}$?

- (a) $-\frac{3\pi}{4}$
- (b) $-\frac{\pi}{4}$
- (c) $\frac{\pi}{4}$
- (d) $\frac{3\pi}{4}$

47. What is the modulus of

$$\left(\frac{\sqrt{-3}}{2} - \frac{1}{2} \right)^{200} ?$$

- (a) $\frac{1}{4}$
- (b) $\frac{1}{2}$
- (c) 1
- (d) 2^{200}

48. Consider the following statements :

1. $\frac{n!}{3!}$ is divisible by 6, where $n > 3$
2. $\frac{n!}{3!} + 3$ is divisible by 7, where $n > 3$

Which of the above statements is/are correct ?

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

49. In how many ways can a team of 5 players be selected out of 9 players so as to exclude two particular players?

- (a) 14
- (b) 21
- (c) 35
- (d) 42

50. In the expansion of $\left(x + \frac{1}{x}\right)^{2n}$, what is the $(n+1)$ th term from the end (when arranged in descending powers of x)?

- (a) $C(2n, n)x$
- (b) $C(2n, n-1)x$
- (c) $C(2n, n)$
- (d) $C(2n, n-1)$

51. If the sum of the first 9 terms of an AP is equal to sum of the first 11 terms, then what is the sum of the first 20 terms?

- (a) 20
- (b) 10
- (c) 2
- (d) 0

52. If the 5th term of an AP is $\frac{1}{10}$ and its 10th term is $\frac{1}{5}$, then what is the sum of first 50 terms?

- (a) 25
- (b) 25.5
- (c) 26
- (d) 26.5

53. What is $(1110011)_2 \div (10111)_2$ equal to?

- (a) $(101)_2$
- (b) $(1001)_2$
- (c) $(111)_2$
- (d) $(1011)_2$

54. If $x^3 + y^3 = (100010111)_2$ and $x + y = (11111)_2$, then what is $(x - y)^2 + xy$ equal to?

- (a) $(1101)_2$
- (b) $(1001)_2$
- (c) $(1011)_2$
- (d) $(1111)_2$

55. Consider the inequations

$5x - 4y + 12 < 0$, $x + y < 2$, $x < 0$ and $y > 0$. Which one of the following points lies in the common region?

- (a) (0, 0)
- (b) (-2, 4)
- (c) (-1, 4)
- (d) (-1, 2)

56. Consider the following statements in respect of the function $y = [x]$, $x \in (-1, 1)$ where $[.]$ is the greatest integer function:

1. Its derivative is 0 at $x = 0.5$
2. It is continuous 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

57. What is the degree of the differential

equation $1 + \left(\frac{dy}{dx}\right)^2 = \left(\frac{d^2y}{dx^2}\right)^{\frac{4}{3}}$?

- (a) $\frac{4}{3}$
- (b) 2
- (c) 3
- (d) 4

58. A radioactive substance decays at a rate proportional to the amount of substance present. If half of the substance decays in 100 years, then what is the decay constant (proportionality constant)?

- (a) $\frac{\ln 2}{100}$
- (b) $\frac{\ln 5}{100}$
- (c) $\frac{\ln 10}{100}$
- (d) $\frac{2 \ln 2}{100}$

59. What is the domain of the function

$f(x) = \sqrt{1 - (x-1)^2}$?

- (a) (0, 1)
- (b) [-1, 1]
- (c) (0, 2)
- (d) [0, 2]

60. The area of the region bounded by the parabola $y^2 = 4kx$, where $k > 0$ and its latus rectum is 24 square units. What is the value of k ?

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

61. What is $\int_0^{\frac{\pi}{4}} \frac{dx}{(\sin x + \cos x)^2}$ equal to ?

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

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

(c) 1

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

62. What is $\int (\sin x)^{-1/2} (\cos x)^{-3/2} dx$ equal to ?

(a) $\sqrt{\tan x} + c$

(b) $2\sqrt{\tan x} + c$

(c) $\sqrt{\cot x} + c$

(d) $\sqrt{2 \tan x} + c$

63. If $I_1 = \int \frac{e^x dx}{e^x + e^{-x}}$ and $I_2 = \int \frac{dx}{e^{2x} + 1}$, then what is $I_1 + I_2$ equal to ?

(a) $\frac{x}{2} + c$

(b) $x + c$

(c) $\ln(e^x + e^{-x}) + c$

(d) $\ln(e^x - e^{-x}) + c$

64. What is $\int_{-2}^{-1} \frac{x}{|x|} dx$ equal to ?

(a) -2

(b) -1

(c) 1

(d) 2

65. How many extreme values does $\sin 4x + 2x$, where $0 < x < \frac{\pi}{2}$ have ?

(a) 1

(b) 2

(c) 4

(d) 8

66. What is the maximum value of the function $f(x) = \frac{1}{\tan x + \cot x}$, where $0 < x < \frac{\pi}{2}$?

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

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

(c) 1

(d) 2

67. If

$$4f(x) - f\left(\frac{1}{x}\right) = \left(2x + \frac{1}{x}\right)\left(2x - \frac{1}{x}\right),$$

then what is $f(2)$ equal to ?

(a) 0

(b) 1

(c) 2

(d) 4

68. If $f(x) = 4x + 3$, then what is $f \circ f \circ f(-1)$ equal to ?

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

69. If $x^y y^x = 1$, then what is $\frac{dy}{dx}$ at (1, 1) equal to ?

- (a) -1
- (b) 0
- (c) 1
- (d) 4

70. If $y = (x^x)^x$, then what is the value of $\frac{dy}{dx}$ at $x = 1$?

- (a) $\frac{1}{2}$
- (b) 1
- (c) 2
- (d) 4

71. Let $y = [x + 1]$, $-4 < x < -3$ where $[.]$ is the greatest integer function. What is the derivative of y with respect to x at $x = -3.5$?

- (a) -4
- (b) -3.5
- (c) -3
- (d) 0

72. If $\frac{dy}{dx} = (\ln 5)y$ with $y(0) = \ln 5$, then what is $y(1)$ equal to ?

- (a) 0
- (b) 5
- (c) $2\ln 5$
- (d) $5\ln 5$

73. Consider the following in respect of the function $f(x) = 10^x$:

1. Its domain is $(-\infty, \infty)$
2. It is a continuous function
3. It is differentiable at $x = 0$

Which of the above statements are correct ?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

74. What is $\lim_{x \rightarrow 0} x^3 (\operatorname{cosec} x)^2$ equal to ?

- (a) 0
- (b) $\frac{1}{2}$
- (c) 1
- (d) Limit does not exist

75. What is $\lim_{x \rightarrow 1} \frac{x^3 - 1}{\sqrt{x} - 1}$ equal to ?

- (a) 0
- (b) 3
- (c) 6
- (d) Limit does not exist

76. In which one of the following intervals is the function $f(x) = \frac{x^3}{3} - \frac{7x^2}{2} + 6x + 5$ decreasing ?

- (a) $(-\infty, 1)$ only
- (b) $(1, 6)$
- (c) $(6, \infty)$ only
- (d) $(-\infty, 1) \cup (6, \infty)$

77. If the derivative of the function $f(x) = \frac{m}{x} + 2nx + 1$ vanishes at $x = 2$, then what is the value of $m + 8n$?

- (a) -2
- (b) 0
- (c) 2
- (d) Cannot be determined due to insufficient data

78. What is the area included in the first quadrant between the curves $y = x$ and $y = x^3$?

- (a) $\frac{1}{8}$ square unit
- (b) $\frac{1}{4}$ square unit
- (c) $\frac{1}{2}$ square unit
- (d) 1 square unit

79. If $xy = 4225$ where x, y are natural numbers, then what is the minimum value of $x + y$?

- (a) 130
- (b) 260
- (c) 2113
- (d) 4226

80. What does the equation $x \frac{dy}{dx} - 2y = 0$ represent ?

- (a) A family of straight lines
- (b) A family of circles
- (c) A family of parabolas
- (d) A family of ellipses

81. If the points with coordinates $(-5, 0)$, $(5p^2, 10p)$ and $(5q^2, 10q)$ are collinear, then what is the value of pq where $p \neq q$?

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

82. What is the equation of the straight line which passes through the point $(1, -2)$ and cuts off equal intercepts from the axes ?

- (a) $x + y - 1 = 0$
- (b) $x - y - 1 = 0$
- (c) $x + y + 1 = 0$
- (d) $x - y - 2 = 0$

83. What is the equation of the circle which touches both the axes in the first quadrant and the line $y - 2 = 0$?

(a) $x^2 + y^2 - 2x - 2y - 1 = 0$

(b) $x^2 + y^2 + 2x + 2y + 1 = 0$

(c) $x^2 + y^2 - 2x - 2y + 1 = 0$

(d) $x^2 + y^2 - 4x - 4y + 4 = 0$

84. What is the equation of the parabola with focus $(-3, 0)$ and directrix $x - 3 = 0$?

(a) $y^2 = 3x$

(b) $x^2 = 12y$

(c) $y^2 = 12x$

(d) $y^2 = -12x$

85. What is the distance between the foci of the ellipse $x^2 + 2y^2 = 1$?

(a) 1

(b) $\sqrt{2}$

(c) 2

(d) $2\sqrt{2}$

86. Let a, b, c be the lengths of sides BC, CA, AB respectively of a triangle ABC . If p is the perimeter and q is the area of the triangle, then what is

$p(p - 2a) \tan\left(\frac{A}{2}\right)$ equal to?

(a) q

(b) $2q$

(c) $3q$

(d) $4q$

87. A straight line passes through the point of intersection of $x + 2y + 2 = 0$ and $2x - 3y - 3 = 0$. It cuts equal intercepts in the fourth quadrant. What is the sum of the absolute values of the intercepts?

(a) 2

(b) 3

(c) 4

(d) 6

88. Under which one of the following conditions are the lines $ax + by + c = 0$ and $bx + ay + c = 0$ parallel ($a \neq 0, b \neq 0$)?

(a) $a - b = 0$ only

(b) $a + b = 0$ only

(c) $a^2 - b^2 = 0$

(d) $ab + 1 = 0$

89. What is the equation of the locus of the mid-point of the line segment obtained by cutting the line $x + y = p$, (where p is a real number) by the coordinate axes ?

(a) $x - y = 0$

(b) $x + y = 0$

(c) $x - y = p$

(d) $x + y = p$

90. If the point (x, y) is equidistant from the points $(2a, 0)$ and $(0, 3a)$ where $a > 0$, then which one of the following is correct ?

(a) $2x - 3y = 0$

(b) $3x - 2y = 0$

(c) $4x - 6y + 5a = 0$

(d) $4x - 6y - 5a = 0$

Consider the following for the next **three (03)** items that follow :

The plane $6x + ky + 3z - 12 = 0$ where $k \neq 0$ meets the coordinate axes at A, B and C respectively. The equation of the sphere passing through the origin and A, B, C is $x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$.

91. What is the value of k ?

(a) 3

(b) 4

(c) 6

(d) 12

92. If p is the perpendicular distance from the centre of the sphere to the plane, then which one of the following is correct ?

(a) $0 < p < 0.5$

(b) $0.5 < p < 1$

(c) $1 < p < 1.5$

(d) $p > 1.5$

93. What is the equation of the line through the origin and the centre of the sphere ?

(a) $x = y = z$

(b) $2x = 3y = 4z$

(c) $6x = 3y = 4z$

(d) $6x = 4y = 3z$

Consider the following for the next **two (02)** items that follow :

Let the plane $\frac{2x}{k} + \frac{2y}{3} + \frac{z}{3} = 2$ pass through the point $(2, 3, -6)$.

94. What are the direction ratios of a normal to the plane ?

(a) $\langle 3, 2, 1 \rangle$

(b) $\langle 2, 3, 6 \rangle$

(c) $\langle 6, 3, 2 \rangle$

(d) $\langle 1, 2, 3 \rangle$

95. If p , q and r are the intercepts made by the plane on the coordinate axes respectively, then what is $(p+q+r)$ equal to ?

- (a) 10
- (b) 11
- (c) 12
- (d) 13

96. If $4\hat{i} + \hat{j} - 3\hat{k}$ and $p\hat{i} + q\hat{j} - 2\hat{k}$ are collinear vectors, then what are the possible values of p and q respectively ?

- (a) 4, 1
- (b) 1, 4
- (c) $\frac{8}{3}, \frac{2}{3}$
- (d) $\frac{2}{3}, \frac{8}{3}$

97. If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of the vertices A, B, C respectively of a triangle ABC and G is the centroid of the triangle, then what is \vec{AG} equal to ?

- (a) $\frac{\vec{a} + \vec{b} + \vec{c}}{3}$
- (b) $\frac{2\vec{a} - \vec{b} - \vec{c}}{3}$
- (c) $\frac{\vec{b} + \vec{c} - 2\vec{a}}{3}$
- (d) $\frac{\vec{a} - 2\vec{b} - 2\vec{c}}{3}$

98. Consider the following statements :

1. Dot product over vector addition is distributive
2. Cross product over vector addition is distributive
3. Cross product of vectors is associative

Which of the above statements is/are correct ? :

- (a) 1 only
- (b) 2 only
- (c) 1 and 2 only
- (d) 1, 2 and 3

99. Let $\vec{a}, \vec{b}, \vec{c}$ be three non-zero vectors such that $\vec{a} \times \vec{b} = \vec{c}$. Consider the following statements :

1. \vec{a} is unique if \vec{b} and \vec{c} are given
2. \vec{c} is unique if \vec{a} and \vec{b} are given

Which of the above statements is/are correct ?

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

100. Let \vec{a} and \vec{b} be two unit vectors such that $|\vec{a} - \vec{b}| < 2$. If 2θ is the angle between \vec{a} and \vec{b} , then which one of the following is correct?

- (a) $0 < \sin\theta < 1$ only
- (b) $-\frac{1}{2} < \sin\theta < \frac{1}{2}$ only
- (c) $-1 < \sin\theta < 0$ only
- (d) $-1 < \sin\theta < 1$

101. Two digits out of 1, 2, 3, 4, 5 are chosen at random and multiplied together. What is the probability that the last digit in the product appears as 0?

- (a) $\frac{1}{10}$
- (b) $\frac{1}{5}$
- (c) $\frac{2}{5}$
- (d) $\frac{4}{5}$

102. The frequency curve (assuming uni-modal) corresponding to the data obtained in an experiment is skewed to the left. What conclusion can be drawn from the curve?

- (a) Mean > Median > Mode
- (b) Mean > Mode > Median
- (c) Median > Mean > Mode
- (d) Mode > Median > Mean

103. The variance of five positive observations is 3.6. If four of the observations are 2, 2, 4, 5 then what is the remaining observation?

- (a) 4
- (b) 5
- (c) 7
- (d) 9

104. What is the arithmetic mean of 50 terms of an AP with first term 4 and common difference 4?

- (a) 50
- (b) 51
- (c) 100
- (d) 102

105. What is the coefficient of mean deviation of 21, 34, 23, 39, 26, 37, 40, 20, 33, 27 (taken from mean)?

- (a) 0.11
- (b) 0.22
- (c) 0.33
- (d) 0.44

Consider the following for the next **three (03)** items that follow :

The algebraic sum of the deviations of a set of values $x_1, x_2, x_3, \dots x_n$ measured from 100 is -20 and the algebraic sum of the deviations of the same set of values measured from 92 is 140.

106. What is the mean of the values ?

- (a) 91
- (b) 96
- (c) 98
- (d) 99

107. What is the algebraic sum of the deviations of the same set of values measured from 99 ?

- (a) 0
- (b) 10
- (c) 20
- (d) 40

108. If the algebraic sum of the deviations of the same set of values measured from y is 180, then what is the value of y ?

- (a) 80
- (b) 85
- (c) 90
- (d) 95

Consider the following data for the next **three (03)** items that follow :

The marks obtained by 51 students in a class are in AP with its first term 4 and common difference 3.

109. What is the mean of the marks ?

- (a) 67
- (b) 71
- (c) 75
- (d) 79

110. What is the median of the marks ?

- (a) 79.5
- (b) 79
- (c) 78.5
- (d) 77

111. What is the sum of the deviations measured from the median ?

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

Consider the following data for the next *three (03)* items that follow :

There are 90 applicants for a job. Some of them are graduates. Some of them have less than three years experience.

	<i>Number of graduates</i>	<i>Number of non-graduates</i>
At least 3 years experience	18	9
Less than 3 years experience	36	27

Let G be the event that the first applicant interviewed is a graduate and T be the event that first applicant interviewed has at least 3 years experience.

112. What is $P(G \cap \bar{T})$ equal to ?

- (a) $\frac{1}{5}$
- (b) $\frac{2}{5}$
- (c) $\frac{3}{5}$
- (d) $\frac{4}{5}$

113. What is $P(G | \bar{T})$ equal to ?

- (a) $\frac{2}{7}$
- (b) $\frac{3}{7}$
- (c) $\frac{4}{7}$
- (d) $\frac{5}{7}$

114. What is $P(\bar{T} | \bar{G})$ equal to ?

- (a) $\frac{1}{4}$
- (b) $\frac{1}{3}$
- (c) $\frac{3}{5}$
- (d) $\frac{3}{4}$

Consider the following data for the next *three (03)* items that follow :

The incidence of suffering from a disease among workers in an industry has a chance of $33\frac{1}{3}\%$.

115. What is the probability that exactly 3 out of 6 workers suffer from a disease ?

- (a) $\frac{80}{729}$
- (b) $\frac{10}{81}$
- (c) $\frac{10}{243}$
- (d) $\frac{160}{729}$

116. What is the probability that no one out of 6 workers suffers from a disease ?

(a) $\frac{665}{729}$

(b) $\frac{64}{729}$

(c) $\frac{4}{243}$

(d) $\frac{1}{729}$

117. What is the probability that at least one out of 6 workers suffer from a disease ?

(a) $\frac{728}{729}$

(b) $\frac{665}{729}$

(c) $\frac{653}{729}$

(d) $\frac{596}{729}$

Consider the following frequency distribution for the next *three (03)* items that follow :

Class	0-20	20-40	40-60	60-80	80-100
Frequency	17	$p + q$	32	$p - 3q$	19

The total frequency is 120. The mean is 50.

118. What is the value of p ?

(a) 25

(b) 26

(c) 27

(d) 28

119. What is the value of q ?

(a) 1

(b) 2

(c) 3

(d) 4

120. If the frequency of each class is doubled, then what would be the mean ?

(a) 25

(b) 50

(c) 75

(d) 100

SPACE FOR ROUGH WORK

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