NDA Paper Sept 2016

1. Let S be a set of all distinct numbers of the form $\dfrac{p}{q}$, where $p,\ q \in \{1,2,3,4,5,6\}$. What is the cardinality of the set S?

    a.   21   b.   23   c.   32   d.   36

2. If $c > 0$ and $4a + c < 2b$, then $ax^2 - bx + c = 0$ has a root in which one of the following intervals?

    a.   (0, 2)   b.   (2, 3)   c.   (3, 4)   d.   (−2, 0)

3. If $A = \{x \in \mathbf{R} : x^2 + 6x - 7 < 0\}$ and $B = \{x \in \mathbf{R} : x^2 + 9x + 14 > 0\}$, then which of the following is/are correct?

    1. $A \cap B = \{x \in \mathbf{R} : -2 < x < 1\}$

    2. $A \setminus B = \{x \in \mathbf{R} : -7 < x < -2\}$

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

4. If A is a square matrix of order 3 and det A = 5, then what is det $[(2A)^{-1}]$ equal to?

    a.   1/10   b.   2/5   c.   8/5   d.   1/40

5. What is $\omega^{100} + \omega^{200} + \omega^{300}$ equal to, where ω is the cube root of unity?

    a.   1   b. 3ω c. $3\omega^2$ d.   0

6. If $\operatorname{Re}\left(\dfrac{z-1}{z+1}\right) = 0$, were $z = x + iy$ is a complex number, then which one of the following is correct?

    a. $z = 1 + i$ b. $|z| = 2$ c. $z = 1 - i$ d. $|z| = 1$

7. What is $\begin{bmatrix} x & y & z \end{bmatrix} \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$ equal to"

    a. $\begin{bmatrix} ax + hy + gz & h + b + f & g + f + c \end{bmatrix}$

    b. $\begin{bmatrix} a & h & g \\ hx & by & fz \\ g & f & c \end{bmatrix}$

    c. $\begin{bmatrix} ax + hy + gz \\ hx + by + fz \\ gx + fy + cz \end{bmatrix}$

    d. $\begin{bmatrix} ax + hy + gz & hx + by + fz & gx + fy + cz \end{bmatrix}$

8. Out of 15 points in a plane, n points are in the same straight line. 445 triangles can be formed by joining these points. What is the value of n?

a.   3   b.   4   c.   5   d.   6

9.   If $z = \left(\dfrac{\sqrt{3}}{2} + \dfrac{i}{2}\right)^{107} + \left(\dfrac{\sqrt{3}}{2} - \dfrac{i}{2}\right)^{107}$, then what is the imaginary part of z equal to?

   a.   0   b. $\dfrac{1}{2}$ c. $\dfrac{\sqrt{3}}{2}$ d.   1

10.   If both the roots of the equation

   $x^2 - 2kx + k^2 - 4 = 0$ lie between -3 and 5, then which one of the following is correct?

   a. $-2 < k < 2$ b. $-5 < k < 3$

   c. $-3 < k < 5$ d. $-1 < k < 3$

11.   What is the number of distinct solutions of the equation $z^2 + |z| = 0$ (where z is a complex number)?

   a.   One   b.   Two   c.   Three   d.   Five

12.   How many geometric progressions is/are possible containing 27, 8 and 12 as three of its/their terms?

   a.   One   b.   Two   c.   Four   d.   Infinitely many

13.   Let R be a relation from $A = \{1, 2, 3, 4\}$ to $B = \{1, 3, 5\}$ such that $R = (a, b): a < b$, where $a \in A$ and $b \in B)$. What is RoR^{-1} equal to?

   a. $\{(1, 3), (1, 5), (2, 3), (2, 5), (3, 5), (4, 5)\}$

   b. $\{(3, 1), (5, 1), (3, 2), (5, 2), (5, 3), (5, 4)\}$

   c. $\{(3, 3), (3, 5), (5, 3), (5, 5)\}$

   d. $\{(3, 3), (3, 4), (4, 5)\}$

14.   A five-digit number divisible by 3 is to be formed using the digits 0, 1, 2, 3 and 4 without repetition of digits. What is the number of ways this can be done?

   a.   96   b.   48

c.   32   d.   No number can be formed

15.   What is $^{47}C_4 + {}^{51}C_3 + \sum\limits_{j=2}^{5} {}^{52-j}C_3$ equal to?

   a. $^{52}C_4$ b. $^{51}C_5$ c. $^{53}C_4$ d. $^{52}C_5$

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

   Let a, x, y, z, b be in AP, where $x + y + z = 15$. Let a, p, q, r, b be in HP, where $p^{-1} + q^{-1} + r^{-1} = 5/3$.

16.   What is the value of ab?

   a.   10   b.   9   c.   8   d.   6

17.   What is the value of xyz?

| | a. | 120 | b. | 105 | c. | 90 | d. | Cannot be determined |

18. What is the value of *pqr*?

| | a. | 35/243 | b. | 81/35 | c. | 243/35 | d. | Cannot be determined |

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

The sixth term of an AP is 2 and its common difference is greater than 1.

19. What is the common difference of the AP so that the product of the first, fourth and fifth terms is greatest?

| | a. | 8/5 | b. | 9/5 | c. | 2 | d. | 11/5 |

20. What is the first term of the AP so that the product of the first, fourth and fifth terms is greatest?

| | a. | –4 | b. | –6 | c. | –8 | d. | –10 |

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

Let $ax^3 + bx^2 + cx + d = \begin{vmatrix} x+1 & 2x & 3x \\ 2x+3 & x+1 & x \\ 2-x & 3x+4 & 5x-1 \end{vmatrix}$, then

21. What is the value of *c*?

| | a. | –1 | b. | 34 | c. | 35 | d. | 50 |

22. What is the value of $a+b+c+d$?

| | a. | 62 | b. | 63 | c. | 65 | d. | 68 |

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

The interior angles of a polygon of n sides are in AP. The smallest angle is 120º and the common difference is 5º.

23. How many possible values can n have?

| | a. | One | b. | Two | c. | Three | d. | Infinitely many |

24. What is the largest interior angle of the polygon?

| | a. | 160º only | | b. | 195º only |

c. Either 160º or 195º   d. Neither 160º nor 195º

25. If $m = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $n = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, then what is the value of the determinant of

$m\cos\theta - n\sin\theta$?

| | a. | –1 | b. | 0 | c. | 1 | d. | 2 |

26. If $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then which of the following are correct?

1. $f(\theta) \times f(\phi) = f(\theta + \phi)$.

2. The value of the determinants of the matrix $f(\theta) \times f(\phi)$ is 1.

3. The determinant of $f(x)$ is an even function.

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

27. Which of the following are correct in respect of the system of equations $x + y + z = 8$, $x - y + 2z = 6$ and $3x - y + 5z = k$?

1. They have no solution, if $k = 15$.

2. They have infinitely many solutions, if $k = 20$.

3. They have unique solution, if $k = 25$.

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

28. If $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ -1 & -2 \end{bmatrix}$, then which of the following is/are correct?

1. $AB(A^{-1}B^{-1})$ is a unit matrix.

2. $(AB)^{-1} = A^{-1}B^{-1}$

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

29. If $x^{ln\left(\frac{y}{z}\right)} \Box y^{ln(xz)^2} \Box z^{ln\left(\frac{x}{y}\right)} = y^{4lny}$ for any $x > 1$, $y > 1$ and $z > 1$, then which one of the following is correct?

a. $ln\ y$ is the GM of $ln\ x$, $ln\ x$, $ln\ x$ and $ln\ z$

b. $ln\ y$ is the AM of $ln\ x$, $ln\ x$, $ln\ x$ and $ln\ z$

c. $ln\ y$ is the HM of $ln\ x$, $ln\ x$, $ln\ x$ and $ln\ z$

d. $ln\ y$ is the AM of $ln\ x$, $ln\ x$, $ln\ z$ and $ln\ z$

30 If the number 235 in decimal system is converted into binary system, then what is the resulting number?

a. $(11110011)_2$ b. $(11101011)_2$

c. $(11110101)_2$ d. $(11011011)_2$

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

Let α and β be the roots of the equation

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

31. Under what condition does the above equation have real roots?

a. $a^2 < \dfrac{1}{2}$ b. $a^2 > \dfrac{1}{2}$ c. $a^2 \leq \dfrac{1}{2}$ d. $a^2 \geq \dfrac{1}{2}$

32. Under what condition is $\dfrac{1}{\alpha^2} + \dfrac{1}{\beta^2} < 1$?

    a. $a^2 < \dfrac{1}{2}$ b. $a^2 > \dfrac{1}{2}$ c. $a^2 > 1$ d. $a^2 \in \left(\dfrac{1}{3}, \dfrac{1}{2}\right)$ only

33. What is $\sqrt{\dfrac{1+\omega^2}{1+\omega}}$ equal to, where ω is the cube root of unity?

    a. 1   b. ω c. ω^2 d. $i\omega$, where $i = \sqrt{-1}$

34. In an examination, 70% students passed in Physics, 80% students passed in Chemistry, 75% students passed in Mathematics and 85% students passed in Biology, and x% students failed in all the four subjects. What is the minimum value of x?

    a. 10   b. 12   c. 15   d. None of these

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

For the system of linear equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$ and $2x + 3y + \lambda z = \mu$.

35. Under what condition does the above system of equations have infinitely many solutions?

    a. $\lambda = 5$ and $\mu \neq 9$ b. $\lambda = 5$ and $\mu = 9$

    c. $\lambda = 9$ and $\mu = 5$ d. $\lambda = 9$ and $\mu \neq 5$

36. Under what condition does the above system of equations have unique solutions?

    a. $\lambda = 5$ and $\mu = 9$ b. $\lambda \neq 5$ and $\mu = 7$ only

    c. $\lambda \neq 5$ and μ has any real value   d. λ has any real value and $\mu \neq 9$

37. What is the number of odd integers between 1000 and 9999 with no digit repeated?

    a. 2100   b. 2120   c. 2240   d. 3331

38. What is the greatest value of the positive integer n satisfying the condition

$$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots + \frac{1}{2^{n-1}} < 2 - \frac{1}{1000} ?$$

    a. 8   b. 9   c. 10   d. 11

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

$2x^2 + 3x - \alpha = 0$ has roots -2 and β while the equation $x^2 - 3mx + 2m^2 = 0$ has roots positive, where $\alpha > 0$ and $\beta > 0$.

39. What is the value of α?

    a. 1/2   b. 1   c. 2   d. 4

40. If β, 2, $2m$ are in GP, then what is the value of $\beta\sqrt{m}$?

    a. 1   b. 2   c. 4   d. 6

41. $\sin A + 2\sin 2A + \sin 3A$ is equal to which of the following?

1. $4\sin 2A\cos^2\left(\dfrac{A}{2}\right)$

2. $2\sin 2A\left(\sin\dfrac{A}{2} + \cos\dfrac{A}{2}\right)^2$

3. $8\sin A\cos A\cos^2\left(\dfrac{A}{2}\right)$

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

42. If $x = \sin 70° \cdot \sin 50°$ and $y = \cos 60° \cdot \cos 80°$, then what is xy equal to?

a. 1/16   b. 1/8   c. 1/4   d. 1/2

43. If $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 + \sin\theta_4 = 4$, then what is the value of $\cos\theta_1 + \cos\theta_2 + \cos\theta_3 + \cos\theta_4$?

a. 0   b. 1   c. 2   d. 4

44. What is the value of $\left(1+\cos\dfrac{\pi}{8}\right)\left(1+\cos\dfrac{3\pi}{8}\right)\left(1+\cos\dfrac{5\pi}{8}\right)\left(1+\cos\dfrac{7\pi}{8}\right)$?

a. $\dfrac{1}{2}$ b. $\dfrac{1}{2} + \dfrac{1}{2\sqrt{2}}$ c. $\dfrac{1}{2} - \dfrac{1}{2\sqrt{2}}$ d. $\dfrac{1}{8}$

45. If $x\cos\theta + y\sin\theta = z$, then what is the value of $(x\sin\theta - y\cos\theta)^2$?

a. $x^2 + y^2 - z^2$ b. $x^2 - y^2 - z^2$

c. $x^2 - y^2 + z^2$ d. $x^2 + y^2 + z^2$

46. What is the value of $\cos(2\cos^{-1}0.8)$?

a. 0.81   b. 0.56   c. 0.48   d. 0.28

47. The top of a hill when observed from the top and bottom of a building of height h is at angles of elevation p and q respectively. What is the height of the hill?

a. $\dfrac{h\cot q}{\cot q - \cot p}$ b. $\dfrac{h\cot q}{\cot p - \cot q}$

c. $\dfrac{2h\tan p}{\tan p - \tan q}$ d. $\dfrac{2h\tan q}{\tan q - \tan p}$

48. If $\sin 18° = \dfrac{\sqrt{5}-1}{4}$, then what is the value of $\sin 81°$?

a. $\dfrac{\sqrt{3+\sqrt{5}} + \sqrt{5-\sqrt{5}}}{4}$ b. $\dfrac{\sqrt{3+\sqrt{5}} + \sqrt{5+\sqrt{5}}}{4}$

c. $\dfrac{\sqrt{3-\sqrt{5}}+\sqrt{5-\sqrt{5}}}{4}$ 　　　　　 d. $\dfrac{\sqrt{3+\sqrt{5}}-\sqrt{5-\sqrt{5}}}{4}$

49. A moving boat is observed from the top of a cliff of 150 m height. The angle of depression of the boat changes from 60º to 45º in 2 minutes. What is the speed of the boat in metres per hour?

　　a. $\dfrac{4500}{\sqrt{3}}$ 　　　　　 b. $\dfrac{4500(\sqrt{3}-1)}{\sqrt{3}}$

　　c. $4500\sqrt{3}$ 　　　　　 d. $\dfrac{4500(\sqrt{3}+1)}{\sqrt{3}}$

50. What is $\dfrac{1-\tan 2°\cot 62°}{\tan 152°-\cot 88°}$ equal to?

　　a. $\sqrt{3}$ 　　　 b. $-\sqrt{3}$ 　　　 c. $\sqrt{2}-1$ 　　　 d. $1-\sqrt{2}$

51. An equilateral triangle has one vertex at (0, 0) and another at (3, $\sqrt{3}$). What are the coordinates of the third vertex?

　　a. (0, $2\sqrt{3}$) only 　　　　　 b. (3, $-\sqrt{3}$) only

　　c. (0, $2\sqrt{3}$) or (3, $-\sqrt{3}$) 　　　　　 d. Neither (0, $2\sqrt{3}$) nor (3, $-\sqrt{3}$)

52. What is the equation of the right bisector of the line segment joining (1, 1) and (2, 3)?

　　a. $2x+4y-11=0$ 　　　　　 b. $2x-4y-5=0$

　　c. $2x-4y-11=0$ 　　　　　 d. $x-y+1=0$

53. What is the radius of the circle passing through the point (2, 4) and having centre at the intersection of the lines $x-y=4$ and $2x+3y+7=0$?

　　a. 3 units 　　　 b. 5 units 　　　 c. $3\sqrt{3}$ units 　　 d. $5\sqrt{2}$ units

54. What is the equation of the hyperbola having latus rectum and eccentricity 8 and $\dfrac{3}{\sqrt{5}}$ respectively?

　　a. $\dfrac{x^2}{25}-\dfrac{y^2}{20}=1$ 　　　　　 b. $\dfrac{x^2}{40}-\dfrac{y^2}{20}=1$

　　c. $\dfrac{x^2}{40}-\dfrac{y^2}{30}=1$ 　　　　　 d. $\dfrac{x^2}{30}-\dfrac{y^2}{25}=1$

55. If the point (a, a) lies between the lines $|x+y|=2$, then which one of the following is correct?

　　a. $|a|<2$ 　　　 b. $|a|<\sqrt{2}$ 　　　 c. $|a|<1$ 　　　 d. $|a|<\dfrac{1}{\sqrt{2}}$

56. What is the equation of the straight line which passed through the point of intersection of the straight lines $x+2y=5$ and $3x+7y=17$ and is perpendicular to the straight line $3x+4y=10$?

a. $4x+3y+2=0$ b. $4x-y+2=0$

c. $4x-3y-2=0$ d. $4x-3y+2=0$

57. If (a, b) is at unit distance from the line $8x+6y+1=0$, then which of the following conditions are correct?

     1. $3a-4b-4=0$

     2. $8a+6b+11=0$

     3. $8a+6b-9=0$

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

58. If the ellipse $9x^2+16y^2=144$ intersects the line $3x+4y=12$, then what is the length of the chord so formed?

a. 5 units   b. 6 units   c. 8 units   d. 10 units

59. A straight line cuts off an intercept of 2 units on the positive direction of x-axis and passes through the point (–3, 5). What is the foot of the perpendicular drawn from the point (3, 3) on this line?

a. (1, 3)   b. (2, 0)   c. (0, 2)   d. (1, 1)

60. What is the eccentricity of rectangular hyperbola?

a. $\sqrt{2}$ b. $\sqrt{3}$ c. $\sqrt{5}$ d. $\sqrt{6}$

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

Let Q be the image of the point P(–2, 1, –5) in the plane $3x-2y+2z+1=0$.

61. Consider the following:

     1. The coordinates of Q are (4, –3, –1).

     2. PQ is of length more than 8 units.

     3. The point (1, –1, –3) is the mid-point of the line segment PQ and lies on the given plane.

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

62. Consider the following:

     1. The direction ratios of the line segment PQ are < 3, –2, 2 >.

     2. The sum of the squares of direction cosines of the line segment PQ is unity.

Which of the above statements is/are correct?

a. 1 only   b. 2 only

c. Both 1 and 2   d. Neither 1 or 2

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

A line L passes through the point P(5, –6, 7) and is parallel to the planes $x + y + z = 1$ and $2x - y - 2z = 3$.

63. What are the direction ratios of the line of intersection of the given planes?

   a. $< 1, 4, 3 >$ b. $< -1, -4, 3 >$

   c. $< 1, -4, 3 >$ d. $< 1, -4, -3 >$

64. What is the equation of the line L?

   a. $\dfrac{x-5}{-1} = \dfrac{y+6}{4} = \dfrac{z-7}{-3}$ b. $\dfrac{x+5}{-1} = \dfrac{y+6}{4} = \dfrac{z+7}{-3}$

   c. $\dfrac{x-5}{-1} = \dfrac{y+6}{-4} = \dfrac{z-7}{3}$ d. $\dfrac{x-5}{-1} = \dfrac{y+6}{-4} = \dfrac{z-7}{-3}$

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

Let $\vec{a} = \hat{i} + \hat{j}$, $\vec{b} = 3\hat{i} + 4\hat{k}$ and $\vec{b} = \vec{c} + \vec{d}$, where $\vec{c}$ is parallel to $\vec{a}$ and $\vec{d}$ is perpendicular to $\vec{a}$.

65. What is $\vec{c}$ equal to?

   a. $\dfrac{3(\hat{i} + \hat{j})}{2}$ b. $\dfrac{2(\hat{i} + \hat{j})}{3}$ c. $\dfrac{(\hat{i} + \hat{j})}{2}$ d. $\dfrac{(\hat{i} + \hat{j})}{3}$

66. If $\vec{d} = x\hat{i} + y\hat{j} + z\hat{k}$, then which of the following equations is/are correct?

   1. $y - x = 4$

   2. $2z - 3 = 0$

   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

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

Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, and $|\vec{a}| = 10$, $|\vec{b}| = 6$ and $|\vec{c}| = 14$.

67. What is $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ equal to?

   a. -332 b. -166 c. 0 d. 166

68. What is the angle between $\vec{a}$ and $\vec{b}$?

   a. $30°$ b. $45°$ c. $60°$ d. $75°$

69. In a right-angled triangle ABC, if the hypotenuse AB = p, then what is

   $\overrightarrow{AB} \cdot \overrightarrow{AC} + \overrightarrow{BC} \cdot \overrightarrow{BA} + \overrightarrow{CA} \cdot \overrightarrow{CB}$ equal to?

   a. p b. p^2 c. $2p^2$ d. $\dfrac{p^2}{2}$

70. A force $\vec{F} = 3\hat{i} + 2\hat{j} - 4\hat{k}$ is applied at the point $(1, -1, 2)$. What is the moment of the force about the point $(2, -1, 3)$?

    a. $\hat{i} + 4\hat{j} + 4\hat{k}$ b. $2\hat{i} + \hat{j} + 2\hat{k}$

    c. $2\hat{i} - 7\hat{j} - 2\hat{k}$ d. $2\hat{i} + 4\hat{j} - \hat{k}$

71. What is the domain of the function $f(x) = \dfrac{1}{\sqrt{|x| - x}}$?

    a. $(-\infty, 0)$ b. $(0, \infty)$ c. $0 < x < 1$ d. $x > 1$

72. Consider the following in respect of the function $f(x) = \begin{cases} 2 + x, & x \geq 0 \\ 2 - x, & x < 0 \end{cases}$

    1. $\lim\limits_{x \to 1} f(x)$ does not exist

    2. $f(x)$ is differentiable at $x = 0$.

    3. $f(x)$ is continuous at $x = 0$.

    Which of the above statements is/are correct?

    a.   1 only   b.   3 only   c.   2 and 3 only   d.   1 and 3 only

73. Let $f : A \to R$, where $A = R \setminus \{0\}$ is such that $f(x) = \dfrac{x + |x|}{x}$. On which one of the following sets is $f(x)$ continuous?

    a. A b. $B = \{x \in R : x \geq 0\}$

    c. $C = \{x \in R : x \leq 0\}$ d. $D = R$

74. Which of the following statements is correct in respect of the function $f(x) = x^3 \sin x$?

    a.   It has local maximum at $x = 0$.

    b.   It has local minimum at $x = 0$.

    c.   It has neither maximum nor minimum at $x = 0$.

    d.   It has maximum value 1.

75. What is the area bounded by the curves $|y| = 1 - x^2$?

    a.   4/3 square units   b.   8/3 squares units

    c.   4 square units   d.   16/3 square units

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

$$f(x) = \begin{cases} 3x^2 + 12x - 1, & -1 \leq x \leq 2 \\ 37 - x, & 2 < x \leq 3 \end{cases}$$

76. Which of the following statements is/are correct?

    1. $f(x)$ is increasing in the interval $[-1, 2]$.

    2. $f(x)$ is decreasing in the interval $(2, 3]$.

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

77.   Which of the following statements are correct?

    1. $f(x)$ is continuous at $x = 2$.

    2. $f(x)$ attains greatest value at $x = 2$.

    3. $f(x)$ is differentiable at $x = 2$.

    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

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

Let $f(x) = \{|x| - |x-1|\}^2$.

78.   What is $f'(x)$ equal to when $x > 1$?

a.   0   b. $2x-1$ c. $4x-2$ d. $8x-4$

79.   What is $f'(x)$ equal to when $0 < x < 1$?

a.   0   b. $2x-1$ c. $4x-2$ d. $8x-4$

80.   Which of the following equations is/are correct?

    1. $f'(-2) = f(5)$

    2. $f''(-2) + f'''(0.5) + f'''(3) = 4$

    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

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

Let $f(x) = [x]$, where $[\cdot]$ is the greatest integer function and $g(x) = \sin x$ be two real valued functions over $\mathbf{R}$.

81.   Which of the following statements is correct?

a.   Both $f(x)$ and $g(x)$ are continuous at $x = 0$.

b. $f(x)$ is continuous at $x = 0$, but $g(x)$ is not continuous at $x = 0$.

c. $g(x)$ is continuous at $x = 0$, but $f(x)$ is not continuous at $x = 0$.

d.   Both $f(x)$ and $g(x)$ are discontinuous at $x = 0$.

82.   Which one of the following statements is correct?

a. $\lim_{x \to 0} (fog)(x)$ exists   b. $\lim_{x \to 0} (gof)(x)$ exists

c. $\lim_{x \to 0-} (fog)(x) = \lim_{x \to 0-} (gof)(x)$ d. $\lim_{x \to 0+} (fog)(x) = \lim_{x \to 0+} (gof)(x)$

83.   Which of the following statements are correct?

1. $(fof)(x) = f(x)$

2. $(gog)(x) = g(x)$ only when $x = 0$

3. $(go(fog))(x)$ can take only three values

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

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

Let $f(x) = \begin{cases} \dfrac{e^x - 1}{x}, & x > 0 \\ 0, & x = 0 \end{cases}$ be a real valued function.

84.   Which one of the following statements is correct?

         a. $f(x)$ is a strictly decreasing function in $(0, x)$.

         b. $f(x)$ is a strictly increasing function in $(0, x)$.

         c. $f(x)$ is neither increasing nor decreasing in $(0, x)$.

         d. $f(x)$ is not decreasing in $(0, x)$.

85.   Which of the following statements is/are correct?

         1. $f(x)$ is right continuous at $x = 0$.

         2. $f(x)$ is discontinuous at $x = 1$.

         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

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

Consider the parabola $y = x^2 + 7x + 2$ and the straight line $y = 3x - 3$.

86.   What are the coordinates of the point on the parabola which is closest to the straight line?

         a. $(0, 2)$ b. $(-2, -8)$ c. $(-7, 2)$ d. $(1, 10)$

87.   What is the shortest distance from the above point on the parabola to the line?

         a. $\dfrac{\sqrt{10}}{2}$ b. $\dfrac{\sqrt{10}}{5}$ c. $\dfrac{1}{\sqrt{10}}$ d. $\dfrac{\sqrt{5}}{4}$

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

Let $f(x) = \begin{cases} -2, & -3 \leq x \leq 0 \\ x - 2, & 0 < x \leq 3 \end{cases}$ and $g(x) = f(|x|) + |f(x)|$

88.   Which of the following statements is/are correct?

         1. $g(x)$ is differentiable at $x = 0$.

         2. $g(x)$ is differentiable at $x = 2$.

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

89.   What is the value of the differential coefficient of $g(x)$ a $x = -2$?

a. -2 b.   0   c.   1   d.   2

90.   Which of the following statements are correct?

1. $g(x)$ is continuous at $x = 0$.

2. $g(x)$ is continuous at $x = 2$.

3. $g(x)$ is continuous at $x = -1$.

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

91.   Let $f(x)$ be a function such that

$f'\left(\dfrac{1}{x}\right) + x^3 f'(x) = 0$. What is $\displaystyle\int_{-1}^{1} f(x)\, dx$ equal to?

a. $2f(1)$ b.   0   c. $2f(-1)$ d. $4f(1)$

92.   What is $\displaystyle\int \dfrac{x^4 - 1}{x^2\sqrt{x^4 + x^2 + 1}}\, dx$ equal to?

a. $\sqrt{\dfrac{x^4 + x^2 + 1}{x}} + c$ b. $\sqrt{x^4 + 2 - \dfrac{1}{x^2}} + c$

c. $\sqrt{x^2 + \dfrac{1}{x^2} + 1} + c$ d. $\sqrt{\dfrac{x^4 - x^2 + 1}{x}} + c$

93.   What are the degree and order respectively of the differential equation satisfying

$e^{y\sqrt{1-x^2} + x\sqrt{1-y^2}} = ce^x$, (where $c > 0, |x| < 1, |y| < 1$)?

a.   1, 1   b.   1, 2   c.   2, 1   d.   2, 2

94.   What is the curve which passes through the point (1, 1) and whose slope is $\dfrac{2y}{x}$?

a.   Circle   b.   Parabola   c.   Ellipse   d.   Hyperbola

95.   If $x\,dy = y\,dx + y^2 dy$, $y > 0$ and $y(1) = 1$, then what is $y(-3)$ equal to?

a.   3 only   b. -1 only

c.   Both -1 and 3   d.   Neither -1 nor 3

96.   What is the order of the differential equation $\dfrac{dx}{dy} + \displaystyle\int y\,dx = x^3$?

a.   1   b.   2   c.   3   d.   Cannot be determined

97. Which one of the following differential equations represents the family of straight lines which are at unit distance from the origin?

a. $\left(y - x\dfrac{dy}{dx}\right)^2 = 1 - \left(\dfrac{dy}{dx}\right)^2$

b. $\left(y + x\dfrac{dy}{dx}\right)^2 = 1 + \left(\dfrac{dy}{dx}\right)^2$

c. $\left(y - x\dfrac{dy}{dx}\right)^2 = 1 + \left(\dfrac{dy}{dx}\right)^2$

d. $\left(y + x\dfrac{dy}{dx}\right)^2 = 1 - \left(\dfrac{dy}{dx}\right)^2$

98. What is $\int e^{\sin x} \dfrac{x\cos^3 x - \sin x}{\cos^2 x}\, dx$ equal to?

a. $(x + \sec x)e^{\sin x} + c$

b. $(x - \sec x)e^{\sin x} + c$

c. $(x + \tan x)e^{\sin x} + c$

d. $(x - \tan x)e^{\sin x} + c$

99. If $\displaystyle\int_0^{\pi/2} \dfrac{dx}{3\cos x + 5} = k\cot^{-1} 2$, then what is the value of k?

a. 1/4   b. 1/2   c. 1   d. 2

100. What is $\displaystyle\int_1^3 |1 - x^4|\, dx$ equal to?

a. −232/5   b. −116/5   c. 116/5   d. 232/5

101. A special dice with numbers 1, −1, 2, −2, 0 and 3 is thrown thrice. What is the probability that the sum of the numbers occurring on the upper face is zero?

a. 1/72   b. 1/8   c. 7/72   d. 25/216

102. There is 25% chance that is rains on any particular day. What is the probability that there is at least one rainy day within a period of 7 days?

a. $1 - \left(\dfrac{1}{4}\right)^7$ b. $\left(\dfrac{1}{4}\right)^7$ c. $\left(\dfrac{3}{4}\right)^7$ d. $1 - \left(\dfrac{3}{4}\right)^7$

103. A salesman has a 70% chance to sell a product to any customer. The behaviour of successive customers is independent. If two customers A and B enter, what is the probability that the salesman will sell the product to customer A or B?

a. 0.98   b. 0.91   c. 0.70   d. 0.49

104. A student appears for tests I, II and III. The student is considered successful if he passes in tests I, II or I, III or all the three. The probabilities of the student passing in tests I, II and III are m, n and 1/2 respectively. If the probability of the student to be successful is 1/2, then which one of the following is correct?

a. m (1 + n) = 1

b. n (1 + m) = 1

c. m = 1

d. mn = 1

105. Three candidates solve a question. Odds in favour of the correct answer are 5 : 2, 4 : 3 and 3:4 respectively for the three candidates. What is the probability that at least two of them solve the question correctly?

     a.   209/343   b.   134/343   c.   149/343   d.   60/343

106. Consider the following statements:

    1.   The mean and medium are equal in symmetric distribution.

    2.   The range is the difference between the maximum value and the minimum value in the data.

    3.   The sum of the areas of the rectangles in the histogram is equal to the total area bounded by the frequency polygon and the horizontal axis.

    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

107. The scores of 15 students in an examination were recorded as 10, 5, 8, 16, 18, 20, 8, 10, 16, 20, 18, 11, 16, 14 and 12. After calculating the mean, median and mode, an error is found. One of the values is wrongly written as 16 instead of 18. Which of the following measures of central tendency will change?

    a.   Mean and median   b.   Median and mode

    c.   Mode only   d.   Mean and mode

108. For 10 observations on price (x) and supply (y), the following data was obtained:

$\sum x = 130$, $\sum y = 220$, $\sum x^2 = 2288$, $\sum y^2 = 5506$ and $\sum xy = 3467$.

What is the line of regression of *y* on *x*?

    a. $y = 0\cdot91x + 8\cdot74$ b. $y = 1\cdot02x + 8\cdot74$

    c. $y = 1\cdot02x - 7\cdot02$ d. $y = 0\cdot91x - 7\cdot02$

109. In a study of two groups, the following results were obtained:

	Group A	Group B
Sample size	20	25
Sample mean	22	23
Sample standard deviation	10	12

Which of the following statements is correct?

a. Group A is less variable than Group B because Group A's standard deviation is smaller.

b. Group A is less variable than Group B because Group A's sample size is smaller.

c. Group A is less variable than Group B because Group A's sample mean is smaller.

d. Group A is less variable than Group B because Group A's coefficient of variation is smaller.

110. Consider the following statements in respect of class intervals of grouped frequency distribution:

1. Class intervals need not be mutually exclusive.

2. Class intervals should be exhaustive.

3. Class intervals need not be of equal width.

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

111. A medicine is known to be 75% effective to cure a patient. If the medicine is given to 5 patients, what is the probability that at least one patient is cured by this medicine?

a. $\dfrac{1}{1024}$

b. $\dfrac{243}{1024}$

c. $\dfrac{1023}{1024}$

d. $\dfrac{781}{1024}$

112. For two events, A and B, it is given that $P(A) = \dfrac{3}{5}$, $P(B) = \dfrac{3}{10}$ and $P(A \mid B) = \dfrac{2}{3}$. If $\overline{A}$ and $\overline{B}$ are the complementary events of A and B, then what is $P(\overline{A} \mid \overline{B})$ equal to?

a. $\dfrac{3}{7}$

b. $\dfrac{3}{4}$

c. $\dfrac{1}{3}$

d. $\dfrac{4}{7}$

113. A machine has three parts A, B and C, whose chances of being defective are 0.02, 0.10 and 0.05 respectively. The machine stops working if any one of the parts becomes defective. What is the probability that the machine will not stop working?

a. 0.06

b. 0.16

c. 0.84

d. 0.94

114. Three independent events A_1, A_2 and A_3 occur with probabilities $P(A_i) = \dfrac{1}{1+i}$, $i = 1, 2, 3$.

What is the probability that at least one of the three events occurs?

a. $\dfrac{1}{4}$

b. $\dfrac{2}{3}$

c. $\dfrac{3}{4}$

d. $\dfrac{1}{24}$

115. Two variables, x and y, are uncorrelated and have standard deviations σ_x and σ_y respectively. What is the correlation coefficient between $x + y$ and $x - y$?

a. $\dfrac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}$ s

b. $\dfrac{\sigma_x + \sigma_y}{2\sigma_x \sigma_y}$

c. $\dfrac{\sigma_x^2 - \sigma_y^2}{\sigma_x^2 + \sigma_y^2}$

d. $\dfrac{\sigma_y - \sigma_x}{\sigma_x \sigma_y}$

116. A random sample of 20 people is classified in the following table according to their ages:

Age	Frequency
15 - 25	2

25 - 35	4
35 - 45	6
45 - 55	5
55 - 65	3

What is the mean age of this group of people?

    a.   41.0   b.   41.5   c.   42.0   d.   42.5

117.   If the covariance between x and y is variance of x is 25 and variance of y is 144, then what is the correlation coefficient?

    a.   0.4   b.   0.5   c.   0.6   d.   0.7

118.   A coin is tossed three times. Consider the following events:

    A: No head appears

    B: Exactly one head appears

    C: At least two heads appear

Which one of the following is correct?

    a. $(A \cup B) \cap (A \cup C) = B \cup C$ b. $(A \cap B') \cup (A \cap C') = B' \cup C'$

    c. $A \cap (B' \cup C') = A \cup B \cup C$ d. $A \cap (B' \cup C') = B' \cap C'$

119.   In a series of 3 one-day cricket matches between teams A and B of a college, the probability of team A winning or drawing are 1/3 and 1/6 respectively. If a win, loss or draw gives 2, 0 and 1 point respectively, then what is the probability that team A will score 5 points in the series?

    a. $\dfrac{17}{18}$ b. $\dfrac{11}{12}$ c. $\dfrac{1}{12}$ d. $\dfrac{1}{18}$

120.   Let the random variable X follow $B(6, p)$. If $16P(X = 4) = P(X = 2)$, then what is the value of p?

    a. $\dfrac{1}{3}$ b. $\dfrac{1}{4}$ c. $\dfrac{1}{5}$ d. $\dfrac{1}{6}$