NDA II 2016_Mathematics

Total Time: 150

Total Marks: 300.0

Q.No.1: Let S be the set of all distinct numbers of the form $\frac{p}{q}$ 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

Marks:[2.50]

Q.No.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)

Marks:[2.50]

Q.No.3: If A = $\{x \in \boldsymbol{R} : x^2 + 6x - 7 < 0\}$ and B = $\{x \in \boldsymbol{R} : x^2 + 9x + 14 > 0\}$, then which of the following is /are correct?
(I) $A \cap B = \{x \in \boldsymbol{R} : -2 < x < 1\}$
(II) A\B $\{x \in \boldsymbol{R} : -7 < x < -2\}$
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

Marks:[2.50]

Q.No.4: If A is a square matrix of order 3 and det A = 5, then what is det $\left[2(\mathrm{A})^{-1}\right]$ equal to?

A. $\frac{1}{10}$
B. $\frac{2}{5}$
C. $\frac{8}{5}$
D. $\frac{1}{40}$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.6: If $\mathrm{Re}\left(\frac{z-1}{z+1}\right) = 0$, where $z = x + iy$ is a complex number, then which one of the following is correct?

A. $z = 1 + i$
B. $|z| = 2$
C. $z = 1 - i$
D. $|z| = 1$

Marks:[2.50]

Q.No.7: What is [*x y z*] $\begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$ equal to?

A. $[ax + hy + gz \quad h + b + f \quad g + f + c]$

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. $[ax + hy + gz \quad hx + by + fz \quad gx + fy + cz]$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.9: If $z = \left(\frac{\sqrt{3}}{2} + \frac{i}{2}\right)^{107} + \left(\frac{\sqrt{3}}{2} - \frac{i}{2}\right)^{107}$, then what is the imaginary part of z equal to?

A. 0

B. $\frac{1}{2}$

C. $\frac{\sqrt{3}}{2}$

D. 1

Marks:[2.50]

Q.No.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. $-1 < k < 3$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.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. $[(3, 3), (3, 4), (4, 5)]$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.15: What is ${}^{47}C_4 + {}^{51}C_3 + \sum_{j=2}^{5} {}^{52-j}C_3$ equal to?

A. ${}^{52}C_4$

B. ${}^{51}C_5$

C. ${}^{53}C_4$

D. ${}^{52}C_5$

Marks:[2.50]

Q.No.16: Let *a*, *x*, *y*, *z*, *b* be in AP, where *x* + *y* + *z* = 15. Let *a*, *p*, *q*, *r*, *b* be in HP, where $p^{-1} + q^{-1} + r^{-1} = 5/3$.

What is the value of *ab*?

A. 10

B. 9

C. 8

D. 6

Marks:[2.50]

Q.No.17: Let *a*, *x*, *y*, *z*, *b* be in AP, where *x* + *y* + *z* = 15. Let *a*, *p*, *q*, *r*, *b* be in HP, where $p^{-1} + q^{-1} + r^{-1} = 5/3$.

What is the value of *xyz*?

A. 120

B. 105

C. 90

D. Cannot be determined

Marks:[2.50]

Q.No.18: Let *a*, *x*, *y*, *z*, *b* be in AP, where *x* + *y* + *z* = 15. Let *a*, *p*, *q*, *r*, *b* be in HP, where $p^{-1} + q^{-1} + r^{-1} = 5/3$.

What is the value of *pqr*?

A. $\frac{35}{243}$

B. $\frac{81}{35}$

C. $\frac{243}{35}$

D. Cannot be determined

Marks:[2.50]

Q.No.19: The sixth term of an AP is 2 and its common difference is greater than 1.
What is the common difference of the AP so that the product of the first, fourth and the fifth terms isthe greatest?

A. 8/5
B. 9/5
C. 2
D. 11/5

Marks:[2.50]

Q.No.20: The sixth term of an AP is 2 and its common difference is greater than 1.
What is the first term of the AP, so that the product of the first,fourth and the fifth terms is the greatest?

A. –4
B. –6
C. –8
D. –10

Marks:[2.50]

Q.No.21: 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
What is the value of *c*?

A. –1
B. 34
C. 35
D. 50

Marks:[2.50]

Q.No.22: 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

What is the value of *a* + *b* + *c* + *d*?

A. 62

B. 63

C. 65

D. 68

Marks:[2.50]

Q.No.23: The interior angles of a polygon of *n* sides are in AP. The smallest angle is 120° and the common difference is 5°.
How many possible values can *n* have

A. One

B. Two

C. Three

D. Infinitely many

Marks:[2.50]

Q.No.24: The interior angles of a polygon of *n* sides are in AP. The smallest angle is 120° and the common difference is 5°.
What is the largest interior angle of the polygon?

A. 160° only

B. 195° only

C. Either 160° or 195°

D. Neither 160° nor 195°

Marks:[2.50]

Q.No.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* cosθ – *n* sinθ?

A. –1

B. 0

C. 1

D. 2

Marks:[2.50]

Q.No.26: If $f\left(x \right) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then which of the following are correct?

1. $f(\theta) \times f(\phi) = f(\theta + \phi)$.
2. The value of the determinant 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

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.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. $AB\left(A^{-1}B^{-1}\right)$ 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

Marks:[2.50]

Q.No.29: If $x^{\ln\left(\frac{y}{z}\right)} \cdot y^{\ln\,(xz)^2} \cdot z^{\ln\left(\frac{x}{y}\right)} = y^{4\ln\,y}$ 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*

Marks:[2.50]

Q.No.30: If the number 235 in the decimal system is converted into the binary system, then what is the resulting number?

A. $(11110011)_2$

B. $(11101011)_2$

C. $(11110101)_2$

D. $(11011011)_2$

Marks:[2.50]

Q.No.31: Let α and β be the roots of the equation
$x^2 - \left(1 - 2a^2\right)x + \left(1 - 2a^2\right) = 0.$
Under what condition, does the above equation have real roots?

A. $a^2 < \frac{1}{2}$

B. $a^2 > \frac{1}{2}$

C. $a^2 \leq \frac{1}{2}$

D. $a^2 \geq \frac{1}{2}$

Marks:[2.50]

Q.No.32: Let α and β be the roots of the equation
$x^2 - \left(1 - 2a^2\right)x + \left(1 - 2a^2\right) = 0.$
Under what condition is $\frac{1}{\alpha^2} + \frac{1}{\beta^2} < 1$?

A. $a^2 < \frac{1}{2}$

B. $a^2 > \frac{1}{2}$

C. $a^2 > 1$

D. $a^2 \in \left(\frac{1}{3}, \frac{1}{2}\right)$ only

Marks:[2.50]

Q.No.33: What is $\sqrt{\frac{1+\omega^2}{1+\omega}}$ equal to, where ω is the cube root of unity?

A. 1

B. ω

C. ω^2

D. $i\omega, \text{ where } i = \sqrt{-1}$

Marks:[2.50]

Q.No.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 the above

Marks:[2.50]

Q.No.35: For the system of linear equations, $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$ and $2x + 3y + \lambda z = \mu$
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 $\mu \neq 5$

Marks:[2.50]

Q.No.36: For the system of linear equations, $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$ and $2x + 3y + \lambda z = \mu$
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 $\mu \neq 9$

Marks:[2.50]

Q.No.37: What is the number of odd integers between 1000 and 9999 with no

digit repeated?

A. 2100
B. 2120
C. 2240
D. 3331

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.39: $2x^2+3x-\alpha=0$ has roots –2 and β while the equation $x^2-3mx+2m^2=0$ has both the roots positive, where *α* > 0 and *β* > 0. What is the value of *α*?

A. 1/2
B. 1
C. 2
D. 4

Marks:[2.50]

Q.No.40: $2x^2+3x-\alpha=0$ has roots –2 and β while the equation $x^2-3mx+2m^2=0$ has both the roots positive, where α > 0 and β > 0. If β, 2, 2m is in GP, then what is the value of $\beta\sqrt{m}$?

A. 1
B. 2
C. 4
D. 6

Marks:[2.50]

Q.No.41: Sin A + 2 sin 2A + sin 3A is equal to which of the following?

1. $4\ \sin\ 2\mathrm{A}\ \cos^2\left(\frac{\mathrm{A}}{2}\right)$
2. $2\ \sin\ 2\mathrm{A}\left(\sin\frac{\mathrm{A}}{2}+\cos\frac{\mathrm{A}}{2}\right)^2$
3. $8\ \sin\ \mathrm{A}\ \cos\ \mathrm{A}\ \cos^2\ \left(\frac{\mathrm{A}}{2}\right)$

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

Marks:[2.50]

Q.No.42: If x = sin 70° · sin 50° and y = cos 60° · cos 80°, then what is xy equal to?

A. 1/16
B. 1/8
C. 1/4
D. 1/2

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.44: What is the value of $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$?

A. $\frac{1}{2}$
B. $\frac{1}{2}+\frac{1}{2\sqrt{2}}$
C. $\frac{1}{2}-\frac{1}{2\sqrt{2}}$
D. $\frac{1}{8}$

Marks:[2.50]

Q.No.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. $x^2 + y^2 + z^2$

Marks:[2.50]

Q.No.46: What is the value of cos $\left(2\cos^{-1}\ 0\ .8\right)$?

A. 0.81
B. 0.56
C. 0.48
D. 0.28

Marks:[2.50]

Q.No.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. $\frac{h\ \cot\ q}{\cot\ q - \cot\ p}$
B. $\frac{h\ \cot\ p}{\cot\ p - \cot\ q}$
C. $\frac{2h\ \tan\ p}{\tan\ p - \tan\ q}$
D. $\frac{2h\ \tan\ q}{\tan\ q - \tan\ p}$

Marks:[2.50]

Q.No.48: If $\sin\ 18^\circ = \frac{\sqrt{5}-1}{4}$, then what is the value of sin 81°?

A. $\frac{\sqrt{3+\sqrt{5}}+\sqrt{5-\sqrt{5}}}{4}$
B. $\frac{\sqrt{3+\sqrt{5}}+\sqrt{5+\sqrt{5}}}{4}$
C. $\frac{\sqrt{3-\sqrt{5}}+\sqrt{5-\sqrt{5}}}{4}$
D. $\frac{\sqrt{3+\sqrt{5}}-\sqrt{5-\sqrt{5}}}{4}$

Marks:[2.50]

Q.No.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 60° to 45° in 2 minutes. What is the speed of the boat in meter per hour?

A. $\frac{4500}{\sqrt{3}}$
B. $\frac{4500\left(\sqrt{3}-1\right)}{\sqrt{3}}$

C. $4500\sqrt{3}$

D. $\frac{4500\left(\sqrt{3}+1\right)}{\sqrt{3}}$

Marks:[2.50]

Q.No.50: What is $\frac{1-\tan\ 2^{\circ}\cot\ 62^{\circ}}{\tan\ 152^{\circ}-\cot\ 88^{\circ}}$ equal to?

A. $\sqrt{3}$

B. $-\sqrt{3}$

C. $\sqrt{2}-1$

D. $1-\sqrt{2}$

Marks:[2.50]

Q.No.51: An equilateral triangle has one vertex at (0, 0) and another at $\left(3,\sqrt{3}\right)$. What are the coordinates of the third vertex?

A. $\left(0,\ 2\sqrt{3}\right)$ Only

B. $\left(3,-\sqrt{3}\right)$ Only

C. $\left(0,\ 2\sqrt{3}\right)$ or $\left(3,-\sqrt{3}\right)$

D. Neither $\left(0,\ 2\sqrt{3}\right)$ nor $\left(3,-\sqrt{3}\right)$

Marks:[2.50]

Q.No.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. $x-y+1=0$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.54: What is the equation of the hyperbola having latus rectum and eccentricity 8 and $\frac{3}{\sqrt{5}}$ respectively?

A. $\frac{x^2}{25} - \frac{y^2}{20} = 1$

B. $\frac{x^2}{40} - \frac{y^2}{20} = 1$

C. $\frac{x^2}{40} - \frac{y^2}{30} = 1$

D. $\frac{x^2}{30} - \frac{y^2}{25} = 1$

Marks:[2.50]

Q.No.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. $|a| < \frac{1}{\sqrt{2}}$

Marks:[2.50]

Q.No.56: What is the equation of the straight line which passes 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. $4x - 3y + 2 = 0$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.58: If the ellipse $9x^2 + 16y^2 = 144$ intercepts 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

Marks:[2.50]

Q.No.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)

Marks:[2.50]

Q.No.60: What is the eccentricity of rectangular hyperbola?

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $\sqrt{5}$

D. $\sqrt{6}$

Marks:[2.50]

Q.No.61: Let Q be the image of the point P (–2, 1, –5) in the plane $3x - 2y + 2z + 1 = 0$.
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

Marks:[2.50]

Q.No.62: Let Q be the image of the point P (–2, 1, –5) in the plane $3x - 2y + 2z + 1 = 0$.
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 nor 2

Marks:[2.50]

Q.No.63: A line L passes through the point P(5, –6, 7) and is parallel to the planes $x + y + z = 1$ and $2x - y - 2z = 3$.
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 >

Marks:[2.50]

Q.No.64: A line L passes through the point P(5, –6, 7) and is parallel to the planes $x + y + z = 1$ and $2x - y - 2z = 3$.
What is the equation of the line L?

A. $\frac{x-5}{-1} = \frac{y+6}{4} = \frac{z-7}{-3}$

B. $\frac{x+5}{-1} = \frac{y-6}{4} = \frac{z+7}{-3}$

C. $\frac{x-5}{-1} = \frac{y+6}{-4} = \frac{z-7}{3}$

D. $\frac{x-5}{-1} = \frac{y+6}{-4} = \frac{z-7}{-3}$

Marks:[2.50]

Q.No.65: 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 $\vec{a}$.

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

A. $\frac{3\left(\hat{i}+\hat{j}\right)}{2}$

B. $\frac{2\left(\hat{i}+\hat{j}\right)}{3}$

C. $\frac{\left(\hat{i}+\hat{j}\right)}{2}$

D. $\frac{\left(\hat{i}+\hat{j}\right)}{3}$

Marks:[2.50]

Q.No.66: 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 $\vec{a}$.

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

Marks:[2.50]

Q.No.67: Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, and $|\vec{a}| = 10,\ \left|\vec{b}\right| = 6$ and $\left|\vec{c}\right| = 14$.

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

Marks:[2.50]

Q.No.68: Let $\overrightarrow{a}$, $\overrightarrow{b}$ and $\overrightarrow{c}$ be three vectors such that $\overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c} = \overrightarrow{0}$, and $\overrightarrow{|a|} = 10$, $\left|\overrightarrow{b}\right| = 6$ and $\left|\overrightarrow{c}\right| = 14$.

What is the angle between $\overrightarrow{a}$ and $\overrightarrow{b}$?

A. 30°

B. 45°

C. 60°

D. 75°

Marks:[2.50]

Q.No.69: In a right-angled triangle ABC, if the hypotenuse AB = *p*, then what is $\overrightarrow{\mathrm{AB}} \cdot \overrightarrow{\mathrm{AC}} + \overrightarrow{\mathrm{BC}} \cdot \overrightarrow{\mathrm{BA}} + \overrightarrow{\mathrm{CA}} \cdot \overrightarrow{\mathrm{CB}}$ equal to?

A. *p*

B. p^2

C. $2p^2$

D. $\frac{p^2}{2}$

Marks:[2.50]

Q.No.70: A force $\overrightarrow{F} = 3\hat{i} + 2\hat{j} - 4\hat{k}$ 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. $2\hat{i} + 4\hat{j} - \hat{k}$

Marks:[2.50]

Q.No.71: What is the domain of the function $f\left(x\right) = \frac{1}{\sqrt{|x|-x}}$?

A. (–∞, 0)
B. (0, ∞)
C. $0 < x < 1$
D. $x > 1$

Marks:[2.50]

Q.No.72: Consider the following in respect of the function
$f\left(x\right) = \begin{cases} 2+x, & x \geq 0 \\ 2-x, & x < 0 \end{cases}$

1. $\lim_{x \to 1} f\left(x\right)$ does not exist.
2. $f(x)$ is differentiable at $x = 0$.
3. $f(x)$ is continuous at $x = 0$.

Which of the above statement is/are correct?

A. 1 only
B. 3 only
C. 2 and 3 only
D. 1 and 3 only

Marks:[2.50]

Q.No.73: Let f : A → **R** where A = **R**\[0] is such that $f\left(x\right) = \frac{x+|x|}{x}$. On which one of the following sets is $f(x)$ continuous?

A. A
B. B = $\{x \in \mathbf{R} : x \geq 0\}$
C. C = $\{x \in \mathbf{R} : x \leq 0\}$
D. D = **R**

Marks:[2.50]

Q.No.74: Which one of the following statements is correct with respect to the function $f\left(x\right) = x^3 \sin x$?

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.

Marks:[2.50]

Q.No.75: What is the area bounded by the curves $|y| = 1 - x^2$?

A. 4/3 square units

B. 8/3 square units

C. 4 square units

D. 16/3 square units

Marks:[2.50]

Q.No.76: $f(x) = \begin{cases} 3x^2 + 12x - 1, & -1 \leq x \leq 2 \\ 37 - x, & 2 < x \leq 3 \end{cases}$

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

Marks:[2.50]

Q.No.77: $f(x) = \begin{cases} 3x^2 + 12x - 1, & -1 \leq x \leq 2 \\ 37 - x, & 2 < x \leq 3 \end{cases}$

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

Marks:[2.50]

Q.No.78: Let $f(x) = [|x| - |x-1|]^2$.
What is $f'(x)$ equal to when $x > 1$?

A. 0
B. $2x - 1$
C. $4x - 2$
D. $8x - 4$

Marks:[2.50]

Q.No.79: Let $f(x) = [|x| - |x-1|]^2$.
What is $f'(x)$ equal to when $0 < x < 1$?

A. 0
B. $2x - 1$
C. $4x - 2$
D. $8x - 4$

Marks:[2.50]

Q.No.80: Let $f(x) = [|x| - |x-1|]^2$.
Which of the following equations is/are correct?
1. $f(-2) = f(5)$
2. $f''(-2) + f''(0 \cdot 5) + f''(3) = 4$
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

Marks:[2.50]

Q.No.81: Let $f(x) = [x]$, where $[\cdot]$ is the greatest integer function and $g(x) = \sin x$ be two real valued functions over $\mathbb{R}$.
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 $x = 0$.

Marks:[2.50]

Q.No.82: Let $f(x) = [x]$, where $[\cdot]$ is the greatest integer function and $g(x) = \sin x$ be two real valued functions over $\mathbb{R}$.

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

Marks:[2.50]

Q.No.83: Let $f(x) = [x]$, where $[\cdot]$ is the greatest integer function and $g(x) = \sin x$ be two real valued functions over $\mathbb{R}$.
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

Marks:[2.50]

Q.No.84: Let $f(x) = \begin{cases} \frac{e^x-1}{x}, & x > 0 \\ 0, & x = 0 \end{cases}$ be a real valued function.
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 $(0, x)$.

Marks:[2.50]

Q.No.85: Let $f(x) = \begin{cases} \frac{e^x-1}{x}, & x > 0 \\ 0, & x = 0 \end{cases}$ be a real valued function.
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

Marks:[2.50]

Q.No.86: Consider the parabola $y = x^2 + 7x + 2$ and the straight line $y = 3x - 3$.

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)

Marks:[2.50]

Q.No.87: Consider the parabola $y = x^2 + 7x + 2$ and the straight line $y = 3x - 3$.

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

A. $\frac{\sqrt{10}}{2}$

B. $\frac{\sqrt{10}}{5}$

C. $\frac{1}{\sqrt{10}}$

D. $\frac{\sqrt{5}}{4}$

Marks:[2.50]

Q.No.88: Let $f\left(x\right) = \begin{cases} -2, & -3 \le x \le 0 \\ x - 2, & 0 < x \le 3 \end{cases}$ and $g(x) = f\left(|x|\right) + |f\left(x\right)|$

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

Marks:[2.50]

Q.No.89: Let $f\left(x\right) = \begin{cases} -2, & -3 \le x \le 0 \\ x - 2, & 0 < x \le 3 \end{cases}$ and $g(x) = f\left(|x|\right) + |f\left(x\right)|$

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

A. −1

B. 0

C. 1

D. 2

Marks:[2.50]

Q.No.90: Let $f\left(x\right) = \begin{cases} -2, & -3 \leq x \leq 0 \\ x-2, & 0 < x \leq 3 \end{cases}$ and $g(x) = f\left(|x|\right) + |f\left(x\right)|$

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

Marks:[2.50]

Q.No.91: Let $f(x)$ be a function such that $f'\left(\frac{1}{x}\right) + x^3\, f'\left(x\right) = 0$. What is $\int_{-1}^{1} f\left(x\right)\ dx$ equal to?

A. $2f(1)$

B. 0

C. $2f\,(-1)$

D. $4\ f(1)$

Marks:[2.50]

Q.No.92: What is $\int \frac{x^4-1}{x^2\sqrt{x^4+x^2+1}}dx$ equal to?

A. $\sqrt{\frac{x^4+x^2+1}{x}} + C$

B. $\sqrt{x^4+2-\frac{1}{x^2}} + C$

C. $\sqrt{x^2+\frac{1}{x^2}+1} + C$

D. $\sqrt{\frac{x^4-x^2+1}{x}} + C$

Marks:[2.50]

Q.No.93: What is the degree and order, respectively, of the differential equation satisfying $e^{y\sqrt{1-x^2}+x\sqrt{1-y^2}} = ce^x$, $(\text{where } c > 0, |x| < 1, |y| < 1)$?

A. 1, 1
B. 1, 2
C. 2, 1
D. 2, 2

Marks:[2.50]

Q.No.94: What is the curve that passes through the point (1, 1) and whose slope is $\frac{2y}{x}$?

A. Circle
B. Parabola
C. Ellipse
D. Hyperbola

Marks:[2.50]

Q.No.95: If $xdy = ydx + y^2dy$, $y > 0$ 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

Marks:[2.50]

Q.No.96: What is the order of the differential equation $\frac{dx}{dy} + \int y\,dx = x^3$?

A. 1
B. 2
C. 3
D. Cannot be determined

Marks:[2.50]

Q.No.97: Which one of the following differential equations represents the family of straight lines, which are at unit distance from the origin?

A. $\left(y - x\frac{dy}{dx}\right)^2 = 1 - \left(\frac{dy}{dx}\right)^2$
B. $\left(y + x\frac{dy}{dx}\right)^2 = 1 + \left(\frac{dy}{dx}\right)^2$

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

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

Marks:[2.50]

Q.No.98: What is $\int e^{\sin x} \frac{x\cos^3 x - \sin x}{\cos^2 x} dx$ 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. $(x - \tan\ x)\, e^{\sin\ x} + C$

Marks:[2.50]

Q.No.99: If $\int_0^{\pi/2} \frac{dx}{3\ \cos\ x + 5} = k\ \cot^{-1} 2$, then what is the value of *k*?

A. 1/4

B. 1/2

C. 1

D. 2

Marks:[2.50]

Q.No.100: What is $\int_1^3 \left|1 - x^4\right| dx$ equal to?

A. –232/5

B. –116/5

C. 116/5

D. 232/5

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.102: There is 25% chance that it rains on any particular day. What is the

probability that there is at least one rainy day within a period of 7 days?

A. $1-\left(\frac{1}{4}\right)^7$

B. $\left(\frac{1}{4}\right)^7$

C. $\left(\frac{3}{4}\right)^7$

D. $1-\left(\frac{3}{4}\right)^7$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.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. $mn=1$

Marks:[2.50]

Q.No.105: Three candidates solve a question. Odds in favour of the correct answer are 5 : 2, 4 : 3 and 3 : 4 respectively for three candidates. What is the probability that at least two of them solve the question correctly?

A. 134/343

B. 149/343

C. 60/343

D. 209/343

Marks:[2.50]

Q.No.106: Consider the following statements :

1. The mean and median 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

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.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. $y = 0.91x + 8.74$
B. $y = 1.02x + 8.74$
C. $y = 1.02x - 7.02$
D. $y = 0.91x - 7.02$

Marks:[2.50]

Q.No.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.

Marks:[2.50]

Q.No.110: Consider the following statements with respect to the 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

Marks:[2.50]

Q.No.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. $\frac{1}{1024}$

B. $\frac{243}{1024}$

C. $\frac{1023}{1024}$

D. $\frac{781}{1024}$

Marks:[2.50]

Q.No.112: For two events A and B, it is given that P(A) = $\frac{3}{5}$, P(B) = $\frac{3}{10}$ and $\mathrm{P}\left(\mathrm{A}\left|\mathrm{B}\right.\right)=\frac{2}{3}$. If $\overline{\mathrm{A}}$ and $\overline{\mathrm{B}}$ are the complementary events of A and B , then what is $\mathrm{P}\left(\overline{\mathrm{A}}\left|\overline{\mathrm{B}}\right.\right)$ equal to?

A. $\frac{3}{7}$

B. $\frac{3}{4}$

C. $\frac{1}{3}$

D. $\frac{4}{7}$

Marks:[2.50]

Q.No.113: A machine had 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

Marks:[2.50]

Q.No.114: Three independent events, A_1, A_2 and A_3 occur with probabilities $\mathrm{P}\left(\mathrm{A}_i\right)=\frac{1}{1+i},\ \mathrm{i}=1,\ 2,\ 3$. What is the probability that at least one of the three events occurs?

A. $\frac{1}{4}$

B. $\frac{2}{3}$

C. $\frac{3}{4}$

D. $\frac{1}{24}$

Marks:[2.50]

Q.No.115: Two variance, *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. $\frac{\sigma_x \sigma y}{\sigma_x^2+\sigma_y^2}$

B. $\frac{\sigma_x+\sigma_y}{2\sigma_x+\sigma_y}$

C. $\frac{\sigma_x^2-\sigma_y^2}{\sigma_x^2+\sigma_y^2}$

D. $\frac{\sigma_y-\sigma_x}{\sigma_x\sigma_y}$

Marks:[2.50]

Q.No.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

Marks:[2.50]

Q.No.117: If the covariance between *x* and *y* is 30, 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

Marks:[2.50]

Q.No.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. $A \cap (B' \cup C') = B' \cap C'$

Marks:[2.50]

Q.No.119: In a series of 3 one-day cricket matches between terms 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. $\frac{17}{18}$

B. $\frac{11}{12}$

C. $\frac{1}{12}$

D. $\frac{1}{18}$

Marks:[2.50]

Q.No.120: Let the random variable X follow B (6, *p*). If 16 P(X = 4) = P(X = 2), then what is the value of *p*?

A. $\frac{1}{3}$

B. $\frac{1}{4}$

C. $\frac{1}{5}$

D. $\frac{1}{6}$

Marks:[2.50]