

Section 3 – Mathematics

121) If $(-4, 5)$ is the image of the point $(6, 1)$ with respect to the line L , then L is given by

- A) $5x + 2y = 1$
- B) $5x - 2y = 0$
- C) $5x - 2y + 1 = 0$
- D) $2x - 5y + 1 = 0$

122) Evaluate integral of $x^3 / (x^2 + (9-x)^2)$ with limits from 4 to 5. The result is

- A) $1/2$
- B) 0
- C) 1
- D) 2

123) The values of x for which $4^x + 4^{1-x} - 5 < 0$, is given by

- A) $x = 1$
- B) $x = 0, 1$
- C) $x = 0$
- D) $0 < x < 1$

124) Derivative of $\cos^{-1}(2x^2 - 1)$ with respect to $\sqrt{1+2x}$ at $x = 1/2$ is

- A) $4/3$
- B) $\sqrt{6}/5$
- C) $\sqrt{6}/3$
- D) $-4\sqrt{6}/3$

125) If x is one of the first fifty numbers chosen at random, then the probability that $x + 3/x$ is greater than 20 is

- A) $11/50$
- B) $21/50$
- C) $31/50$
- D) $41/50$

126) Which of the following is TRUE about the function $f(x) = x^4 - 4x^2$?

- A) It has two local minima and one local maxima
- B) It has two local minima and zero local maxima
- C) It has one local minima and one local maxima
- D) It has two local minima and two local maxima

127) Which of the following is the range of the function $3(\sin^{-1}x)^2 + 2(\cos^{-1}x)^2 + 7$?

- A) $(3\pi^2 + 70)/10$ to $(11\pi^2 + 28)/4$
- B) $(3\pi^2 + 70)/10$ to $(7\pi^2 + 28)/4$
- C) $(3\pi^2 + 70)/10$ to $(3\pi^2 + 28)/4$
- D) $(11\pi^2 + 70)/10$ to $(11\pi^2 + 28)/4$

128) A function $f(x)$ is differentiable for all $x \in [1, 2]$ such that $|f'(x)| < 2$. Which of the following options can be true?

- A) $f(1) = 9, f(2) = 13$
- B) $f(1) = 4, f(2) = 6$
- C) $f(1) = -3, f(2) = -2$
- D) $f(1) = -7, f(2) = -10$

129) Suppose P, Q and R are three sets, each with three elements. The number of subsets of the set $P \times Q \times R$, that have at least 2 elements is

- A) 134217700
- B) 134217701
- C) 134217727
- D) 134217728

130) z is a complex number such that $\arg(z) < 0$. What will be the value of $\arg(-z) - \arg(z)$?

- A) $\pi/2$
- B) π
- C) 0
- D) $\pi/4$

131) There is a set P of ordered pairs in which each pair has a vowel as first element and a consonant as second element. It is given that $R = 2^{2^5}$. How many elements will be there in power set of P ?

- A) $16(R^4)$
- B) $32(R^4)$
- C) $16(R^5)$
- D) $32(R^5)$

132) You are given a curve, $y = \ln(x + e)$. What will be the area enclosed between this curve and the coordinate axes?

- A) 1
- B) 0
- C) $2e$
- D) $e - 1$

133) The mapping $f: N \rightarrow N$ given by $f(n) = n^2 + 3, n \in N$ where N is the set of natural number, is

- A) One to one and onto
- B) One to one but not onto
- C) Onto but not one to one
- D) Neither one to one nor onto

134) A cubic equation $x^3 + rx - p = 0$ has roots a, b and c. A square matrix $M = [m_{ij}]$, $i, j = 0, 1$ and 2 , of size 3×3 is made such that $m_{00} = a$, $m_{11} = b$ and $m_{22} = c$. All other elements of M are 1 . What should be the least value of p so that $|M|$ is an odd prime?

- A) 0
 B) 1
 C) -1
 D) -2

135) Which term of the sequence $\{9-8i, 8-6i, 7-4i, \dots\}$ is a real number?

- A) 4^{th} term
 B) 5^{th} term
 C) 6^{th} term
 D) 7^{th} term

136) If $y = \tan^{-1}\left(\frac{x-a}{1+ax}\right)$ then $\frac{dy}{dx} =$

- A) $\frac{1}{\sqrt{1+x^2}}$
 B) $\frac{1}{1+x^2}$
 C) $\frac{1}{\sqrt{1-x^2}}$
 D) $\frac{1}{1-x^2}$

137) A person goes 2 km east, then 3 km north, then 4 km west and then 1 km north, starting from the origin. This point is taken as vector A . The vector B such that $3A + 5B = (9, 32)$, is

- A) $(4, 3)$
 B) $(-3, 4)$
 C) $(-4, 3)$
 D) $(3, 4)$

138) Which of the following functions is inverse of itself?

- A) $f(t) = (1-t)/(1+t)$
 B) $f(t) = (1-t^2)/(1+t^2)$
 C) $f(t) = 4^{\log t}$
 D) $f(t) = 2^t$

139) The number of all positive odd divisors of 17500 is

- A) 5
 B) 8
 C) 9
 D) 10

140) A is a 3×3 matrix where its first row is $(1 \ 0 \ 0)$, second row is $(2 \ 1 \ 0)$ and third row is $(3 \ 2 \ 1)$. P , Q and R are column matrices such that $AP = (1 \ 0 \ 0)^T$, $AQ = (2 \ 3 \ 0)^T$ and $AR = (0 \ 0 \ 1)^T$. If P , Q and R are three columns of matrix U , then $|U| =$

- A) 0
 B) 1
 C) 3
 D) 9

141) If $\cot(\sin^{-1}x) = \cos(\tan^{-1}\sqrt{3})$, then $x =$

- A) 0
 B) $\frac{2}{\sqrt{3}}$
 C) 2
 D) $\frac{2}{\sqrt{5}}$

142) If $n(P)=8$, $n(Q)=10$ and $n(R)=5$ (n denotes cardinality) for three disjoint sets P , Q , R then $n(P \cup Q \cup R) =$

- A) 23
 B) 20
 C) 18
 D) 15

143) The sum value of the series $\frac{3}{4} + \frac{5}{36} + \frac{7}{144} + \frac{9}{400} + \dots$ is

- A) 1
 B) 2
 C) 32
 D) 0

144) Which of the following number cannot be in the range of $f(x) = 4 \operatorname{cosec}^2 x - 7 + 3 \sec^2 x + 11$?

- A) 11
 B) 96
 C) 101.5
 D) 43

145) If 60 times the 60^{th} term of an AP with non zero common difference is equal to 40 times the 40^{th} term, then the 100^{th} term of this AP is

- A) 0
 B) 1
 C) -1
 D) 2

146) The domain of the function $f(x) = \frac{\log(x+5)}{x^2+4x+3}$ is

- A) $(-\infty, -1)$
 B) $[-3, -1]$
 C) $\mathbb{R} - [-3, -1]$
 D) $(-5, \infty) - [-3, -1]$

147) What will be the distance of $(1, 0, 2)$ from the point of intersection of plane $x-y+z=16$ and the line $(x-2)/3 = (y+1)/4 = (z-2)/12$?

- A) 13 units
- B) 17 units
- C) 25 units
- D) 19 units

148) In a system of linear equations, three equations are given as

$$5x + 4y + 2z = 13; 4x - y - kz = 6; 2x + 3y + 3z = 16.$$

What should be the value of k so that the equations have no solution?

- A) 3
- B) 5
- C) -3
- D) -5

149) One of the roots of the equation $2x^2 - 9x^2 + kx - 13 = 0$ is $2 + 3i$. What will be the real root of the equation?

- A) 1
- B) $1/4$
- C) $-1/2$
- D) $1/2$

150) The equation of a circle is $C: x^2 + y^2 - 6x - 4y + 11 = 0$. A point $P(4, 3)$, that lies on this circle is taken. A diameter with P as an end is drawn. What will be the coordinates of its other end?

- A) (2, 1)
- B) (4, 3)
- C) (5, 4)
- D) (1, 3)

151) What should be the positive value of p so that the magnitude of $(3 + pi)$ where $i = \sqrt{-1}$ is twice that of $(3/4) + pi$?

- A) 1
- B) 0
- C) $3/2$
- D) 3

152) For 'c' is the arbitrary constant, the solution of the differential equation $(x^2 + 2y^2) dx - xy dy = 0$ is

- A) $x^2 + y^2 = x^4 c^2$
- B) $x^2 - y^2 = x^2 c^2$
- C) $x + y = x^4 c^2$
- D) $x^2 + y^2 = c^2$

153) $\sin(ix) =$

- A) $i \sinh x$
- B) $i \sin x$
- C) $\sin x$
- D) $\sinh x$

154) Natural numbers from 51 to 150 are written on 100 cards. A card is drawn randomly from this set of 100 cards. What is the probability that the number written on the card drawn will either be a perfect square or a perfect cube?

- A) $1/25$
- B) $3/50$
- C) $2/25$
- D) $1/20$

155) Between 1 and 2, how many local maxima the function $f(x) = 6x^5 - 7x^4 + 3x^3 + 2x^2 + 11x - 17$ has?

- A) 0
- B) 1
- C) 2
- D) 3

156) It is given that $P =$ Sum of all integral powers of $(4/5)$ from 1 to n . Also, $Q = 1 - P$. The smallest natural number for which $Q > P$ is

- A) 3
- B) 7
- C) 9
- D) Never possible

157) Let P and Q are two matrices such that $PQ=Q$ and $QP=P$, then $P^2+Q^2 =$

- A) P
- B) Q
- C) $P+Q$
- D) $P-Q$

158) The equation $xy=0$ in 3D space represents

- A) a pair of straight lines
- B) a plane
- C) a pair of planes at right angles
- D) a pair of parallel planes

159) In a triangle PQR , A , B and C are the angles opposite to the corresponding sides of lengths a , b and c respectively. If the sides are $a=5$, $b=13$ and $c=12$ then $\sin B/2 + \cos B/2 =$

- A) $1/2$
- B) $1/\sqrt{2}$
- C) $\sqrt{2}$
- D) 1

160) The minimum value of the function $Z=2x - y$ subjected to the constraints, $x+y \leq 5$, $x+2y \geq 8$, $x \geq 0$, $y \geq 0$ is

- A) $Z = 5$
- B) $Z = 1$
- C) $Z = -4$
- D) $Z = -5$

161) If $\alpha + \beta = \pi/2$ & $\beta + \gamma = \alpha$, then $\sin \gamma =$

- A) $\cos 2\beta$
- B) 1
- C) $\sin 2\beta$
- D) $\tan 2\beta$

162) P speaks truth in 70% cases and Q speaks in 80% of the cases. In what percentage of cases are they likely to contradict each other in stating the same fact?

- A) 28%
- B) 38%
- C) 42%
- D) 48%

163) If $3^x + 3^y = 3^{x+y}$, then at $x=y=1$, $dy/dx =$

- A) 1
- B) -1
- C) 0
- D) -2

164) The co-efficient of x^7 in the expansion of $(1+2x+3x^2+\dots)^{1/2}$ is

- A) 250
- B) 280
- C) 300
- D) 330

165) It is given that $f(x) = e^x$, when $0 \leq x \leq 1$ and $f(x) = 2 - e^{x-1}$, when $1 < x \leq 2$. If $g(x) = \text{integral of } f(x) \text{ from } 0 \text{ to } x$, then the point where $g(x)$ has local maxima is

- A) 0
- B) 1
- C) 2
- D) NOT determinable

166) For 'c' is the arbitrary constant, the solution of the differential equation $(x^2 - yx^2) \frac{dy}{dx} + (y^2 + xy^2) = 0$ is

- A) $\log(xy) + (1/x + 1/y) = c$
- B) $\log(xy) + (1/x - 1/y) = c$
- C) $\log(x/y) - (1/x + 1/y) = c$
- D) $\log(x/y) + (1/x - 1/y) = c$

167) Three points M, N and P are taken on a cartesian plane such that the triangle formed by them lies completely inside the circle $x^2 + y^2 - 4x - 5 = 0$. What could the coordinates of the points M, N and P?

- A) M(0,0) , N(0,2) , P(0, -3)
- B) M(4,0) , N(0,2) , P(0, -3)
- C) M(4,0) , N(0,2) , P(0, 0)
- D) M(0, 0) , N(4,0) , P(0, -3)

168) A line through P(3,5) is such that its intercept between the axes bisected at P. Its equation is

- A) $5x+3y=30$
- B) $3x+5y=30$
- C) $x+5y=30$
- D) $5x+y=30$

169) A differential equation $dy/dx = (y + 4x - 4)^2$ is given. At $x = 0$, $y = 4$ the solution of this differential equation is given by

- A) $y + 4x = 2 \tan(2x)$
- B) $y + 4x - 4 = 2 \tan(x)$
- C) $y + 4x - 4 = 2 \tan(2x)$
- D) $y + 4x - 4 = \tan(2x)$

170) If $\sin^{-1}x \cos^{-1}x = p$, then the value of $(\sin^{-1}x)^3 + (\cos^{-1}x)^3$ is

- A) $(\pi/2) (\pi/4 - 3p)$
- B) $(\pi/4) (\pi^2/4 - 3p)$
- C) $(\pi/2) (\pi^3/4 - 3p)$
- D) $(\pi/4) (\pi^2/2 - 3p)$

171) In which of these cases, the parabola generated by the given pair of directrix and focus will be a degenerate case?

- A) Directrix: $2x + 4y - 7 = 0$, Focus: (3, 5)
- B) Directrix: $7x - 3y - 2 = 0$, Focus: (2, 4)
- C) Directrix: $8x - 3y + 21 = 0$, Focus: (2, -4)
- D) Directrix: $x = 3$, Focus: (6, 1)

172) Given a function $f(x) = x^4 e^x$ where $x \neq 0$. Which of the given options is a correct expression for $f''(x)$?

- A) $((12/x) - x)f(x) + 2f'(x)$
- B) $8f(x) + 2f'(x)$
- C) $((12/x^2) - 1)f(x) + 2f'(x)$
- D) $8f(x)/x + 3f'(x)$

173) If $P(A)=1/4$, $P(B)=1/5$ and $P(AB)=1/8$ then $P(A^c/B^c) =$

- A) 21/32
- B) 25/32
- C) 27/32
- D) 29/32

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174) Here, $[x]$ denotes the greatest integer less than or equal to x . Given that $f(x) = [x] + x$. The value obtained when this function is integrated with respect to x with lower limit as $3/2$ and upper limit as $9/2$, is

- A) 12
- B) 10.5
- C) 8
- D) 16.5

175) Evaluate the integral: $\int dy/[(y+6)(y+5)^{1/2}]$. The result is

- A) $2 \tan^{-1}(\sqrt{y+6}) + \text{constant}$
- B) $2 \tan^{-1}(y+6) + \text{constant}$
- C) $2 \tan^{-1}(\sqrt{y+5}) + \text{constant}$
- D) $2 \tan^{-1}(y+5) + \text{constant}$

176) The mean of three positive numbers is 9. The mean is larger than only one of these numbers. The mean deviation about mean is 2. The smallest number is

- A) 5
- B) 6
- C) 7
- D) 7.5

177) If α, β, γ are the angles made by a vector with the co-ordinate axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma =$

- A) 0
- B) 1
- C) -1
- D) 2

178) A can solve 75% of the problems and B can solve 80% of the problems. If one problem is selected at random, the probability that the problem will be solved is

- A) 0.95
- B) 0.85
- C) 0.72
- D) 0.65

179) The value of ' x ' for which the points $(1,2,1)$, $(0,1,3)$, $(1,0,1)$ and $(2,0,x)$ are coplanar is

- A) $x=0$
- B) $x=1$
- C) $x=-1$
- D) $x=2$

180) If a and b are unit vectors then the vector $(a+b) \times (a \times b)$ is parallel to the vector

- A) $a+b$
- B) a
- C) b
- D) $a-b$

Space for Rough Work:

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