GENERAL STUDIES
Part – I

1. Who among the following refused the Padma Award 2015 ?
(a) Salim Khan
(b) Rekha
(c) Amitabh Bachchan
(d) Mahesh Bhatt

2. No confidence motion to be admitted in Lok Sabha, needs the support of
(a) 50 members
(b) 80 members
(c) 140 members
(d) 110 members

3. Asteroid 316201 'Malala' is located in the main belt between which planets ?
(a) Mercury & Mars
(b) Venus & Mars
(c) Mars & Earth
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4. A huge Engineering fair with participation of about 350 companies from different parts of the World was recently (April 2015) organized in
(a) France (b) Germany
(c) Canada (d) Italy

5. Time Higher Education has released the 'World Reputation Ranking 2015" list of universities. Which one of the universities has been placed at first position in this list ?
(a) University of Cambridge
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6. Central Agricultural University in Uttar Pradesh is being developed at
(a) Banda
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(c) Bareily
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7. Which one of the following canals is not located in Uttar Pradesh ?
(a) Hanumangarh Canal
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8. Who amongst the following won the Sultan Azlan Shah Hockey Tournament 2015 ?
(a) New Zealand
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9. In March 2015, an empowered committee of State Finance Ministers on goods and service tax was appointed by the government. The chairman of committee is
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Part – II

31. If a square matrix A is such that $A \neq 0$, $A^2 \neq 0$ but $A^3 = 0$, then $(I - A)^{-1}$ is equal to

(a) $I + A$ (b) $I - A$
(c) $A + A^2$ (d) $I + A + A^2$

× **32.** The range of the function

$f(x) = \dfrac{1}{2 - \cos 3x}$

is equal to

(a) $\left(\frac{1}{3}, 1\right]$ (b) $\left[\frac{1}{3}, 1\right]$
(c) $\left[\frac{1}{3}, 1\right)$ (d) $\left(\frac{1}{3}, 1\right)$

33. If a coin is tossed three times, then the probability of getting at least two heads is

(a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{2}{3}$ (d) $\frac{5}{6}$

34. If $x = 1 + y + y^2 + y^3 + \ldots\ldots$ to ∞, then y is equal to

(a) $\dfrac{x}{1-x}$ (b) $\dfrac{1-x}{x}$
(c) $\dfrac{x}{x-1}$ (d) $\dfrac{x-1}{x}$

35. Let $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ be the determinant for linear equations $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$ and $a_3x + b_3y + c_3 = 0$. Then for consistency of the above linear equations $D = 0$ is

(a) only necessary but not sufficient condition
(b) only sufficient but not necessary condition
(c) necessary as well as sufficient condition
(d) neither necessary nor sufficient condition

$x - 1 = \dfrac{y}{1-y}$

$(x-1)(1-y) = y$

$x - xy - 1 + y = y \quad \left(\dfrac{x-1}{x} = y\right)$

36. A bag contains 10 white and 6 red balls, two balls are drawn at random one after other without replacement. Then the probability that both balls are red will be

(a) $\frac{3}{8}$ (b) $\frac{5}{8}$
(c) $\frac{1}{8}$ (d) $\frac{7}{8}$

37. If n^{th} term of series $3, \sqrt{3}, 1, \ldots\ldots$ is $\frac{1}{243}$, then n is equal to

(a) 12 (b) 13
(c) 14 (d) 15

38. The function $f : R \longrightarrow R$ be defined by $f(x) = x^2 + 1$, then $f^{-1}\{(-8)\}$ is equal to

(a) $\{\pm 3\}$ (b) $\{\pm\sqrt{3}\}$
(c) $\{\pm 2\}$ (d) ϕ

39. If R be an equivalence relation in a set $A \neq \phi$, then R^{-1} is

(a) not a transitive relation
(b) not an equivalence relation
(c) an equivalence relation
(d) None of the above

40. The value of the determinant

$$\begin{vmatrix} a-b & b-c & c-a \\ b-c & c-a & a-b \\ c-a & a-b & b-c \end{vmatrix}$$

is

(a) 0
(b) 1
(c) abc
(d) $(a-b)(b-c)(c-a)$

60. If $x = r\cos\theta$, $y = r\sin\theta$, then $\frac{\partial(x, y)}{\partial(r, \theta)}$ is equal to

(a) $r\tan\theta$ (b) r

(c) $\frac{1}{r}$ (d) $\frac{1}{r^2}$

61. If $u = x\left(\frac{x+y}{x-y}\right) + \frac{x+2y}{x-2y}$, then the value of

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x\,\partial y} + y^2\frac{\partial^2 u}{\partial y^2}$$

is

(a) u (b) 1

(c) u + 1 (d) 0

62. The sum of the degree and order of the differential equation obtained from the family of curves $y = cx - c^2 - c^3$ is

(a) 5 (b) 2

(c) 3 (d) 4

63. An integrating factor of differential equation $(x^2 + y^2 + 2x)\,dx + 2y\,dy = 0$ is

(a) e^x (b) e^{-x}

(c) e^y (d) e^{-y}

64. The solution of the differential equation

$(2x - y + 1)dx + (2y - x - 1)dy = 0$

represents a family of

(a) ellipses (b) parabolas

(c) pair of lines (d) hyperbolas

65. The solution of differential equation $(1 + y + x^2y)dx + (x + x^3)\,dy = 0$ is

(a) $xy + \tan^{-1}x = cx^2$

(b) $xy + \cot^{-1}x = c$

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

(d) $xy + \tan^{-1}x = c$

66. If $2^x + 2^y = 2^{x+y}$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{2^x + 2^y}{2^x - 2^y}$ (b) $\frac{2^x + 2^y}{1 + 2^{x+y}}$

(c) $\frac{2^{x+y} - 2^x}{2^y - 2^{x+y}}$ (d) $\frac{2^{x+y} - 2^x}{2^y}$

67. If $y = C\left[x + \sqrt{(x^2 - 1)}\right]^n + D\left[x - \sqrt{(x^2 - 1)}\right]^{-n}$ and n is positive integer, then the value of $\frac{y_{n+2}}{y_{n+1}}$ is

(a) $\frac{2nx}{1 - x^2}$ (b) $\frac{(2n + 1)x}{1 - x^2}$

(c) $\frac{(2n + 1)x}{x^2 - 1}$ (d) $\frac{2nx}{x^2 - 1}$

68. If $u = \sin^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to

(a) tan u

(b) sin u

(c) u

(d) None of the above

69. If $x = \sec\theta - \cos\theta$ and $y = \sec^n\theta - \cos^n\theta$, then the value of $(x^2 + 4)\left(\frac{dy}{dx}\right)^2$ is

(a) $\frac{n^2}{x^2 + 4}$ (b) $x^2(y^2 + 4)$

(c) $n(y^2 + 4)$ (d) $n^2(y^2 + 4)$

70. The slope of the tangent to the curve $x = t^2 + 3t - 8$, $y = 2t^2 - 2t - 5$ at $(2, -1)$ is

(a) $\frac{22}{7}$ (b) $\frac{7}{6}$

(c) $\frac{6}{7}$ (d) $-\frac{6}{7}$

71. If $u = \dfrac{1}{\sqrt{(x^2 + y^2 + z^2)}}$, then the value of $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} + z\dfrac{\partial u}{\partial z}$ is equal to

(a) -24
(b) -4
(c) 24
(d) None of the above

72. The normal at the point (1, 1) on the curve $2y + x^2 = 3$ is

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

73. The value of the integral

$$\int_a^b \frac{x^n}{x^n + (a + b - x)^n}\, dx$$

is

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

74. The area between the curve $y^2(2a - x) = x^3$ and its asymptote is

(a) πa^2 (b) $3\pi a^2$
(c) $2\pi a^2$ (d) $4\pi a^2$

75. The value of

$$\int_{1/4}^{3/4} \frac{\left(\frac{\pi}{2} + \cos^{-1}x\right) dx}{2\sin^{-1}x + 3\cos^{-1}x + \cos^{-1}(1 - x)}$$

is equal to

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

76. The pedal equation of the curve is

$r^n = a^n \cos n\theta$

is

(a) $a^n r = p^{n+1}$
(b) $p r^n = a^{n+1}$
(c) $a r^n = p^{n+1}$
(d) $p a^n = r^{n+1}$

77. Which of the following functions defined on [0, 1] is not Riemann integrable ?

(a) Characteristic function of all rational numbers
(b) Identity function
(c) Zero function
(d) Square function

78. If $f(x) = \tan^{-1}\sqrt{\left(\dfrac{1 + \sin x}{1 - \sin x}\right)}$, where $0 \le x \le \dfrac{\pi}{2}$, then $f'\left(\dfrac{\pi}{6}\right)$ is

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

79. What will be the remainder if we divide $14^{10} + 2$ by 11 ?

(a) 7 (b) 5
(c) 3 (d) 2

80. The set of all points, where the function

$f(x) = x\,|x|$

is differentiable, is equal to

(a) $[0, \infty]$
(b) $(-\infty, 0)$
(c) $(-1, 1)$
(d) $(-\infty, \infty)$

101. If the polars of (x_1, y_1) and (x_2, y_2) with respect to hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ are at right angles, then

(a) $\frac{x_1x_2}{y_1y_2} + \frac{a^2}{b^2} = 0$ (b) $\frac{y_1y_2}{x_1x_2} + \frac{a^4}{b^4} = 0$

(c) $\frac{x_1x_2}{y_1y_2} - \frac{a^4}{b^4} = 0$ (d) $\frac{x_1x_2}{y_1y_2} + \frac{a^4}{b^4} = 0$

102. The equation $13x^2 - 18xy + 37y^2 + 2x + 14y - 2 = 0$ represents

(a) a hyperbola
(b) a pair of straight lines
(c) a parabola
(d) an ellipse

103. The difference of the focal distances of a point on a hyperbola is equal to

(a) the eccentricity of the hyperbola.
(b) the distance between foci of the hyperbola.
(c) the length of the transverse axis of the hyperbola.
(d) the half of the length of the transverse axis of the hyperbola.

104. The angle between the lines $x = 1$, $y = 2$ and $y = -1$, $z = 0$ is

(a) 60° (b) 90°
(c) 30° (d) 0°

105. The angle between the line $\bar{r} = \bar{a} + t\bar{b}$ and plane $\bar{r} \cdot \bar{n} + d = 0$ is equal to

(a) $\cos^{-1}\frac{|\bar{b} \times \bar{n}|}{|\bar{b}|\,|\bar{n}|}$ (b) $\cos^{-1}\frac{|\bar{b} \cdot \bar{n}|}{|\bar{b}|\,|\bar{n}|}$

(c) $\sin^{-1}\frac{|\bar{b} \times \bar{n}|}{|\bar{b}|\,|\bar{n}|}$ (d) $\sin^{-1}\frac{|\bar{a} \times \bar{n}|}{|\bar{a}|\,|\bar{n}|}$

106. Work done by the conservative force $\bar{F} = 3x^2y\hat{i} + (x^3 + 2yz)\hat{j} + y^2\hat{k}$ in moving an object from (1, −2, 1) to (3, 1, 4) along a curve is

(a) 25 (b) 26
(c) 28 (d) 29

107. The straight lines OP and OQ are drawn from O in space with direction ratios 1, −2, −1 and 3, −2, 3. The direction ratios of the normal to the plane POQ are

(a) 4, 3, −2 (b) 2, 3, −2
(c) 1, 2, −1 (d) 3, 2, −4

108. The shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{2x-2}{3} = \frac{3y-5}{9} = \frac{-z+3}{5}$ is

(a) 3
(b) 2
(c) 0
(d) None of the above

109. The distance between the planes $2x - 2y + z + 3 = 0$ and $4x - 4y + 2z + 5 = 0$, is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{6}$ (d) $\frac{1}{\sqrt{2}}$

110. For what values of k the straight line $x + y = k$ will be tangent to the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1$?

(a) ±10 (b) ±6
(c) ±5 (d) ±3

(3,4,5) (3,0,5) $\sqrt{3^2+5^2}$

111. The equation of the plane bisecting the acute angle between the planes $x + y + z + 3 = 0$ and $2x - y + 3z + 5 = 0$ is

(a) $\sqrt{14}\,(x + y + z + 3) = \sqrt{3}\,(2x - y + 3z + 5)$

(b) $\sqrt{14}\,(2x - y + 3z + 5) = \sqrt{3}\,(x + y + z + 3)$

(c) $\sqrt{14}\,(2x - y + 3z + 5) = -\sqrt{3}\,(x + y + z + 3)$

(d) $\sqrt{14}\,(x + y + z + 3) = -\sqrt{3}\,(2x - y + 3z + 5)$

112. If a line makes an angle α, β and γ with the coordinate axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is equal to

(a) 0

(b) 1

(c) 2

(d) None of the above

113. The equation to the plane passing through the points $(2, 3, -4)$ and $(1, -1, 3)$ and parallel to x-axis is

(a) $2x + 3 = 0$

(b) $7y + 4z = 5$ 2y – z.

(c) $2y + 3z = 5$

(d) None of the above

114. If two lines $x - \alpha = 0$ and $y - \beta = 0$ are conjugate with respect to the hyperbola $xy = c^2$, then

(a) $\alpha\beta = 2c^2$ (b) $\alpha\beta = c^2$

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

115. The distance of the point (3, 4, 5) from the y-axis is

(a) $\sqrt{41}$ (b) $\sqrt{34}$

(c) 5 (d) 3

3×0 + 4×1 + 5 $\sqrt{50}$

116. The orthocentre of the triangle formed by the lines $xy = 0$ and $x + y = 1$ is

(a) $\left(\frac{1}{4}, \frac{1}{4}\right)$ (b) (0, 0)

(c) $\left(\frac{1}{3}, \frac{1}{3}\right)$ (d) $\left(\frac{1}{2}, \frac{1}{2}\right)$

117. The value of $\oint_C (yzdx + zxdy + xydz)$ where C is the intersection of $x^2 + 9y^2 = 9$ and $Z = y^2 + 1$ is

(a) $-\pi$

(b) 21

(c) 0.

(d) None of the above

118. If $\bar{F} = x^2y\hat{i} + zx\hat{j} + 2yz\hat{k}$, then the value of curl $\bar{F}$ at the point $(-1, 1, 1)$ will be

(a) $\hat{i} + \hat{j}$ (b) $\hat{j} + \hat{k}$

(c) $3\hat{i}$ (d) $3\hat{k}$

119. Which one of the following is incorrect statement for a ring $(R, +, \cdot)$?

(a) $a \cdot 0 = 0 = 0 \cdot a\ \forall a \in R$

(b) $a \cdot (-b) = -(ab) = (-a) \cdot b,\ \forall a, b \in R$

(c) $(-a) \cdot (-b) = ab\ \forall a, b \in R$

(d) $a \cdot b = 0 \Rightarrow a = 0$ or $b = 0$, $a, b \in R$

120. Number of group homomorphism from the group $(\mathbb{Z}_{10}, +_{10})$ to group $(\mathbb{Z}, +)$ is

(a) $\underline{|10}$

(b) number of divisors of 10

(c) infinite

(d) None of the above

121. The number of elements in the cyclic subgroup generated by $\frac{1+i}{\sqrt{2}}$ of the group e* of the non-zero complex numbers under multiplication is

(a) 4 (b) 6

(c) 8 (d) 16

122. The remainder, when 3^{47} is divided by 23, is

(a) 1 (b) 2

(c) 3 (d) 4

123. If $r = |\bar{r}|$ where $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then grad r^m is equal to

(a) $m\, r^{m-2}\, \bar{r}$

(b) $m\, r^{m-1}\, \bar{r}$

(c) $m\, r^{m-2}\, \hat{r}$

(d) None of the above

124. Which of the following statements is true ?

(a) $\mathbb{Z}_n$ has zero divisors if n is not prime.

(b) Ring $n\mathbb{Z}$ has zero divisors if n is not prime.

(c) The characteristic of ring $n\mathbb{Z}$ is n.

(d) As a ring $\mathbb{Z}$ is isomorphic to $n\mathbb{Z}$.

125. If 'a' be an element of order n in a group G and p be prime to n, then $o(a^p)$ is equal to

(a) $\dfrac{p^2+1}{n}$

(b) p^2/n

(c) p^n

(d) None of the above

126. The converse of the Lagrange's theorem for a group does not hold in the

(a) Klein's four group V_4

(b) Hamiltonian group Q_8

(c) Symmetric group S_3

(d) Alternating group A_4

127. For a non-empty subset H of a finite group (G, o) to be a subgroup the condition $a, b \in H \Rightarrow aob \in H$ is

(a) only necessary but not sufficient

(b) only sufficient but not necessary

(c) neither necessary nor sufficient

(d) necessary as well as sufficient

128. If w_1 and w_2 are two subspaces of a vector space V where dim V = 50, dim w_1 = 49, dim w_2 = 45 and $w_2 \not\subseteq w_1$, then dim $(w_1 \cap w_2)$ is equal to

(a) 49 (b) 45

(c) 44 (d) 4

129. If $W_1 = \{(x, y, z) : x, y, z \in \mathbb{R}$ and $x - 2y + z = 0\}$ and $W_2 = \{(x, y, z) : x, y, z \in \mathbb{R}$ and $x = y = z\}$ are subspaces of the vector space $\mathbb{R}^3(\mathbb{R})$, then $W_1 + W_2$ is

(a) $\mathbb{R}^3$

(b) W_1

(c) W_2

(d) None of the above

130. Let the linear transformation $T : \mathbb{R}^2(\mathbb{R}) \rightarrow \mathbb{R}^3(\mathbb{R})$ be defined by $T(x, y) = (-x - y, 3x + 8y, 9x - 11y)$. Then the rank and nullity of T are respectively

(a) 2 and 0

(b) 1 and 1

(c) 0 and 2

(d) None of the above

131. Let w_1, w_2 be two subspaces of a vector space V. Then the smallest subspace of V containing w_1 and w_2 is

(a) $w_1 \cup w_2$

(b) $w_1 \cap w_2$

(c) $w_1 + w_2$

(d) None of the above

132. If T_1 and T_2 are linear transformations on the vector space $\mathbb{R}^3(\mathbb{R})$ such that rank of $T_1 = 2$ and $T_2^{\,2} = I$, then the rank of $T_1 o T_2$ will be

(a) 3 (b) 1

(c) 0 (d) 2

133. The value of $\iint\limits_{S} \vec{r}\,.\,\hat{n}\,ds$, where s is part of the sphere $x^2 + y^2 + z^2 = 1$ above xy – plane, is

(a) $\frac{4}{3}\pi$ (b) 4π

(c) $\frac{2}{3}\pi$ (d) 2π

134. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector then grad $(\bar{a} \cdot \bar{r})$ is equal to

(a) $\bar{r}$

(b) $r^2\bar{a}$

(c) $\bar{a}$

(d) None of the above

135. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector, then curl$(\bar{a} \times \bar{r})$ is equal to

(a) $\bar{o}$ (b) $\bar{a}$

(c) $2\bar{a}$ (d) $3\bar{a}$

136. If $\vec{p} = \vec{A}\cos kt + \vec{B}\sin kt$, where $\vec{A}$ and $\vec{B}$ are constant vectors and K is a constant scalar, the value of $\frac{d}{dt}\left(\vec{p} \times \frac{d\vec{p}}{dt}\right)$ is equal to

(a) $|p|^2$

(b) $\vec{0}$

(c) $2\vec{p}$

(d) None of the above

137. The area bounded by a simple closed curve C is equal to

(a) $\oint\limits_{C}(x\,dy + y\,dx)$

(b) $\oint\limits_{C}(x\,dy - y\,dx)$

(c) $\frac{1}{2}\oint\limits_{C}(x\,dy + y\,dx)$

(d) $\frac{1}{2}\oint\limits_{C}(x\,dy - y\,dx)$

138. The minimum force parallel to a rough plane which will prevent a body of weight 20 kg from sliding down the plane inclined at an angle 30° to the horizon (coefficient of the friction of the rough plane is $\frac{1}{2\sqrt{3}}$) is

(a) 10 kg.wt.

(b) 5 kg.wt.

(c) $5\sqrt{3}$ kg.wt.

(d) None of the above

139. A sphere impinges directly on an equal sphere at rest. If the coefficient of restitution is $\frac{1}{2}$, then their velocities after impact will be in the ratio

(a) 3 : 4 (b) 1 : 2

(c) 1 : 3 (d) 2 : 3

140. The distance of the centre of gravity of a thin uniform hemispherical shell, whose radius is a, from the centre is

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

(c) $\frac{a^2}{2}$ (d) $\frac{a^2}{4}$

141. If the horizontal range of a projectile is $4\sqrt{3}$ times its maximum height, then its angle of projection is

(a) 60° $\frac{\sqrt{3}}{2}$

(b) 45°

(c) 30°

(d) None of the above

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7. Which one of the following canals is not located in Uttar Pradesh ?
   (a) Hanumangarh Canal
   (b) Dhasan Canal
   (c) Matatila Canal
   (d) Betwa Canal

8. Who amongst the following won the Sultan Azlan Shah Hockey Tournament 2015 ?
   (a) New Zealand
   (b) Netherlands
   (c) Pakistan
   (d) Australia

9. In March 2015, an empowered committee of State Finance Ministers on goods and service tax was appointed by the government. The chairman of committee is
   (a) Arun Jaitley
   (b) K.M. Mani
   (c) Krishna Kumar Bhatt
   (d) Akhilesh Yadav

10. In which year, the two words 'Socialist' and 'Secular' were added in the preamble to the constitution of India ?
(a) 1976 (b) 1977
(c) 1978 (d) 1979

11. To whom the Council of Ministers shall be collectively responsible ?
(a) To the President
(b) To the Vice President
(c) To the Supreme Court
(d) To the Lok Sabha

12. Who was the Chief Justice of India when Public Interest Litigation (PIL) was introduced to the Judicial System of India ?
(a) M. Hidayatullah
(b) A.S. Anand
(c) P.N. Bhagwati
(d) A.M. Ahmadi

13. Who among the following has told, the Prime Minister of India, Narendra Modi, as "Man of Action ?
(a) Vladimir Putin
(b) Barack Obama
(c) Angela Merkel
(d) David Cameroon

14. National Movement in India became an organized mass movement from the year
(a) 1857 (b) 1885
(c) 1914 (d) 1919

15. 'Panchayati Raj' is a system of
(a) Local Government
(b) Local Administration
(c) Local Self Government
(d) Rural local self Government

16. Aqua Regia is a mixture of
(a) HCl and H_2SO_4
(b) HCl and HNO_3
(c) HCl and HBr
(d) HCl and HF

17. 'Pitch Blende' is the main source of
(a) Uranium (b) Thorium
(c) Magnesium (d) Calcium

18. World Environment day is
(a) 7^{th} April
(b) 10^{th} December
(c) 15^{th} May
(d) 5^{th} June

19. Which of the following urban centres is located on Coromandel coast ?
(a) Nagappattinam
(b) Vishakhapatnam
(c) Ratnagiri
(d) Ernakulam

20. Chitrakoot waterfall is located in which of the following States of India ?
(a) Madhya Pradesh
(b) Uttar Pradesh
(c) Chhattisgarh
(d) Jharkhand

21. The Greenwich meridian and the equator cross each other in
(a) Kenya
(b) Atlantic Ocean
(c) Chile
(d) Pacific Ocean

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(d) Pacific Ocean

22. Which one of the following is not the unit of distance ?

(a) Parsec

(b) Light year

(c) Nautical mile

(d) Square mile

23. Match the two lists and choose the right answer from the code given below :

List – I (Tribes)	List – II (Regions)
A. Chuar	1. Western Ghat
B. Col	2. Okha
C. Ramosi	3. Midnapore
D. Baghera	4. Chhota Nagpur

Codes :

	A	B	C	D
(a)	4	2	3	1
(b)	1	3	4	2
(c)	3	4	1	2
(d)	2	4	1	3

24. When and where 'Quit India Movement' was started ?

(a) 8th August, 1942 in Bombay

(b) 15th August, 1942 in Delhi

(c) 7th July, 1942 in Lahore

(d) 7th August, 1942 in Wardha

25. 40 men can cut 60 trees in 8 hrs. If 8 men leave the job, how many trees will be cut in 12 hrs. ?

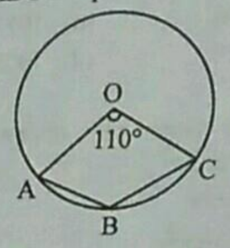
(a) 72 trees

(b) 80 trees

(c) 84 trees

(d) 64 trees

26. In the figure, O is the centre of the circle and $\angle AOC = 110°$, then $\angle ABC$ is equal to



(a) 55°
(b) 125°
(c) 110°
(d) 100°

27. If $x + 1$ and $x - 2$ are factors of the polynomial $x^3 + ax^2 - bx - 6$, then the values of a and b are respectively

(a) –2 and 5
(b) 2 and –5
(c) 2 and 5
(d) 5 and 2

28. Peetambari is a variety of

(a) Yellow mustard

(b) Sunflower

(c) Linseed

(d) Groundnut

29. Which fertilizer contains nitrogen in Amide form ?

(a) Ammonium sulphute

(b) Urea

(c) Ammonium chloride

(d) Sodium nitrate

30. Which one of the following is not micro nutrient ?

(a) Manganese

(b) Boron

(c) Zinc

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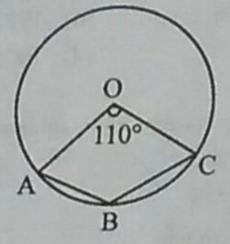

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MATHEMATICS

Part – II

31. If a square matrix A is such that $A \neq 0$, $A^2 \neq 0$ but $A^3 = 0$, then $(I - A)^{-1}$ is equal to

(a) $I + A$
(b) $I - A$
(c) $A + A^2$
(d) $I + A + A^2$

32. The range of the function

$$f(x) = \frac{1}{2 - \cos 3x}$$

is equal to

(a) $\left(\frac{1}{3}, 1\right]$
(b) $\left[\frac{1}{3}, 1\right]$
(c) $\left[\frac{1}{3}, 1\right)$
(d) $\left(\frac{1}{3}, 1\right)$

33. If a coin is tossed three times, then the probability of getting at least two heads is

(a) $\frac{1}{3}$
(b) $\frac{1}{2}$
(c) $\frac{2}{3}$
(d) $\frac{5}{6}$

34. If $x = 1 + y + y^2 + y^3 + \ldots\ldots$ to ∞, then y is equal to

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

35. Let $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ be the determinant for linear equations $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$ and $a_3x + b_3y + c_3 = 0$. Then for consistency of the above linear equations $D = 0$ is

(a) only necessary but not sufficient condition
(b) only sufficient but not necessary condition
(c) necessary as well as sufficient condition
(d) neither necessary nor sufficient condition

$x-1 = \frac{y}{1-y}$

$(x-1)(1-y) = y$

$x - xy - 1 + y = y$ $\quad \frac{x-1}{x} = y$

36. A bag contains 10 white and 6 red balls, two balls are drawn at random one after other without replacement. Then the probability that both balls are red will be

(a) $\frac{3}{8}$
(b) $\frac{5}{8}$
(c) $\frac{1}{8}$
(d) $\frac{7}{8}$

37. If n^{th} term of series $3, \sqrt{3}, 1, \ldots\ldots$ is $\frac{1}{243}$, then n is equal to

(a) 12
(b) 13
(c) 14
(d) 15

38. The function $f : R \longrightarrow R$ be defined by $f(x) = x^2 + 1$, then $f^{-1}\{(-8)\}$ is equal to

(a) $\{\pm 3\}$
(b) $\{\pm \sqrt{3}\}$
(c) $\{\pm 2\}$
(d) ϕ

39. If R be an equivalence relation in a set $A \neq \phi$, then R^{-1} is

(a) not a transitive relation
(b) not an equivalence relation
(c) an equivalence relation
(d) None of the above

$x-1 = \frac{y}{1-}$

40. The value of the determinant

$$\begin{vmatrix} a-b & b-c & c-a \\ b-c & c-a & a-b \\ c-a & a-b & b-c \end{vmatrix}$$

is

(a) 0
(b) 1
(c) abc
(d) $(a-b)(b-c)(c-a)$

MATHEMATICS
Part – II

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(a) 0
(b) 1
(c) abc
(d) $(a - b)(b - c)(c - a)$

41. If $a^x = b^y = c^z$ and a, b, c are in G.P. then x, y, z are in

(a) A.P.
(b) G.P.
(c) H.P.
(d) None of the above

13

42. If $\frac{1}{q+r}, \frac{1}{r+p}, \frac{1}{p+q}$ are in A.P., then

(a) p, q, r are in A.P.
(b) p^2, q^2, r^2 are in A.P.
(c) $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in A.P.
(d) None of the above

43. If the coefficients of $(r - 1)^{th}$ and $(2r + 3)^{th}$ terms in the expansion of $(1 + x)^{15}$ are equal, then r is

(a) 5
(b) 7
(c) 9
(d) None of the above

44. If the binomial coefficients c_4, c_5, c_6 in the expansion $(1 + x)^n = \sum_{r=0}^{n} c_r x^r$ are in Arithmetic progression, then n is equal to

(a) 7
(b) 8
(c) 5
(d) 10

45. If α, β are the roots of the equation $2x^2 + 3x + 5 = 0$, then the value of the determinant

$$\begin{vmatrix} 0 & \beta & \beta \\ \alpha & 0 & \alpha \\ \beta & \alpha & 0 \end{vmatrix}$$

is

(a) $-\frac{3}{5}$
(b) $-\frac{15}{4}$
(c) $\frac{3}{5}$
(d) $\frac{15}{4}$

46. The value of the determinant

$$\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix}$$

is

(a) $2(abc + bc + ca + ab)$
(b) $2(bc + ca + ab)$
(c) $3abc$
(d) $abc + bc + ca + ab$

47. If $A_\alpha = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then which of the following is not true ?

(a) $A_\alpha A_\beta = A_{\alpha\beta}$
(b) $A_\alpha A_\beta = A_\beta A_\alpha$
(c) $(A_\alpha)^n = A_{n\alpha}$
(d) $A_\alpha A_{-\alpha} = I$

48. Matrices A and B will be inverse of each other if

(a) AB = BA
(b) AB = BA = 0
(c) AB = 0, BA = I
(d) AB = BA = I

49. If A and B are symmetric matrices of the same order, then (AB – BA) is a

(a) skew-symmetric matrix
(b) symmetric matrix
(c) zero matrix
(d) identity matrix

50. The values of x which satisfy the equation

$$\begin{vmatrix} a & a & x \\ m & m & m \\ b & x & b \end{vmatrix} = 0$$

are

(a) a, b
(b) a, m
(c) b, m
(d) a, b, m

41. If $a^x = b^y = c^z$ and a, b, c are in G.P. then x, y, z are in

(a) A.P.

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(c) H.P.

(d) None of the above

13 Full

42. If $\frac{1}{q+r}, \frac{1}{r+p}, \frac{1}{p+q}$ are in A.P., then

(a) p, q, r are in A.P.

(b) p^2, q^2, r^2 are in A.P.

(c) $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in A.P.

(d) None of the above

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(a) 7 (b) 8

(c) 5 (d) 10

45. If α, β are the roots of the equation $2x^2 + 3x + 5 = 0$, then the value of the determinant

$$\begin{vmatrix} 0 & \beta & \beta \\ \alpha & 0 & \alpha \\ \beta & \alpha & 0 \end{vmatrix}$$

is

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46. The value of the determinant

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(d) identity matrix

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$$\begin{vmatrix} a & a & x \\ m & m & m \\ b & x & b \end{vmatrix} = 0$$

are

(a) a, b (b) a, m

(c) b, m (d) a, b, m

$R \cap S \neq \phi$

51. Let R and S be non-empty relations in a set A. Then which of the following is false ?

(a) If R is symmetric, then $R \cap R^{-1} \neq \phi$.

(b) If R and S are transitive, then $R \cup S$ is transitive.

(c) If R and S are symmetric, then $R \cup S$ is symmetric.

(d) If R and S are reflexive, then $R \cup S$ is reflexive.

52. Let $\mathbb{Z}$ be the set of integers. Then the map $f : \mathbb{Z} \longrightarrow \mathbb{Z} \times \mathbb{Z}$ defined by $f(x) = (x - 1, 1), \forall x \in \mathbb{Z}$ is

$x-1, 1$

(a) one-one into

(b) one-one onto

(c) many-one into

(d) many-one onto

53. If R is symmetric relation in a set S, then the incorrect statement is

(a) $R \cup R^{-1} = R$ $\quad R \cup R^{-1} = R$

(b) $R \cap R^{-1} = R^{-1}$

(c) $R \circ R^{-1}$ is symmetric in S

(d) $R \circ R^{-1} = R$

54. If a matrix $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then A^5 is equal to

(a) 5 A (b) 15 A

(c) 81 A (d) 243 A

55. If $f : R \longrightarrow R$ be given by $f(x) = (3 - x^3)^{\frac{1}{3}}$, then $(f \circ f)(x)$ is equal to

(a) $x^{\frac{1}{3}}$ (b) x^3

(c) x (d) $3 - x^2$

$f : R \to R$ $\quad A^5 =$

56. Area of loop of the curve

$$y^2 = x(x - 1)^2$$

is

(a) $\frac{4}{15}$ units (b) $\frac{7}{15}$ units

(c) $\frac{8}{15}$ units (d) $\frac{7}{12}$ units

57. At $x = 1$, function

$$f(x) = \begin{cases} 1 - x & \text{when } x < 1 \\ x^2 - 1 & \text{when } x \geq 1 \end{cases}$$

is

(a) continuous but not differentiable.

(b) differentiable but not continuous.

(c) continuous as well as differentiable.

(d) neither continuous nor differentiable.

58. If f is Riemann integrable on [a, b], then

(a) $\left| \int_a^b f\,dx \right| = \int_a^b |f|\,dx$

(b) $\left| \int_a^b f\,dx \right| \leq \int_a^b |f|\,dx$

(c) $\left| \int_a^b f\,dx \right| \geq \int_a^b |f|\,dx$

(d) None of the above

59. Solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x} = x^2$$

is

(a) $xy = x^4 + c$ (b) $4xy + x^4 = c$

(c) $ye^x = x^4 + c$ (d) $4xy = x^4 + c$

$xy = \frac{x^4}{4} + c$

$dxy =$

$R \cap S \neq \phi$

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(a) $R \cup R^{-1} = R$ $\quad R \cup R^{-1} = R$

(b) $R \cap R^{-1} = R^{-1}$

(c) $R \text{ o } R^{-1}$ is symmetric in S

(d) $R \text{ o } R^{-1} = R^2$

54. If a matrix $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then A^5 is equal to

(a) 5 A

(b) 15 A

(c) 81 A

(d) 243 A

55. If $f : R \longrightarrow R$ be given by $f(x) = (3 - x^3)^{\frac{1}{3}}$, then $(f \text{ o } f)(x)$ is equal to

(a) $x^{\frac{1}{3}}$

(b) x^3

(c) x

(d) $3 - x^2$

$f : R \to R$ $\quad A^5 =$

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(d) $\frac{7}{12}$ units

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(d) neither continuous nor differentiable.

58. If f is Riemann integrable on [a, b], then

(a) $\left| \int_a^b f \, dx \right| = \int_a^b |f| \, dx$

(b) $\left| \int_a^b f \, dx \right| \leq \int_a^b |f| \, dx$

(c) $\left| \int_a^b f \, dx \right| \geq \int_a^b |f| \, dx$

(d) None of the above

59. Solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x} = x^2$$

is

(a) $xy = x^4 + c$

(b) $4xy + x^4 = c$

(c) $ye^x = x^4 + c$

(d) $4xy = x^4 + c$

$xy = \frac{x^4}{4} + c$

60. If $x = r\cos\theta$, $y = r\sin\theta$, then $\frac{\partial(x, y)}{\partial(r, \theta)}$ is equal to

(a) $r\tan\theta$ (b) r

(c) $\frac{1}{r}$ (d) $\frac{1}{r^2}$

$\frac{\partial x}{\partial r}\cdot\frac{\partial y}{\partial r}$ $\frac{\partial x}{\partial \theta}\ \frac{\partial y}{\partial \theta}$

61. If $u = x\left(\frac{x+y}{x-y}\right) + \frac{x+2y}{x-2y}$, then the value of

$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x\,\partial y} + y^2\frac{\partial^2 u}{\partial y^2}$

is

(a) u (b) 1

(c) u + 1 (d) 0

62. The sum of the degree and order of the differential equation obtained from the family of curves $y = cx - c^2 - c^3$ is

(a) 5 (b) 2

(c) 3 (d) 4

63. An integrating factor of differential equation $(x^2 + y^2 + 2x)\,dx + 2y\,dy = 0$ is

(a) e^x (b) e^{-x}

(c) e^y (d) e^{-y}

64. The solution of the differential equation

$(2x - y + 1)dx + (2y - x - 1)dy = 0$

represents a family of

(a) ellipses (b) parabolas

(c) pair of lines (d) hyperbolas

65. The solution of differential equation $(1 + y + x^2y)dx + (x + x^3)\,dy = 0$ is

(a) $xy + \tan^{-1}x = cx^2$

(b) $xy + \cot^{-1}x = c$

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

(d) $xy + \tan^{-1}x = c$

66. If $2^x + 2^y = 2^{x+y}$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{2^x + 2^y}{2^x - 2^y}$ (b) $\frac{2^x + 2^y}{1 + 2^{x+y}}$

(c) $\frac{2^{x+y} - 2^x}{2^y - 2^{x+y}}$ (d) $\frac{2^{x+y} - 2^x}{2^y}$

67. If $y = C\left[x + \sqrt{(x^2 - 1)}\right]^n + D\left[x - \sqrt{(x^2 - 1)}\right]^{-n}$ and n is positive integer, then the value of $\frac{y_{n+2}}{y_{n+1}}$ is

(a) $\frac{2nx}{1 - x^2}$ (b) $\frac{(2n + 1)x}{1 - x^2}$

(c) $\frac{(2n + 1)x}{x^2 - 1}$ (d) $\frac{2nx}{x^2 - 1}$

68. If $u = \sin^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to

(a) tan u

(b) sin u

(c) u

(d) None of the above

69. If $x = \sec\theta - \cos\theta$ and $y = \sec^n\theta - \cos^n\theta$, then the value of $(x^2 + 4)\left(\frac{dy}{dx}\right)^2$ is

(a) $\frac{n^2}{x^2 + 4}$ (b) $x^2(y^2 + 4)$

(c) $n(y^2 + 4)$ (d) $n^2(y^2 + 4)$

70. The slope of the tangent to the curve $x = t^2 + 3t - 8$, $y = 2t^2 - 2t - 5$ at $(2, -1)$ is

(a) $\frac{22}{7}$ (b) $\frac{7}{6}$

(c) $\frac{6}{7}$ (d) $-\frac{6}{7}$

60. If $x = r\cos\theta$, $y = r\sin\theta$, then $\frac{\partial(x, y)}{\partial(r, \theta)}$ is equal to

(a) $r\tan\theta$ (b) r $\frac{\partial x}{\partial r} \cdot \frac{\partial y}{\partial r}$

(c) $\frac{1}{r}$ (d) $\frac{1}{r^2}$ $\frac{\partial x}{\partial \theta}$ $\frac{\partial y}{\partial \theta}$

61. If $u = x\left(\frac{x+y}{x-y}\right) + \frac{x+2y}{x-2y}$, then the value of

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x\,\partial y} + y^2\frac{\partial^2 u}{\partial y^2}$$

is

(a) u (b) 1

(c) u + 1 (d) 0

62. The sum of the degree and order of the differential equation obtained from the family of curves $y = cx - c^2 - c^3$ is

(a) 5 (b) 2

(c) 3 (d) 4

63. An integrating factor of differential equation $(x^2 + y^2 + 2x)\,dx + 2y\,dy = 0$ is

(a) e^x (b) e^{-x}

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64. The solution of the differential equation $(2x - y + 1)dx + (2y - x - 1)dy = 0$ represents a family of

(a) ellipses (b) parabolas

(c) pair of lines (d) hyperbolas

65. The solution of differential equation $(1 + y + x^2y)dx + (x + x^3)\,dy = 0$ is

(a) $xy + \tan^{-1}x = cx^2$

(b) $xy + \cot^{-1}x = c$

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

(d) $xy + \tan^{-1}x = c$

66. If $2^x + 2^y = 2^{x+y}$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{2^x + 2^y}{2^x - 2^y}$ (b) $\frac{2^x + 2^y}{1 + 2^{x+y}}$

(c) $\frac{2^{x+y} - 2^x}{2^y - 2^{x+y}}$ (d) $\frac{2^{x+y} - 2^x}{2^y}$

67. If $y = C\left[x + \sqrt{(x^2 - 1)}\right]^n + D\left[x - \sqrt{(x^2 - 1)}\right]^{-n}$ and n is positive integer, then the value of $\frac{y_{n+2}}{y_{n+1}}$ is

(a) $\frac{2nx}{1 - x^2}$ (b) $\frac{(2n+1)x}{1 - x^2}$

(c) $\frac{(2n+1)x}{x^2 - 1}$ (d) $\frac{2nx}{x^2 - 1}$

68. If $u = \sin^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to

(a) tan u

(b) sin u

(c) u

(d) None of the above

69. If $x = \sec\theta - \cos\theta$ and $y = \sec^n\theta - \cos^n\theta$, then the value of $(x^2 + 4)\left(\frac{dy}{dx}\right)^2$ is

(a) $\frac{n^2}{x^2 + 4}$ (b) $x^2(y^2 + 4)$

(c) $n(y^2 + 4)$ (d) $n^2(y^2 + 4)$

70. The slope of the tangent to the curve $x = t^2 + 3t - 8$, $y = 2t^2 - 2t - 5$ at $(2, -1)$ is

(a) $\frac{22}{7}$ (b) $\frac{7}{6}$

(c) $\frac{6}{7}$ (d) $-\frac{6}{7}$

71. If $u = \frac{1}{\sqrt{(x^2 + y^2 + z^2)}}$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$ is equal to

(a) -24

(b) -4

(c) 24

(d) None of the above

72. The normal at the point (1, 1) on the curve $2y + x^2 = 3$ is

(a) $x + y = 0$ (b) $x - y = 0$

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

73. The value of the integral

$$\int_a^b \frac{x^n}{x^n + (a + b - x)^n} dx$$

is

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

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

74. The area between the curve $y^2(2a - x) = x^3$ and its asymptote is

(a) πa^2 (b) $3\pi a^2$

(c) $2\pi a^2$ (d) $4\pi a^2$

75. The value of

$$\int_{1/4}^{3/4} \frac{\left(\frac{\pi}{2} + \cos^{-1}x\right) dx}{2\sin^{-1}x + 3\cos^{-1}x + \cos^{-1}(1 - x)}$$

is equal to

(a) $\frac{1}{2}$ (b) $\frac{1}{8}$

(c) 1 (d) $\frac{1}{4}$

76. The pedal equation of the curve is

$r^n = a^n \cos n\theta$

is

(a) $a^n r = p^{n+1}$

(b) $p r^n = a^{n+1}$

(c) $a r^n = p^{n+1}$

(d) $p a^n = r^{n+1}$

77. Which of the following functions defined on [0, 1] is not Riemann integrable ?

(a) Characteristic function of all rational numbers

(b) Identity function

(c) Zero function

(d) Square function

78. If $f(x) = \tan^{-1}\sqrt{\left(\frac{1 + \sin x}{1 - \sin x}\right)}$, where $0 \le x \le \frac{\pi}{2}$, then $f'\left(\frac{\pi}{6}\right)$ is

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

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

79. What will be the remainder if we divide $14^{10} + 2$ by 11 ?

(a) 7 (b) 5

(c) 3 (d) 2

80. The set of all points, where the function

$f(x) = x\,|x|$

is differentiable, is equal to

(a) $[0, \infty]$

(b) $(-\infty, 0)$

(c) $(-1, 1)$

(d) $(-\infty, \infty)$

81. Let (G, o) be a group and ($\mathbf{Z}$, f) be the additive group of integers. If $f : G \longrightarrow \mathbf{Z}$ is a group homomorphism such that $f(a^{-1}) = 3$ and $f(b) = -2$ where $a, b \in G$, then $f(aob^{-1})$ is equal to

(a) 2 (b) –2

(c) 1 (d) –1

82. The minimum number of elements is a non-commutative group will be

(a) 4 (b) 5

(c) 6 (d) 8

83. In group theory, which one of the following statements is correct ?

(a) Abelian groups may have non-abelian subgroups.

(b) Cyclic groups may have non-cyclic subgroups.

(c) Non-abelian groups may have abelian subgroups.

(d) Non-cyclic groups cannot have cyclic subgroups.

84. Area bounded by the curves $y^2 = 2x$ and $y^2 = -4(x - 3)$ is

(a) 8 (b) 4

(c) 2 (d) 16

85. Value of $\int_{-\pi/4}^{\pi/4} \log(\sin x + \cos x)\, dx$ is equal to

(a) $\frac{\pi}{4} \log 2$ (b) $-\frac{\pi}{4} \log 2$

(c) $\frac{\pi}{2} \log 2$ (d) $-\frac{\pi}{2} \log 2$

86. For real x, the minimum value of $\frac{1 - x + x^2}{1 + x + x^2}$ is

(a) 3 (b) 1

(c) $\frac{1}{3}$ (d) 0

87. If $f(x) = x^3$ and $f(x + h) = f(x) + h f'(x) + \frac{h^2}{2!} f''(x + \theta h)$, $0 < \theta < 1$, then the value of θ is

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

(c) $\frac{1}{4}$ (d) $\frac{1}{3}$

88. If $f'(3) = 3$ and $f''(3) = 2$, then $\lim_{x \to 3} \frac{2x^2 - 6 f'(x)}{x - 3}$ is

(a) 0

(b) 1

(c) 3

(d) None of the above

89. Let T be a linear transformation from a 3-dimensional vector space V_1 into a 2-dimensional vector space V_2. Then T can be

(a) injective but not subjective.

(b) subjective but not injective.

(c) both injective and subjective.

(d) neither injective nor subjective.

90. If $f(x) = 2x^2 + 3x + 4$ satisfies the conditions of Lagrange's mean value theorem in the interval [1, 2] and C is a point such that $C \in (1, 2)$, then value of C will be

(a) $\frac{5}{2}$

(b) 2

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

(d) None of the above

81. Let (G, o) be a group and ($\mathbb{Z}$, f) be the additive group of integers. If f : G $\longrightarrow$ $\mathbb{Z}$ is a group homomorphism such that $f(a^{-1}) = 3$ and $f(b) = -2$ where $a, b \in G$, then $f(aob^{-1})$ is equal to

(a) 2 (b) −2

(c) 1 (d) −1

82. The minimum number of elements is a non-commutative group will be

(a) 4 (b) 5

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83. In group theory, which one of the following statements is correct ?

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84. Area bounded by the curves $y^2 = 2x$ and $y^2 = -4(x-3)$ is

(a) 8 (b) 4

(c) 2 (d) 16

$2x = -4x + 12$

$6x = 12$

$x = 2$

85. Value of $\int_{-\pi/4}^{\pi/4} \log(\sin x + \cos x)\, dx$ is equal to

(a) $\frac{\pi}{4}\log 2$ (b) $-\frac{\pi}{4}\log 2$

(c) $\frac{\pi}{2}\log 2$ (d) $-\frac{\pi}{2}\log 2$

86. For real x, the minimum value of $\frac{1-x+x^2}{1+x+x^2}$ is

(a) 3 (b) 1

(c) $\frac{1}{3}$ (d) 0

87. If $f(x) = x^3$ and $f(x+h) = f(x) + h\,f'(x) + \frac{h^2}{2!} f''(x + \theta h)$, $0 < \theta < 1$, then the value of θ is

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

(c) $\frac{1}{4}$ (d) $\frac{1}{3}$

88. If $f'(3) = 3$ and $f''(3) = 2$, then
$$\lim_{x \to 3} \frac{2x^2 - 6\,f'(x)}{x-3}$$
is

(a) 0

(b) 1

(c) 3

(d) None of the above

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90. If $f(x) = 2x^2 + 3x + 4$ satisfies the conditions of Lagrange's mean value theorem in the interval [1, 2] and C is a point such that $C \in (1, 2)$, then value of C will be

(a) $\frac{5}{2}$

(b) 2

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

(d) None of the above

91. The angle between the straight lines represented by $x^2 - xy - 2y^2 = 0$ is

(a) $\tan^{-1}(-2)$ (b) $\tan^{-1}(-3)$

(c) $\tan^{-1}(1)$ (d) $\tan^{-1}(2)$

92. The probability of getting the sum as a prime number when two dice are thrown together, is

(a) $\frac{1}{2}$ (b) $\frac{7}{12}$

(c) $\frac{5}{12}$ (d) None of these

93. The eccentricity of the hyperbola which passes through the points $(3\sqrt{2}, 2)$ and $(3, 0)$ is

(a) $\frac{\sqrt{13}}{3}$ (b) $\frac{\sqrt{7}}{5}$

(c) $\frac{\sqrt{13}}{5}$ (d) $\frac{\sqrt{13}}{7}$

94. A straight line which makes an angle of 60° with each of y-and z-axes, is inclined with x-axis at an angle

(a) 30° (b) 45°

(c) 60° (d) 75°

95. If $|\vec{a} \times \vec{b}| - \sqrt{3}\ |\vec{a} \cdot \vec{b}| = 0$, then the angle between $\vec{a}$ and $\vec{b}$ is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$

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

96. If $\hat{a}, \hat{b}, \hat{c}$ are unit vectors such that $\hat{a} + \hat{b} + \hat{c} = \vec{0}$, then $(\hat{a} \cdot \hat{b} + \hat{b} \cdot \hat{c} + \hat{c} \cdot \hat{a})$ is equal to

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

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

1+1+1+2

97. Moment of the force, represented by $\hat{i} + 2\hat{j} + 3\hat{k}$ and passing through the point $2\hat{i} + 3\hat{j} + \hat{k}$, about the point $\hat{i} + 2\hat{j} - \hat{k}$ is

(a) $\hat{i} + \hat{j} + \hat{k}$ (b) $\hat{i} + \hat{j} - \hat{k}$

(c) $\hat{i} - \hat{j} - \hat{k}$ (d) $-\hat{i} - \hat{j} + \hat{k}$

F=F.

98. If the line $\bar{r} = \bar{a} + t\bar{b}$ intersects the line $\bar{r} \cdot \bar{n}_1 + d_1 = 0 = \bar{r} \cdot \bar{n}_2 + d_2$, then

(a) $\dfrac{\bar{b} \cdot \bar{n}_1 + d_1}{\bar{a} \cdot \bar{n}_1} = \dfrac{\bar{b} \cdot \bar{n}_2 + d_2}{\bar{a} \cdot \bar{n}_2}$

(b) $\dfrac{|\bar{a} \times \bar{n}_1| + d_1}{\bar{b} \cdot \bar{n}_1} = \dfrac{|\bar{a} \times \bar{n}_2| + d_2}{\bar{b} \cdot \bar{n}_2}$

(c) $\dfrac{\bar{a} \cdot \bar{n}_1 + d_1}{\bar{b} \cdot \bar{n}_1} = \dfrac{\bar{a} \cdot \bar{n}_2 + d_2}{\bar{b} \cdot \bar{n}_2}$

(d) None of the above

99. Forces of magnitude 5, 3, 1 units act in the directions $6\hat{i} + 2\hat{j} + 3\hat{k}$, $3\hat{i} - 2\hat{j} + 6\hat{k}$, $2\hat{i} - 3\hat{j} - 6\hat{k}$ respectively on a particle which is displaced from the point (2, –1, –3) to (5, –1, 1). The total work done is

(a) 33 units (b) 231 units

(c) 69 units (d) 49 units

100. The value of $[\hat{i}, \hat{k}, \hat{j}] + [\hat{k}, \hat{j}, \hat{i}] + [\hat{j}, \hat{k}, \hat{i}]$ is

(a) 1 (b) 3

(c) –3 (d) –1

101. If the polars of (x_1, y_1) and (x_2, y_2) with respect to hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ are at right angles, then

(a) $\frac{x_1x_2}{y_1y_2} + \frac{a^2}{b^2} = 0$ (b) $\frac{y_1y_2}{x_1x_2} + \frac{a^4}{b^4} = 0$

(c) $\frac{x_1x_2}{y_1y_2} - \frac{a^4}{b^4} = 0$ (d) $\frac{x_1x_2}{y_1y_2} + \frac{a^4}{b^4} = 0$

102. The equation $13x^2 - 18xy + 37y^2 + 2x + 14y - 2 = 0$ represents

(a) a hyperbola
(b) a pair of straight lines
(c) a parabola
(d) an ellipse

103. The difference of the focal distances of a point on a hyperbola is equal to

(a) the eccentricity of the hyperbola.
(b) the distance between foci of the hyperbola.
(c) the length of the transverse axis of the hyperbola.
(d) the half of the length of the transverse axis of the hyperbola.

104. The angle between the lines $x = 1$, $y = 2$ and $y = -1$, $z = 0$ is

(a) 60° (b) 90°
(c) 30° (d) 0°

105. The angle between the line $\bar{r} = \bar{a} + t\bar{b}$ and plane $\bar{r} \cdot \bar{n} + d = 0$ is equal to

(a) $\cos^{-1} \frac{|\bar{b} \times \bar{n}|}{|\bar{b}|\,|\bar{n}|}$ (b) $\cos^{-1} \frac{|\bar{b} \cdot \bar{n}|}{|\bar{b}|\,|\bar{n}|}$

(c) $\sin^{-1} \frac{|\bar{b} \times \bar{n}|}{|\bar{b}|\,|\bar{n}|}$ (d) $\sin^{-1} \frac{|\bar{a} \times \bar{n}|}{|\bar{a}|\,|\bar{n}|}$

106. Work done by the conservative force $\bar{F} = 3x^2y\,\hat{i} + (x^3 + 2yz)\,\hat{j} + y^2\hat{k}$ in moving an object from (1, –2, 1) to (3, 1, 4) along a curve is

(a) 25 (b) 26
(c) 28 (d) 29

107. The straight lines OP and OQ are drawn from O in space with direction ratios 1, –2, –1 and 3, –2, 3. The direction ratios of the normal to the plane POQ are

(a) 4, 3, –2 (b) 2, 3, –2
(c) 1, 2, –1 (d) 3, 2, – 4

108. The shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{2x-2}{3} = \frac{3y-5}{9} = \frac{-z+3}{5}$ is

(a) 3
(b) 2
(c) 0
(d) None of the above

109. The distance between the planes $2x - 2y + z + 3 = 0$ and $4x - 4y + 2z + 5 = 0$, is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{6}$ (d) $\frac{1}{\sqrt{2}}$

110. For what values of k the straight line $x + y = k$ will be tangent to the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1$?

(a) ± 10 (b) ± 6
(c) ± 5 (d) ± 3

$c = \sqrt{a^2m^2 + b^2}$

(3,4,5) (3,0,5) $\sqrt{3^2+5^2}$

111. The equation of the plane bisecting the acute angle between the planes $x + y + z + 3 = 0$ and $2x - y + 3z + 5 = 0$ is

(a) $\sqrt{14}\,(x + y + z + 3) = \sqrt{3}\,(2x - y + 3z + 5)$

(b) $\sqrt{14}\,(2x - y + 3z + 5) = \sqrt{3}\,(x + y + z + 3)$

(c) $\sqrt{14}\,(2x - y + 3z + 5) = -\sqrt{3}\,(x + y + z + 3)$

(d) $\sqrt{14}\,(x + y + z + 3) = -\sqrt{3}\,(2x - y + 3z + 5)$

112. If a line makes an angle α, β and γ with the coordinate axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is equal to

(a) 0

(b) 1

(c) 2

(d) None of the above

113. The equation to the plane passing through the points (2, 3, – 4) and (1, –1, 3) and parallel to x-axis is

(a) $2x + 3 = 0$ x=0

(b) $7y + 4z = 5$ 2y-z.

(c) $2y + 3z = 5$

(d) None of the above

114. If two lines $x - \alpha = 0$ and $y - \beta = 0$ are conjugate with respect to the hyperbola $xy = c^2$, then

(a) $\alpha\beta = 2c^2$ (b) $\alpha\beta = c^2$

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

115. The distance of the point (3, 4, 5) from the y-axis is

(a) $\sqrt{41}$ (b) $\sqrt{34}$ 4

(c) 5 (d) 3

3×0 + 4×1 + 5 $\sqrt{50}$

116. The orthocentre of the triangle formed by the lines $xy = 0$ and $x + y = 1$ is

(a) $\left(\frac{1}{4}, \frac{1}{4}\right)$ (b) (0, 0)

(c) $\left(\frac{1}{3}, \frac{1}{3}\right)$ (d) $\left(\frac{1}{2}, \frac{1}{2}\right)$

117. The value of $\oint_C (yzdx + zxdy + xydz)$ where C is the intersection of $x^2 + 9y^2 = 9$ and $Z = y^2 + 1$ is

(a) $-\pi$

(b) 21

(c) 0.

(d) None of the above

118. If $\bar{F} = x^2y\hat{i} + zx\hat{j} + 2yz\hat{k}$, then the value of curl $\bar{F}$ at the point (–1, 1, 1) will be

(a) $\hat{i} + \hat{j}$ (b) $\hat{j} + \hat{k}$

(c) $3\hat{i}$ (d) $3\hat{k}$

119. Which one of the following is incorrect statement for a ring $(R, +, \cdot)$?

(a) $a \cdot 0 = 0 = 0 \cdot a\ \forall a \in R$

(b) $a \cdot (-b) = -(ab) = (-a) \cdot b,\ \forall a, b \in R$

(c) $(-a) \cdot (-b) = ab\ \forall a, b \in R$

(d) $a \cdot b = 0 \Rightarrow a = 0$ or $b = 0$, $a, b \in R$

120. Number of group homomorphism from the group $(\mathbb{Z}_{10}, +_{10})$ to group $(\mathbb{Z}, +)$ is

(a) $\underline{|10}$

(b) number of divisors of 10

(c) infinite

(d) None of the above

121. The number of elements in the cyclic subgroup generated by $\frac{1+i}{\sqrt{2}}$ of the group e* of the non-zero complex numbers under multiplication is

(a) 4 (b) 6

(c) 8 (d) 16

(3, 4, 5) (3, 0, 5) $\sqrt{3^2+5^2}$

111. The equation of the plane bisecting the acute angle between the planes $x + y + z + 3 = 0$ and $2x - y + 3z + 5 = 0$ is

(a) $\sqrt{14}\,(x + y + z + 3) = \sqrt{3}\,(2x - y + 3z + 5)$

(b) $\sqrt{14}\,(2x - y + 3z + 5) = \sqrt{3}\,(x + y + z + 3)$

(c) $\sqrt{14}\,(2x - y + 3z + 5) = -\sqrt{3}\,(x + y + z + 3)$

(d) $\sqrt{14}\,(x + y + z + 3) = -\sqrt{3}\,(2x - y + 3z + 5)$

112. If a line makes an angle α, β and γ with the coordinate axes, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is equal to

(a) 0

(b) 1

(c) 2

(d) None of the above

113. The equation to the plane passing through the points $(2, 3, -4)$ and $(1, -1, 3)$ and parallel to x-axis is

(a) $2x + 3 = 0$

(b) $7y + 4z = 5$ 2y - z.

(c) $2y + 3z = 5$

(d) None of the above

114. If two lines $x - \alpha = 0$ and $y - \beta = 0$ are conjugate with respect to the hyperbola $xy = c^2$, then

(a) $\alpha\beta = 2c^2$ (b) $\alpha\beta = c^2$

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

115. The distance of the point (3, 4, 5) from the y-axis is

(a) $\sqrt{41}$ (b) $\sqrt{34}$

(c) 5 (d) 3

3×0 + 4×1 + 5

116. The orthocentre of the triangle formed by the lines $xy = 0$ and $x + y = 1$ is

(a) $\left(\frac{1}{4}, \frac{1}{4}\right)$ (b) (0, 0)

(c) $\left(\frac{1}{3}, \frac{1}{3}\right)$ (d) $\left(\frac{1}{2}, \frac{1}{2}\right)$

117. The value of $\oint_C (yzdx + zxdy + xydz)$ where C is the intersection of $x^2 + 9y^2 = 9$ and $Z = y^2 + 1$ is

(a) $-\pi$

(b) 21

(c) 0.

(d) None of the above

118. If $\bar{F} = x^2y\hat{i} + zx\hat{j} + 2yz\hat{k}$, then the value of curl $\bar{F}$ at the point $(-1, 1, 1)$ will be

(a) $\hat{i} + \hat{j}$ (b) $\hat{j} + \hat{k}$

(c) $3\hat{i}$ (d) $3\hat{k}$

119. Which one of the following is incorrect statement for a ring $(R, +, \cdot)$?

(a) $a \cdot 0 = 0 = 0 \cdot a\ \forall a \in R$

(b) $a \cdot (-b) = -(ab) = (-a) \cdot b,\ \forall a, b \in R$

(c) $(-a) \cdot (-b) = ab\ \forall a, b \in R$

(d) $a \cdot b = 0 \Rightarrow a = 0$ or $b = 0$, $a, b \in R$

120. Number of group homomorphism from the group $(\mathbb{Z}_{10}, +_{10})$ to group $(\mathbb{Z}, +)$ is

(a) $\underline{|10}$

(b) number of divisors of 10

(c) infinite

(d) None of the above

121. The number of elements in the cyclic subgroup generated by $\frac{1+i}{\sqrt{2}}$ of the group e* of the non-zero complex numbers under multiplication is

(a) 4 (b) 6

(c) 8 (d) 16

122. The remainder, when 3^{47} is divided by 23, is

(a) 1 (b) 2

(c) 3 (d) 4

123. If $r = |\bar{r}|$ where $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then grad r^m is equal to

(a) $m\,r^{m-2}\,\bar{r}$

(b) $m\,r^{m-1}\,\bar{r}$

(c) $m\,r^{m-2}\,\hat{r}$

(d) None of the above

124. Which of the following statements is true ?

(a) $\mathbb{Z}_n$ has zero divisors if n is not prime.

(b) Ring $n\mathbb{Z}$ has zero divisors if n is not prime.

(c) The characteristic of ring $n\mathbb{Z}$ is n.

(d) As a ring $\mathbb{Z}$ is isomorphic to $n\mathbb{Z}$.

125. If 'a' be an element of order n in a group G and p be prime to n, then $o(a^p)$ is equal to

(a) $\dfrac{p^2+1}{n}$

(b) p^2/n

(c) p^n

(d) None of the above

126. The converse of the Lagrange's theorem for a group does not hold in the

(a) Klein's four group V_4

(b) Hamiltonian group Q_8

(c) Symmetric group S_3

(d) Alternating group A_4

127. For a non-empty subset H of a finite group (G, o) to be a subgroup the condition $a, b \in H \Rightarrow aob \in H$ is

(a) only necessary but not sufficient

(b) only sufficient but not necessary

(c) neither necessary nor sufficient

(d) necessary as well as sufficient

128. If w_1 and w_2 are two subspaces of a vector space V where dim V = 50, dim w_1 = 49, dim w_2 = 45 and $w_2 \not\subseteq w_1$, then dim $(w_1 \cap w_2)$ is equal to

(a) 49 (b) 45

(c) 44 (d) 4

129. If $W_1 = \{(x, y, z) : x, y, z \in \mathbb{R}$ and $x - 2y + z = 0\}$ and $W_2 = \{(x, y, z) : x, y, z \in \mathbb{R}$ and $x = y = z\}$ are subspaces of the vector space $\mathbb{R}^3(\mathbb{R})$, then $W_1 + W_2$ is

(a) $\mathbb{R}^3$

(b) W_1

(c) W_2

(d) None of the above

130. Let the linear transformation $T : \mathbb{R}^2(\mathbb{R}) \to \mathbb{R}^3(\mathbb{R})$ be defined by $T(x, y) = (-x - y, 3x + 8y, 9x - 11y)$. Then the rank and nullity of T are respectively

(a) 2 and 0

(b) 1 and 1

(c) 0 and 2

(d) None of the above

131. Let w_1, w_2 be two subspaces of a vector space V. Then the smallest subspace of V containing w_1 and w_2 is

(a) $w_1 \cup w_2$

(b) $w_1 \cap w_2$

(c) $w_1 + w_2$

(d) None of the above

132. If T_1 and T_2 are linear transformations on the vector space $\mathbb{R}^3(\mathbb{R})$ such that rank of $T_1 = 2$ and $T_2^{\,2} = I$, then the rank of $T_1 o T_2$ will be

(a) 3 (b) 1

(c) 0 (d) 2

133. The value of $\iint_S \vec{r}.\hat{n}\, ds$, where s is part of the sphere $x^2 + y^2 + z^2 = 1$ above xy – plane, is

(a) $\frac{4}{3}\pi$ (b) 4π

(c) $\frac{2}{3}\pi$ (d) 2π

134. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector then grad $(\bar{a} \cdot \bar{r})$ is equal to

(a) $\bar{r}$

(b) $r^2\bar{a}$

(c) $\bar{a}$

(d) None of the above

135. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector, then curl$(\bar{a} \times \bar{r})$ is equal to

(a) $\bar{0}$ (b) $\bar{a}$

(c) $2\bar{a}$ (d) $3\bar{a}$

136. If $\vec{p} = \vec{A}\cos kt + \vec{B}\sin kt$, where $\vec{A}$ and $\vec{B}$ are constant vectors and K is a constant scalar, the value of $\frac{d}{dt}\left(\vec{p} \times \frac{d\vec{p}}{dt}\right)$ is equal to

(a) $|p|^2$

(b) $\vec{0}$

(c) $2\vec{p}$

(d) None of the above

137. The area bounded by a simple closed curve C is equal to

(a) $\oint_C (x\,dy + y\,dx)$

(b) $\oint_C (x\,dy - y\,dx)$

(c) $\frac{1}{2}\oint_C (x\,dy + y\,dx)$

(d) $\frac{1}{2}\oint_C (x\,dy - y\,dx)$

138. The minimum force parallel to a rough plane which will prevent a body of weight 20 kg from sliding down the plane inclined at an angle 30° to the horizon (coefficient of the friction of the rough plane is $\frac{1}{2\sqrt{3}}$) is

(a) 10 kg.wt.

(b) 5 kg.wt.

(c) $5\sqrt{3}$ kg.wt.

(d) None of the above

139. A sphere impinges directly on an equal sphere at rest. If the coefficient of restitution is $\frac{1}{2}$, then their velocities after impact will be in the ratio

(a) 3 : 4 (b) 1 : 2

(c) 1 : 3 (d) 2 : 3

140. The distance of the centre of gravity of a thin uniform hemispherical shell, whose radius is a, from the centre is

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

(c) $\frac{a^2}{2}$ (d) $\frac{a^2}{4}$

141. If the horizontal range of a projectile is $4\sqrt{3}$ times its maximum height, then its angle of projection is

(a) 60° $\frac{\sqrt{3}}{2}$

(b) 45°

(c) 30°

(d) None of the above

133. The value of $\iint_S \vec{r}.\hat{n}\, ds$, where s is part of the sphere $x^2 + y^2 + z^2 = 1$ above xy – plane, is

(a) $\frac{4}{3}\pi$ (b) 4π

(c) $\frac{2}{3}\pi$ (d) 2π

134. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector then grad $(\bar{a} \cdot \bar{r})$ is equal to

(a) $\bar{r}$

(b) $r^2\bar{a}$

(c) $\bar{a}$

(d) None of the above

135. If $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\bar{a}$ is a constant vector, then curl$(\bar{a} \times \bar{r})$ is equal to

(a) $\bar{0}$ (b) $\bar{a}$

(c) $2\bar{a}$ (d) $3\bar{a}$

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(b) $\vec{0}$

(c) $2\vec{p}$

(d) None of the above

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(b) $\oint_C (x\,dy - y\,dx)$

(c) $\frac{1}{2}\oint_C (x\,dy + y\,dx)$

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141. If the horizontal range of a projectile is $4\sqrt{3}$ times its maximum height, then its angle of projection is

(a) 60° $\frac{\sqrt{3}}{2}$

(b) 45°

(c) 30°

(d) None of the above

142. For a common catenary, which one of the following relations is not correct ?

(a) $y = c \cosh\left(\frac{x}{c}\right)$

(b) $y^2 = c^2 + s^2$

(c) $y = c \sec \psi$

(d) $x = \log(\sec \psi + \tan \psi)$

143. If a uniform heavy string of length l is suspended between two points in the same horizontal line distance a apart, then the parameter c of the cantenary is given by

(a) $l = 2c \sin h \frac{a}{2c}$

(b) $l = c \sin h \frac{a}{c}$

(c) $l = 2c \sin h \frac{a}{c}$

(d) $l = c \sin h \frac{a}{2c}$

144. If a particle moves on a curve $r = ae^{\theta}$ with constant velocity, then its acceleration is proportional to

(a) $\frac{1}{r}$ (b) r

(c) $\frac{1}{r^2}$ (d) r^2

145. Forces equal to 3P, 5P and 7P act along the sides BC, CA and AB respectively of an equilateral triangle ABC, the magnitude of their resultant is

(a) 3P (b) $2\sqrt{5}$ P

(c) $2\sqrt{3}$ P (d) 15 P

146. The value of expression

$\frac{(\sin \alpha + i \cos \alpha)^4}{(\cos \alpha - i \sin \alpha)^3}$ is

(a) $\cos \alpha + i \sin \alpha$

(b) $\cos \alpha - i \sin \alpha$

(c) $\sin \alpha + i \cos \alpha$

(d) $\sin \alpha - i \cos \alpha$

147. If $|z - \frac{2}{z}| = 6$, then the greatest value of $|z|$ is

(a) $-3 + \sqrt{11}$

(b) $3 - \sqrt{11}$

(c) $3 + \sqrt{11}$

(d) None of the above

148. If $|z_1 + z_2| = |z_1| + |z_2|$ then the value of $\mathrm{Arg}(z_1) - \mathrm{Arg}(z_2)$ is

(a) 0 (b) $\frac{\pi}{2}$

(c) $\frac{\pi}{4}$ (d) π

149. The equation, whose roots are the n^{th} powers of the roots of the equation $x^2 - 2x \cos \theta + 1 = 0$ is

(a) $x^2 + 2x \cos n\theta + 1 = 0$

(b) $x^2 - 2x \sin n\theta + 1 = 0$

(c) $x^2 + 2x \sin n\theta + 1 = 0$

(d) $x^2 - 2x \cos n\theta + 1 = 0$

150. If $\tan^{-1}2x + \tan^{-1}3x = \frac{\pi}{4}$, then the only solution of this equation for x will be

(a) $x = \frac{1}{6}$ (b) $x = \frac{1}{5}$

(c) $x = 1$ (d) $x = \frac{1}{3}$

$5x = 1$
$x = \frac{1}{5}$