SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC | **EMACET MODEL** | **Date: 17/04/2020**
Time: 3 Hours | | **Max. Marks: 160**

MATHS – 2A

Syllabus: Unit I & II

1. **Which of the following is not periodic?**

1) $|\sin 3x| + \sin^2 x$ 2) $\cos\sqrt{x} + \cos^2 x$ 3) $\cos 4x + \tan^2 x$ 4) $\cos 2x + \sin x$

2. **A function f from the set of natural numbers to integers defined by**

$$f(n) = \begin{cases} \frac{n-1}{2}, \text{ when n is odd} \\ \frac{-n}{2} \text{ when n is even} \end{cases}$$ is

1) one – one but not onto 2)one – one and onto both
3)onto but not one-one 4) neither one-one nor onto

3. **If $f: R \to R$ satisfies $f(x+y) = f(x) + f(y)$, for all $x, y \in R$ and $f(1) = 7$, then $\sum_{r=1}^{n} f(r)$ is equal to**

1) $\frac{7n}{2}$ 2) $\frac{7(n+1)}{2}$ 3) $7n(n+1)$ 4) $\frac{7n(n+1)}{2}$

4. **The function $f(x) = \log\left(x + \sqrt{x^2+1}\right)$ is**

1) an even function 2) an odd function
3)a periodic function 4) neither an even nor an odd function

5. **If $f: R \to S$, defined by $f(x) = \sin x - \sqrt{3}\cos x + 1$, is onto, then interval of S is**

1) $[0,3]$ 2) $[-1,1]$ 3) $[0,1]$ 4) $[-1,3]$

6. **In a triangle with sides $a, b, c, r_1 > r_2 > r_3$ (which are the ex-radii) then**

1) $a > b > c$ 2) $a < b < c$ 3) $a > b \text{ and } b < c$ 4) $a < b \text{ and } b > c$

7. **The sides of triangle $3x+4y, 4x+3y \text{ and } 5x+5y$ where $x, y > 0$ then the triangle is**

1) right angled 2) obtuse angled 3) equilateral 4) none of these

8. **If in a triangle ABC, $a\cos^2\left(\frac{C}{2}\right) + c\cos^2\left(\frac{A}{2}\right) = \frac{3b}{2}$, then the sides a, b and c**

1) are in A.P 2) are in G.P 3) are in M.P 4) satisfy a+b=c

9. **If the lengths of the sides of triangle are 3, 5, and 7, then the largest angle of the triangle is**

1) $\frac{\pi}{2}$ 2) $\frac{5\pi}{6}$ 3) $\frac{2\pi}{3}$ 4) $\frac{3\pi}{4}$

10. **In triangle ABC, $\angle B = \frac{\pi}{3}, \text{and } \angle C = \frac{\pi}{4}$. Let D divide BC internally in the ratio 1 : 3. Then $\frac{\sin \angle BAD}{\sin \angle CAD}$ equals**

1) $\frac{1}{\sqrt{6}}$ 2) $\frac{1}{3}$ 3) $\frac{1}{\sqrt{3}}$ 4) $\sqrt{\frac{2}{3}}$

11. **2+3+5+6+8+9+………2n terms =**

1) $3n^2+2n$ 2) $4n^2+2n$ 3) $4n^2$ 4) none

12. **In the sequence $\{1\}, \{2,3\}, \{4,5,6\}, \{7,8,9,10\}, ...$ of sets the sum of elements in the 50th set is**

1) 62525 2) 65225 3) 56255 4) 55625

13. **If $n \in N$ then $n^3 + 2n$ is divisible by**

1) 3 2) 8 3) 9 4) 11

14. $\sinh\left[\log\left(2+\sqrt{5}\right)\right]=$

1) 2 2) 3 3) $2-\sqrt{5}$ 4) $2+\sqrt{5}$

15. $\dfrac{1+\tanh\frac{x}{2}}{1-\tanh\frac{x}{2}}=$

1) e^{-x} 2) e^{x} 3) $2e^{\frac{x}{2}}$ 4) $2e^{\frac{-x}{2}}$

16. If the function $f:[1,\infty)\to[1,\infty)$ is defined by $f(x)=2^{x(x-1)}$, then $f^{-1}(x)$ is

1) $\left(\frac{1}{2}\right)^{x(x-1)}$ 2) $\frac{1}{2}\left(1+\sqrt{1+4\log_2 x}\right)$

3) $\frac{1}{2}\left(1-\sqrt{1+4\log_2 x}\right)$ 4) not defined

17. Let α *and* β be such that $\pi<\alpha-\beta<3\pi$. If $\sin\alpha+\sin\beta=-21/65$ and $\cos\alpha+\cos\beta=-27/65$, then the value of $\cos\left[(\alpha-\beta)/2\right]$ is

1) $-\frac{3}{\sqrt{130}}$ 2) $\frac{3}{\sqrt{130}}$ 3) $\frac{6}{65}$ 4) $\frac{6}{-65}$

18. If $0<x<\pi$ and $\cos x+\sin x=1/2$, then $\tan x$ is

1) $\frac{\left(1-\sqrt{7}\right)}{4}$ 2) $\frac{\left(4-\sqrt{7}\right)}{3}$ 3) $-\frac{4+\sqrt{7}}{3}$ 4) $\frac{1+\sqrt{7}}{4}$

19. Let $\cos(\alpha+\beta)=4/5$ and let $\sin(\alpha-\beta)=5/13$, where $0\le\alpha,\beta\le\pi/4$. Then $\tan 2\alpha$ is equal to

1) $\frac{20}{7}$ 2) $\frac{25}{16}$ 3) $\frac{56}{33}$ 4) $\frac{19}{12}$

20. In a ΔPQR, if $3\sin P+4\cos Q=6$ *and* $4\sin Q+3\cos P=1$, Then the angle R is equal to:

1) $\frac{5\pi}{6}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{4}$ 4) $\frac{3\pi}{4}$

21. The expression $\frac{\tan A}{1-\cot A}+\frac{\cot A}{1-\tan A}$ can be written as:

1) $\sin A\cos A+1$ 2) $\sec A\,\mathrm{cosec}\,A+1$ 3) $\tan A+\cot A$ 4) $\sec A+\mathrm{cosec}\,A$

22. Given $A=\sin^2\theta+\cos^4\theta$, then for all real θ,

1) $1\le A\le 2$ 2) $3/4\le A\le 1$ 3) $13/16\le A\le 1$ 4) $3/4\le A\le 13/16$

23. The value of $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$ is

1) 1/4 2) 3/4 3) 1/8 4) 3/8

24. The value of the expression $\sqrt{3}\cos ec20\circ-\sec 20^\circ$ is equal to

1) 2 2) $2\sin 20^\circ/\sin 40^\circ$ 3) 4 4) $4\sin 20^\circ/\sin 40^\circ$

25. The number of solutions to $\tan x+\sec x=2\cos x$ in $[0,2\pi]$ is

1) 2 2) 3 3) 0 4) 1

26. The number of values of x in the interval $[0,3\pi]$ satisfying the equation $2\sin^2 x+5\sin x-3=0$ is

1) 4 2) 6 3) 1 4) 2

27. The general solution of the trigonometric equation $\sin x+\cos x=1$ is given by

1) $x=2n\pi, n=0,\pm1,\pm2,.....$ 2) $x=2n\pi+\pi/2; n=0,\pm1,\pm2,.....$

3) $x=n\pi+(-1)^n\frac{\pi}{4}-\frac{\pi}{4}n=0,\pm1,\pm2,.....$ 4) none of these

28. **The equation** $(\cos p-1)x^2+(\cos p)x+\sin p=0$ **in the variable *x* has real roots. Then p can take any value in the interval**

1) $(0,2\pi)$ 2) $(-\pi,0)$ 3) $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ 4) $(0,\pi)$

29. **The number of solutions of the equation** $\tan x+\sec x=2\cos x$ **lying in the interval** $[0,2\pi]$ **is**

1) 0 2) 1 3) 2 4) 3

30. **The general values of** θ **satisfying the equation** $2\sin^2\theta-3\sin\theta-2=0\ is\ (n\in z)$

1) $n\pi+(-1)^n\pi/6$ 2) $n\pi+(-1)^n\pi/2$ 3) $n\pi+(-1)^n 5\pi/6$ 4) $n\pi+(-1)^n 7\pi/6$

31. **The number of distinct real roots of** $\begin{vmatrix}\sin x & \cos x & \cos x\\ \cos x & \sin x & \cos x\\ \cos x & \cos x & \sin x\end{vmatrix}=0$ **in the interval** $-\frac{\pi}{4}\le x\le\frac{\pi}{4}\ is$ **is**

1) 0 2) 2 3) 1 4) 3

32. **The number of integral values of K for which the equation** $7\cos x+5\sin x=2k+1$ **has a solution is**

1) 4 2) 8 3) 10 4) 12

33. $\cot^{-1}\left(\sqrt{\cos a}\right)-\tan^{-1}\left(\sqrt{\cos a}=x\right.$**, then sin *x* is equal to**

1) $\tan^2\frac{a}{2}$ 2) $\cot^2\frac{a}{2}$ 3) $\tan a$ 4) $\cot\frac{a}{2}$

34. **The trigonometric equation** $\sin^{-1}x=2\sin^{-1}a$ **has a solution for**

1) $\frac{1}{2}<|a|<\frac{1}{\sqrt{2}}$ 2) All real values of a 3) $|a|<1/2$ 4) $|a|\ge\frac{1}{\sqrt{2}}$

35. **If** $\sin^{-1}\frac{x}{5}+\operatorname{cosec}^{-1}\frac{5}{4}=\frac{\pi}{2}$**, then a value of *x* is**

1) 1 2) 3 3) 4 4) 5

36. **The function** $f(x)=\tan^{-1}(\sin x+\cos x)$ **is an increasing function in**

1) $\left(\frac{\pi}{4},\frac{\pi}{2}\right)$ 2) $\left(-\frac{\pi}{2},\frac{\pi}{4}\right)$ 3) $\left(0,\frac{\pi}{2}\right)$ 4) $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$

37. **The value of** $\cot\left(\operatorname{cosec}^{-1}\frac{5}{3}+\tan^{-1}\frac{2}{3}\right)$ **is**

1) $\frac{6}{17}$ 2) $\frac{3}{17}$ 3) $\frac{4}{17}$ 4) $\frac{5}{17}$

38. **The value of** $\tan\left[\cos^{-1}\left(\frac{4}{5}\right)+\tan^{-1}\left(\frac{2}{3}\right)\right]$ **is**

1) $\frac{6}{17}$ 2) $\frac{7}{16}$ 3) $\frac{16}{7}$ 4) none of these

39. **The principal value of** $\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$ **is**

1) $\frac{-2\pi}{3}$ 2) $\frac{2\pi}{3}$ 3) $\frac{\pi}{3}$ 4) $\frac{5\pi}{3}$

40. **If we consider only the principal values of the inverse trigonometric functions, then the value of** $\tan\left(\cos^{-1}\frac{1}{5\sqrt{2}}-\sin^{-1}\frac{4}{\sqrt{17}}\right)$ **is**

1) $\frac{\sqrt{29}}{3}$ 2) $\frac{29}{3}$ 3) $\frac{\sqrt{3}}{29}$ 4) $\frac{3}{29}$

MATHS – 2B

41. If A, B, C are collinear pts, such that A(3, 4), B(7, 7) and AC = 10 then C =
1) (5, 2) 2) (–5, 2) 3) (–5, –2) 4)(5, –2)

42. The vertices of a triangle are (6, 6), (0, 6), (6, 0). The distance between the circumcentre and certroid is
1) $2\sqrt{2}$ 2) 2 3) $\sqrt{2}$ 4) 1

43. If a, b, c are in A.P and x, y, z are in G.P. The points (a, x), (b, y), (c, z) are collinear, if
1) $x^2 = y$ 2) $x = z^2$ 3) $y^2 = z$ 4) $x = y = z$

44. The locus of the point represented by $x = \cos^2 t,\ y = 2\sin t$ is
1) $y^2 = 4x$ 2) $y^2 - 4x = 4$ 3) $y^2 + 4x = 1$ 4) $y^2 + 4x = 4$

45. A straight rod of length 9 unit, sides with its ends A, B always on the x and y axes respectively. Then the locus of the centroid of ΔOAB is
1) $x^2 + y^2 = 3$ 2) $x^2 + y^2 = 9$ 3) $x^2 + y^2 = 1$ 4) $x^2 - y^2 = a^2$

46. If A(a, 0), B(–a, 0) are two pts, if a point P moves such that $\angle PAB - \angle PBA = \frac{\pi}{2}$, the locus of P is
1) $x^2 + y^2 = a^2$ 2) $x^2 - y^2 + a^2 = 9$ 3) $x^2 - 2xy - y^2 = a^2$ 4) $x^2 + y^2 = 81$

47. If A(2, 3), B(–2, 3) are two pts, the locus of P which moves such that $PA - PB = 4$ is
1) $y + 3 = 0$ 2) $y - 3 = 0$ 3) $y^2 + 3 = 0$ 4) $y^2 - 3 = 0$

48. The transformed equation of $x\sin\alpha - y\cos\alpha = P$ when the axes are rotated through an angle α is
1) X = P 2) Y = P 3) X+P = 0 4) $Y + P = 0$

49. The line joining the ptsA(2, 0), B(3, 1) is rotated through an angle of 45°, about A in the anticlockwise direction. The coordinates of B in the new position is
1) $\left(2, \sqrt{2}\right)$ 2) $\left(\sqrt{2}, 2\right)$ 3) $(2, 2)$ 4) $\left(\sqrt{2}, \sqrt{2}\right)$

50. The angle of rotation of the axes so that the equation $\sqrt{3}x - y + 5 = 0$ may be reduced to the form Y = constant is
1) $\frac{\pi}{6}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{2}$

51. The pt. A(2, 1) is translated parallel to the line $x - y = 3$ by a distance 4 units. If the new position A' is in the third quadrant, then the coordinates of A' are
1) $\left(2+2\sqrt{2}, 1+2\sqrt{2}\right)$ 2) $\left(-2+2\sqrt{2}, -1-2\sqrt{2}\right)$ 3) $\left(2-2\sqrt{2}, 1-2\sqrt{2}\right)$ 4) $\left(-2+2\sqrt{2}, 1-2\sqrt{2}\right)$

52. The area of a triangle is 5sq.units. Two of its vertices are (2, 1), (3, –2) and the third vertex lies on the line $y = x + 3$ the third vertex can be
1) $\left(\frac{7}{2}, \frac{13}{2}\right)$ 2) $\left(\frac{3}{2}, \frac{3}{2}\right)$ 3) $\left(\frac{7}{2}, -\frac{13}{2}\right)$ 4) $\left(\frac{3}{2}, -\frac{3}{2}\right)$

53. If t_1, t_2, t_3 are distinct the pts. $\left(t_1, 2at_1 + at_1^3\right), \left(t_2, 2at_2 + at_2^3\right)$ and $\left(t_3, 2at_3 + at_3^3\right)$ are collinear, if
1) $t_1t_2t_3 = 1$ 2) $t_1 + t_2 + t_3 = t_1t_2t_3$ 3) $t_1 + t_2 + t_3 = 0$ 4) $t_1 + t_2 + t_3 = -1$

54. An equation of a line whose segment between the coordinate axes is divided by the pt. $\left(\frac{1}{2}, \frac{1}{3}\right)$ in the ratio 2 : 3 is
1) $6x + 9y = 5$ 2) $9x + 6y = 5$ 3) $4x + 9y = 5$ 4) $9x + 4y = 5$

55. The combined equation of the sides of a triangle is $\left(x^2 - y^2\right)(2x + 3y - 6) = 0$. If the pt. $(0, \alpha)$ lies in the interior of this triangle, then
1) $-2 < \alpha < 0$ 2) $-2 < \alpha < 2$ 3) $0 < \alpha < 2$ 4) $\alpha \geq 2$

56. The perpendicular bisector of the line segment joining P(1, 4) and Q(K, 3) has Y-intercept –4, then a possible value of K is
1) 2 2) – 2 3) – 4 4) 1

57. **The equation to the base of an equilateral triangle is** $3x-4y+15=0$ **and one vertex is (1, 2), the length of the side is**

1) $\frac{4}{\sqrt{3}}$ 2) 1 3) $\frac{\sqrt{3}}{4}$ 4) $\frac{2}{\sqrt{3}}$

58. **The distance of the pt (2, 3) from the line** $2x-3y+9=0$ **measured along a line** $x-y+1=0$ **is**

1) $\sqrt{2}$ 2) 2 3) $2\sqrt{2}$ 4) $4\sqrt{2}$

59. **If A(2, –1), B(6, 5) are two pts, the ratio in which the foot of the perpendicular from (4, 1) to AB divides it is**

1) 8 : 15 2) 5 : 8 3) – 5 : 8 4) – 8 : 5

60. **The range of** θ **in** $(0,\pi)$ **such that the pt.** $(3,5)$ *and* $(\sin\theta,\cos\theta)$ **lie on the same side of the line** $x+y-1=0$ **is**

1) $\left(0,\frac{\pi}{4}\right)$ 2) $\left(0,\frac{\pi}{2}\right)$ 3) $\left(\frac{\pi}{4},\frac{3\pi}{4}\right)$ 4) $\left(\frac{\pi}{2},\frac{3\pi}{4}\right)$

61. **The number of lines that can be drawn through the pt. (5, 2) at a distance of 5 units from the pt. (2, –2) is**

1) 0 2) 1 3) 2 4) infinite

62. **If P, Q, R lie on** $xy=c^2$**, then the orthocentre of** ΔPQR **lie on**

1) $x+y=0$ 2) $xy+c^2=0$ 3) $xy=c^2$ 4) $x-y=0$

63. **The equation of the line with slope** $\frac{-3}{2}$ **and which is concurrent with the lines** $4x+3y-7=0$ **and** $8x+5y-1=0$ **is**

1) $3x+2y-63=0$ 2) $3x+2y-2=0$ 3) $2y-3x-2=0$ 4) $3x+2y+2=0$

64. **If the pair of lines** $2x^2+3xy+y^2=0$ **makes angles** θ_1 *and* θ_2 **with x-axis then** $\tan(\theta_1-\theta_2)=$

1) 1 2) 1/2 3) 1/3 4) 1/4

65. **If the pair of lines** $3x^2-5xy+py^2=0$ *and* $6x^2-xy-5y^2=0$ **have one line in common, then p =**

1) 2, 25/4 2) – 2, 25/4 3) – 2,– 25/4 4)2,– 25/4

66. **The pair of lines** $h(x^2-y^2)+pxy=0$ **bisects the angles between the pair** $ax^2+2hxy+by^2=0$ **the value of p is**

1) a – b 2) b – a 3) a + b 4) – a – b

67. **If the pair of st. lines given by** $Ax^2+2Hxy+By^2=0\left(H^2>AB\right)$ **forms an equilateral triangle with line** $ax+by+c=0$ **then** $(A+3B)(3A+B)=$

1) H^2 2) $-H^2$ 3) $2H^2$ 4) $4H^2$

68. **If the pair of st. lines** $xy-x-y+1=0$ **and the line** $ax+2y-3=0$ **are concurrent, then a =**

1) – 1 2) 3 3) 1 4) 0

69. **The sum of the intercepts cut off by the axes on the lines**

$x+y=a,\ x+y=ar,\ x+y=ar^2.....\ where\ a\neq 0\ and\ r=\frac{1}{2}$ **is**

1) 2a 2) $\sqrt{2}a$ 3) $2\sqrt{2}a$ 4) $\frac{a}{\sqrt{2}}$

70. **The line passing through the pts. (5, 1, a), (3, b, 1) crosses the YZ-plane at the pt.** $\left(0,\frac{17}{2},-\frac{13}{2}\right)$ **then (a, b)**

1) $(6,4)$ 2) $(4,6)$ 3) $(8,2)$ 4) $(2,8)$

71. **If the extremities of a diagonal of a square are (1, –2, 3), (2,–3, 5) then the length of its side is**

1) $\sqrt{6}$ 2) $\sqrt{3}$ 3) $\sqrt{5}$ 4) $\sqrt{7}$

72. **The locus of the pt.** $(2\sec\alpha,\cos\beta,2\sec\alpha\sin\beta,2\tan\alpha)$ **is**

1) $x^2+y^2-z^2=4$ 2) $x^2+y^2+z^2=4$ 3) $x^2-y^2+z^2=4$ 4) $x^2-y^2-z^2=4$

73. If the angle made by a straight line with coordinate axes are $\alpha, \frac{\pi}{2}-\alpha, \beta$ then $\beta =$

1) 0 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{2}$ 4) π

74. If $P(0,1,2), Q(4,-2,1), O(0,0,0)$ then $\angle POQ =$

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{2}$

75. The projection of the join of the two pts. (1, 4, 5), (6, 7, 2) on the line whose d.r's are (4, 5, 6) is

1) $\frac{13}{\sqrt{77}}$ 2) $\frac{7}{6}$ 3) 21 4) $\frac{7}{9}$

76. If the d.r's of two lines are given by $l+m+n=0$ and $mn-2\ln+lm=0$ then the angle between the lines is

1) $\frac{\pi}{4}$ 2) $\frac{\pi}{3}$ 3) $\frac{\pi}{2}$ 4) 0

77. If $\lambda x+4y+5z=7, 4x+4\lambda y+10z=14$ represents same plane then $\lambda =$

1) 1 2) 2 3) 0 4) 3

78. A plane meets the coordinate axes in P, Q, R respectively. If the centroid of ΔPQR is $\left(1,\frac{1}{2},\frac{1}{3}\right)$ then the equation of the plane is

1) $2x+4y+3z=5$ 2) $x+2y+3z=3$ 3) $x+4y+6z=5$ 4) $2x-2y+6z=3$

79. The plane passing through the pts. (1, 1, 1), (1, – 1, 1) and (– 7, – 3, – 5) is parallel to

1) X-axis 2) Y-axis 3) Z-axis 4) None

80. A paralleopiped is formed by planes drawn through the pts. (2, 3, 5) and (5, 9, 7) parallel to the coordinate planes. The length of a diagonal of the parallelopied is

1) 7 2) $\sqrt{38}$ 3) $\sqrt{155}$ 4) $\sqrt{35}$

PHYSICS

81. A particle is projected with a velocity v, so that its range on a horizontal plane is twice the greatest height attained. If g is acceleration due to gravity, then its range is:

1) $\frac{4v^2}{5g}$ 2) $\frac{4g}{5v^2}$ 3) $\frac{4v^3}{5g^2}$ 4) $\frac{4v}{5g^2}$

82. A projectile is fired with velocity u making an angle θ with the horizontal. What is the angular momentum of the projectile at the highest point about the starting point?
(Given the mass of the projectile is m)

1) $\frac{m\cos\theta}{2g}$ 2) $\frac{mu^2\sin^2\theta\cos\theta}{2g}$ 3) $\frac{mu^3\cos^2\theta}{2g}$ 4) $\frac{mu^3\sin^2\theta\cos\theta}{2g}$

83. The maximum height attained by a projectile is increased by 10%. Keeping the angle of projection constant, what is the percentage increase in the time of flight?

1) 5% 2) 10% 3) 20% 4) 40%

84. A body of mass 2kg has an initial velocity of 3 m/s along x-axis and it is subjected to a force of 4N in Y-direction. The distance of the body from origin after 4 seconds will be: (the body was subjected to force at the origin at t = 0)

1) 12 m 2) 28 m 3) 20 m 4) 48 m

85. The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Its angle of projection will be:

1) 45° 2) 60° 3) 90° 4) 30°

86. **The Vander Waals equation of state for some gases can be expressed as:** $\left(P+\frac{a}{v^2}\right)(V-b)=RT$ **where p is the pressure, V the molar volume and T is the absolute temperature of the given sample of gas, a,b and R constants. The dimensions of 'a' are:**

1) $\left[ML^5T^{-2}\right]$ 2) $\left[ML^{-1}T^{-2}\right]$ 3) $\left[L^3\right]$ 4) $\left[L^6\right]$

87. **The number of particles crossing the unit area perpendicular to the x-axis per unit time is given by:** $N=-D\left(\frac{n_2-n_1}{x_2-x_1}\right)$**, where** n_1 *and* n_2 **arethe numbers of particles per unit volume for the values of** *x* **meant to be** x_1 *and* x_2 **respectively. What is the dimensional formula for the diffusion constant D?**

1) $\left[M^0LT^2\right]$ 2) $\left[M^0L^2T^4\right]$ 3) $\left[M^0LT^{-3}\right]$ 4) $\left[M^0L^2T^{-1}\right]$

88. **If energy (E), velocity (v) and force (F) be taken as fundamental quantities, then what are the dimensions of mass?**

1) $\left[Ev^2\right]$ 2) $\left[Ev^{-2}\right]$ 3) $\left[Fv^{-1}\right]$ 4) $\left[Fv^{-2}\right]$

89. **The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of the kinetic energy obtained by measuring mass and speed?**

1) 11% 2) 8% 3) 5% 4) 1%

90. **The radius of a ball is** $(5.2\pm0.2)\,cm$**. The percentage error in the volume of the ball is:**

1) 11% 2) 4% 3) 7% 4) 9%

91. **Three particles of masses 1kg, 2kg and 3kg are situated at the corners of an equilateral triangle of side b. The co-ordinates of the centre of mass are:**

1) $\left(0,\frac{7b}{12},\frac{3\sqrt{3}b}{12}\right)$ 2) $\left(\frac{3\sqrt{3}b}{12},\frac{7b}{12},0\right)$ 3) $\left(\frac{7b}{12},\frac{3\sqrt{3}b}{12},0\right)$ 4) $\left(\frac{7b}{12},0,\frac{3\sqrt{3}b}{12}\right)$

92. **If the linear density of the rod of length L varies as** $\lambda=A+Bx$**, then its centre of mass is given by:**

1) $X_{CM}=\frac{L(2A+BL)}{3(3A+2BL)}$ 2) $X_{CM}=\frac{L(3A+2BL)}{3(2A+BL)}$ 3) $X_{CM}=\frac{L(3A+2BL)}{3}$ 4) $X_{CM}=\frac{L(2A+3BL)}{3}$

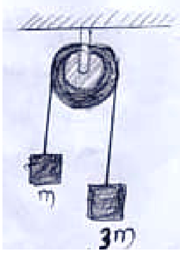
93. **A dog weighing 5kg is and standing on a flat boat so that it is 10m from the shore. The dog walks 4m on the boat towards the shore and then halts. The boat weighs 20kg and one can assume that there is no friction between it and the water. How far is the dog from the shore at the end of this time?**

1) 3.2 m 2) 0.8 m 3) 10 m 4) 6.8 m

94. **Particles of masses m, 2m, 3m….nm grams are placed on the same line at distances** $l,2l,3l....,nl\ cm$ **from a fixed point. The distance of the centre of mass of the particles from the fixed point (in centimeters) is:**

1) $\frac{(2n+1)l}{3}$ 2) $\frac{l}{n+1}$ 3) $\frac{n(n^2+1)l}{2}$ 4) $\frac{2l}{n(n^2+1)}$

95. **If the system is released, then the acceleration of the centre of mass of the system is:**



1) $\frac{g}{4}$ 2) $\frac{g}{2}$ 3) g 4) 2g

96. A small disc of radius 2cm is cut from a disc of radius 6cm. If the distance between their centres is 3.2 cm, what is the shift in the centre of mass of the disc?

1) 0.4 cm 2) 2.4 cm 3) 1.8 cm 4) 1.2 cm

97. A uniform chain has a mass m and length *l*. It is held on a frictionless table with one-sixth of its length hanging over the edge. The work done in just pulling the hanging part back on the table is:

1) $\frac{mgl}{72}$ 2) $\frac{mgl}{36}$ 3) $\frac{mgl}{12}$ 4) $\frac{mgl}{6}$

98. A spring is held compressed so that its stored energy is 2.4 J. Its ends are in contact with masses 1g and 48g placed on a frictionless table. When the spring is released, the heavier mass will acquire a speed of:

1) $\frac{2.4}{49}ms^{-1}$ 2) $\frac{2.4\times48}{49}ms^{-1}$ 3) $\frac{10^3}{7}cm\,s^{-1}$ 4) $\frac{10^6}{7}cm\,s^{-1}$

99. An object of mass m accelerates uniformly from rest to a speed v_F in time t_F. The work done on the object as a function of time t in terms of v_F and t_F is:

1) $W=\frac{1}{2}mv_F^2t_F^2t^2$ 2) $W=\frac{1}{2}m\left(\frac{v_F}{t_F}\right)t^2$ 3) $W=zero$ 4) $W=\frac{1}{2}m\left(\frac{v_F}{t_F}\right)^2t^2$

100. The speed v reached by a car of mass m, driven with constant power P, given by:

1) $v=\frac{3xp}{m}$ 2) $v=\left(\frac{3xp}{m}\right)^{\frac{1}{2}}$ 3) $v=\left(\frac{3xp}{m}\right)^{\frac{1}{3}}$ 4) $v=\left(\frac{3xp}{m}\right)^2$

101. A bullet of mass m moving with velocity v strikes a suspended wooden block of mass M. If the block rises to a height h, the initial velocity of the bullet will be:

1) $\sqrt{2gh}$ 2) $\left(\frac{M+m}{m}\right)\sqrt{2gh}$ 3) $\frac{m}{(M+m)}\sqrt{2gh}$ 4) $\frac{(M-m)}{m}\sqrt{2gh}$

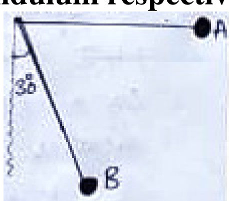
102. Aneutron moving with velocity u collides elastically with an atom of mass number A. If the collision is head-on and the initial kinetic energy of neutron is E, then the final kinetic energy of the neutron after collision is:

1) $\left(\frac{A+1}{A-1}\right)^2E$ 2) $\left(\frac{A-1}{A+1}\right)^2E$ 3) $\left(\frac{A-1}{A+1}\right)E$ 4) $\left(\frac{A+1}{A-1}\right)E$

103. A particle of mass m is driven by a machine that delivers a constant power K watts. If the particle starts from rest, then force on the particle at time t, is:

1) $\left(\sqrt{mk}\right)t^{-1/2}$ 2) $\left(\sqrt{2mk}\right)t^{-1/2}$ 3) $\left(\frac{1}{2}\sqrt{mk}\right)t^{-1/2}$ 4) $\left(\sqrt{\frac{mk}{2}}\right)t^{-1/2}$

104. A simple pendulum is released from A as shown in figure. If m and *l*represent the mass of the bob and the length of the pendulum respectively, the gain in kinetic energy at B is:



1) $\frac{mgl}{2}$ 2) $\frac{mgl}{\sqrt{2}}$ 3) $\frac{\sqrt{3}}{2}mgl$ 4) $\frac{2}{\sqrt{3}}mgl$

105. A string of length L and mass M is lying on a horizontal table. A force F is applied at one of its ends. Tension in the string at a distance y from the end at which the force is applied is:

1) zero 2) F 3) $\frac{F(L-y)}{L}$ 4) $\frac{F(L-y)}{M}$

106. Two masses 2kg and 3kg are attached to the ends of the sting passed over a pulley fixed at the top. The tension and acceleration in the string in terms of 'g' are:

1) $\left(\frac{7g}{8}, \frac{g}{8}\right)$ 2) $\left(\frac{21g}{8}, \frac{g}{8}\right)$ 3) $\left(\frac{21g}{8}, \frac{g}{5}\right)$ 4) $\left(\frac{12g}{5}, \frac{g}{5}\right)$

107. A block of mass m is placed on a smooth inclined plane of inclination θ with the horizontal. The inclined plane is accelerated horizontally so that the block does not slide down. What is the vertical force exerted by the inclined plane on the block?

1) $mg\sin\theta$ 2) $mg\cos\theta$ 3) mg 4) None of these

108. A balloon of mass M is descending at a constant acceleration α. When a mass M is released from the balloon its starts rising with the same acceleration a. Assuming that its volume does not change. What is the value of m?

1) $\left[\frac{\alpha}{\alpha+g}\right]M$ 2) $\left[\frac{2\alpha}{\alpha+g}\right]M$ 3) $\left[\frac{\alpha+g}{\alpha}\right]M$ 4) $\left[\frac{\alpha+g}{2\alpha}\right]M$

109. If the coefficient of friction between an insect and bowl is μ and the radius of the bowl is r, the maximum height to which the insect can crawl in the bowl is:

1) $\frac{r}{\sqrt{1+\mu^2}}$ 2) $r\left[1-\frac{1}{\sqrt{1+\mu^2}}\right]$ 3) $r\sqrt{1+\mu^2}$ 4) $r\left[\sqrt{1+\mu^2}-1\right]$

110. A homogeneous chain of length L lies on a table. The coefficient of friction between the chain and the table is μ. The maximum length which can hang over the table in equilibrium is:

1) $\left(\frac{\mu}{\mu+1}\right)L$ 2) $\left(\frac{1-\mu}{\mu}\right)L$ 3) $\left(\frac{1-\mu}{1+\mu}\right)L$ 4) $\left(\frac{2\mu}{\mu+1}\right)L$

111. A smooth block is released at rest on a 45^0 incline and then slides a distance d. Then time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is:

1) $\mu_s = 1-\frac{1}{n^2}$ 2) $\mu_s = \sqrt{1-\frac{1}{n^2}}$ 3) $\mu_k = 1-\frac{1}{n^2}$ 4) $\mu_k = \sqrt{1-\frac{1}{n^2}}$

112. A body, possessing kinetic energy T, moving on a rough horizontal surface, is stopped in a distance y. The frictional force exerted on the body is:

1) Ty 2) $\frac{\sqrt{T}}{y}$ 3) $\frac{T}{y}$ 4) $\frac{T}{\sqrt{y}}$

113. A boat moves perpendicular to the bank with a velocity of 7.2 km/h. The current carries it150 m downstream, find the velocity of the current (The width of the river is 0.5 km).

1) $0.4\,ms^{-1}$ 2) $1.2\,ms^{-1}$ 3) $0.5\,ms^{-1}$ 4) $0.6\,ms^{-1}$

114. The angular frequency of a fan increases from 30 rpm to 60 rpm in πs. A dust particle is present at a distance of 20 cm from axis of rotation. The tangential acceleration of the particle is

1) $0.8\,ms^{-2}$ 2) $0.34\,ms^{-2}$ 3) $0.2\,ms^{-2}$ 4) $1.2\,ms^{-2}$

115. A ball is projected horizontally from top of a building 19.6 m high. If the line joining the point of projection to the point where it hits the ground makes an angle of 45^0 to the horizontal, the initial velocity of the ball is

1) $4.9\,ms^{-1}$ 2) $9.8\,ms^{-1}$ 3) $19.6\,ms^{-1}$ 4) $14.7\,ms^{-1}$

116. A stone is projected horizontally with a velocity $9.8\,ms^{-1}$ from a tower of height 100m. Its velocity one second after projection is

1) $9.8\,ms^{-1}$ 2) $4.9\,ms^{-1}$ 3) $9.8\sqrt{2}\,ms^{-1}$ 4) $4.9\sqrt{2}\,ms^{-1}$

117. Two thin wood screens A and B are separated by 200m. A bullet travelling horizontally at a speed of $600\,ms^{-1}$ hits the screen A, penetrates through it and finally emerges out from B making holes in A and B. If the resistance of a is and wood are negligible, the difference of heights of the holes in A and B is:

1) 5m   2) $\frac{49}{90}m$ 3) $\frac{7}{\sqrt{90}}m$ 4) zero

118. At what angle the two vectors of magnitudes (A+B) and (A – B) must act, so that the resultant is $\sqrt{A^2+B^2}$?

1) $\cos^{-1}\left(\frac{A^2-B^2}{A^2+B^2}\right)$ 2) $\cos^{-1}\left(\frac{A^2+B^2}{B^2-A^2}\right)$ 3) $\cos^{-1}\left(\frac{A^2-B^2}{2\left(A^2+B^2\right)}\right)$ 4) $\cos^{-1}\left(\frac{A^2+B^2}{2\left(B^2-A^2\right)}\right)$

119. Resultant of two vectors $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ is of magnitude p. If $\overrightarrow{F_2}$ is reversed, then resultant is of magnitude Q. What is the value of P^2+Q^2 ?

1) $F_1^2+F_2^2$ 2) $F_1^2-F_2^2$ 3) $2\left(F_1^2-F_2^2\right)$ 4) $2\left(F_1^2+F_2^2\right)$

120. If a vector $2\hat{i}+3\hat{j}+8\hat{k}$ isperpendicular to the vector $4\hat{j}-4\hat{i}+\alpha\hat{k}$, then the value of α is:

1) $\frac{1}{2}$ 2) $-\frac{1}{2}$ 3) 1   4) –1

CHEMISTRY

121. The Isoelectronic species with CO is

1) CN^- 2) OH^- 3) N_2^+ 4) O_2^-

122. Wave Length of a Radiation is 300nm. Then its frequency is

1) $2\times10^{15}\ Hz$ 2) $1\times10^{15}\ Hz$ 3) $1\times10^{21}\ Hz$ 4) $3\times10^{10}\ Hz$

123. K.E of electron in a particular orbit is 3.4 ev potential energy is

1) – 3.4 ev   2) 6.8 ev   3) – 6.8 ev   4) 3.4 ev

124. What is the wave number of 4th line in Balmer series of hydrogen spectrum? $\left(R=109677\ cm^{-1}\right)$

1) $24630\ cm^{-1}$ 2) $24360\ cm^{-1}$ 3) $24730\ cm^{-1}$ 4) $24372\ cm^{-1}$

125. An orbital in which $n=4, l=2$ is expressed as

1) 4p   2) 4d   3) 4f   4) 3d

126. The set of quantum numbers for the outermost electron for copper in its ground state is

1) $4,1,1,+\frac{1}{2}$ 2) $3,2,2,+\frac{1}{2}$ 3) $4,0,0,+\frac{1}{2}$ 4) $4,2,2,+\frac{1}{2}$

127. The general electronic configuration of f-block element is

1) $ns^2np^6\left(n-1\right)d^{0-1}\left(n-2\right)f^{1-14}$ 2) $ns^2\left(n-1\right)d^{0.1}\left(n-2\right)f^{1-14}$

3) $ns^2\left(n-1\right)d^{0.1}\left(n-2\right)f^{1-13}$ 4) $ns^2\left(n-1\right)d^{0.1}\left(n-1\right)f^{1-14}$

128. If the Radius of Fe^{++} is $0.76A^\circ$ the radius of Fe^{3+} is

1) $0.64A^\circ$ 2) $0.76A^\circ$ 3) $0.88A^\circ$ 4) $1.08A^\circ$

129. The Ionisation energy and Electron Affinity of an element are 13.0 ev and 3.8 ev respectively. It's electronegativity is

1) 2.8   2) 3.0   3) 3.5   4) 4.0

130. Nature of Sb_4O_6 is

1) Acidic   2) Neutral   3) Basic   4) Amphoteric

131. An element with electronic arrangement as 2, 8, 18, 1 will exhibit the following stable oxidation states

1) +2 & +4   2) +1 & +2   3) +2 & +7   4) +1 only

132. The correct order of electron affinities of N,O,S and Cl is

1) $N<O<S<Cl$ 2) $O<N<Cl<S$ 3) $O\approx Cl<N\approx S$ 4) $O<S<Cl<N$

133. The number of valence electrons in PO_4^{-3} ion are

1) 8   2) 12   3) 28   4) 32

134. Which of the following has the lowest boiling points?

1) CH_4 2) H_2O 3) HF 4) C_2H_5OH

135. Which one of the following has $d\pi - P\pi$ bonding

1) NO_3^- 2) SO_3^{-2} 3) BO_3^{-3} 4) CO_3^{-2}

136. Which of the following is paramagnetic

1) O_2^- 2) CN^- 3) CO 4) NO^+

137. The shape of $\left[Ni\left(CN\right)_4\right]^{-2}$ is

1)square planar 2) pyramidal 3) plane trianglular 4) angular

138. The Bond length in O_2^+, O_2, O_2^- & O_2^{-2} follow the order

1) $O_2^{-2} > O_2^- > O_2 > O_2^+$ 2) $O_2^+ > O_2 > O_2^- > O_2^{-2}$ 3) $O_2 > O_2^- > O_2^{-2} > O_2^{+2}$ 4) $O_2^- > O_2^{-2} > O_2^+ > O_2$

139. 4gr of methane at 380 torr and $273^\circ c$ occupies a volume of

1) 5.6 L 2) 11.2L 3) 16.8 L 4) 22.4L

140. Ansil's alarm is used to detect _____ in mines

1) CO_2 2) CO 3) CH_4 4) $COCl_2$

141. The ratio of kinetic energies of 2gm of H_2 and 4 gram of CH_4 at given temperature?

1) 4 : 1 2) 2 : 32 3) 1 : 4 4) 16 : 2

142. At low pressure the vander wall's equation is written as $\left(P + \frac{a}{v^2}\right)v = RT$ the compressibility factor is then equal to.

1) $\left(1 - \frac{a}{RTv}\right)$ 2) $\left(1 - \frac{RTv}{a}\right)$ 3) $\left(1 + \frac{a}{RTv}\right)$ 4) $\left(1 + \frac{RTv}{a}\right)$

143. If z is a compressibility factor, vanderwaal's equation at low pressure can be written as

1) $z = 1 + \frac{RT}{pb}$ 2) $z = 1 - \frac{a}{RTv}$ 3) $z = 1 - \frac{pb}{RT}$ 4) $z = 1 + \frac{pb}{RT}$

144. The most probable velocity of a gas molecules at 298k is 300 m/s. It'sRms velocity (in m/sec) is

1) 402 2) 420 3) 245 4) 367

145. The number of atoms present in 4.25 gr of NH_3 is approximately.

1) 1×10^{23} 2) 1.5×10^{23} 3) 2×10^{23} 4) 6×10^{23}

146. Equivalent weight of potassium permanganate in neutral @ dilute alkaline medium is

1) $\frac{M.w}{1}$ 2) $\frac{M.w}{3}$ 3) $\frac{M.w}{5}$ 4) $\frac{M.w}{6}$

147. The empirical formula of a compound is CH_2O. If the molecular weight of the compound is 180 the molecular formula is?

1) $C_6H_{12}O_6$ 2) $C_3H_6O_3$ 3) $C_4H_8O_2$ 4) $C_5H_{10}O_5$

148. Oxidation number of sulphur in marshall's acid is?

1) +5 2) +8 3) +6 4) +7

149. In the Redox reaction $x\ KMnO_4 + NH_3 \rightarrow y\ KNO_3 + MnO_2 + KOH + H_2O$ x and y are?

1) $x = 8,\ y = 3$ 2) $x = 8,\ y = 6$ 3) $x = 4,\ y = 6$ 4) $x = 3,\ y = 8$

150. Strongest Reducing Agent is

1) Br^- 2) F^- 3) I^- 4) Cl^-

151. Kp for the reaction : $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ is correctly expressed as

1) $Kp = \frac{P_{CaO} \times P_{CO_2}}{P_{CaCO_3}}$ 2) $Kp = \frac{P_{CaCO_3}}{P_{CaO} \times P_{CO_2}}$ 3) $Kp = P_{CO_2}$ 4) $Kp = \frac{P_{CO_2}}{P_{CaCO_3}}$

152. The active mass of 5.6 liters of O_2 at STP is

1) $\frac{5.6}{22.4}$ 2) $\frac{8}{5.6}$ 3) $\frac{32}{5.6}$ 4) $\frac{0.25}{5.6}$

153. For which of the reversible reaction $Kp = Kc$

1) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ 2) $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

3) $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{3(g)}$ 4) $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

154. When 1 mole of $H_{2(g)}$ is heated with one mole of $I_{2(g)}$ it was found that 1.48 moles of $HI_{(g)}$ is formed at equilibrium. It's K_C is

1) 6 2) 32 3) 8 4) 24

155. If the equilibrium constant for the reaction $2AB \rightleftharpoons A_2 + B_2$ is 49. What is the equilibrium constant for $AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$?

1) 7 2) $\frac{1}{7}$ 3) 24.5 4) 49

156. Concentration of CN^- in 0.1 M HCN is $\left(K_a = 4\times10^{-10}\right)$

1) $2.5\times10^{-6}\ M$ 2) $4.5\times10^{-6}\ M$ 3) $6.3\times10^{-6}\ M$ 4) $9.2\times10^{-6}\ M$

157. The conjugate acid of HPO_4^{-2} is

1) PO_4^{-3} 2) $H_2PO_4^-$ 3) H_3PO_4 4) H_3PO_3

158. Solubility product of $BaCl_2$ is 4×10^{-9} .It's solubility in moles/liter would be

1) 1×10^{-27} 2) 4×10^{-27} 3) 1×10^{-9} 4) 1×10^{-3}

159. Hydrolysis constant for a salt of weak acid & weak base would be

1) $K_h = \frac{K_w}{K_a.K_b}$ 2) $K_h = \frac{K_w}{K_a}$ 3) $K_h = \frac{K_w}{K_b}$ 4) None of these

160. The PH of a 0.02 N solution of hydrochloride acid is.

1) 2.2 2) 0.3 3) 2.0 4) 1.7

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