# MELUHA INTERNATIONAL SCHOOL

## HYDERABAD

**SR MPC JEE MAINS** | **UNIT – II** | **Date: 22-04-2020**
**Time:** | **ASSIGNMENT – 2** | **Max. Marks:**

**MATHS**

**Syllabus:** ***TRIGNOMETRY:– 1. TRIGNOMETRIC RATIOS, 2. COMPOUND ANGLES, 3.MUTIPLES AND SUBMULTIPLE, 4.TRANSFORMATIONS, 5.PERIODICITY AND EXTREME VALUES, 6. TRIGNOMETRIC EQUATIONS , 7.INVERSE TRIGNOMETRIC FUNCTIONS, 8.PROPERTIES OF TRIANGLES, 9.HEIGHTS AND DISTANCES, 10.COMPLEX NUMBERS , 11. DEMOIVERSES THEOREM***

1. Find the value of cos (x/2), if tan x = 5/12 and x lies in third quadrant
   (1) $5\sqrt{13}$ (2) $5/\sqrt{26}$ (3) 5/13 (4) $\sqrt{1/26}$

2. If $\tan\alpha = \frac{b}{a}, a > b > 0$ and $0 < \alpha < \frac{\pi}{4}$, then $\sqrt{\frac{a+b}{a-b}} - \sqrt{\frac{a-b}{a+b}}$ is equal to
   (1) $\frac{2\sin\alpha}{\sqrt{\cos 2\alpha}}$ (2) $\frac{2\cos\alpha}{\sqrt{\cos 2\alpha}}$ (3) $\frac{2\sin\alpha}{\sqrt{\sin 2\alpha}}$ (4) $\frac{2\cos\alpha}{\sqrt{\sin 2\alpha}}$

3. The value of $\frac{\cot x - \tan x}{\cot 2x}$ is
   (1) 1 (2) 2 (3) – 1 (4) 4

4. The value of $\frac{\cot 54^\circ}{\tan 36^\circ} + \frac{\tan 20^\circ}{\cot 70^\circ}$ is
   (1) 0 (2) 2 (3) 3 (4) 1

5. If sin A + sin B + sin C = 3, then cos A + cos B + cos C is equal to
   (1) 3 (2) 2 (3) 1 (4) 0

6. In a $\Delta ABC, \frac{c+b}{c-b}.\tan\frac{A}{2}$ is equal to
   (1) $\tan\left(\frac{A}{2}+B\right)$ (2) $\cot\left(\frac{A}{2}+B\right)$ (3) $\tan\left(A+\frac{B}{2}\right)$ (4) $\tan\left(\frac{A+B}{2}\right)$

7. If k be the perimeter of the $\Delta ABC$ then $b\cos^2\frac{C}{2} + c\cos^2\frac{B}{2}$ is equal to
   (1) k (2) 2k (3) k/2 (4) None of these

8. In a $\Delta ABC, \cot\frac{A-B}{2}.\tan\frac{A+B}{2}$ is equal to
   (1) $\frac{a+b}{a-b}$ (2) $\frac{a-b}{a+b}$ (3) $\frac{a(a-b)}{b(a+b)}$ (4) None of these

9. In a $\Delta ABC, a^2\cos^2 A = b^2 + c^2$ then
   (1) $A < \frac{\pi}{4}$ (2) $\frac{\pi}{4} < A < \frac{\pi}{2}$ (3) $A > \frac{\pi}{2}$ (4) $A = \frac{\pi}{2}$

10. If in a $\Delta ABC, \tan\frac{A}{2}$ and $\tan\frac{B}{2}$ satisfy $6x^2 - 5x + 1 = 0$. Then
    (1) $a^2 + b^2 > c^2$ (2) $a^2 - b^2 = c^2$ (3) $a^2 + b^2 = c^2$ (4) $b^2 + a^2 < c^2$

11. In a $\Delta ABC, a = 8, b = 10$ and c = 12. Then C is equal to
    (1) A/2 (2) 2A (3) 3A (4) A/3

12. In a $\Delta ABC, a=5, b=4$ and $\tan\frac{C}{2}=\sqrt{\frac{7}{9}}$. The side c is

(1) 6 (2) 3 (3) 2 (4) 5

13. If in a $\Delta ABC, AC=12, BC=13$ and AB = 5, then the distance of A from BC is

(1) 1.923 (2) 4.615 (3) 5.412 (4) 5.000

14. In a $\Delta ABC, \cos A=\frac{3}{5}$ and $\cos B=\frac{5}{13}$. The value of cos C can be

(1) 0.538 (2) 0.923 (3) 0.508 (4) 0.908

15. If the area of a $\Delta ABC$ be 1.2 then $a^2\sin 2B+b^2\sin 2A$ is equal to

(1) 2.400 (2) 1.200 (3) 4.800 (4) 6.000

16. If in $\Delta ABC; a=8, b=10 \,\&\, c=12$. Then cos C =

(1) 0.120 (2) 0.225 (3) 0.125 (4) 0.750

17. In a $\Delta ABC$, (c + a + b) (a + b – c) = ab. The measure of $\angle C$ is

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

18. In a $\Delta ABC$, A : B : C = 3 : 5 : 4. Then a + b + c$\sqrt{2}$ is equal to

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

19. The equation $ax^2 + bx + c = 0$, where a, b, c are the sides of a $\Delta ABC$, and the equation $x^2+\sqrt{2}x+1=0$ have a common root. The measure of $\angle C$ is

(1) 90° (2) 45° (3) 60° (4) 30°

20. Two sides of a triangle are given by the roots of the equation $x^2-2\sqrt{3}x+2=0$. The angle between the sides is $\frac{\pi}{3}$. The perimeter of the triangle is

(1) $6+\sqrt{3}$ (2) $2\sqrt{3}+\sqrt{6}$ (3) $2\sqrt{3}+\sqrt{10}$ (4) $\sqrt{10}-2\sqrt{3}$

21. The sides of a $\Delta ABC$ are AB = $\sqrt{13}\,cm$, BC = $4\sqrt{3}\,cm$ and CA = 7 cm. Then $\sin\theta$, where $\theta$ is the smallest angle of the triangle, is equal to

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

22. In a $\Delta ABC$, if $\tan\frac{A}{2}=\frac{5}{6}$ and $\tan\frac{B}{2}=\frac{20}{37}$ then

(1) 2a = b + c (2) a > b > c (3) 2c = a + b (4) a < b < c

23. In a $\Delta ABC$, a = 2b and $|A-B|=\frac{\pi}{3}$. The measure of $\angle C$ is

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

24. In a $\Delta ABC$, the tangent of half the difference of two angles is one third the tangent of half the sum of the two angles. The ratio of the sides opposite the angles is

(1) 2 : 3 (2) 1 : 3 (3) 1 : 2 (4) 3 : 4

25. In a $\Delta ABC$, $A=\frac{2\pi}{3}$, b – c = $3\sqrt{3}\,cm$ and ar ($\Delta ABC$) = $\frac{9\sqrt{3}}{2}cm^2$. Then a is

(1) $6\sqrt{3}$ cm (2) 9 cm (3) 18 cm (4) 81 cm

26. In a $\Delta ABC$ , the values of cot A, cot B, cot C are in AP, then
(1) a, b, c are in AP  (2) $a^2$, $b^2$, $c^2$ are in AP
(3) cos A, cos B, cos C are in AP  (4) None of these

27. If in a $\Delta ABC$ , $\frac{a}{\cos A} = \frac{b}{\cos B}$, then
(1) 2 sin A sin B sin C = 1  (2) $\sin^2 A + \sin^2 B = \sin^2 C$
(3) 2 sin A cos B = sin C  (4) 2sinA sinB = sinC

28. If in a $\Delta ABC$ . 3a = b + c then $\tan\frac{B}{2}.\tan\frac{C}{2}$ is equal to
(1) $\tan\frac{A}{2}$  (2) 1  (3) 2  (4) 1/2

29. If in a $\Delta ABC$ , a = 1 and the perimeter is six times the AM of the sines of the angles. The measure of $\angle A$ is
(1) $\frac{\pi}{3}$  (2) $\frac{\pi}{2}$  (3) $\frac{\pi}{6}$  (4) $\frac{\pi}{4}$

30. sin A, sin B and sin C are in AP for the $\Delta ABC$ . Then
(1) The altitudes are in AP  (2) The altitudes are in HP
(3) The medians are in GP  (4) The medians are in AP

31. If $\alpha, \beta, \gamma$ are altitudes of a $\Delta ABC$ and 2s denotes its perimeter then $\alpha^{-1} + \beta^{-1} + \gamma^{-1}$ is equal to
(1) $\frac{\Delta}{s}$  (2) $\frac{s}{\Delta}$  (3) $s.\Delta$  (4) $\frac{1}{s.\Delta}$

32. In a $\Delta ABC$ , 2s = perimeter and R = circumradius. Then s/R is equal to
(1) $\sin A + \sin B + \sin C$  (2) $\cos A + \cos B + \cos C$
(3) $\sin\frac{A}{2} + \sin\frac{B}{2} + \sin\frac{C}{2}$  (4) None of these

33. The diameter of the circumcircle of a triangle with sides 5 cm, 6 cm and 7 cm is
(1) $\frac{3\sqrt{6}}{2}cm$  (2) $2\sqrt{6}$ cm  (3) $\frac{35}{48}cm$  (4) None of these

34. The angles of a right-angles triangled are in AP. The ratio of the inradius and the perimeter is
(1) $\left(2-\sqrt{3}\right):2\sqrt{3}$  (2) $1:8\sqrt{3}\left(2+\sqrt{3}\right)$  (3) $\left(2+\sqrt{3}\right):4\sqrt{3}$  (4) None of these

35. If for a $\Delta ABC$ , cot A . cot B . cot C > 0 then the triangle is
(1) Right angled  (2) Acute angled
(3) Obtuse angled  (4) All these options are possible

36. In a $\Delta ABC$ , the inradius and three exradii are $r, r_1, r_2$ and $r_3$ respectively. In usual notations the values of $r.r_1.r_2.r_3$ is equal to
(1) $2\Delta^2$  (2) $\Delta^2$  (3) $\frac{abc}{4R}$  (4) $\frac{\Delta^2}{2}$

37. The area of a $\Delta ABC$ is $a^2 - (b-c)^2$ . Then tan A is equal to
(1) 1.333  (2) 0.750  (3) 0.533  (4) 1.666

38. Two angles of a triangle are $\frac{\pi}{6}$ and $\frac{\pi}{4}$, and the length of the included side is $\left(\sqrt{3}+1\right)cm$ . The area of the triangle is
(1) 0.366  (2) 0.500  (3) 1.366  (4) 0.866

39. In a $\Delta ABC$, the sides a, b and c are such that they are the roots of $x^3 - 11x^2 + 38x - 40 = 0$. Then $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c}$ is equal to

(1) 0.750 (2) 1.000 (3) 0.563 (4) 0.365

40. In a $\Delta ABC$, the sides are in the ratio 4 : 5 : 6. The ratio of the circumradius and the inradius is

(1) 1.143 (2) 1.500 (3) 2.333 (4) 2.286

41. The ratio of the circumradius and in radius of an equilateral triangles is

(1) 3.000 (2) 1.000 (3) 1.500 (4) 2.000

42. If sinx + cosx + tanx + cot x + secx + cosecx = 7 and sin2x = a – b$\sqrt{7}$, then ordered pair (a, b) can be,

(1) (6, 2) (2) (8, 3) (3) (22, 8) (4) (11, 4)

43. If tan(πcosθ) = cot(πsinθ), then cosθ, sinθ are roots of the equation

(1) $4x^2 - 4x - 1 = 0$ (2) $4x^2 - 2x - 1 = 0$ (3) $8x^2 - 4x - 3 = 0$ (4) none of these

44. $\tan^{-1}\frac{(\sin 1 - 1)}{\cos 1}$ equals

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

45. If 4nα = π then the value of tanα tan2α tan3α … tan(2n – 1)α is equal to

(1) 1 (2) 0 (3) – 1 (4) none of these

46. If x cos α + y sin α = x cos β + y sin β = 2a then cos α . cos β is

(1) $\frac{4xy}{x^2 + y^2}$ (2) $\frac{4a^2 - y^2}{x^2 + y^2}$ (3) $\frac{4ay}{x^2 + y^2}$ (4) $\frac{4a^2 - x^2}{x^2 + y^2}$

47. The value of $\tan(\sin^{-1}(\cos(\sin^{-1}x)))\tan(\cos^{-1}(\sin(\cos^{-1}x)))$, $x \in (0, \pi/2)$ is equal to

(1) 0 (2) 1 (3) –1 (4) none of these.

48. If $0 < \alpha < \beta < \gamma < \frac{\pi}{2}$ then $\frac{\sin\alpha + \sin\beta + \sin\gamma}{\cos\alpha + \cos\beta + \cos\gamma}$ lies between

(1) sin α and sin γ (2) tan α and tan γ (3) cos α and cos γ (4) none of these

49. If $0 < x < \frac{\pi}{2}$ then

(1) $\cos x > 1 - \frac{2x}{\pi}$ (2) $\cos x < 1 - \frac{2x}{\pi}$ (3) $\cos x > \frac{2x}{\pi}$ (4) $\cos x < \frac{2x}{\pi}$

50. The value of $\sin^3 10^0 + \sin^3 50^0 - \sin^3 70^0$ is equal to

(1) $-\frac{3}{2}$ (2) $\frac{3}{4}$ (3) $-\frac{3}{4}$ (4) $-\frac{3}{8}$

51. If $\theta_1, \theta_2, \theta_3$ are three values lying in [0, 2π] for which tan θ = λ, then $\tan\frac{\theta_1}{3}\tan\frac{\theta_2}{3} + \tan\frac{\theta_2}{3}\tan\frac{\theta_3}{3} + \tan\frac{\theta_1}{3}\tan\frac{\theta_3}{3}$ is equal to

(1) 3λ (2) –3 (3) λ (4) –3λ

52. If in ΔABC, ∠ A = $\sin^{-1}(x)$, ∠ B = $\sin^{-1}(y)$ and ∠ C = $\sin^{-1}(z)$, then $x\sqrt{1-y^2}\sqrt{1-z^2} + y\sqrt{1-x^2}\sqrt{1-z^2} + z\sqrt{1-x^2}\sqrt{1-y^2}$ is equal to

(1) xyz (2) x+y+z (3) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z}$ (4) None of these

53. If x = α, β satisfy both the equations $a\cos^2 x + b\cos x + 1 = 0$ and $a\sin^2 x + p\sin x + 1 = 0$, then

(1) $2a(a + 2) = b^2 - p^2$ (2) $2a(a - 2) = b^2 + p^2$
(3) $2a(a + 2) = b^2 + p^2$ (4) None of these

54. If $\tan\theta = n \tan\phi$, then maximum value of $\tan^2(\theta - \phi)$ is equal to

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

55. $\tan\frac{\pi}{8}$ is the root of the equation

(1) $x^4 + 6x^2 + 1 = 0$ (2) $x^4 - 6x^2 + 1 = 0$ (2) $x^4 - 6x^2 - 1 = 0$ (4) none of these

56. If $\theta_1$, $\theta_2$ are the roots of equation $\tan^2\theta - a\tan\theta - a - 1 = 0$ (where $a < -2$) then the area of the triangle formed by three straight lines $y = \tan\theta_1 x$, $y = \tan\theta_2 x$ and $y = a$ is

(1) $\frac{a^2(a-2)}{2(a+1)}$ (2) $\frac{-a^2(a+2)}{2(a-1)}$ (3) $\frac{-a^2(a-2)}{2(a-1)}$ (4) $\frac{a^2(a+2)}{2(a+1)}$

57. If $\theta_1$, $\theta_2$ and $\theta_3$ lies in the interval $(0, \pi)$ and $a + b + c = 2$, then minimum value of the expression $(a\sin\theta_1 + b\sin\theta_2 + c\sin\theta_3)(a\,\text{cosec}\theta_1 + b\,\text{cosec}\theta_2 + c\,\text{cosec}\theta_3)$ is

(1) 2 (2) 3 (3) 4 (4) none of these

58. Which of the following statements about $\tan 10^0$ is true?

(1) It is a rational number (2) It is a irrational number
(3) It is less than 2 (4) It is greater than 2.

59. If $\left(\cos^2 x + \frac{1}{\cos^2 x}\right)(1 + \tan^2 2y)(3 + \sin 3z) = 4$, then

(1) x may be a multiple of $\pi$ (2) x can not be an even multiple of $\pi$
(3) z can be a multiple of $\pi$ (4) y can be a multiple of $\pi/2$.

60. $\tan^{-1}\frac{(\sin 1 - 1)}{\cos 1}$ equals

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

61. If $4n\alpha = \pi$ then the value of $\tan\alpha \tan 2\alpha \tan 3\alpha \ldots \tan(2n-1)\alpha$ is equal to

(1) 1 (2) 0 (3) – 1 (4) none of these

62. If $x\cos\alpha + y\sin\alpha = x\cos\beta + y\sin\beta = 2a$ then $\cos\alpha \cdot \cos\beta$ is

(1) $\frac{4xy}{x^2+y^2}$ (2) $\frac{4a^2-y^2}{x^2+y^2}$ (3) $\frac{4ay}{x^2+y^2}$ (4) $\frac{4a^2-x^2}{x^2+y^2}$

63. The value of $\tan(\sin^{-1}(\cos(\sin^{-1}x)))\tan(\cos^{-1}(\sin(\cos^{-1}x)))$, $x \in (0, \pi/2)$ is equal to

(1) 0 (2) 1 (3) –1 (4) none of these.

64. If $0 < \alpha < \beta < \gamma < \frac{\pi}{2}$ then $\frac{\sin\alpha + \sin\beta + \sin\gamma}{\cos\alpha + \cos\beta + \cos\gamma}$ lies between

(1) $\sin\alpha$ and $\sin\gamma$ (2) $\tan\alpha$ and $\tan\gamma$ (3) $\cos\alpha$ and $\cos\gamma$ (4) none of these

65. If $\left(\cos^2 x + \frac{1}{\cos^2 x}\right)(1 + \tan^2 2y)(3 + \sin 3z) = 4$, then

(1) x may be a multiple of $\pi$ (2) x can not be an even multiple of $\pi$
(3) z can be a multiple of $\pi$ (4) y can be a multiple of $\pi/2$.

66. If $0 < x < \frac{\pi}{2}$ then

(1) $\cos x > 1 - \frac{2x}{\pi}$ (2) $\cos x < 1 - \frac{2x}{\pi}$ (3) $\cos x > \frac{2x}{\pi}$ (4) $\cos x < \frac{2x}{\pi}$

67. Which of the following statements about $\tan 10^0$ is true?

(1) It is a rational number (2) It is a irrational number
(3) It is less than 2 (4) It is greater than 2.

68. The value of $\sin^3 10^0 + \sin^3 50^0 - \sin^3 70^0$ is equal to

(1) $-\frac{3}{2}$ (2) $\frac{3}{4}$ (3) $-\frac{3}{4}$ (4) $-\frac{3}{8}$

69. If $\theta_1$, $\theta_2$, $\theta_3$ are three values lying in $[0, 2\pi]$ for which $\tan\theta = \lambda$, then $\tan\frac{\theta_1}{3}\tan\frac{\theta_2}{3}+\tan\frac{\theta_2}{3}\tan\frac{\theta_3}{3}+\tan\frac{\theta_1}{3}\tan\frac{\theta_3}{3}$ is equal to

(1) $3\lambda$ (2) $-3$ (3) $\lambda$ (4) $-3\lambda$

70. If in $\Delta ABC$, $\angle A = \sin^{-1}(x)$, $\angle B = \sin^{-1}(y)$ and $\angle C = \sin^{-1}(z)$, then $x\sqrt{1-y^2}\sqrt{1-z^2}+y\sqrt{1-x^2}\sqrt{1-z^2}+z\sqrt{1-x^2}\sqrt{1-y^2}$ is equal to

(1) xyz (2) x+y+z (3) $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}$ (4) None of these

71. If $x = \alpha, \beta$ satisfy both the equations $a\cos^2x + b\cos x + 1 = 0$ and $a\sin^2x + p\sin x + 1 = 0$, then

(1) $2a(a + 2) = b^2 - p^2$ (2) $2a(a - 2) = b^2 + p^2$

(3) $2a(a + 2) = b^2 + p^2$ (4) None of these

72. If $\tan\theta = n\tan\phi$, then maximum value of $\tan^2(\theta - \phi)$ is equal to

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

73. $\tan\frac{\pi}{8}$ is the root of the equation

(1) $x^4 + 6x^2 + 1 = 0$ (2) $x^4 - 6x^2 + 1 = 0$ (2) $x^4 - 6x^2 - 1 = 0$ (4) none of these

74. If $\theta_1$, $\theta_2$ are the roots of equation $\tan^2\theta - a\tan\theta - a - 1 = 0$ (where $a < -2$) then the area of the triangle formed by three straight lines $y = \tan\theta_1 x$, $y = \tan\theta_2 x$ and $y = a$ is

(1) $\frac{a^2(a-2)}{2(a+1)}$ (2) $\frac{-a^2(a+2)}{2(a-1)}$ (3) $\frac{-a^2(a-2)}{2(a-1)}$ (4) $\frac{a^2(a+2)}{2(a+1)}$

75. If $\theta_1$, $\theta_2$ and $\theta_3$ lies in the interval $(0, \pi)$ and $a + b + c = 2$, then minimum value of the expression $(a\sin\theta_1 + b\sin\theta_2 + c\sin\theta_3)(a\,\text{cosec}\theta_1 + b\,\text{cosec}\theta_2 + c\,\text{cosec}\theta_3)$ is

(1) 2 (2) 3 (3) 4 (4) none of these

76. $\sin x + \cos x = y^2 - y + a$ has no value of x for any y if 'a' belongs to

(1) $(0, \sqrt{3})$ (2) $(-\sqrt{3}, 0)$ (3) $(-\infty, -\sqrt{3})$ (4) $(\sqrt{3}, \infty)$

77. The value of a for which the equation $4\text{cosec}^2(\pi(a + x)) + a^2 - 4a = 0$ has a real solution, is

(1) a = 1 (2) a = 2 (3) a = 10 (4) None of these

78. $\cos\left(\frac{\pi}{4}+\frac{1}{2}\cos^{-1}\frac{a}{b}\right) + \cos\left(\frac{\pi}{4}-\frac{1}{2}\cos^{-1}\frac{a}{b}\right)$ is equal to

(1) $\pm\sqrt{\frac{a+b}{b}}$ (2) $\sqrt{\frac{b}{a+b}}$ (3) $\sqrt{\frac{a+b}{b}}$ (4) None of these

79. The inequality $\log_2 x < \sin^{-1}(\sin 5)$ holds if

(1) $x \in (0, 2^{5-2\pi})$ (2) $x \in (2^{5-2\pi}, \infty)$ (3) $x \in (2^{2\pi-5}, \infty)$ (4) None of these

80. The solution(s) x, of the equation $\sqrt{3}\cos x - \sin x = (\cos^{10}y + \sec^{10}y)$, is (are)

(1) $\pi/6$ (2) $-\pi/6$ (3) $-\pi/3$ (4) $\pi/3$

81. If all the solutions 'x' of $a^{\cos x} + a^{-\cos x} = 6$ $(a > 1)$ are real, then set of values of a is

(1) $[3+2\sqrt{2}, \infty)$ (2) $(6, 12)$ (3) $(1, 3 + 2\sqrt{2})$ (4) none of these.

82. The number of roots of $2^{\cos x} = |\sin x|$ in $[-2\pi, 2\pi]$ are equal to;

(1) 4 (2) 6 (3) 8 (4) 10

83. If $|\sin^{-1}x| + |\cos^{-1}x| = \frac{\pi}{2}$, then x belongs to

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

84. If $2^{\frac{2\pi}{\sin^{-1}x}} - 2(a+2)2^{\frac{\pi}{\sin^{-1}x}} + 8a < 0$ for atleast one real x, then

(1) $\frac{1}{8} \le a < 2$ (2) $a < 2$

(3) $a \in R - \{2\}$ (4) $a \in \left[0, \frac{1}{8}\right) \cup (2, \infty)$

85. A root of the equation, sinx + x - 1 = 0, lies in the interval

(1) $(0, \pi/2)$ (2) $(-\pi/2, 0)$ (3) $(\pi/2, \pi)$ (4) $(-\pi, -\pi/2)$

## PHYSICS

**Syllabus:** ***1. GRAVITATION, 2. OSCILLATIONS AND WAVES***

1. The particle of mass m oscillation at the end of a spring constant K is acted upon by a dumping for F = – bv. Its motion will be critically damped if b =

(1) $\sqrt{\frac{K}{m}}$ (2) $2\sqrt{Km}$ (3) $\sqrt{\frac{K^2}{2m}}$ (4) $\sqrt{\frac{K}{2m}}$

2. The displacement of a particle varies according to the relation $x = 4(\cos\pi t + \sin\pi t)$. The amplitude of the particle is

(1) – 4 (2) 4 (3) $4\sqrt{2}$ (4) 8

3. A particle of mass m is attached to a spring (of spring constant K) and has a natural angular frequency $\omega_0$. An external force F(t) equal to $F = F_0 \cos\omega t$ is applied to the oscillator. The amplitude of the oscillator will be

(1) $\frac{m}{|\omega_0^2 - \omega^2|}$ (2) $\frac{F_0}{m|\omega_0^2 - \omega^2|}$ (3) $\frac{1}{m(\omega_0^2 + \omega^2)}$ (4) $\frac{m}{\omega_0^2 + \omega^2}$

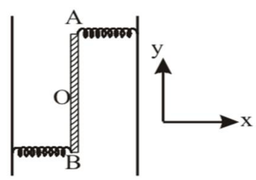
4. A mass 'M', attached to a horizontal spring, executes SHM with amplitude $A_1$. When the mass 'M' passes through its mean position then a smaller mass 'm' is placed over it and both of them together with amplitude $A_2$. The ratio of $\left(\frac{A_1}{A_2}\right)$ is

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

5. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude in 5s. In another 10s it will decrease to $\alpha$ times its original magnitude. Then $\alpha$ equals

(1) 0.7 (2) 0.81 (3) 0.729 (4) 0.027

6. Two light identical springs of spring constant K are attached horizontally at the two ends of a uniform horizontal rod AB of length $l$ and mass m. The rod is pivoted at its centre 'O' and can rotate freely in horizontal plane. The other ends of the two springs are fixed to rigid supports as shown in figure. The rod is gently pushed through a small angle and released. The frequency of resulting oscillation is:




(1) $\frac{1}{2\pi}\sqrt{\frac{6K}{m}}$ (2) $\frac{1}{2\pi}\sqrt{\frac{2K}{m}}$ (3) $\frac{1}{2\pi}\sqrt{\frac{K}{m}}$ (4) $\frac{1}{2\pi}\sqrt{\frac{3K}{m}}$

7. A mass of 2kg oscillates on a spring with force constant 50 N/m when a damping force with constant b = 12 in SI unit is introduced, frequency of oscillation (Damping force, f = – bv)

(1) Decreases by 10% (2) Decreases by 25%

(3) Decreases by 50% (4) Decreases by 20%

8. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2s. The period of oscillation of the same pendulum on the planet would be $\sqrt{n}$ times that on earth, find 'n'.

(1) 3 (2) 5 (3) 7 (4) 6

9. A cylindrical plastic bottle of negligible mass is filled with 3140 ml of water and left floating in a pond with still water. If pressed downward slightly and released, it starts performing simple harmonic motion at angular frequency $\omega$. If radius of the bottle is 2.5 cm then $\omega$ in rad/s close to: (density of water = $10^3$ kg/m$^3$)

(1) 2.5s (2) 3.75 (3) 5.00 (4) 1.25

10. At t = 0, a particle executing SHM with a time period 3s is in phase with another particle executing SHM. The time period of the second particle is T (less than 3 s). If they are again in the same phase for the third time after 45s, then the value of T is (in sec)

(1) 1.00 (2) 1.50 (3) 2.00 (4) 2.50

11. A disc of radius R is pivoted at the rim and is set for small oscillations. If disc is replaced by ring, then to have the same time period as that of the disc, radius of ring should be 'n' times of disc, find 'n'.

(1) 0.75 (2) 0.80 (3) 0.78 (4) 0.65

12. The potential energy of a particle of mass 5mg executing simple motion along x-axis is given by $V(x)=(1.23)+(4.84)x^2$, where V(x) is in joules and x is in meters. The frequency of oscillation of the particle in Hz is

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

13. The mathematical forms for three sinusoidal travelling waves are given by,

Wave 1: y(x, t) = (2cm) sin(3x – 6t)

Wave 2: y(x, t) = (3cm) sin(4x – 12t)

Wave 3: y(x, t) = (4cm) sin(5x – 11t)

Where x is in meters and t is in seconds. Of these waves:

(1) Wave 1 has the greatest wave speed and the greatest maximum transverse string speed.

(2) Wave 2 has the greatest wave speed and wave 1 has the greatest maximum transverse string speed.

(3) Wave 3 has the greatest wave speed and the greatest maximum transverse string speed.

(4) Wave 2 has the greatest wave speed and wave 3 has the greatest maximum transverse string speed.

14. A sinusoidal wave travelling in the positive direction of x on a stretched string has amplitude 2.0 cm, wavelength 1 m and wave velocity 5.0 m/s. At x = 0 and t = 0, it is given that displacement y = 0 and $\frac{\partial y}{\partial t} < 0$. Express the wave function correctly in the form y = f(x, t)

(1) $y=(0.02m)\sin 2\pi(x-5t)$ (2) $y=(0.02cm)\cos 2\pi(x-5t)$

(3) $y=(0.02m)\sin 2\pi\left(x-5t+\frac{1}{4}\right)$ (4) $y=(0.02cm)\cos 2\pi\left(x-5t+\frac{1}{4}\right)$

15. An observer standing at sea coast observe 54 waves reaching the coast per minute if the wavelength of wave is 10 m, its velocity is

(1) 90 m/s (2) 90 cm/s (3) 9 m/s (4) 900 m/s

16. A wave of frequency 680 Hz travels with a speed of 340 m/s in a medium. The distance between two nearest points which are out of phase is
(1) 1/3m (2) 1/12m (3) 1/6m (4) 1/4m

17. Two particles separated by a distance 22 mm in a progressive wave are out of phase. If the number of waves passing across a point in the medium is 3750 the velocity of wave is
(1) 3300 m/s (2) 330 m/s (3) 330 cm/s (4) 165 m/s

18. The maximum particle velocity in a progressive wave is 4 times of the wave velocity. If the amplitude of the particle is 'a'. The propagation constant is
(1) 4/a (2) 2/a (3) a/4 (4) a/2

19. The minimum distance between two particles in similar phase is 10 cm. The time after which a given particle comes to same phase is 0.05 second. What is the velocity of progressive wave?
(1) 2000 cm/sec (2) 100 cm/sec (3) 200 cm/sec (4) 50 cm/sec

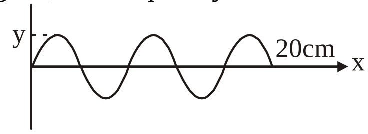
20. Find the equation of plane progressive wave travelling along X-axis in the positive direction having a amplitude of 0.04 m, frequency 440 Hz and wave velocity 330 m/s. (y = 0 at x = 0 and t = 0)
(1) $y = 0.04 \sin 2\pi\left(440t - \frac{4x}{3}\right)$ (2) $y = 0.04 \sin 2\pi\left(440t + \frac{4x}{3}\right)$
(3) $y = 0.04 \cos 2\pi\left(440t - \frac{4x}{3}\right)$ (4) $y = 0.04 \cos 2\pi\left(440t + \frac{4x}{3}\right)$

21. The maximum particle velocity is 3 times the wave velocity of a progressive wave. If the amplitude of the particle is 'a'. The phase difference between the two particles separated by a distance of 'x' is
(1) x/a (2) 3x/a (3) 3a/x (4) $3\pi x / a$

22. $y(x, t) = 0.8/[(4x + 5t)^2 + 5]$ represents a moving pulse, where x, y are in meter and t in second. Then
(a) pulse is moving in + x direction
(b) in 2 second it will travel a distance 2.5 m
(c) its maximum displacement is 0.16 m
(d) its maximum displacement is 0.8 m
(1) a & b are correct (2) b & c are correct (3) a, b & c correct (4) All are correct

23. The equation of a progressive wave is given by $y = 0.4 \sin\left[\pi\left(\frac{t}{5} - \frac{x}{9}\right) + \frac{\pi}{6}\right]$ (in SI units). Then which of the following is correct?
(1) Time taken to propagate 1 wave across a point is 10s
(2) The wavelength is 18m
(3) The amplitude is 0.4m
(4) All the above

24. For the wave shown in the figure, the frequency and wavelength if its speed is 320 m/s are



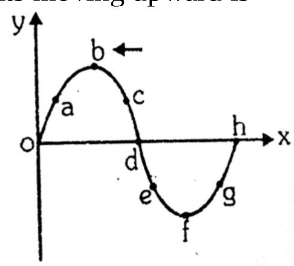

(1) 8 cm, 400 Hz (2) 80 cm, 40 Hz (3) 8 cm, 4000 Hz (4) 40cm, 8000 Hz

25. The equation of a wave travelling on a string stretched along the X-axis is given by $y = Ae^{-\left(\frac{x}{a}+\frac{t}{T}\right)^2}$ where A, a and T are constant of appropriate dimensions.

(A) The speed of the wave is a/T
(B) The wave is travelling along negative X-axis
(C) The maximum of the pulse located at t = T is x = – a
(D) The maximum of the pulse located at t = 2T is x = – 2a

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

26. The figure represents the instantaneous picture of a transverse harmonic wave travelling along the negative X-axis. Choose the correct alternative(s) related to the movement of the nine points shown in the figure. The points moving upward is




(1) a (2) c (3) d (4) e

27. A transverse wave whose amplitude is 0.5 m wavelength is 1 m and frequency is 2Hz, is travelling along positive X-direction. The equation of this wave will be

(1) $y = 0.5\cos(2\pi x - 4\pi t)$ (2) $y = 0.5\cos(2\pi x + 4\pi t)$
(3) $y = 0.5\sin(\pi x - 2\pi t)$ (4) $y = 0.5\sin(2\pi x + 2\pi t)$

28. The linear density of a vibrating string is $10^{-4}$ kg/m. A transverse wave is propagating on the string, which is described by the equation y = 0.02 sin 9(x + 30t), where x and y are in meters and time t is in seconds. The tension in the string is

(1) 0.09 N (2) 0.36 N (3) 0.9 N (4) 3.6 N

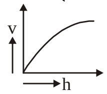
29. If the length of a stretched string is shortened by 40% and the tension is increased by 44% then the ratio of the final and initial wave velocity is

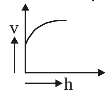
(1) 6 : 5 (2) 3 : 4 (3) 3 : 2 (4) 1 : 3

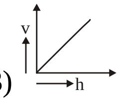
30. The motion is given by $y = 2e^{2x}.e^{3t}$, where y and x are in meters and t is in second.

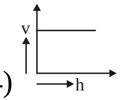
(1) This represents a progressive wave travelling in – ve x-direction
(2) This represents a progressive wave travelling in + ve x-direction
(3) This represents a stationary wave
(4) This represents a wave pulse

31. A uniform rope having mass ‘m’ hangs vertically from a rigid support. A transverse wave pulse is produced at the lower end. The speed (v) of wave pulse varies with height ‘h’ from the lower end as: (lower end of rope is free)

(1) 

(2) 

(3) 

(4) 


32. A transverse wave is represented by the equation $y = y_0 \sin\frac{2\pi}{\lambda}(vt - x)$ for what value of $\lambda$ is the maximum particle velocity equal to two times the wave velocity?

(1) $\lambda = 2\pi y_0$ (2) $\lambda = \frac{\pi y_0}{3}$ (3) $\lambda = \frac{\pi y_0}{2}$ (4) $\lambda = \pi y_0$

## SECTION-II
## (Numerical Value Answer Type)

33. A uniform rope of length 12 m and mass 12 kg hangs vertically from a rigid support. A block of mass 4 kg is attached to the free end of the rope. A transverse pulse of wavelength 0.04 m is produced at the lower end of the rope. Find the wavelength of the pulse when it reaches the top of the rope.

(1) 0.04 m (2) 0.08 m (3) 0.02 m (4) 0.1 m

34. A wave is represented by the equation y = 0.5 sin(10t + x) meter. It is a travelling wave propagating along x-direction with velocity (in m/s)

(1) 10 (2) 20 (3) 5 (4) 2

35. A transverse wave pulse is given by $Y = \frac{6}{3+(3t-2x)^2}$, where x is in meter and t is in second. Find the velocity of the wave pulse. (in m/s)

(1) 1.5 (2) 1.55 (3) 2.00 (4) 2.50

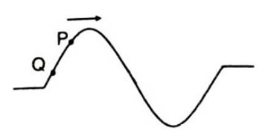
36. A particle of mass 'm' is subjected to two SHM's given by $y_1 = 4\sin\left(\omega t + \frac{\pi}{2}\right)$ and $y_2 = 2\sin\left(\omega t - \frac{\pi}{2}\right)$. The maximum speed of the particle is $n\omega$, find n

(1) 2 (2) 3 (3) 0.5 (4) 4

37. If two simple harmonic motions are represented by equations $y_1 = 10\sin\left(3\pi t + \frac{\pi}{4}\right)$ and $y_2 = 5\left(\sin 3\pi t + \sqrt{3}.\cos 3\pi t\right)$, find the ratio of their amplitudes.

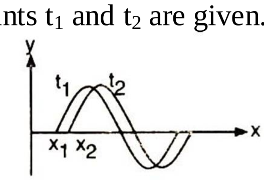
(1) 1 (2) 1.5 (3) 5 (4) 2

38. In the given wave pulse, the ratio of particle speed and wave speed at P and Q are x and y respectively. Then




(1) x > y (2) x = y (3) x < y (4) x $\leq$ y

39. The snapshots of a wave at two instants $t_1$ and $t_2$ are given. The speed of wave is




(1) $\frac{x_1}{t_1}$ (2) $\frac{x_2}{t_2}$ (3) $\frac{x_1+x_2}{t_1+t_2}$ (4) $\frac{x_2-x_1}{t_2-t_1}$

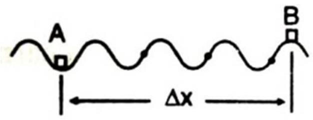
40. A flexible loop of radius R spins with a linear velocity $v_1$. A kink moves in the loop with a speed $v_2$ relative to ground. Then, $\frac{v_1}{v_2}$ = (motion of kink is in same sense as rotation)

(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) None of these

41. A harmonic wave $y = A\sin(10t - x)$ where A is in centimetre, x in meter and t is in second. If wave velocity is 50 times the maximum particle velocity, A =

(1) 1 cm (2) 2 cm (3) 0.5 cm (4) 0.8 cm

42. The phase difference between two corks A and B on the water wave is




(1) zero (2) $3\pi$ (3) $6\pi$ (4) $7\pi$

43. A plane progressive wave of frequency 50 Hz, travelling along positive x-axis is represented as $y = (5 \times 10^{-5}\ \text{m}) \sin(100\pi t)$ at x = 0, wave speed is 300 m/s. Maximum difference in displacements at x = 0, and x = –3 m, is

(1) $5 \times 10^{-5}$ m (2) $2.5 \times 10^{-4}$ m (3) $5 \times 10^{-4}$ m (4) $10^{-4}$ m

44. The path difference between two waves $y_1 = 0.02\sin(8t - 0.1x)$ and $y_2 = 0.01\cos\left(8t - 0.1x + \frac{\pi}{3}\right)$ is

(1) $\frac{20\pi}{3}$ (2) $\frac{25\pi}{3}$ (3) $5\pi$ (4) None of these

45. Which of the following is a wave equation?

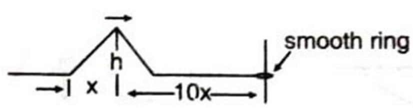
(a) $y = ax^2 - bt^2$ (b) $y = A\sin\omega t\cos kx$

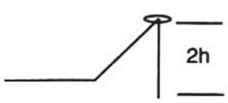
(c) $y = \cos^2(kx - \omega t)$ (d) $y = (x - vt)^3$

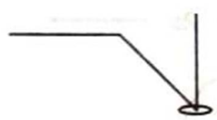
46. The phase difference in displacement and acceleration of a particle in a vibrating string is

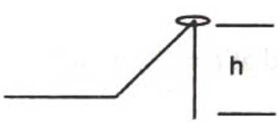
(1) zero (2) 180° (3) time varying (4) none of these

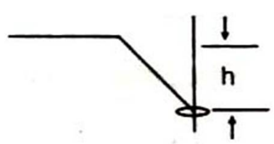
47. A triangular pulse moves towards right with a speed v. After a time t = $10\frac{x}{v}$, the shape of the pulse at the non-rigid boundary is given as



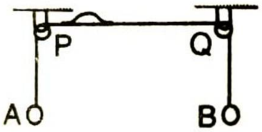

(1) 


(2) 

(3) 

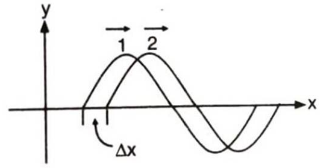

(4) 


48. The transverse pulse has velocity $v_1$ (w.r.t. the string) while moves from P to Q when the load at B is 6m. It has velocity $v_2$ (w.r.t. the string) while moving from P to Q when the load at B is 3m. Then $\frac{v_1}{v_2}$ = (mass of A is 3m)




(1) $\frac{4}{\sqrt{3}}$ (2) $\frac{2}{\sqrt{3}}$ (3) $\frac{\sqrt{3}}{\sqrt{4}}$ (4) None of these

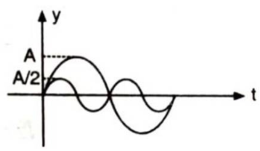
49. Two snap-shots 1 and 2 of a sine wave are given. Then




(1) 2 is ahead of a phase $\frac{2\pi}{\lambda}\Delta x$ from 1 (2) 1 is ahead of 2 by a phase $\frac{2\pi}{\lambda}\Delta x$

(3) 1 and 2 are in same phase if $\Delta x = \lambda$ (4) 2 is ahead of 1 by a phase $\frac{\pi}{\lambda}\Delta x$

50. Two waves 1 and 2 are shown at a time t = $t_1$, say in two identical strings having same tensions. Then, the ratio of (1 and 2). $(\lambda_1 = 2\lambda_2)$



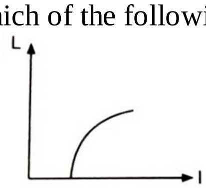

(1) amplitudes is 1 : 2 (2) frequencies is 2 : 1
(3) intensities is 1 : 1 (4) phases is 1 : 1

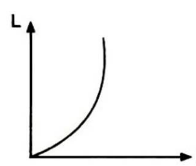
51. If the pressure amplitude is $\Delta P_0$, the difference in pressures at the maximum compressed and maximum rarefied position is

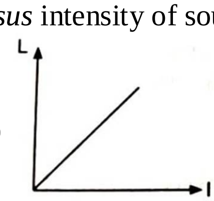
(1) $\frac{\Delta P_0}{2}$ (2) $\Delta P_0$ (3) $4\Delta P_0$ (4) $2\Delta P_0$

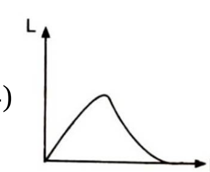
52. Intensity of sound wave is (wave speed is fixed)
(1) increased by four times when pressure amplitude becomes twice and frequency remains the same
(2) increased by four times when displacement amplitude becomes twice and frequency remains the same
(3) increased by four times when displacement amplitude remains same and frequency becomes twice
(4) all of the above

53. Which of the following represents loudness *versus* intensity of sound graph?

(1) 

(2) 

(3) 

(4) 


54. When a longitudinal wave moves in different media, which of the following remains constant?

(1) Amplitude (2) Frequency (3) Intensity (4) Wavelength

55. At the place of maximum compressed zone
(1) Particle (molecular) speed is maximum (2) Particle (molecular) speed is zero
(3) Displacement of an element of air is zero (4) Velocity of the layer of air is zero

56. A point source emits sound in all directions. The ratio of radial distance $\left(\frac{\gamma_1}{\gamma_2}\right)$ from the source where the difference in sound level is 3dB ($\log_{10}2 = 0.3$), is

(1) $\frac{1}{2}$ (2) $\frac{1}{\sqrt{3}}$ (3) $\frac{1}{\sqrt{2}}$ (4) None of these

57. Equation of a longitudinal wave is given as $y = 10^{-2} \sin 2\pi \left(1000t + \frac{50x}{17}\right)$ (all SI units). At t = 0, the excess pressure is maximum at x =

(1) 0.34 (2) 0.255 (3) 0.085 (4) 0.325

## CHEMISTRY

**Syllabus: SECOND YEAR IN ORGANIC CHEMISTRY:– *1.GENERAL PRINCIPAL OF METALLURGY, 2.GROUP -15 ELEMENTS, 3. GROUP -16 ELEMENTS, 4. GROUP -17 ELEMENTS , 5.GROUP -18 ELEMENTS, 6.D AND F -BLOCK ELEMENTS AND CO-ORDINATION COMPOUNDS***

**1.** The number of unpaired electrons in the ground state electronic configuration of Group 15 elements is

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

**2.** The sum of atomicity of nitrogen and phosphorus is

(1) 4 (2) 5 (3) 6 (4) 7

**3.** The acid obtained by the action of cold water on $P_xO_y$ is $H_3PO_3$ where x + y is

(1) 10 (2) 12 (3) 15 (4) 5

**4.** The atomicity of yellow phosphorus is

(1) 4 (2) 3 (3) 5 (4) 8

**5.** The number of $P-O-H$ links in orthophosphoric acid molecule is

(1) 2 (2) 4 (3) 3 (4) 1

**6.** $H_2SO_4$ acts as oxidising agent. In this respect the correct order is

(1) $H_3PO_4 > H_2SO_4 > HNO_3$ (2) $H_3PO_4 < H_2SO_4 < HNO_3$

(3) $H_3PO_4 < HNO_3 < H_2SO_4$ (4) $H_2SO_4 > H_3PO_4 > HNO_3$

**7.** Oxygen is more electronegative than sulphur, Yet $H_2S$ is acidic while $H_2O$ is neutral. This is Because

(1) Water is highly associated compound

(2) H- S bond is weaker than H- O bond

(3) $H_2S$ is a gas while $H_2O$ is liquid

(4) Molecular weight of $H_2S$ is more than that of $H_2O$

**8.** When $H_2S$ gas is passed into aqueous sulphur dioxide

(1) A clear solution of $H_2SO_4$ is formed

(2) $SO_2$ is converted into a yellow precipitate of sulphur

(3) $H_2S$ is converted into a yellow precipitate of sulphur

(4) Both $SO_2$ and $H_2S$ are converted into a yellow precipitate of sulphur

**9.** Sulphuryl chloride is dissolved in water. Which of the following statement is wrong about the solution

(1) Gives white ppt with barium chloride insoluble in any acid

(2) The solution contain two different types of acids a monobasic and a dibasic acid

(3) The solution contain mixture of two different acids

(4) The oxidation states of the elements in $SO_2Cl_2$ donot change when dissolved in water

10. $XeF_6$ on complete hydrolysis forms a compound 'A'. The compound 'A' explodes in dry state. Compound 'A' is.

(1) $XeO_3$ (2) $XeOF_2$ (3) $XeO_2F_2$ (4) $XeOF_4$

11. Hybridization in $XeOF_4$ is same as that of

(1) $XeF_2$ (2) $XeF_4$ (3) $XeF_6$ (4) $XeOF_2$

12. Chlorine gas can be dried by passing over :

(1) Quicklime (2) soda lime

(3) Caustic potash sticks (4) concentrated sulphuric acid

13. Solid $Cl_2O_6$ exists as :

(1) $ClO_2^+.ClO_4^-$ (2) Covalent species (3) $(ClO_3)_2$ (4) $(Cl_2O_6)_2$

14. $PCl_3$ reacts with water to form

(1) $PH_3$ (2) $H_3PO_3$, HCl (3) $POCl_3$ (4) $H_3PO_4$

15. Which one is the anhydride of $HClO_4$?

(1) $Cl_2O$ (2) $ClO_2$ (3) $Cl_2O_6$ (4) $Cl_2O_7$

16. Charge distribution in iodine monochloride is best represented as

(1) $I^+Cl^-$ (2) $I^{\delta+}Cl^{\delta-}$ (3) $I^-Cl^+$ (4) $I^{\delta-}Cl^{\delta+}$

17. Which of the following is most stable to heat?

(1) HCl (2) HOCl (3) HBr (4) HI

18. The correct order of acidic strength is

(1) $Cl_2O_7 > SO_2 > P_4O_{10}$ (2) $CO_2 > N_2O_5 > SO_3$

(3) $Na_2O > MgO > Al_2O_3$ (4) $K_2O > CaO > MgO$

19. Which of the following statements is incorrect about ozone?

(1) Ozone is formed in the upper atmosphere by a photochemical reactions involving dioxygen.

(2) Ozone is more reactive than dioxygen.

(3) Ozone is diamagnetic while dioxygen is paramagnetic.

(4) Ozone protects earth's inhabitants by absorbing gamma radiations.

20. Which of the following statements regarding sulphur dioxide is not correct?

(1) $SO_2$ is an angular molecule.

(2) $SO_2$ is an anhydride of sulphuric acid.

(3) $SO_2$ is an acidic oxide.

(4) The S−O bond length is smaller than the expected value

21. Which set describes shapes of $XeF_2$, $XeF_4$, $XeF_6$, respectively?

(1) V-shaped, tetrahedral, octahedral

(2) Linear, tetrahedral, distorted octahedral

(3) V-shaped, square planar, octahedral

(4) Linear, square planar, distorted octahedral

22. Electron affinity of chlorine is greater than that of fluorine; fluorine is a better oxidising agent than chlorine. Pick up the appropriate answer.

(1) ΔH (dissociation) of $F_2(g)$ < ΔH (dissociation) of $Cl_2(g)$

(2) ΔH (Hydration) of $F^-$ ion > ΔH (Hydration) of $Cl^-$ ion

(3) net energy released for $\frac{1}{2}F_2(g) \longrightarrow F^-(aq)$ is greater than that for $\frac{1}{2}Cl_2(g) \longrightarrow Cl^-(aq.)$

(4) fluorine is more electronegative than chlorine

23. Which of the following statement is incorrect?

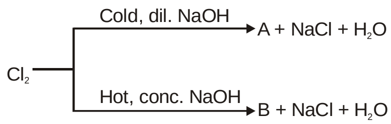
(1) In acid solution $HClO_2$ disproportionates to $ClO_2$ and $Cl^-$.

(2) In warm acid solution $ClO^-$ disproportionates to yield $Cl^-$ and $ClO_3^-$.

(3) Both $ClO_4^-$ and $ClO_3^-$ are powerful oxidising agents then $ClO^-$

(4) All of them.

**24.**




Compound (A) and (B) are

(1) $NaClO_3$, NaClO (2) $NaOCl_2$, NaOCl

(3) $NaClO_4$, $NaClO_3$ (4) NaOCl, $NaClO_3$

**25.** HBr and HI can be prepared by heating NaBr and NaI respectively with concentrated

(1) HCl (2) $H_2SO_4$ (3) $HNO_3$ (4) $H_3PO_4$

## SECTION-II
## (Numerical Value Answer Type)

**26.** The sum of number of lone pairs and the number of S-S bonds in $S_8$ molecules are respectively:

(1) 8 (2) 24 (3) 16 (4) 12

**27.** Available chlorine in a given sample of bleaching powder is 42. How much chlorine gas is obtained at N.T.P., when 10 g of this bleaching powder is treated with HC*l* ?

(1) $1\cdot325L$ (2) $2\cdot650L$ (3) $4\cdot2L$ (4) $6\cdot3L$

**28.** Chlorine water on cooling deposits greenish – yellow crystals of $Cl_2.xH_2O$ then find x is

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

**29.** Boiling of dil. HC*l* acid does not increase its concentration beyond x percent because hydrochloric acid forms a constant boiling mixture. Here x is

(1) 2.22 (2) 22.2 (3) 11.1 (4) 1.11

**30.** Total number of lone pair in $XeO_3$ is

(1) 1 (2) 9 (3) 10 (4) 7

**31.** Which one of the following pairs of substances when mixed, produces chlorine gas at room temperature

(1) $NaCl$ and $MnO_2$ (2) $NaCl$ and $HNO_3$ (conc.)

(3) $NaCl$ and $H_2SO_4$ (conc.) (4) $HCl$ (conc.) and $KMnO_4$

**32.** Concentrated $H_2SO_4$ cannot be used to prepare $HBr$ from $NaBr$, because it

(1) Reduces $HBr$ (2) Oxidises $HBr$

(3) Disproportionates $HBr$ (4) Reacts slowly with $NaBr$

**33.** Which of the following halides is least stable and has doubtful existence

(1) $CI_4$ (2) $GeI_4$ (3) $SnI_4$ (4) $PbI_4$

**34.** Chlorine cannot displace

(1) Fluorine from $NaF$ (2) Iodine from $NaI$

(3) Bromine from $NaBr$ (4) None of these

**35.** When fluoride is heated with conc. $H_2SO_4$ and $MnO_2$ the gas evolved is

(1) $F_2$ (2) $SF$ (3) $HF$ (4) None

**36.** $Cl_2$ reacts with $CS_2$ in presence of $I_2$ catalyst to form

(1) $CHCl_3$ (2) $CCl_4$ (3) $C_2H_5Cl$ (4) $C_2H_6$

**37.** Amongst $LiCl, RbCl, BeCl_2$ and $MgCl_2$. Maximum and minimum ionic character will be shown by the compounds

(1) $LiCl, MgCl_2$ (2) $RbCl, BeCl_2$ (3) $RbCl, MgCl_2$ (4) $MgCl_2, BeCl_2$.

**38.** Which is formed when fluorine react with hot and concentrated sodium hydroxide

(1) $O_2$ (2) $O_3$ (3) $NaO$ (4) $HF$

**39.** Which of the following condition is used to find atomic $Cl_2$ from molecular $Cl_2$

(1) High temperature, high pressure
(2) Low temperature, high pressure
(3) High temperature, low pressure
(4) Low temperature, low pressure

1 mole 2 moles

**40.** Which one is least basic

(1) $BI_3$ (2) $BBr_3$ (3) $BCl_3$ (4) $BF_3$

**41.** On heating $NaCl + K_2Cr_2O_7 +$ conc. $H_2SO_4$, the gas comes out is

(1) $O_2$ (2) $Cl_2$ (3) $CrOCl_2$ (4) $CrO_2Cl_2$

**42.** Aqua regia is a mixture of

(1) $3HCl + 1HNO_3$ (2) $H_3PO_4 + H_2SO_4$ (3) $3HNO_3 + 1HCl$ (4) $HCl + CH_3COOH$

**43.** Unlike other halogens fluorine does not show higher oxidation states because

(1) It is highly electronegative
(2) It has no *d*-orbitals
(3) Its atomic radius is very small
(4) The $F^-$ ion is stable and isoelectronic with neon

**44.** Which halogen does not show variable oxidation state

(1) $F_2$ (2) $Cl_2$ (3) $Br_2$ (4) $I_2$

**45.** To purify fluorine gas, fumes of $HF$ are removed by

(1) Solid $NaF$ (2) $H_2$ gas (3) Solid $KHF_2$ (4) None of these

**46.** Fluorine is prepared by

(1)Oxidation of $HF$ (2) Electrolysis of $KF$
(3)Electrolysis of fused $KHF_2$ (4)Decomposition of $HgF_2$

**47.** Amongst halogens fluorine is most oxidising because

(1) Fluorine has highest electron affinity
(2) Fluorine is most electronegative
(3) Dissociation energy for fluorine molecule is lowest
(4) All are correct

**48.** The alkali metal halides are soluble in water but $LiF$ is insoluble because

(1) It is amphoteric (2) The $Li-F$ bond is highly ionic
(3) Its lattice energy is high (4) $Li^+$ ion is least hydrated

**49.** In which of the following pairs does the first gas bleaches flowers by reduction while the second gas does so by oxidation

(1) $CO$ and $Cl_2$ (2) $SO_2$ and $Cl_2$ (3) $H_2$ and $Br_2$ (4) $NH_3$ and $SO_2$

**50.** Which of the following halogens does not form oxyacid

(1)Fluorine (2) Chlorine (3) Bromine (4) Iodine

51. Which of the following molecule is theoritically not possible

(1) $OF_4$ (2) $OF_2$ (3) $SF_4$ (4) $O_2F_2$

52. Iodine is released when potassium iodide reacts with

(1) $ZnSO_4$ (2) $CuSO_4$ (3) $FeSO_4$ (4) $(NH_4)_2SO_4$

53. Which of the following is used in the preparation of chlorine

(1) Only $MnO_2$ (2) Only $KMnO_4$

(3) Both $MnO_2$ and $KMnO_4$ (4) Either $MnO_2$ or $KMnO_4$

54. Among $Cl^-$, $Br^-$, $I^-$, the correct order for being oxidise to dihalogen is

(1) $I^- > Cl^- > Br^-$ (2) $Cl^- > Br^- > I^-$ (3) $I^- > Br^- > Cl^-$ (4) $Br^- > I^- > Cl^-$

55. On heating $KClO_3$, we get

(1) $Cl_2O$ (2) $ClO_2$ (3) $ClO_3$ (4) $Cl_2O_7$

56. For which one of the following properties of halogens the sequence $F > Cl > Br > I$ holds good

(1) Electron affinity (2) Electronegativity

(3) Atomic radius (4) Boiling point

57. Which of the following properties increases on going down from $F$ to $I$ in Group VII-A of the periodic table ?

(1) Electronegativity (2) Volatile nature

(3) Ionic radius (4) Oxidising power

58. Among the halogens, the one which is oxidised by nitric acid i

(1) Fluorine (2) Iodine (3) Chlorine (4) Bromine

59. The reaction of the type $2X_2 + S \rightarrow SX_4$ is shown by sulphur when $X$ is

(1) Fluorine or chlorine (2) Chlorine only

(3) Chlorine and bromine only (4) None

60. When $I_2$ is passed through $KCl$, $KF$ and $KBr$ solutions

(1) $Cl_2$ and $Br_2$ are evolved (2) $Cl_2$ is evolved

(3) $Cl_2$, $Br_2$ and $F_2$ are evolved (4) None of these

61. The solubility of $I_2$ increases in water in the presence of

(1) $KI$ (2) $H_2SO_4$ (3) $KMnO_4$ (4) $NH_3$

62. Which of the hydrogen halides forms salts like $KHX_2$ (where $X$ is a halogen atom)

(1) $HF$ (2) $HCl$ (3) $HI$ (4) $HBr$

63. With cold and dilute sodium hydroxide fluorine reacts to give

(1) $NaF$ and $OF_2$ (2) $NaF + O_3$ (3) $O_2$ and $O_3$ (4) $NaF + O_2$

64. Which one of the following oxides is expected exhibit paramagnetic behaviour

(1) $CO_2$ (2) $SO_2$ (3) $ClO_2$ (4) $SiO_2$

65. Of the following acids, the one that is strongest is

(1) $HBrO_4$ (2) $HOCl$ (3) $HNO_2$ (4) $H_3PO_3$

66. Which of the following is anhydride of perchloric acid

(1) $Cl_2O_7$ (2) $Cl_2O_5$ (3) $Cl_2O_3$ (4) $HClO$

67. $I_2$ dissolves in $KI$ solution due to the formation of

(1) $KI_2$ and $I^-$ (2) $K^+, I^-$ and $I_2$ (3) $KI_3^-$ (4) None of these

68. Which of the following noble gas does not have an octet of electrons in its outermost shell

(1) Neon (2) Radon (3) Argon (4) Helium

**69.** The low chemical reactivity of the rare gases can be attributed to their

(1) Being non-metals
(2) Having high ionization energies
(3) Being gases
(4) Found in nature in small quantities

**70.** Percentage of $Ar$ in air is about

(1) 1% (2) 2% (3) 3% (4) 4%

**71.** Which of the following is not obtained by direct reaction of constituent elements

(1) $XeF_2$ (2) $XeF_4$ (3) $XeO_3$ (4) $XeF_6$

**72.** Fluorine forms chemical compounds with

(1) $He$ (2) $Ne$ (3) $Ar$ (4) $Xe$

**73.** Which of the following has $sp^3$ hybridisation

(1) $XeO_3$ (2) $BCl_3$ (3) $XeF_4$ (4) $BBr_3$

**74.** Which element out of $He$, $Ar$, $Kr$, and $Xe$ forms least number of compounds

(1) $He$ (2) $Ar$ (3) $Kr$ (4) $Xe$

**75.** Which of the following exhibits the weakest intermolecular forces

(1) $He$ (2) $HCl$ (3) $NH_3$ (4) $H_2O$

Zero group element are attached with weak intermolecular force.

**76.** of the following are formed by Xenon

(1) $XeF_3$ (2) $XeF_4$ (3) $XeF_5$ (4) $XeF_6$

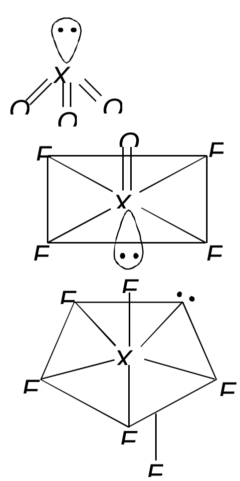
**77.** Among the following molecule

(1) $XeO_3$ (2) $XeOF_4$ (3) $XeF_6$

Those having same number of lone pairs on $Xe$ are

(1) (i) and (ii) only
(2) (i) and (iii) only
(3) (ii) and (iii) only
(4) (i),(ii) and (iii)

$XeO_3$ :



**78.** Who among the following first prepared a stable compound of noble gas

(1) Rutherford
(2) Rayleigh
(3) Ramsay
(4) Neil Bartlett

**79.** The last member of inert gas elements is

(1) Helium
(2) Neon
(3) Argon
(4) Radon

**80.** Which of the following gas is/are called rare gas

(1) $Ne$ (2) $He$ (3) $Kr$ (4) All of these

**81.** Which one of the following statements regarding helium is incorrect

(1) It is used to produce and sustain powerful superconducting magnets

(2) It is used as a cryogenic agent for carrying out experiments at low temperatures

(3) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable

(4) It is used in gas-cooled nuclear reactors

**82.** Which of the following inert gas liquifies easily

(1) *Kr* (2) *He* (3) *Ne* (4) *Ar*

***83.*** The oxidation number of xenon in $XeOF_2$ is

(1) Zero (2) 2 (3) 4 (4) 3

**84.** Which inert gas having highest boiling point

(1)*Xe* (2) *Ar* (3) *Kr* (4) *He*

**85.** Which of the following is an inert gas

(1) $H_2$ (2) $O_2$ (3) $N_2$ (4) Argon

**86.** Which of the following is planar

(1) $XeF_2$ (2) $XeO_3F$ (3) $XeO_2F_2$ (4) $XeF_4$

******

# MELUHA INTERNATIONAL SCHOOL

## HYDERABAD

**SR MPC JEE MAINS** | **UNIT – II** | **Date: 22-04-2020**
**Time:** | **ASSIGNMENT – 2** | **Max. Marks:**

## MATHS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1) **4** | 2) **1** | 3) **2** | 4) **2** | 5) **4** | 6) **1** | 7) **3** | 8) **1** | 9) **3** | 10) **3** |
| 11) **2** | 12) **1** | 13) **2** | 14) **3** | 15) **3** | 16) **3** | 17) **3** | 18) **3** | 19) **2** | 20) **2** |
| 21) **2** | 22) **2** | 23) **2** | 24) **3** | 25) **2** | 26) **2** | 27) **3** | 28) **4** | 29) **3** | 30) **2** |
| 31) **2** | 32) **1** | 33) **4** | 34) **1** | 35) **2** | 36) **2** | 37) **3** | 38) **3** | 39) **3** | 40) **4** |
| 41) **4** | 42) **3** | 43) **3** | 44) **4** | 45) **1** | 46) **2** | 47) **2** | 48) **2** | 49) **1** | 50) **4** |
| 51) **2** | 52) **1** | 53) **3** | 54) **1** | 55) **2** | 56) **4** | 57) **3** | 58) **2,3** | 59) **1,4** | 60) **4** |
| 61) **1** | 62) **2** | 63) **2** | 64) **2** | 65) **1,4** | 66) **1** | 67) **2,3** | 68) **4** | 69) **2** | 70) **1** |
| 71) **3** | 72) **1** | 73) **2** | 74) **4** | 75) **3** | 76) **4** | 77) **2** | 78) **3** | 79) **1** | 80) **2** |
| 81) **1** | 82) **3** | 83) **1** | 84) **4** | 85) **1** | | | | | |

## PHYSICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1) **2** | 2) **3** | 3) **2** | 4) **2** | 5) **3** | 6) **1** | 7) **4** | 8) **1** | 9) **1** | 10) **4** |
| 11) **1** | 12) **2** | 13) **4** | 14) **1** | 15) **3** | 16) **4** | 17) **4** | 18) **1** | 19) **3** | 20) **1** |
| 21) **2** | 22) **2** | 23) **4** | 24) **3** | 25) **1** | 26) **1** | 27) **1** | 28) **1** | 29) **1** | 30) **1** |
| 31) **1** | 32) **4** | 33) **2** | 34) **1** | 35) **1** | 36) **1** | 37) **1** | 38) **3** | 39) **4** | 40) **2** |
| 41) **1** | 42) **4** | 43) **4** | 44) **2** | 45) **4** | 46) **2** | 47) **1** | 48) **4** | 49) **1** | 50) **3** |
| 51) **4** | 52) **4** | 53) **1** | 54) **2** | 55) **3** | 56) **3** | 57) **3** | | | |

## CHEMISTRY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1) **2** | 2) **3** | 3) **1** | 4) **1** | 5) **3** | 6) **2** | 7) **2** | 8) **4** | 9) **1** | 10) **1** |
| 11) **2** | 12) **4** | 13) **1** | 14) **2** | 15) **4** | 16) **2** | 17) **1** | 18) **1** | 19) **4** | 20) **2** |
| 21) **4** | 22) **3** | 23) **3** | 24) **4** | 25) **4** | 26) **2** | 27) **1** | 28) **4** | 29) **2** | 30) **3** |
| 31) **4** | 32) **2** | 33) **4** | 34) **1** | 35) **3** | 36) **2** | 37) **2** | 38) **1** | 39) **3** | 40) **4** |
| 41) **4** | 42) **1** | 43) **2** | 44) **1** | 45) **1** | 46) **3** | 47) **3** | 48) **3** | 49) **2** | 50) **1** |
| 51) **1** | 52) **2** | 53) **3** | 54) **3** | 55) **2** | 56) **2** | 57) **3** | 58) **2** | 59) **4** | 60) **4** |
| 61) **1** | 62) **1** | 63) **1** | 64) **3** | 65) **1** | 66) **1** | 67) **3** | 68) **4** | 69) **2** | 70) **1** |
| 71) **3** | 72) **4** | 73) **1** | 74) **1** | 75) **1** | 76) **2** | 77) **4** | 78) **4** | 79) **4** | 80) **4** |
| 81) **3** | 82) **1** | 83) **3** | 84) **1** | 85) **4** | 86) **4** | | | | |

## HINTS & SOLUTIONS
## MATHS

6. (1)

$$\frac{c+b}{c-b}\tan\frac{A}{2}=\frac{\sin C+\sin B}{\sin C-\sin B}\tan\frac{A}{2}=\frac{2\sin\frac{B+C}{2}.\cos\frac{C-B}{2}}{2\cos\frac{B+C}{2}.\sin\frac{C-B}{2}}.\tan\frac{A}{2}$$

$$=\tan\frac{B+C}{2}.\cot\frac{C-B}{2}.\tan\frac{A}{2}=\cot\frac{C-B}{2}=\cot\frac{\pi-A-B-B}{2}$$

$$=\cot\left(\frac{\pi}{2}-\overline{\frac{A}{2}+B}\right)=\tan\left(\frac{A}{2}+B\right)$$

7. (3)

$$b\cos^2\frac{C}{2}+c\cos^2\frac{B}{2}=\frac{b}{2}(1+\cos C)+\frac{c}{2}(1+\cos B)$$

$$=\frac{b}{2}+\frac{c}{2}+\frac{1}{2}(b\cos C+c\cos B)=\frac{a+b+c}{2}=\frac{k}{2}$$

8. (1)

Napier’s analogy.

9. (3)

$$\cos A=\frac{b^2+c^2-a^2}{2bc}=\frac{a^2\cos^2 A-a^2}{2bc}=\frac{a^2\left(\cos^2 A-1\right)}{2bc}<0$$

So, $A>\frac{\pi}{2}$

10. (3)

$$\tan\frac{A}{2}+\tan\frac{B}{2}=\frac{5}{6},\tan\frac{A}{2}.\tan\frac{B}{2}=\frac{1}{6}\Rightarrow\tan\left(\frac{A+B}{2}\right)=1$$

$$\Rightarrow A+B=2\times\frac{\pi}{4}$$

11. (2)

$$\cos C=\frac{8^2+10^2-12^2}{2.8.10}=\frac{1}{8}$$

$$\cos A=\frac{10^2+12^2-8^2}{2.10.12}=\frac{3}{4}$$

$$\cos 2A=2\cos^2 A-1=2\times\frac{9}{16}-1=\frac{1}{8}$$

So, cos C = cos 2A$\Rightarrow$ $C=2A$

12. (1)

$$\tan^2\frac{C}{2}=\frac{(s-a)(s-b)}{s(s-c)}=\frac{(9+c-10)(9+c-8)}{(9+c)(9-c)}=\frac{c^2-1}{81-c^2}$$

$$\therefore\ \frac{7}{9}=\frac{c^2-1}{81-c^2}\Rightarrow c=6$$

13. (2)

$$\frac{1}{2}.p.a=area=\sqrt{s(s-a)(s-b)(s-c)}$$

14. (3)

tan A = $\frac{4}{3}$ and tan B = $\frac{12}{5}$. Clearly, tan C should be such that

$\tan A+\tan B+\tan C=\tan A\tan B\tan C$

$\therefore\ \frac{4}{3}+\frac{12}{5}+\tan C=\frac{4}{3}.\frac{12}{5}.\tan C$ or $\frac{56}{15}+\tan C=\frac{16}{5}\tan C$

Or $\tan C=\frac{56}{33}$

$\therefore\ \cot C=\frac{33}{65}=0.508$

15. (3)

$a^2\sin 2B+b^2\sin 2A=2a^2\sin B.\cos B+2b^2\sin A\cos A$

$=\frac{a^2b}{R}\cos B+\frac{b^2a}{R}\cos A$

$=\frac{ab}{R}\left(a\cos B+b\cos A\right)=\frac{abc}{R}=2bc\sin A$

$=4\left(\frac{1}{2}bc\sin A\right)=4\times 1.2=4.8$

16. (3)

Use cosine formula.

17. (3)

$2s\left(2s-2c\right)=ab$ *or* $\frac{s\left(s-c\right)}{ab}=\frac{1}{4}$

Or $\cos^2\frac{C}{2}=\frac{1}{4}$ *or* $\cos\frac{C}{2}=\frac{1}{2}$ $\left(\because \frac{C}{2}\text{ must be acute}\right)$

18. (3)

Clearly, A = 45°, B = 75°, C = 60°. So $\frac{a}{\sin 45°}=\frac{b}{\sin 75°}=\frac{c}{\sin 60°}=2R$

$\therefore\ a=\sqrt{2}R, b=\frac{\sqrt{3}+1}{\sqrt{2}}R, c=\sqrt{3}R$

Now, a + b + c$\sqrt{2}$ = $\left(\sqrt{2}+\frac{\sqrt{3}+1}{\sqrt{2}}+\sqrt{6}\right)R=3b$

19. (2)

Clearly, the roots of $x^2+\sqrt{2}x+1=0$ are non real complex. So, one root common implies both roots are common.

So, $\frac{a}{1}=\frac{b}{\sqrt{2}}=\frac{c}{1}=k$

$\therefore\ \cos C=\frac{a^2+b^2-c^2}{2ab}=\frac{k^2+2k^2-k^2}{2.k.\sqrt{2}k}=\frac{1}{\sqrt{2}}$

20. (2)

Here a + b = $2\sqrt{3}$, ab = 2 and C = $\frac{\pi}{3}$.

$\cos C = \frac{a^2+b^2-c^2}{2ab} \Rightarrow \frac{1}{2} = \frac{a^2+b^2-c^2}{2ab} \Rightarrow a^2+b^2-c^2 = ab$

Or $(a+b)^2 - 2ab - c^2 = ab$ *or* $12-4-c^2 = 2$ *or* $c = \sqrt{6}$

$\therefore$ the perimeter = a + b + c = $2\sqrt{3}+\sqrt{6}$

21. (2)

22. (2)

Clearly, $\tan\frac{A}{2} > \tan\frac{B}{2}$; $\therefore \frac{A}{2} > \frac{B}{2}$ *or* $A > B$

$\tan\frac{A+B}{2} = \frac{\frac{5}{6}+\frac{20}{37}}{1-\frac{5}{6}.\frac{20}{37}} = \frac{305}{122}$ Or $\tan\frac{C}{2} = \frac{305}{122}$

As $\frac{20}{37} > \frac{122}{305}$, we get

$\tan\frac{B}{2} > \tan\frac{C}{2} \Rightarrow \frac{B}{2} > \frac{C}{2}$ i.e., B > C

$\therefore$ A > B > C $\therefore$ a > b > c

$\therefore$ 2a > b + c and a +b > 2c

23. (2) Clearly, A > B $(\because a > b)$

Now $\tan\frac{A-B}{2} = \frac{a-b}{a+b}\cot\frac{C}{2} \Rightarrow \tan 30 = \frac{1}{3}\cot\frac{C}{2}$

$\therefore \sqrt{3} = \cot\frac{C}{2}$ *or* $\frac{C}{2} = \frac{\pi}{6}$

24. (3)

$\tan\frac{A-B}{2} = \frac{1}{3}\tan\frac{A+B}{2} = \frac{1}{3}cot\frac{C}{2}$

$\Rightarrow \frac{a-b}{a+b} = \frac{1}{3}$

25. (2)

$\frac{1}{2}b\sin\frac{2\pi}{3} = \frac{9\sqrt{3}}{2}$ *or* $\frac{1}{2}.\frac{\sqrt{3}}{2}.bc = \frac{9\sqrt{3}}{2} \Rightarrow bc = 18$

Also, $\cos\frac{2\pi}{3} = \frac{b^2+c^2-a^2}{2bc} \Rightarrow -\frac{1}{2} = \frac{(b-c)^2+2bc-a^2}{2bc}$

Or $(b-c)^2 + 3bc - a^2 = 0$ *or* $27+54 = a^2$

26. (2) cot A, cot B, cot C are in AP

$\Rightarrow \frac{b^2+c^2-a^2}{2bc.\frac{a}{2R}}, \frac{c^2+a^2-b^2}{2ca.\frac{b}{2R}}, \frac{a^2+b^2-c^2}{2ab.\frac{c}{2R}}$ are in AP

$\Rightarrow b^2+c^2-a^2, c^2+a^2-b^2, a^2+b^2-c^2$ are in AP

$\Rightarrow -2a^2, -2b^2, -2c^2$ are in AP (subtracting $a^2+b^2+c^2$ from each)

27. (3)

$$\frac{2R\sin A}{\cos A}=\frac{2R\sin B}{\cos B} \quad or \quad \sin A\cos B=\cos A\sin B$$

Or 2 sin A cos B = cos A sin B + sin A cos B = sin (A + B) = sin C

28. (4)

3sin A = sin B + sin C $\Rightarrow \quad 6\sin\frac{A}{2}.\cos\frac{A}{2}=2\sin\frac{B+C}{2}.\cos\frac{B-C}{2}$

$$\Rightarrow \quad 3\cos\frac{B+C}{2}. = \cos\frac{B-C}{2}$$

$$\Rightarrow \quad 3\left(\cos\frac{B}{2}.\cos\frac{C}{2}-\sin\frac{B}{2}.\sin\frac{C}{2}\right)=\cos\frac{B}{2}\ .\cos\frac{C}{2}+\sin\frac{B}{2}\sin\frac{C}{2}$$

$$\Rightarrow \quad 2\cos\frac{B}{2}\ .\cos\frac{C}{2}=4\sin\frac{B}{2}\sin\frac{C}{2} \quad \Rightarrow \quad \tan\frac{B}{2}.\tan\frac{C}{2}=\frac{1}{2}$$

29. (3)

1 + b + c = 6 . $\frac{\text{sinA}+\text{sinB}+\text{sinC}}{3}=2\left(\frac{1}{2R}+\frac{b}{2R}+\frac{c}{2R}\right)=\frac{1}{R}(1+b+c)$

$\therefore \quad R=1 \qquad (\because 1+b+c\neq 0)$

So, $\frac{1}{\sin A}=2R=2 \quad \Rightarrow \quad A=\frac{\pi}{6}$

30. (2)

Sin A, sin B, sin C are in AP

$\Rightarrow \frac{a}{2R},\frac{b}{2R},\frac{c}{2R}$ are in AP $\quad \Rightarrow \quad$ a, b, c are in AP

$\Rightarrow \frac{2\Delta}{h_1},\frac{2\Delta}{h_2},\frac{2\Delta}{h_3}$ are in AP $\quad \Rightarrow \frac{1}{h_1},\frac{1}{h_2},\frac{1}{h_3}$ are in AP

Now medians are $\sqrt{\frac{c^2+b^2}{2}-\frac{a^2}{4}},\sqrt{\frac{a^2+c^2}{2}-\frac{b^2}{4}},\sqrt{\frac{a^2+b^2}{2}-\frac{c^2}{4}}$

These are neither in AP nor GP.

31. (2)

$\frac{1}{2}\alpha\,.\,a=\Delta; \qquad \therefore\frac{1}{\alpha}=\frac{a}{2\Delta}$. Similarly for others.

$$\therefore \alpha^{-1}+\beta^{-1}+\gamma^{-1}=\frac{1}{2\Delta}(a+b+c)=\frac{s}{\Delta}$$

32. (1)

$$\frac{s}{R}=\frac{(a+b+c)}{2R}=\frac{a}{2R}+\frac{b}{2R}+\frac{c}{2R}=\sin A+\sin B+\sin C$$

33. (4)

34. (1)

$(\alpha-\beta)+\alpha+(\alpha+\beta)=180°$ and $\alpha+\beta=90°$

$\therefore$ the angles are 30°, 60°, 90°

$$\therefore \quad \frac{a}{\sin 30°}=\frac{b}{\sin 60°}=\frac{c}{\sin 90°}=2R \quad or \quad a=R,b=\sqrt{3}R,c=2R$$

$$r=\frac{\Delta}{s}=\frac{\frac{1}{2}R.\sqrt{3}R}{\frac{1}{2}\left(R+\sqrt{3}R+2R\right)}=\frac{\sqrt{3}R}{3+\sqrt{3}}$$

and 2s = $R+\sqrt{3}R+2R=\left(3+\sqrt{3}\right)R$

$$\therefore\ \frac{r}{2s}=\frac{\sqrt{3}R}{3+\sqrt{3}}\times\frac{1}{\left(3+\sqrt{3}R\right)}=\frac{1}{\left(3+\sqrt{3}\right)\left(\sqrt{3}+1\right)}$$

$$=\frac{1}{6+4\sqrt{3}}=\frac{1}{2\sqrt{3}\left(2++\sqrt{3}\right)}=\frac{2-\sqrt{3}}{2\sqrt{3}}$$

35. (2); cot A . cot B . cot C > 0 $\Rightarrow$ cot A > 0, cot B > 0, cot C > 0
because two or more of cot A, cot B, cot C cannot be negative at the same time in a triangle.

36. (2)

$$r.r_1.r_2.r_3=\frac{\Delta}{s}.\frac{\Delta}{s-a}.\frac{\Delta}{s-b}.\frac{\Delta}{s-c}=\frac{\Delta^4}{\Delta^2}=\Delta^2$$

37. (3)

Here $\Delta=a^2-\left(b^2-c^2\right)\Rightarrow\ \Delta=\left(2s-2c\right)\left(2s-2b\right)=4\left(s-b\right)\left(s-c\right)$

$$\therefore\ \frac{1}{4}=\frac{\left(s-b\right)\left(s-c\right)}{\Delta}=\tan\frac{A}{2}\Rightarrow\ \tan A=\frac{2\tan\frac{A}{2}}{1-\tan^2\frac{A}{2}}=\frac{2\times\frac{1}{4}}{1-\left(\frac{1}{4}\right)^2}$$

38. (3)

$$A=\pi-\frac{\pi}{4}-\frac{\pi}{6}=105^\circ$$

So, $\frac{\sqrt{3}+1}{\sin 105^\circ}=\frac{c}{\sin\frac{\pi}{6}}\ \Rightarrow\ c=\frac{\frac{\sqrt{3}+}{2}}{\frac{\sqrt{3}+1}{2\sqrt{2}}}=\sqrt{2}$

$\therefore$ area = $\frac{1}{2}ac\sin B=\frac{1}{2}.\left(\sqrt{3}+1\right)\sqrt{2}.\sin\frac{\pi}{4}$

39. (3)

Expression = $\frac{b^2+c^2-a^2}{2abc}+\frac{c^2+a^2-b^2}{2abc}+\frac{a^2+b^2-c^2}{2abc}=\frac{a^2+b^2+c^2}{2abc}$

$$=\frac{\left(a+b+c\right)^2-2\left(ab+bc+ca\right)}{2abc}=\frac{11^2-2.38}{2.40}=\frac{9}{16}$$

40. (4) Here a = 4k, b = 5k, c = 6k $\qquad\therefore\ s=\frac{15k}{2}$

$$\therefore\ \Delta=\sqrt{\frac{15k}{2}\left(\frac{15k}{2}-4k\right)\left(\frac{15k}{2}-5k\right)\left(\frac{15k}{2}-6k\right)}=\frac{15\sqrt{7}}{4}k^2$$

But R = $\frac{abc}{4\Delta}=\frac{4k.5k.6k}{15\sqrt{7}k^2}=\frac{8}{\sqrt{7}}k$

And r = $\frac{\Delta}{s}=\frac{15\sqrt{7}}{4}k^2.\frac{2}{15k}=\frac{\sqrt{7}}{2}k$

$$\therefore\ \frac{R}{r}=\frac{8k/\sqrt{7}}{\sqrt{7}k/2}=\frac{16}{7}$$

41. (4)

$\frac{r}{R}=\frac{a\cos A+b\cos B+c\cos C}{a+b+c}=\frac{3k\cos 60°}{3k}=\frac{1}{2}$, where side = k, angle = 60° in an equilateral triangle.

42. 3 sinx + cosx + tanx + cotx + secx + cosecx = 7

$\Rightarrow$ (sinx + cosx) + $\left(\frac{1}{\sin x\cos x}\right)+\frac{(\sin x+\cos x)}{\sin x.\cos x}=7$

$\Rightarrow$ (sinx + cosx) $\left(1+\frac{2}{\sin 2x}\right)=\left(7-\frac{2}{\sin 2x}\right)$

$\Rightarrow$ (1 + sin2x) $\left(1+\frac{4}{\sin^2 2x}+\frac{4}{\sin 2x}\right)$ = 49 + $\frac{4}{\sin^2 2x}-\frac{28}{\sin 2x}$ (squaring both sides)

$\Rightarrow$ $\sin^3 2x - 44\sin^2 2x + 36\sin 2x = 0$

$\Rightarrow$ sin2x = $22 - 8\sqrt{7}$.

43. 3

tan(πcosθ) = cot(πsinθ) $\Rightarrow$ π cosθ = $\left(\frac{\pi}{2}-\pi\sin\theta\right)+n\pi$

$\Rightarrow$ cosθ + sinθ = $n+\frac{1}{2}$, $n \in I$ $\Rightarrow$ sinθ + cosθ = $\frac{1}{2}, -\frac{1}{2}$ $\Rightarrow$ sinθcosθ = $-\frac{3}{8}$

$\Rightarrow$ cosθ, sinθ are roots of the equation $\Rightarrow 8x^2 \pm 4x - 3 = 0$.

44. 4

$$\tan^{-1}\frac{(\sin 1-1)}{\cos 1}=-\tan^{-1}\frac{(1-\sin 1)}{\cos 1}=-\tan^{-1}\frac{\left(1-\tan\frac{1}{2}\right)}{\left(1+\tan\frac{1}{2}\right)}=-\left(\frac{\pi}{4}-\frac{1}{2}\right)=\frac{1}{2}-\frac{\pi}{4}$$

45. 1

tanα tan2α tan3α … tan(2n – 1)α

= {tanα tan(2n – 1)α} {tan2α tan(2n– 2)α} ….. { tan(n – 1)α tan(n + 1)α} tan nα,

= {tanα tan(π/2 – α)} {tan2α tan(π/2 – 2α)} …. $\tan\frac{\pi}{4}$ = 1.1.1. ….1 = 1

46. 2

α and β are the roots of the equation x cos θ + y sin θ = 2a $\Rightarrow$ cos α cos β = $\frac{4a^2-y^2}{x^2+y^2}$.

47. 2

We know that $\cos(\sin^{-1}x) = \sqrt{1-x^2}$

$\sin(\cos^{-1}x) = \sqrt{1-x^2}$

$\Rightarrow \sin^{-1}(\cos(\sin^{-1}x)) + \cos^{-1}(\sin(\cos^{-1}x)) = \pi/2$

$\Rightarrow \tan[\sin^{-1}(\cos(\sin^{-1}x))].\tan[\cos^{-1}(\sin(\cos^{-1}x))] = 1$.

48. 2

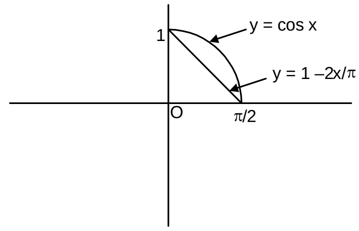
3 sinα < sinα + sinβ + sinγ < 3 sinγ

Also, $\frac{1}{3\cos\alpha}<\frac{1}{\cos\alpha+\cos\beta+\cos\gamma}<\frac{1}{3\cos\gamma}$

Multiplying tan α < $\frac{\sin\alpha+\sin\beta+\sin\gamma}{\cos\alpha+\cos\beta+\cos\gamma}$ < tanγ.

49. 1

From the graph it is clear that $\cos x > 1-\frac{2x}{\pi}$




50. **4** We have $\sin^3 10^0 + \sin^3 50^0 - \sin^3 70^0$

$= \frac{1}{4}[(3\sin 10^0 - \sin 30^0) + (3\sin 50^0 - \sin 150^0) - (3\sin 70^0 - \sin 210^0)]$

$= \frac{1}{4}\left[3(\sin 10^0 + \sin 50^0 - \sin 70^0) - \frac{3}{2}\right]$

$= \frac{1}{4}\left[3(\sin 10^0 - 2\cos 60^0 \cdot \sin 10^0) - \frac{3}{2}\right] = -\frac{3}{8}.$

51. **2**

$\tan\theta = \dfrac{3\tan\frac{\theta}{3} - \tan^3\frac{\theta}{3}}{1 - 3\tan^2\frac{\theta}{3}} = \lambda$

$\tan^3\frac{\theta}{3} - 3\lambda\tan^2\frac{\theta}{3} - 3\tan\frac{\theta}{3} + \lambda = 0$

$\sum \tan\frac{\theta_1}{3}\,\frac{\tan\theta_2}{3} = -3.$

52. **1** In a $\Delta ABC$

Sin(A+ B+ C)= 0

= sinA cosB cosC + sinB cosC cosA + sinC cosA cosB – sinA sinB sinC

$\Rightarrow xyz = x\sqrt{(1-y^2)(1-z^2)} + y\sqrt{(1-x^2)(1-z^2)} + z\sqrt{(1-x^2)(1-x^2)}$

53. **3** $\cos\alpha + \cos\beta = -\frac{b}{a}$ . . . . (1)

$\cos\alpha\cos\beta = \frac{1}{a}$

$\sin\alpha + \sin\beta = -\frac{p}{a}$ . . . . (2)

$\sin\alpha\sin\beta = \frac{1}{a}$

Squaring and adding (1) and (2)

$2 + 2[\cos\alpha\cos\beta + \sin\alpha\sin\beta] = \frac{p^2+b^2}{a^2}$

$\Rightarrow 2a(a+2) = b^2 + p^2$

54 **1** $\tan^2(\theta-\phi) = \dfrac{(n-1)^2\tan^2\phi}{1+n^2\tan^4\phi+2n\tan^2\phi} = \dfrac{(n-1)^2}{\cot^2\phi+n^2\tan^2\phi+2n}$

denominator is minimum at $\tan^2\phi = 1/n$

So maximum value of $\tan^2(\theta-\phi)$ is $\frac{(n-1)^2}{4n}$

55. **2** Let $\tan\frac{\pi}{8} = x$

$\Rightarrow \frac{\pi}{8} = \tan^{-1} x$

$\Rightarrow 4\tan^{-1} x = \frac{\pi}{2}$

$\Rightarrow 2 \times \tan^{-1} \frac{2x}{1-x^2} = \frac{\pi}{2}$

$\Rightarrow \tan^{-1} \frac{\frac{4x}{1-x^2}}{1-\left(\frac{2x}{1-x^2}\right)^2} = \frac{\pi}{2}$

$\Rightarrow \tan^{-1} \frac{4x(1-x^2)}{1-6x^2+x^4} = \frac{\pi}{2}$

$\Rightarrow x^4 - 6x^2 + 1 = 0$

56. **4**

Area of triangle $\rightarrow \frac{1}{2}a^2 |(\cot\theta_1 - \cot\theta_2)|$

$= \frac{1}{2} a^2 \left|\frac{\tan\theta_1 - \tan\theta_2}{\tan\theta_1 \tan\theta_2}\right| = \frac{1}{2} \frac{a^2(a+2)}{(a+1)}$

57. 3

Weighted A.M. $\geq$ H.M.

$\frac{a\sin\theta_1 + b\sin\theta_2 + c\sin\theta_3}{a+b+c} \geq \frac{a+b+c}{\frac{a}{\sin\theta_1}+\frac{b}{\sin\theta_2}+\frac{c}{\sin\theta_2}}$

$\Rightarrow (a \sin\theta_1 + b \sin\theta_2 + c \sin\theta_3)(a \operatorname{cosec}\theta_1 + b \operatorname{cosec}\theta_2 + c \operatorname{cosec}\theta_3) \geq 2^2 \quad \geq 4.$

58. **2,3**

$\tan 10^0 < \tan 15^0 = 2-\sqrt{3} < 2$

$\tan 30^0 = \frac{3\tan 10^0 - \tan^3 10^0}{1-3\tan^2 10^0}$

If $\tan 10^0$ is rational then $\tan 30^0$ must be rational which is not true.

$\therefore \tan 30^0$ is irrational

59. **1,4** $\left(\cos^2 x + \frac{1}{\cos^2 x}\right)(1+\tan^2 2y)(3+\sin 3z) = 4$

Since, $\cos^2 x + \frac{1}{\cos^2 x} \geq 2$, $1+\tan^2 2y \geq 1$, $2 \leq 3+\sin 3z \leq 4$

So, the only possiblility is

$\cos^2 x + \frac{1}{\cos^2 x} = 2$, $1+\tan^2 2y = 1$, $3+\sin 3z = 2$

$\Rightarrow \cos x = \pm 1 \Rightarrow x = n\pi$

$\tan 2y = 0 \Rightarrow y = \frac{m\pi}{2}$

$\sin 3z = -1 \Rightarrow z = (4k-1)\frac{\pi}{6}$ ; m, n, k $\in$

60. 4

$\tan^{-1}\frac{(\sin 1 - 1)}{\cos 1} = -\tan^{-1}\frac{(1-\sin 1)}{\cos 1} = -\tan^{-1}\frac{\left(1-\tan\frac{1}{2}\right)}{\left(1+\tan\frac{1}{2}\right)} = -\left(\frac{\pi}{4}-\frac{1}{2}\right) = \frac{1}{2}-\frac{\pi}{4}$

61. 1 $\tan\alpha \tan 2\alpha \tan 3\alpha \ldots \tan(2n-1)\alpha$

$= \{\tan\alpha \tan(2n-1)\alpha\} \{\tan 2\alpha \tan(2n-2)\alpha\} \ldots\ldots \{\tan(n-1)\alpha \tan(n+1)\alpha\} \tan n\alpha,$

$= \{\tan\alpha \tan(\pi/2 - \alpha)\} \{\tan 2\alpha \tan(\pi/2 - 2\alpha)\} \ldots\ldots \tan\frac{\pi}{4} = 1.1.1. \ldots.1 = 1$

62. 2

$\alpha$ and $\beta$ are the roots of the equation x cos θ + y sin θ = 2a ⇒ $\cos\alpha\cos\beta = \frac{4a^2 - y^2}{x^2 + y^2}$.

63. 2

We know that $\cos(\sin^{-1}x) = \sqrt{1-x^2}$

$\sin(\cos^{-1}x) = \sqrt{1-x^2}$

$\Rightarrow \sin^{-1}(\cos(\sin^{-1}x)) + \cos^{-1}(\sin(\cos^{-1}x)) = \pi/2$

$\Rightarrow \tan[\sin^{-1}(\cos(\sin^{-1}x))].\tan[\cos^{-1}(\sin(\cos^{-1}x))] = 1.$

64. 2

$3\sin\alpha < \sin\alpha + \sin\beta + \sin\gamma < 3\sin\gamma$

Also, $\frac{1}{3\cos\alpha} < \frac{1}{\cos\alpha + \cos\beta + \cos\gamma} < \frac{1}{3\cos\gamma}$

Multiplying $\tan\alpha < \frac{\sin\alpha + \sin\beta + \sin\gamma}{\cos\alpha + \cos\beta + \cos\gamma} < \tan\gamma$.

65. **1,4**

$$\left(\cos^2 x + \frac{1}{\cos^2 x}\right)(1 + \tan^2 2y)(3 + \sin 3z) = 4$$

Since, $\cos^2 x + \frac{1}{\cos^2 x} \geq 2$, $1 + \tan^2 2y \geq 1$, $2 \leq 3 + \sin 3z \leq 4$

So, the only possiblility is

$\cos^2 x + \frac{1}{\cos^2 x} = 2$, $1 + \tan^2 2y = 1$, $3 + \sin 3z = 2$

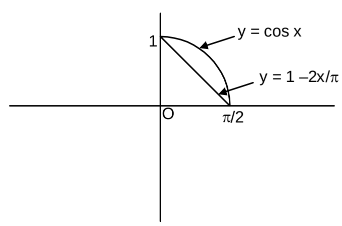
$\Rightarrow \cos x = \pm 1 \Rightarrow x = n\pi$

$\tan 2y = 0 \Rightarrow y = \frac{m\pi}{2}$

$\sin 3z = -1 \Rightarrow z = (4k - 1)\frac{\pi}{6}$ ; m, n, k ∈ I.

66. 1

From the graph it is clear that $\cos x > 1 - \frac{2x}{\pi}$

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$\tan 10^0 < \tan 15^0 = 2 - \sqrt{3} < 2$

$\tan 30^0 = \frac{3\tan 10^0 - \tan^3 10^0}{1 - 3\tan^2 10^0}$

If $\tan 10^0$ is rational then $\tan 30^0$ must be rational which is not true.

∴ $\tan 30^0$ is irrational

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$= \frac{1}{4}\left[3(\sin 10^0 - 2\cos 60^0 \cdot \sin 10^0) - \frac{3}{2}\right] = -\frac{3}{8}$.

69. **(2)** $\tan\theta = \dfrac{3\tan\frac{\theta}{3} - \tan^3\frac{\theta}{3}}{1-3\tan^2\frac{\theta}{3}} = \lambda$

$\tan^3\frac{\theta}{3} - 3\lambda\tan^2\frac{\theta}{3} - 3\tan\frac{\theta}{3} + \lambda = 0$

$\sum \tan\frac{\theta_1}{3}\frac{\tan\theta_2}{3} = -3.$

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Sin(A+ B+ C)= 0

= sinA cosB cosC + sinB cosC cosA + sinC cosA cosB – sinA sinB sinC

$\Rightarrow xyz = x\sqrt{(1-y^2)(1-z^2)} + y\sqrt{(1-x^2)(1-z^2)} + z\sqrt{(1-x^2)(1-x^2)}$

71. $3\cos\alpha + \cos\beta = -\dfrac{b}{a}$ . . . . (1)

$\cos\alpha\cos\beta = \dfrac{1}{a}$

$\sin\alpha + \sin\beta = -\dfrac{p}{a}$ . . . . (2)

$\sin\alpha\sin\beta = \dfrac{1}{a}$

Squaring and adding (1) and (2)

$2 + 2[\cos\alpha\cos\beta + \sin\alpha\sin\beta] = \dfrac{p^2+b^2}{a^2}$

$\Rightarrow 2a(a+2) = b^2 + p^2$

72. 1 $\tan^2(\theta-\phi) = \dfrac{(n-1)^2\tan^2\phi}{1+n^2\tan^4\phi+2n\tan^2\phi} = \dfrac{(n-1)^2}{\cot^2\phi+n^2\tan^2\phi+2n}$

denominator is minimum at $\tan^2\phi = 1/n$

So maximum value of $\tan^2(\theta-\phi)$ is $\dfrac{(n-1)^2}{4n}$

73. **2** Let $\tan\dfrac{\pi}{8} = x$

$\Rightarrow \dfrac{\pi}{8} = \tan^{-1}x$

$\Rightarrow 4\tan^{-1}x = \dfrac{\pi}{2}$

$\Rightarrow 2\times\tan^{-1}\dfrac{2x}{1-x^2} = \dfrac{\pi}{2}$

$\Rightarrow \tan^{-1}\dfrac{\frac{4x}{1-x^2}}{1-\left(\frac{2x}{1-x^2}\right)^2} = \dfrac{\pi}{2}$

$\Rightarrow \tan^{-1}\dfrac{4x(1-x^2)}{1-6x^2+x^4} = \dfrac{\pi}{2} \Rightarrow x^4 - 6x^2 + 1 = 0$

74. **4**

Area of triangle $\rightarrow \dfrac{1}{2}a^2\,|(\cot\theta_1 - \cot\theta_2)|$

$= \dfrac{1}{2}a^2\left|\dfrac{\tan\theta_1-\tan\theta_2}{\tan\theta_1\tan\theta_2}\right| = \dfrac{1}{2}\,\dfrac{a^2(a+2)}{(a+1)}$

75. 3

Weighted A.M. ≥ H.M.

$$\frac{a\sin\theta_1 + b\sin\theta_2 + c\sin\theta_3}{a+b+c} \ge \frac{a+b+c}{\frac{a}{\sin\theta_1}+\frac{b}{\sin\theta_2}+\frac{c}{\sin\theta_2}}$$

$\Rightarrow$ (a $\sin\theta_1$ + b $\sin\theta_2$ + c $\sin\theta_3$) (a $\text{cosec}\theta_1$ + b $\text{cosec}\theta_2$ + c $\text{cosec}\theta_3$) ≥ $2^2$≥ 4.

76. 4 $y^2 - y + a = \left(y-\frac{1}{2}\right)^2 + a - \frac{1}{4}$ .

Since $-\sqrt{2} \le \sin x + \cos x \le \sqrt{2}$, given equation will have no real value of x for any y if $a - \frac{1}{4} > \sqrt{2}$

i.e. $a \in \left(\sqrt{2}+\frac{1}{4}, \infty\right) \Rightarrow a \in (\sqrt{3}, \infty)$ ( as $\sqrt{2}$ + 1/4 < $\sqrt{3}$ )

77. (2) 4 [1 + $\cot^2 \pi(a + x)$] + $a^2$ – 4a = 0

$4\cot^2\pi (a + x) + (a – 2)^2 = 0$

$\Rightarrow$ a – 2 = 0 and $\cot^2\pi (a + x) = 0$

$\Rightarrow$ a = 2.

78. 3 Let $\frac{1}{2}\cos^{-1}\frac{a}{b} = \theta$, $\theta \in [0, \pi/2]$ (as $\cos^{-1}(a/b) \in [0, \pi]$ )

$\Rightarrow \cos 2\theta = \frac{a}{b} \Rightarrow 2\cos^2\theta = \frac{a+b}{b} \Rightarrow \cos\theta = \sqrt{\frac{a+b}{2b}}$ ( since $\theta \in [0, \pi/2]$ ]

and $\cos\left(\frac{\pi}{4}+\theta\right)+\cos\left(\frac{\pi}{4}-\theta\right) = 2\cos\frac{\pi}{4}\cos\theta = \sqrt{2}\cos\theta$

$= \sqrt{2}\cdot\sqrt{\frac{a+b}{2b}} = \sqrt{\frac{a+b}{b}}$.

79. 4 $\log_2 x < \sin^{-1}\sin[2\pi + (-2\pi + 5)]$

$\log_2 x < 5 - 2\pi$

$x < 2^{5-2\pi}$ and x > 0

80. 2 $\frac{\cos^{10}y + \sec^{10}y}{2} \ge \left(\cos^{10}y\sec^{10}y\right)^{1/2}$

$\Rightarrow \cos^{10}y + \sec^{10}y \ge 2$

But $\sqrt{3}\cos x - \sin x \le 2$

Therefore $\sqrt{3}$ cosx – sinx = $(\cos^{10}y + \sec^{10}y) = 2$

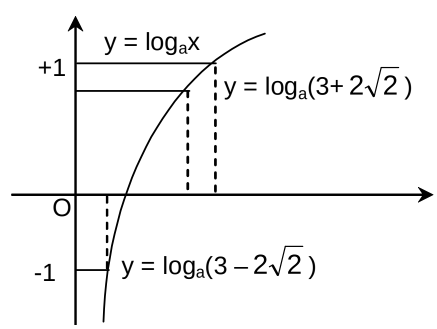
$\Rightarrow \frac{\sqrt{3}}{2}\cos x - \frac{1}{2}\sin x = 1 \Rightarrow x = -\frac{\pi}{6}$.

81. 1 Let $a^{\cos x} = t \Rightarrow t + \frac{1}{t} = 6 \Rightarrow t^2 - 6t + 1 = 0$

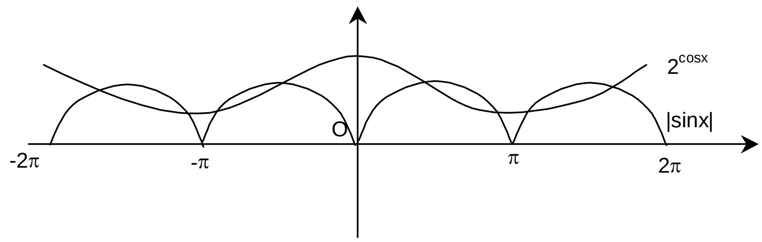
$\Rightarrow t = \frac{6 \pm \sqrt{36-4}}{2} = 3 \pm 2\sqrt{2}$

$\Rightarrow a^{\cos x} = 3 \pm 2\sqrt{2} \Rightarrow \cos x = \log_a(3 \pm 2\sqrt{2})$

since a > 1, for all the roots to be real, we must have $\log_a(3+2\sqrt{2}) \le 1$ and $\log_a(3 - 2\sqrt{2}) \ge -1$, both are true for $a \ge 3 + 2\sqrt{2}$.



82. 3




83. **1**

$|\sin^{-1}x| + \cos^{-1} x = \frac{\pi}{2} \Rightarrow |\sin^{-1} x| = \sin^{-1} x$

$\Rightarrow x \in [0, 1]$.

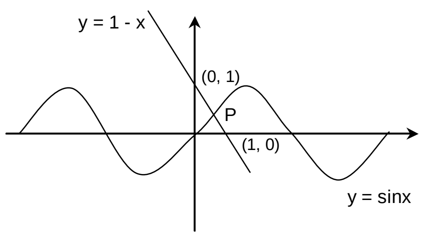
84. **4**

$2^{2\pi/\sin^{-1}x} - 2(a+2)2^{\pi/\sin^{-1}x} + 8a < 0$

$(2^{\pi/\sin^{-1}x} - 4)(2^{\pi/\sin^{-1}x} - 2a) < 0$

Both roots should be real and distinct $\Rightarrow a \in \left[0, \frac{1}{8}\right) \cup [2, \infty)$. As $2^{\pi/\sin^{-1}x} \in \left(0, \frac{1}{4}\right] \cup [4, \infty)$.

85. 1




From graph, point P lies in $\left(0, \frac{\pi}{2}\right)$.

## PHYSCIS

1. (2) For critical damping $b^2 = 4mK$

$\Rightarrow b = \sqrt{4mK} = 2\sqrt{Km}$

2. (3)

Displacement of the particle is given as $x = 4(\cos \pi t + \sin \pi t) = \frac{4}{\sqrt{2}} \times \sqrt{2}[\cos \pi t + \sin \pi t]$

$$\left[\frac{1}{\sqrt{2}}\cos \pi t + \frac{1}{\sqrt{2}}\sin \pi t\right]4\sqrt{2} = \left[\sin\frac{\pi}{4}\cos \pi t + \cos\frac{\pi}{4}\sin \pi t\right]4\sqrt{2}$$

$[\because \sin A \cos B + \cos A + \sin B = \sin(A+B)]$

So, amplitude = $4\sqrt{2}$

3. (2)

For forced oscillation, the displacement is given by

$x = A\sin(\omega t + \phi)$ with $A = \frac{F_0/m}{\omega_0^2 - \omega^2}$

4. (2) $\omega = \sqrt{\frac{K}{M}} \Rightarrow \frac{\omega_1}{\omega_2} = \sqrt{\frac{M_2}{M_1}}$

Here $M_1 = M$, $M_2 = M + m$

$$\frac{\omega_1}{\omega_2}=\sqrt{\frac{m+M}{M}}$$

Linear momentum before= Linear momentum after

$$M_1A_1\omega_1=M_2A_2\omega_2$$

$$\frac{A_1}{A_2}=\frac{M+m}{M}\sqrt{\frac{M}{M+m}}=\sqrt{\frac{M+m}{M}}$$

5. (3) A = $A_0e^{-Kt}$

$0.9A_0=A_0e^{-5K}$ …………(1)

$\alpha A_0=A_0e^{-15K}$ …………..(2)

$$\Rightarrow \frac{\alpha}{0.9}=e^{-10}K=(0.9)^2$$

On solving $\alpha=0.729$

6. (1)

$$\tau=-2Kc\frac{\ell}{2}\cos\theta \Rightarrow \tau=-\left(\frac{K\ell^2}{2}\right)\theta=-C\theta$$

$$\Rightarrow f=\frac{1}{2\pi}\sqrt{\frac{C}{I}}=\frac{1}{2\pi}\sqrt{\frac{\frac{K\ell^2}{2}}{\frac{M\ell^2}{12}}}$$

$$\Rightarrow f=\frac{1}{2\pi}\sqrt{\frac{6K}{M}}$$

7. (4) $\omega=\sqrt{\frac{K}{m}}=5\,rad/s$

$$\omega^1=\sqrt{\omega^2-\left(\frac{b}{2m}\right)^2}=\sqrt{5^2-\left(\frac{12}{2\times2}\right)^2}=4\,rad/s$$

$\Rightarrow$ Frequency decreases by 20%

8. (1) $\because\ g=\frac{GM}{R^2}$

$$\frac{g_p}{g_e}=\frac{M_e}{M_e}\left(\frac{R_e}{R_p}\right)^2=3\left(\frac{1}{3}\right)^2=\frac{1}{3}$$

Also, T $\propto\frac{1}{\sqrt{g}} \Rightarrow \frac{T_p}{T_e}=\sqrt{\frac{g_e}{g_p}}=\sqrt{3} \Rightarrow \sqrt{n}=\sqrt{3} \Rightarrow n=3$

10. (4) They will be in phase for 1st time after 15 sec

$\Rightarrow$ no. of oscillation of 3 sec pendulum = 15/3 = 5 (the slower one). For fast pendulum no. of oscillation must be 6 ($\because$ it's the first time they are in phase)

6T = 15 sec $\Rightarrow$ T = 2.5 sec

11. (1)

$$T = 2\pi\sqrt{\frac{I}{mgh}} \qquad I = \frac{3}{2}mR^2, h = R$$

$$T_1 = 2\pi\sqrt{\frac{\frac{3}{2}mR^2}{mgR}} = 2\pi\sqrt{\frac{3R}{2g}}$$

$$T_2 = 2\pi\sqrt{\frac{2r}{g}} \quad \therefore T_1 = T_2$$

$$2\pi\sqrt{\frac{2r}{g}} = 2\pi\sqrt{\frac{3R}{2g}}$$

$$\therefore\ r = \frac{3}{4}R \Rightarrow n = 0.75$$

12. (2)

$$V(x) = (1.23) + (4.84)x^2$$

$$\frac{1}{2}m\omega^2x^2 = 4.84x^2$$

$$\omega^2 = \frac{2\times 4.84}{m} = \frac{2\times 4.84}{5\times 10^{-3}} = \frac{2\times 4.84\times 10^3}{5}; \quad \omega^2 = 4\times 484 = 4\times 4\times 121$$

$$\omega = 4\times 11; \quad n = \frac{\omega}{2\pi} = \frac{4\times 11}{2\times 22}\times 7 = 7$$

13. (4)

Comparing with standard wave equation y(x, t) = $A\sin(kx - \omega t)$

$$u_{wave} = \frac{\omega}{k}, v_p = \frac{\partial y}{\partial t}$$

14. (1)

All choices show amplitude of 2 cm, wavelength 1 m and wave-velocity of 5.0 m/s

But only (a) shows y = 0 and $\frac{dy}{dt}(\neq 0) < 0$ for x = 0, t = 0

**15. (3)**

Frequency of the sound = $\frac{No.of\ waves}{\text{sec}} = \frac{54}{60} = 9/10\,Hz$

Velocity of the wave (V) = frequency × wavelength = $\left(\frac{9}{10}\right)\times 10 = 9\,m/s$

16. (4)

Velocity of the sound V = 340 m/s, frequency of the sound (n) = 680 Hz

wavelength $(\lambda) = \frac{Velocity}{frequency} = \frac{340}{680} = \frac{1}{2}$

$\Delta x = \frac{\lambda}{2}$ for out of phase

$$\Delta x = \frac{1}{4}m$$

17. (4)

$\Delta x = \frac{\lambda}{2} \Rightarrow \lambda = 44\,mm$

Velocity of the wave (V) = (frequency) (wavelength)

$V = 3750 \times 44 \times 10^{-3} \Rightarrow V = 165\,m/s$

18. (1)

$V_P = 4V_W \Rightarrow a\omega = 4\frac{\omega}{K} \Rightarrow K = \frac{4}{a}$

19. (3)

Minimum distance between two particles in similar phase means (wavelength) $\lambda$ = 10 cm

Time = 0.05 = 5 × $10^2$

$V = \frac{\lambda}{T} = \frac{10}{5 \times 10^{-2}} = 200\,cm/s$

20. (1)

Standard wave equation travelling along x-axis

In positive direction, $y = a\sin(\omega t - kx)$

Here, amplitude (A) = 0.04; Frequency (f) = 440 Hz; Velocity (V) = 330 m/s

So the wave equation, $y = 0.04\sin 2\pi\left(440t - \frac{4x}{3}\right)$

22. (2)

Maximum particle velocity = aK (wave velocity)

$\Rightarrow 3V = aKV \Rightarrow \left(\frac{2\pi}{\lambda}\right) = K = 3/a \Rightarrow$ phase difference = $\left(\frac{2\pi}{\lambda}\right)$path difference

$\Rightarrow$ Phase difference = 3x/a

23. (4)

From equation A = 0.4, $\omega = \pi/5, K = \pi/9, \phi = \pi/6$

$K = \frac{\pi}{9} \Rightarrow \frac{2\pi}{\lambda} = \frac{\pi}{9} \Rightarrow \lambda = 18m$

24. (3) For half cycle, the path is equal to $\lambda/2$

$5(\lambda/2) = 20 \Rightarrow \lambda = 8\,cm$

Velocity = 320 m/s

$V = n\lambda \Rightarrow 320 = (n).8 \times 10^{-2}$

$n$ = 4000 Hz

25. (1)

The general equation is $y = A.e^{-k(x+\partial)^2}$ for a wave travelling along negative X-axis is given by

$y = A.e^{-\frac{1}{a}\left(x+\frac{a}{T}t\right)^2}$. This pulse travel along negative axis.

At t = 0 the maximum of pulses located at x = 0 as the maximum of the pulse moves along negative axis

At t = T is located at d = V × T, d = $\frac{a}{T} \times T = a \Rightarrow x = -a$

At t = 2T$\Rightarrow$ $d = V \times 2T = \frac{a}{T} \times 2T = 2a \Rightarrow X = -2a$

26. (1)

The standard equation is, $y = a\cos(Kx - \omega t) = a\cos\left(\frac{2\pi}{\lambda}x - 2\pi nt\right)$

Given that a = 0.5 m, $\lambda$ = 1 m and n = 2 Hz

$\therefore\ y = 0.5\cos(2\pi x - 4\pi t)$

27. (1)

Mass per unit length of the wire, m = $10^{-4}$ kg/m

Now, $y = 0.02\sin(9x + 270t) = A\sin(kx - \omega t)$

$\therefore$ Wave velocity, $v = \frac{\omega}{k} = \frac{270}{9} = 30\,m/s$

$$v = \sqrt{\frac{T}{m}}$$

$\therefore\ T = v^2 . m$

$= 30 \times 30 \times 10^{-4} = 9 \times 10^{-2}\,N$

= 0.09 N

28. (1)

$$v = \sqrt{\frac{T}{\mu}}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}}$$

$T_2 = 1.44T_1 \Rightarrow v_2 = 1.2v_1$

$$\frac{v_2}{v_1} = 6:5$$

29. (1)

Comparing the given equation with Y = $Ae^{kx} . e^{\omega t}$, we get $\omega = 3$ and k = 2

$\therefore\ v = \frac{\omega}{k} = \frac{3}{2}\,m/s$

Thus, the given equation represents a progressive wave travelling in –ve x-direction with velocity $\frac{3}{2}\,m/s$.

32. (4) $y = y_0\sin\left[\frac{2\pi}{\lambda}vt - \frac{2\pi}{\lambda}x\right] = A\sin(\omega t - kx)$

Maximum particle velocity = $A\omega = y_0 . \frac{2\pi}{\lambda} . v$

Wave velocity = $\frac{\omega}{k} = \frac{2\pi}{\lambda}v . \frac{\lambda}{2\pi} = v$

Now, $y_0 . \frac{2\pi}{\lambda} . v = 2v$

$\therefore\ \lambda = \pi . y_0$

33. (2)

Since, frequency along the string remains the same, velocity changes with tension.

$\because \quad v = n\lambda \qquad \therefore \ \lambda \propto v$

But velocity, $v \propto \sqrt{T}$

$\therefore \ \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{4+12}{4}} = 2$

$\therefore \ \lambda_2 = 0.04 \times 2 = 0.08m$

35. (1)

Comparing the function with $\frac{a}{b+(\omega t - kx)^2}$

$\omega, 3, k = 2 \qquad \therefore \ v = \frac{\omega}{k} = \frac{3}{2} = 1.5\, m/s$

36. (1) $y_1 = 4\sin\left(\omega t + \frac{\pi}{2}\right)$

$\therefore \ \frac{dy_1}{dt} = vl1 = 4\omega\cos\left(\omega t + \frac{\pi}{2}\right)$

$\therefore \ (v_1)_{\max} = 4\omega$

And $y_2 = 2\sin\left(\omega t - \frac{\pi}{2}\right)$

$\frac{dy_2}{dt} = v_2 = 2\omega\cos\left(\omega t - \frac{\pi}{2}\right)$

$\therefore (v_2)_{\max} = 2\omega$

$\because v_1$ and $v_2$ differ in phase by $\pi$

$\therefore$ Maximum resultant velocity = $4\omega - 2\omega = 2\omega$

37. (1)

$y_1 = 10\sin\left(3\pi t + \frac{\pi}{4}\right)$

and $y_2 = 5\sin 3\pi \text{ t} + 5\sqrt{3}\cos 3\pi t$

here $A_1 = 10$ and $A_2 = \sqrt{5^2 + \left(5\sqrt{3}\right)^2} = 10$

$\therefore \ \frac{A_1}{A_2} = \frac{1}{1}$.

## CHEMISTRY

31. $2KMnO_4 + 3H_2SO_4 + 10HCl \rightarrow$

33. $PbI_4$ is least stable because of two reasons

(1) Size of iodine is biggest.

(2) $+2$ oxidation state of Pb is more stable than $+4$ state because of inert pair effect

34. $Cl_2 + NaF \rightarrow$ No reaction

Since $Cl_2$ is less electronegative then $F_2$. Therefore unable to displace fluorine from its salt

36. $CS_2 + 3Cl_2 \xrightarrow{I_2} CCl_4 + S_2Cl_2$

37. According to the Fajan's rule largest cation and smallest anion

38. $2F_2 + 4NaOH \rightarrow 4HF + 2H_2O + O_2$

39. $Cl_2 \rightarrow 2Cl \; \Delta H = +ve$

High temperature and low pressure is favourable

40. $BF_3$ accept lone pair of electrons.

41. $CrO_2Cl_2$ is a orange red gas.

44. Florine always show -1 oxidation state.

45. Solid *NaF* is used to purify fluorine *i.e.* by removing of *HF* fumes

46. $KHF_2 \rightarrow KF + HF$

$KF \rightarrow K^+ + F^-$

At cathode : $K^+ + e^- \rightarrow K$

$2K + 2HF \rightarrow 2KF + H_2$

At anode : $F^- \rightarrow F + e^-$

$F + F \rightarrow F_2$

48. Small atomic size of *Li* and *F* lattice energy is highest.

49. $SO_2$ bleaches flower by reduction

$2H_2O + SO_2 \rightarrow H_2SO_4 + 2[H]$

$$2[H] + \underset{\text{flower}}{\text{Coloured}} \xrightarrow{\text{Reduction}} \underset{\text{reduced flower}}{\text{Colourless}}$$

This bleaching is temporary because reduced flower again oxidised by air to form coloured flower

$Cl_2 + H_2O \rightarrow 2HCl + [O]$

$$[O] + \underset{\text{flower}}{\text{Coloured}} \xrightarrow{\text{Oxidation}} \underset{\text{Oxidised flower}}{\text{Colourless}}$$

This bleaching is permanent because oxidised flower remains colourless.

50. Fluorine does not form oxyacids because it is more electronegative than oxygen

53. $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

$2KMnO_4 + 3H_2SO_4 + 10HCl \rightarrow$

55. $3KClO_3 + 3H_2SO_4 \xrightarrow{\text{Heat}}$

56. $F > Cl > Br > I$. As the size increases electronegativity decreases

57. Ionic radius increases on going down the group because no. of shells increases

58. Reducing properties increase from *F* to *I* so it oxidise by nitric acid.

$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

59. $F, Cl, Br$ all

Fluorine and chlorine are more electronegative than sulphur

60. Upper halogen can replace lower halogen from their compounds solution.

61. Iodine $(I_2)$ is slightly soluble in water but it dissolves in 10% aqueous solution of *KI* due to the formation of potassium triodide $(KI_3)$.

62. Due to highest electronegativity of fluorine the anion $[F---H-F]^-$ exists as a result of strong hydrogen bond by which $K^+$ associate to form $KHF_2$.

63. Fluorine is the most electronegative element. It does not form oxyfluoxides like other halogens. If reacts with *NaOH* to form sodium fluoride and oxygen fluoride.

$2NaOH + 2F_2 \rightarrow 2NaF + OF_2 + H_2O$

64. Due to unpaired $e^-$ $ClO_2$ is paramagnetic

65. Oxidation number of $HBrO_4$ is more than that of $HOCl, HNO_2$ and $H_3PO_3$ so it is the strongest acid among these.

66. Chlorine heptachloride $(Cl_2O_7)$ is the anhydride of perchloric acid.

$2HClO_4 \xrightarrow{\Delta} Cl_2O_7 + H_2O$

67. $I_2$ forms complex ion $I_3^-$ in $KI$ solution due to which it dissolves in it

71. $XeF_2, XeF_4$ & $XeF_6$ can be directly prepared

$$Xe + F_2 \xrightarrow[673\,K]{Ni \text{ tube}} XeF_2 \;;\; Xe + 2F_2 \xrightarrow[6 \text{ atm}]{673\,K} XeF_4$$

$$Xe + 3F_2 \xrightarrow[50-60 \text{ atm}]{523-573\,K} XeF_6$$

$XeO_3$ is obtained by the hydrolysis of $XeF_6$

$$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$$

73. $XeO_3$ shows $sp^3$ hybridization.

74. It is because

(1) Small atomic size

(2) High Ionization energy

(3) Absence of *d*-orbitals

75. Zero group element are attached with weak intermolecular force

76. $XeF_2$, $XeF_4$, $XeF_6$.

78. Neil Bartlett prepared first noble gas compound. Xenon hexafluoroplatinate (IV)

80. *He*, *Ne*, and *Kr* all are found in very little amount in atmosphere, so all are called rare gas

81. Helium is twice as heavy as hydrogen, its lifting power is 92% of that of hydrogen. Helium has the lowest melting and boiling point of any element which makes liquid helium an ideal coolant for many extremely low temperature application such as super conducting magnet and cryogenic research where temperature close to absolute zero are needed

82. The maximum temperature at which gas can be liquified is called its critical temperature. The gas which have high boiling point will change into liquid first and so critical temperature of the gas will be more.

$T_C \propto$ B.P. and B.P. $\propto$ Molecular weight

So *Kr* liquifies first.

83. Suppose the oxidation state of $Xe$ is $x$. $XeOF_2$

$$x + (-2) + 2(-1) = 0 \Rightarrow x - 2 - 2 = 0 \Rightarrow x = 4.$$

84. *He* *Ne* *Ar* *Kr* *Xe* *Rn*

Boiling point of – 269 –246 – 186 –153.6 –108.1 –62

Inert gases

86. In the formation of $XeF_4, sp^3d^2$ hybridisation occurs which gives the molecule an octahedral structure. The xenon and four fluorine atoms are coplanar while the two equatorial positions are occupied by the two lone pairs of electrons.

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