SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR EAMCET | **EAMCET UNIT-3** | **Date: 22-04-2020**

Time: 3 Hours | | **Max Marks : 160**

MATHS-A

SYLLABUS: **Functions (Domain & Range), Matrices & Determinents**

1. **The domain of the function defined by** f(x) = ${}^{(7-x)}P_{(x-3)}$ is

1) {3,7} 2) {3,4,5,6,7} 3) {3,4,5} 4) {1,2,3,4}

2. **The domain of the function** $f(x)=\dfrac{1}{\sqrt{\{\sin x\}+\{\sin(\pi+x)\}}}$ **where** $\{\bullet\}$ **denotes the fractional part, is**

1) $[0,\pi]$ 2) $(2n+1)\dfrac{\pi}{2}, n\in Z$ 3) $(0,\pi)$ 4) $R-\left\{\dfrac{n\pi}{2}, n\in Z\right\}$

3. **The maximum possible domain and the corresponding range of** $f(x)=(-1)^x$ **are**

1) $D_f=R, R_f=[-1,1]$ 2) $D_f=Z, R_f=\{1,-1\}$ 3) $D_f=Z, R_f=[-1,1]$ 4) $D_f=R, R_f=\{-1,1\}$

4. **The set of all real numbers satisfying** $e^{\left(\frac{1}{x}-1\right)}<1$ is

1) $(0,\infty)$ 2) $(-\infty,0)\cup(1,\infty)$ 3) $(-\infty,\infty)$ 4) $(0,1)$

5. **The domain of** $f(x)=\sqrt{e^{\sin^{-1}\left(\log_{16}^{x^2}\right)}}$ **is**

1) $\left[\dfrac{1}{4},4\right]$ 2) $\left[-4,\dfrac{-1}{4}\right]\cup\left[\dfrac{1}{4},4\right]$ 3) $\left[-4,\dfrac{-1}{4}\right]$ 4) $\left[4,\dfrac{1}{4}\right]$

6. **The range of** $f(x)=x^2+\dfrac{1}{x^2+1}$ **is**

1)$[1,\infty)$ 2) $[2,\infty)$ 3) $[\dfrac{3}{2},\infty)$ 4) R

7. **If** $f(x)=ax^7+bx^3+cx-5$ (a,b,c **are real constants) and** $f(-7)=7$, **then the range of** $f(7)+17\cos x$ **is**

1) $[-34,0]$ 2) $[0,34]$ 3) $[-34,34]$ 4) $\{-34,34\}$

8. **If** $A=\begin{bmatrix} a & p \\ b & q \\ c & r \end{bmatrix}$,**then** $\det\left(AA^T\right)=$

1) 0 2) 7 3) 2 4) 3

9. **If** $E(\theta)=\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$, **then** $E(\alpha).E(\beta)$ **is equal to**

1) $E(\alpha-\beta)$ 2) $E(\alpha+\beta)$ 3) $E(\alpha)$ 4) $E(\beta)$

10. **Find the values of x, y and z, if the matrix** $A=\begin{bmatrix} 0 & 2y & z \\ x & y & -1 \\ x & -y & z \end{bmatrix}$ **satisfies the equation** $A'A=I$ **are**

1) $\pm\dfrac{1}{\sqrt{2}},\pm\dfrac{1}{\sqrt{6}},\pm\dfrac{1}{\sqrt{3}}$ 2) $\pm\dfrac{1}{2},\pm\dfrac{1}{6},\pm\dfrac{1}{3}$ 3) $\pm\dfrac{1}{\sqrt{2}},\pm\dfrac{1}{\sqrt{3}},\pm\dfrac{1}{\sqrt{5}}$ 4) None of these

11. If $A=\begin{bmatrix}0&1\\1&1\end{bmatrix}$ and $B=\begin{bmatrix}0&-1\\1&0\end{bmatrix}$, then which of the following is correct?

1) $(A+B).(A-B)=B^2-A^2$
2) $(A+B).(A-B)=A^2-B^2$
3) $(A+B).(A-B)=1$
4) None of these

12. If $A=\begin{bmatrix}1&2&-1\\-1&1&2\\2&-1&1\end{bmatrix}$, then det $(adj(A))$ is

1) $(14)^2$
2) $(13)^2$
3) $(14)^3$
4) $(13)^3$

13. If $i=\sqrt{-1}$, $a=\frac{1+\sqrt{5}}{2}$, $b=\frac{1-\sqrt{5}}{2}$ then which of the following matrix is idempotent

1) $\begin{bmatrix}a&i\\i&-b\end{bmatrix}$
2) $\begin{bmatrix}b&i\\i&a\end{bmatrix}$
3) $\begin{bmatrix}a&i\\i&b\end{bmatrix}$
4) $\begin{bmatrix}a&b\\b&a\end{bmatrix}$

14. If $\begin{vmatrix}a&b&c\\b&c&a\\c&a&b\end{vmatrix}=-(a+b+c)(a+bk+ck^2)(+bk^2+ck)$, then k is equal to

1) 1
2) -1
3) ω
4) $-\omega$

15. $\begin{vmatrix}1+a&1&1\\1&1+b&1\\1&1&1+c\end{vmatrix}$ is equal to

1) abc
2) $\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$
3) $abc\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$
4) $abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$

16. If $A=\begin{bmatrix}1&0&1\\0&1&2\\0&0&4\end{bmatrix}$, then

1) $|3A|=3|A|$
2) $|3A|=9|A|$
3) $|3A|=27|A|$
4) $|3A|=18|A|$

17. $\begin{vmatrix}x+4&2x&2x\\2x&x+4&2x\\2x&2x&x+4\end{vmatrix}$ is equal to

1) $(5x-4)(4+x)^2$
2) $(5x+4)(4-x)^2$
3) $(5x-4)^2(4+x)$
4) $(5x+4)^2(4-x)$

18. $\begin{vmatrix}x&x^2&1+px^3\\y&y^2&1+py^3\\z&z^2&1+pz^3\end{vmatrix}$ is equal to where p is any scalar.

1) $(1+pxyz)(x-y)(y-z)(z-x)$
2) $(1-pxyz)(x+y)(y+z)(z+x)$
3) $(1-pxyz)(x-y)(y-z)(z-x)$
4) $pxyz(x-y)(y-z)(z-x)$

19. $\begin{vmatrix}x&p&q\\p&x&q\\q&q&x\end{vmatrix}$ is equal to

1) $(x+p)(x^2+px-2q^2)$
2) $(x-p)(x^2+px-2q^2)$
3) $(x-p)(x^2-px+2q^2)$
4) $(x+p)(x^2-px+2q^2)$

20. **The value of** x obtained from the equation $\begin{vmatrix} x+\alpha & \beta & \gamma \\ \gamma & x+\beta & \alpha \\ \alpha & \beta & x+\gamma \end{vmatrix} = 0$ **will be**

1) 0 and $-(\alpha+\beta+\gamma)$
2) 0 and $(\alpha+\beta+\gamma)$
3) 1 and $(\alpha-\beta-\gamma)$
4) 0 and $(\alpha^2+\beta^2+\gamma^2)$

21. **The maximum value of** $f(x) = \begin{vmatrix} 1+\sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 1+\cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 1+4\sin 2x \end{vmatrix}$ **is**

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

22. **If** $2s = a+b+c$ **and** $\begin{vmatrix} a^2 & (s-a)^2 & (s-a)^2 \\ (s-b)^2 & b^2 & (s-b)^2 \\ (s-c)^2 & (s-c)^2 & c^2 \end{vmatrix} = ks^3(s-a)(s-b)(s-c)$, **then the numerical quantity** k **should be**

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

23. **If** α, β **and** γ **are the roots of the equation** $x^3 + px + q = 0$, **then the value of the determinant** $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$ **is**

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

24. **If** $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}$, **then** $f(2x) - f(x)$ **is equal to**

1) ax
2) $ax(2a+3x)$
3) $ax(2+3x)$
4) 0

25. **The values of x for which the matrix** $A = \begin{bmatrix} x+1 & -3 & 4 \\ -5 & x+2 & 2 \\ 4 & 1 & x-6 \end{bmatrix}$ **is singular, are**

1) 0, $\frac{3 \pm \sqrt{205}}{2}$
2) 0, $\frac{3}{2}$
3) 0, $\pm\frac{\sqrt{205}}{2}$
4) 0, 1/2

26. $6 + a - 2b + c = 1$ **if** $f(x) = \begin{vmatrix} x+a & x+2 & x+1 \\ x+b & x+3 & x+2 \\ x+c & x+4 & x+3 \end{vmatrix}$, **then**

1) $f(-50) = 501$
2) $f(-50) = -1$
3) $f(50) = 1$
4) $f(50) = -501$

27. **The determinant** $\begin{vmatrix} {}^xC_1 & {}^xC_2 & {}^xC_3 \\ {}^yC_1 & {}^yC_2 & {}^yC_3 \\ {}^zC_1 & {}^zC_2 & {}^zC_3 \end{vmatrix}$ **is:**

1) $\frac{1}{3}xyz(x+y)(y+z)(z+x)$
2) $\frac{1}{4}xyz(x+y-z)(y+z-x)$
3) $\frac{1}{12}xyz(x-y)(y-z)(z-x)$
4) $\frac{1}{6}xyz(x-y)(y-z)(z-x)$

28. The set of homogeneous equations $tx+(t+1)y+(t-1)z=0$, $(t+1)x+ty+(t+2)z=0$, $(t-1)x+(t+2)y+tz=0$ **has non-trivial solution for:**

1) Three values of t 2) Two values of t 3) One value of t 4) No value of t

29. The set of equations: $\lambda x-y+(\cos\theta)z=0$, $3x+y+2z=0$, $(\cos\theta)x+y+2z=0$, $0\le\theta<2\pi$, **has non-trivial solution(s):**

1) For no value of λ and θ
2) For all values of λ and θ
3) For all values of λ and only two values of θ
4) For only one value of λ and all values of θ

30. If the system of equations $x-2y+z=a,\ 2x+y-2z=b$ **and** $x+3y-3z=c$ **have atleast one solution, then the relationship between** a,b **and** c **is:**

1) $a+b+c=0$ 2) $a-b+c=0$ 3) $-a+b+c=0$ 4) $a+b-c=0$

31. The solution of the following equations:
$x-(4k-3)y+2z=0,\ kx-(2k-1)y+(k+1)z=0,\ (2k+2)x+3ky+(k+2)z=0$ **For** $k=1$, (x,y,z) **is given by:**

1) $(t,3t,t)$ 2) $(-2t,-10t,-4t)$ 3) $(9t,-5t,-7t)$ 4) $(4t,6t,t)$

32. If the system of linear equations $x+2ay+az=0,\ x+3by+bz=0,\ x+4cy+cz=0$ **has a non-zero solution, then** a,b,c:

1) are in G.P 2) are in H.P
3) satisfy $a+2b+3c=0$ 4) are in A.P.

33. If $A=\begin{bmatrix}3 & 4\\ 1 & -6\end{bmatrix}$ **and** $B=\begin{bmatrix}-2 & 5\\ 6 & 1\end{bmatrix}$ **then X such that** $A+2X=B$ **equals:**

1) $\begin{bmatrix}2 & 3\\ -1 & 0\end{bmatrix}$ 2) $\begin{bmatrix}3 & 5\\ -1 & 0\end{bmatrix}$ 3) $\begin{bmatrix}5 & 2\\ -1 & 0\end{bmatrix}$ 4) $\begin{bmatrix}5 & 2\\ 0 & 1\end{bmatrix}$

34. Which of the following statements is not correct?

1) $(AB)^T=A^TB^T$ 2) $(A^T)^T=A$
3) $(A+B)^T=B^T+A^T$ 4) $(kA)^T=kA^T\ (k\text{ is a scalar})$

35. If A and B are invertible matrices, which one of the following statements is not correct?

1) $Adj.A=|A|A^{-1}$ 2) $\det(A^{-1})=|\det(A)|^{-1}$
3) $(A+B)^{-1}=B^{-1}+A^{-1}$ 4) $(AB)^{-1}=B^{-1}A^{-1}$

36. If A and B are non-singular matrices of same order then $Adj.(AB)$ **is:**

1) $Adj.(A)(Adj.B)$ 2) $(Adj.B)(Adj.A)$ 3) $Adj.A+Adj.B$ 4) $Adj.A-Adj.B$

37. Let $A=\begin{bmatrix}x+\lambda & x & x\\ x & x+\lambda & x\\ x & x & x+\lambda\end{bmatrix}$, **then** A^{-1} **exists if:**

1) $x\ne0$ 2) $\lambda\ne0$ 3) $3x+\lambda\ne0,\ \lambda\ne0$ 4) $x\ne0,\ \lambda\ne0$

38. If $K\in R_0$ **then** $\det.\{adj(KI_n)\}$ **is equal to:**

1) K^{n-1} 2) $K^{n(n-1)}$ 3) K^n 4) K

39. For a non-singular square matrix A of order n, **which one of the following statement is true?**

1) $adj(KA)=K(adjA)$ 2) $|adjA|=|A|$
3) $(adjKA)=K^{n-1}adjA$ 4) $A.(adj\ A)=A^{-1}$

40. Which of the following is a nilpotent matrix?

1) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ 2) $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ 3) $\begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}$ 4) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

MATHS-B

SYLLABUS: - Limits & Continuity, Derivatives

41. If α is a repeated root of $ax^2 + bx + c = 0$, then $\lim_{x\to\alpha}\frac{\tan(ax^2+bx+c)}{(x-\alpha)^2}$ is

1) a 2) b 3) c 4) 0

42. $\lim_{x\to\alpha}\left(\frac{\sin x}{\sin a}\right)^{\frac{1}{x-a}}$, $a \neq n\pi$, n is an integer, equals

1) $e^{\cot a}$ 2) $e^{\tan a}$ 3) $e^{\sin a}$ 4) $e^{\cos a}$

43. The value of $\lim_{x\to\infty}\left[\sqrt{x+\sqrt{x+\sqrt{x}}} - \sqrt{x}\right]$ is

1) $\frac{1}{2}$ 2) 0 3) 3 4) does not exist

44. $\lim_{x\to\infty}\sqrt{\frac{x+\sin x}{x-\cos x}} =$

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

45. $\lim_{x\to\infty}\frac{1.2+2.3+3.4+......+n(n+1)}{n^3}$ is equal to

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

46. $\lim_{x\to0}\frac{1-\cos^3 x}{x\sin x\cos x} =$

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

47. $\lim_{n\to\infty}\frac{n(2n+1)^2}{(n+2)(n^2+3n-1)}$ is equal to

1) 0 2) 2 3) 4 4) ∞

48. $\lim_{x\to\infty}\frac{(x+1)^{10}+(x+2)^{10}+.......+(x+100)^{10}}{x^{10}+10^{10}}$ is equal to

1) 0 2) 1 3) 10 4) 100

49. $\lim_{x\to0}\frac{\sqrt{1-\cos 2x}}{x}$ is equal to:

1) $\sqrt{2}$ 2) $-\sqrt{2}$ 3) does not exists 4) 0

50. $\lim_{x\to0}\frac{1-\cos x}{x\log(1+x)} =$

1) 1 2) 0 3) -1 4) 1/2

51. $\lim_{x\to0}\frac{(1-\cos 2x)(3+\cos x)}{x\tan 4x} =$

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

52. $\lim_{x\to\frac{\pi}{2}}\frac{\cot x-\cos x}{\left(\frac{\pi}{2}-x\right)^3} =$

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

53. $\lim_{x\to0}\left(\frac{\sec ax-\sec bx}{x^2}\right)=$

1) $\frac{a^2-b^2}{2}$ 2) $\frac{b^2-a^2}{2}$ 3) 0 4) 1

54. $\lim_{x\to0}\frac{e^x-e^{\sin x}}{2(x-\sin x)}=$

1) -1/2 **2) 1/2** **3) 1** **4) 3/2**

55. $\underset{x\to0}{Lim}\frac{8}{x^8}\left(1-\cos\frac{x^2}{2}-\cos\frac{x^2}{4}+\cos\frac{x^2}{2}.\cos\frac{x^2}{4}\right)$ **=**

1) $\frac{1}{16}$ **2)** $\frac{1}{15}$ **3)** $\frac{1}{32}$ **4) 1**

56. If $f(x)=\begin{cases}\frac{3\sin\pi x}{5x} & ,x\neq0\\ 2K & ,x=0\end{cases}$ is continuous at x = 0, then the value of K is

1) $\frac{3\pi}{10}$ 2) $\frac{3\pi}{5}$ 3) $\frac{\pi}{10}$ 4) $\frac{3\pi}{2}$

57. Let $f(x)=\begin{cases}\frac{x(1+a\cos x)-b\sin x}{x^3} & if\ x\neq0\\ 1 & if=0\end{cases}$. The values of a and b so that *f* is a continuous function at *x* = 0, are

1) 5/2, 3/2 2) 5/2, –3/2 3) –5/2, –3/2 4) –5/2, 3/2

58. If $f(x)=\begin{cases}\frac{72^x-9^x-8^x+1}{\sqrt{2}-\sqrt{1+\cos x}}, & if\ x\neq0\\ K\log2\log3\ , & if\ x=0\end{cases}$ is a continuous function then K is equal to

1) $\sqrt{2}$ 2) 24 3) $18\sqrt{3}$ 4) $24\sqrt{2}$

59. $f(x)=\begin{cases}\frac{(x+bx^2)^{1/2}-x^{1/2}}{bx^{3/2}}, & if\ x>0\\ c\ , & if\ x=0\\ \frac{\sin(a+1)x+\sin x}{x}, & if\ x<0\end{cases}$ is continuous at *x* = 0 then

1) $a=\frac{-3}{2},b=0,c=\frac{1}{2}$ 2) $a=\frac{-3}{2},b\neq0,c=\frac{1}{2}$

3) $a=\frac{3}{2},b\neq0,c=\frac{1}{2}$ 4) $a=\frac{3}{2},b\neq0,c=-\frac{1}{2}$

60. If $f(x)=\begin{cases}\frac{\log(1+2ax)-\log(1-bx)}{x}, & x\neq0\\ k\ , & x=0\end{cases}$ is continuous at x = 0, then k is equal to

1) 2a + b 2) 2a – b 3) b – 2a 4) a + b

61. **If** $x^2+xy+3y^2=1$**, then** $(x+6y)^3\frac{d^2y}{dx^2}$ **is**

1) 0 2) – 12 3) 22 4) – 22

62. **If** $x+y=3e^2$ **then** $\frac{d}{dx}\left(x^y\right)=0$ **for** $x=$

1) e 2) e^2 3) e^e 4) $2e^2$

63. **If** $y=\cos^{-1}\left(\frac{9-x^2}{9+x^2}\right)$ **then** $y'(-1)$ **is equal to**

1) $\frac{-3}{5}$ 2) $\frac{3}{5}$ 3) $\frac{2}{7}$ 4) $\frac{3}{8}$

64. **If** $u=f\left(x^2\right), v=g\left(x^3\right), f'(x)=\sin x, g'(x)=\cos x$ **then find** $\frac{du}{dv}=$

1) 1 2) 2/3 3) $\frac{2\sin\left(x^2\right)}{3x\cos\left(x^3\right)}$ 4) $\frac{2\sin\left(x^2\right)}{3\cos\left(x^3\right)}$

65. **If** $y=\tan^{-1}\left(\frac{4\sin 2x}{\cos 2x-6\sin^2 x}\right)$ **then** $\frac{dy}{dx}$ **at** $x=0$ **is**

1) 10 2) 12 3) 6 4) 8

66. **If** $x.e^{xy}=y+\sin^2 x$ **then** $\frac{dy}{dx}$ **at** $x=0$ **is**

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

67. **If** $x\sin y=3\sin y+4\cos y$ **then** $\frac{dy}{dx}=$

1) $\frac{\cos^2 y}{4}$ 2) $\frac{\sin^2 y}{4}$ 3) $-\frac{\cos^2 y}{4}$ 4) $-\frac{\sin^2 y}{4}$

68. **If** $x=\frac{1+t}{t^3}$ **and** $y=\frac{3+4t}{2t^2}$ **then** $x\left(y'\right)^3=$

1) $1-y'$ 2) $1+y$ 3) $y'-1$ 4) y'

69. **The value of** $y''(1)$**, if** $x^3-2x^2y^2+5x+y-5=0$ **when** $y(1)=1$ **is equal to**

1) $\frac{22}{7}$ 2) $-7\frac{21}{28}$ 3) 8 4) $-8\frac{22}{27}$

70. **If** $f'(3)=2$ **then** $\lim\limits_{x\to\infty}\frac{f\left(3+h^2\right)-f\left(3-h^2\right)}{2h^2}$ **is**

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

71. **If** $y=\tan^{-1}\left[\frac{\log ex^{-2}}{\log ex^2}\right]+\tan^{-1}\left[\frac{3+2\log x}{1-6\log x}\right]$ **then** $\frac{d^2y}{dx^2}$ **is**

1) 2 2) 1 3) 0 4) – 1

72. **If** $y=f\left(\frac{3x+4}{5x+6}\right)$ **and** $f(x)\tan x^2$ **then** $\frac{dy}{dx}$ **is equal to**

1) $-2\tan\left(\frac{3x+4}{5x+6}\right)^2\times\frac{1}{(5x+6)^2}$ 2) $f\left(\frac{3\tan x^2+3}{5\tan x^2+6}\right)\tan x^2$

3) $\tan x^2$ 4) tan x

73. **If** $y=\tan^{-1}\sqrt{\frac{1-\cos x}{1+\cos x}}$**, then** $\frac{dy}{dx}$ **is equal to**

1) $2\sec^2(x/2)$ 2) $(1/2)\sec^2(x/2)$ 3) $(1/2)$ 4) $-(1/2)\sec^2(x/2)$

74. **If** $x=2\sin t-\sin 2t, y=2\cos t-\cos 2t$**, then the value of** $\frac{d^2y}{dx^2}$ **at** $t=\frac{\pi}{2}$ **is**

1) 2 2) $-1/2$ 3) $-3/4$ 4) $-3/2$

75. **If** $y = \cot^{-1}\left(\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right)$ **then** $\frac{d^2y}{dx^2}$ **is equal to**

1) 0 2) 1/2 3) $\frac{1}{1+\sin x}$ 4) $\frac{1}{\sqrt{1+\sin x}}+\frac{1}{\sqrt{1-\sin x}}$

76. **If** $x=\cos\theta,\ y=\sin^3\theta$ **then** $\left(\frac{dy}{dx}\right)^2 + y\frac{d^2y}{dx^2}$ **at** $\theta=\pi/2$ **is**

1) 1 2) 2 3) – 2 4) – 3

77. **If** $y=\tan^{-1}\frac{1}{1+x+x^2}+\tan^{-1}\frac{1}{x^2+3x+3}+\tan^{-1}\frac{1}{x^2+5x+7}+...+$ **upto n terms, then** $y''(0)$ **is equal to**

1) $-1/(n^2+1)^2$ 2) $-n^2/(n^2+1)^2$ 3) $n^2/(n^2+1)^2$ 4) $1/(n^2+1)^2$

78. **If** $y=\sin^{-1}\sqrt{\frac{1-x}{1+x}}$ **then** $y'(1/2)$ **is equal to**

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

79. **The derivative at** $x=0$ **of** $\tan^{-1}\frac{\sqrt{1+x^2-1}}{x}$ **w.r.t** $\tan^{-1}\frac{2x\sqrt{1+x^2}}{1-2x^2}$ **is**

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

80. **If** $y=\sqrt{\frac{1-\sin^{-1}x}{1+\sin^{-1}x}}$ **then** $y'(0)$ **is equal to**

1) 1 2) 1/2 3) – 1 4) $\sqrt{2/3}$

PHYSICS

SYLLABUS: Oscillations

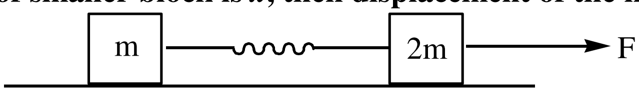
81. **What is the moment of inertia of a solid sphere of density ρ and radius R about its diameter.**

1) $\frac{105}{176}R^5\rho$ 2) $\frac{176}{105}R^5\rho$ 3) $\frac{105}{176}R^2\rho$ 4) $\frac{176}{105}R^2\rho$

82. **When uniform solid sphere and disc of same mass and of same radius roll down an inclined smooth plane from rest to the same distance, then the ratio of the times taken by them is**

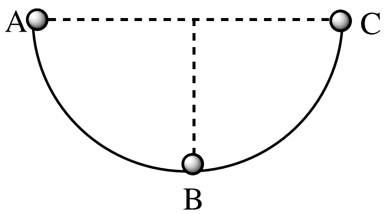
1) 15 : 14 2) $15^2:14^2$ 3) $\sqrt{14}:\sqrt{15}$ 4) 14 : 15

83. **Two blocks of masses m and 2m are kept on a smooth horizontal surface. They are connected by an ideal spring of force constant K. Initially the spring is unstreched. A constant force is applied to the heavier block in the direction shown in figure. Suppose at time t displacement of smaller block is *x*, then displacement of the heavier block at this moment would be**



1) $\frac{x}{2}$ 2) $\frac{Ft^2}{6m}+\frac{x}{3}$ 3) $\frac{x}{3}$ 4) $\frac{Ft^2}{4m}-\frac{x}{2}$

84. **A ball of radius r rolls inside a hemispherical shell of radius R. It is released from rest from point A as shown figure. The angular velocity of centre of the ball in the position B about the centre of the shell is**



1) $2\sqrt{\frac{g}{5(R-r)}}$ 2) $\sqrt{\frac{10g}{7(R-r)}}$ 3) $\sqrt{\frac{2g}{5(R-r)}}$ 4) $\sqrt{\frac{5g}{2(R-r)}}$

85. Three identical uniform rods each of length 1m and mass 2 kg are arranged to form an equilateral triangle. What is moment of inertia of the system about an axis passing through one corner and perpendicular to plane of the triangle

1) $4\ Kg-m^2$ 2) $3\ Kg-m^2$ 3) $2\ Kg-m^2$ 4) $\frac{3}{2}\ Kg-m^2$

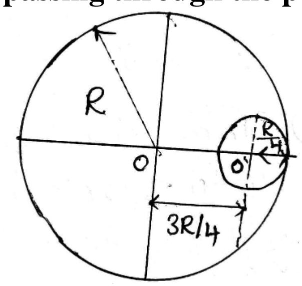
86. A uniform cylinder of length L and mass M having cross – sectional area A is suspended with its length vertical, from a fixed point by a mass less spring, such that it is half sub merged in a liquid of density σ at equilibrium position. The extension x_o of the spring when it is in equilibrium is:

1) $\frac{Mg}{K}\left(1-\frac{LA\sigma}{M}\right)$ 2) $\frac{Mg}{K}\left(1-\frac{LA\sigma}{2M}\right)$ 3) $\frac{Mg}{K}\left(1+\frac{LA\sigma}{M}\right)$ 4) $\frac{Mg}{K}$

87. From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its center and perpendicular to one of its faces is

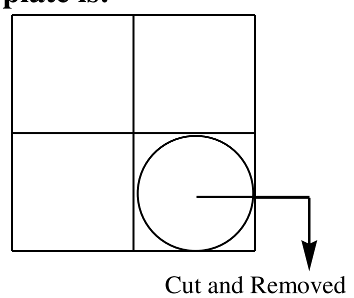
1) $\frac{MR^2}{32\sqrt{2}\pi}$ 2) $\frac{MR^2}{16\sqrt{2}\pi}$ 3) $\frac{4MR^2}{9\sqrt{3}\pi}$ 4) $\frac{4MR^2}{3\sqrt{3}\pi}$

88. A circular hole of radius $\frac{R}{4}$ is made in a thin uniform disc having mass M and radius R, as shown in figure. The moment of inertia of the remaining position of the disc about an axis passing through the point O and perpendicular to the plane of the disc is:



1) $\frac{219\ MR^2}{256}$ 2) $\frac{19\ MR^2}{512}$ 3) $\frac{237\ MR^2}{512}$ 4) $\frac{197\ MR^2}{256}$

89. A uniform square plate has a side of length 2R. A circular piece of maximum possible area is cut and removed from one of the quadrants of the plate as shown in the figure. Shift in the Centre of mass of the plate is:



1) $\frac{\pi R}{\sqrt{2}(16-\pi)}$ 2) $\left(\frac{R}{(16-\pi)}\right)$ 3) $\left(\frac{R}{\pi(16-\pi)}\right)$ 4) $\left(\frac{R\pi}{(16-\pi)}\right)$

90. A uniform thin bar of mass 6m and length 12L is bent to make a regular hexagon. Its moment of inertia about an axis passing through centre of mass and perpendicular to the plane of the hexagon is:

1) $20\ mL^2$ 2) $6\ mL^2$ 3) $\frac{12}{5}\ mL^2$ 4) $30\ mL^2$

91. A thin rod of length L and mass M is held vertically with one end on the floor and is allowed to fall. Find the velocity of the other end when it hits the floor, assuming that the end on the floor does not slip

1) $\sqrt{\frac{3g}{L}}$ 2) $\sqrt{3gL}$ 3) $\sqrt{\frac{L}{3g}}$ 4) $\sqrt{\frac{g}{3L}}$

92. A cylinder of mass M, radius R is resting on a horizontal platform (which is parallel to XY plane) with its axis fixed along the Y axis and free to rotate about its axis. The platform is given a motion in X - direction given by $x = A\cos\omega t$. There is no slipping between cylinder and platform. The maximum torque acting on the cylinder during its motion is:

1) $\frac{1}{2}MRA\omega^2$ 2) $MRA\omega^2$ 3) $2MRA\omega^2$ 4) $2MRA\omega^2\cos wt$

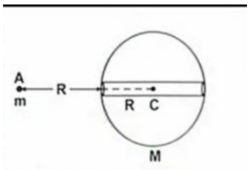
93. If diameter of a planet is four times that of earth. What is the time period of a pendulum on that planet, if it is a second pendulum on earth. Take mean density of the planet equal to that of earth.

1) 4 sec 2) 1 sec 3) 2 sec 4) 3 sec

94. Two particles of masses m_1 and m_2 are initially at rest at infinite separation. When released, what is their relative velocity of approach when they are at a separation d.

1) $\sqrt{\frac{G(m_1+m_2)}{2d}}$ 2) $\sqrt{\frac{G(m_1+m_2)}{d}}$ 3) $\sqrt{\frac{2G(m_1+m_2)}{d}}$ 4) $\sqrt[2]{\frac{2G(m_1+m_2)}{d}}$

95. Figure shows a fixed solid sphere of mass M and radius R with a narrow smooth tunnel along its diameter. Another particle of mass m is placed at point A as shown. If the particle is released from rest, then its speed when it reaches the center of sphere is



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

96. Two satellites A and B of same mass are orbiting earth at altitudes R and 3R respectively, where R is Radius. The earth taking their orbits to be circular, find the ratio of their kinetic energies.

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

97. A Satellite of mass 2×10^3 kg is to be shifted from on orbit of radius 2R to another orbit of radius 3R. Calculate the minimum energy required for this. [R is the Radius of earth] $\left[g = 10ms^{-2}\right]$

1) $1.066\times10^{10}J$ 2) $1.066\times10^{9}J$ 3) $2.132\times10^{10}J$ 4) $2.132\times10^{9}J$

98. An artificial satellite is moving in a circular orbit around earth with a speed equal to half the escape Velocity from earth surface. Find the height of satellite above the earth surface.

1) 3200 Km 2) 6400 Km 3) 10800 Km 4) 19600 Km

99. The radius of a planet is R_1 and a satellite revolves around it in a circular orbit of radius R_2. The period of revolution is T. What is the acceleration due to gravity on the surface of the planet?

1) $\frac{4\pi^2R_1^3}{R_2^2T^2}$ 2) $\frac{\pi^2R_1^3}{R_1T}$ 3) $\frac{4\pi^2R_2^3}{R_1^2T^2}$ 4) $\frac{\pi^2R_1^3}{R_2^2T^2}$

100. A satellite revolves around a planet in an elliptical orbit. Its perigee and apogee are $0.5\times10^7\ m$ and $1.5\times10^7\ m$ respectively. If the minimum speed of satellite in orbit is $5\times10^3\ m/s$, then its maximum speed in orbit is

1) $15\times10^4\ m/s$ 2) $\frac{5}{3}\times10^3\ m/s$ 3) $1.5\times10^4\ m/s$ 4) $\frac{5}{3}\times10^4\ m/s$

101. The distance of the centres of moon and earth is d. The mass of earth is 81 times the mass of the moon. At what distance from the centre of the earth, the gravitional field will be zero.

1) $\frac{d}{2}$ 2) $\frac{2d}{3}$ 3) $\frac{4d}{3}$ 4) $\frac{9d}{10}$

102. Two masses 90 Kg and 160 Kg are at a distance 5 m apart. Find the magnitude of intensity of the gravitational field at a point which is at a distance 3 m from 90 Kg and 4 m from 160 Kg mass.

1) $10\sqrt{2}\,G\,N\,Kg^{-1}$ 2) $10\,G\,N\,Kg^{-1}$ 3) $7\,G\,N\,Kg^{-1}$ 4) $2\,G\,N\,Kg^{-1}$

103. If a man at the equator would weighs of his weight, then angular speed of earth is

1) $\sqrt{\frac{2}{5}\frac{g}{R}}$ 2) $\sqrt{\frac{g}{R}}$ 3) $\sqrt{\frac{R}{g}}$ 4) $\sqrt{\frac{2R}{5g}}$

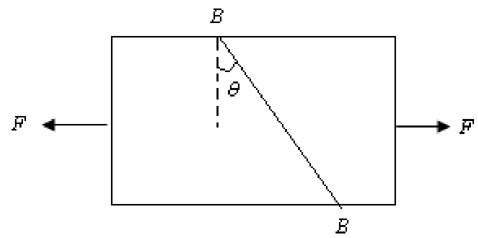
104. One end of uniform wire of length L and of weight W is attached rigidly to a point in the roof and a weight W_1 is suspended from its lower end . If s is the area of cross section of the wire, the stress in the wire at a height $(3L/4)$ from its lower end is

1) $\frac{W_1}{s}$ 2) $\left[W_1+\frac{W}{4}\right]s$ 3) $\left[W_1+\frac{3W}{4}\right]/s$ 4) $\frac{W_1+W}{s}$

105. A solid sphere of radius R made up of a material of bulk modulus K is surrounded by a liquid in a cylindrical container of area of cross section A . A massless piston of area A floats on the surface of the liquid. When a mass M is placed on the piston to compress the liquid the magnitude of fractional change in the radius of the sphere is

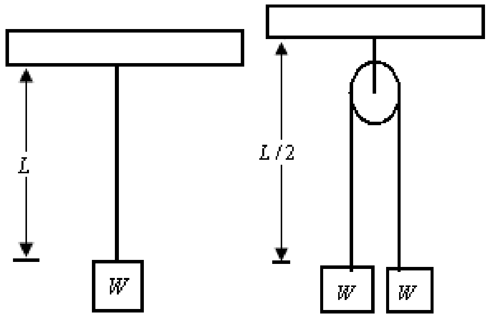
1) $\frac{Mg}{AK}$ 2) $\frac{Mg}{3AK}$ 3) $\frac{3Mg}{AK}$ 4) $\frac{Mg}{2AK}$

106. A bar of cross section A is subjected to two equal and opposite tensile forces as shown. Consider a cross section BB is shown in figure. The shearing stress on surface BB is



1) $\frac{F\cos^2\theta}{A}$ 2) $\frac{F}{A}$ 3) $\frac{F\sin2\theta}{2A}$ 4) zero

107. When a weight W is hung from one end of a wire of length L (other end being fixed) , the length of the wire increases by l. If the same wire is passed over a pulley and two weights W each are hung at the two ends, what will be the total elongation in the wire?



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

108. A rubber ball of bulk modulus B is taken to a depth h of a liquid of density ρ. The magnitude of fractional change in radius of the ball is

1) $\frac{\delta r}{r}=\frac{\rho gh}{3B}$ 2) $\frac{\delta r}{r}=\frac{\rho gh}{2B}$ 3) $\frac{\delta r}{r}=\frac{3\rho gh}{B}$ 4) $\frac{\delta r}{r}=\frac{2\rho gh}{B}$

109. The density of water at the surface of the ocean is ρ .If the bulk modulus of water is B, what is the density of ocean water at a depth where the pressure is in nP_0, where P_0 is he atmospheric pressure ?[Assume % change in density is small]

1) $\frac{\rho B}{B-(n-1)P_0}$ 2) $\frac{\rho B}{B+(n-1)P_0}$ 3) $\frac{\rho B}{B-nP_0}$ 4) $\frac{\rho B}{B+nP_0}$

110. The poisson's ratio of a material is 0.4. If a force is applied to a wire of this material, there is a decrease of cross sectional area by 2%. The percentage increase in its length is

1) 3 % 2) 2.5 % 3) 1% 4) 0.5 %

111. A stone of mass m is attached to one end of a wire of cross sectional area A and Young's modulus Y. The stone is revolved in a horizontal circle at a speed such that the wire makes a constant angle θ with the vertical. The strain produced in the wire will be

1) $\frac{mg\cos\theta}{AY}$ 2) $\frac{mg}{AY\cos\theta}$ 3) $\frac{mg\sin\theta}{AY}$ 4) $\frac{mg}{AY\sin\theta}$

112. A U-tube having identical limbs is partially filled with water. An immiscible oil having density 0.8 g/cc is poured into one side until water rises by 25 cm on the other side. Find the difference in the levels of the free surfaces of the liquids

(1) 125 cm (2)75cm (3)22.5 cm (4)12.5 cm

113. A particle starts its SHM from mean position at t= 0. If its time period is T and amplitude A. The distance travelled by the particle in the time from

t = 0 to $t=\frac{5T}{4}$ is

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

114. For a body in S.H.M. the velocity is given by the relation V = $\sqrt{144-16x^2}$ ms^{-1}. The maximum acceleration is

1) 12 m/s^2 2) 16m/s^2 3) 36m/s^2 4) 48m/s^2

115. The minimum phase difference between two SHM's $y_1=\sin\frac{\pi}{6}\sin\omega t+\sin\frac{\pi}{3}\cos\omega t$;

$y_2=\cos\frac{\pi}{6}\sin\omega t+\cos\frac{\pi}{3}\cos\omega t$ is

1) $\frac{\pi}{3}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{12}$ 4) 0

116. A particle of mass m executes SHM with amplitude A and frequency n. The average kinetic energy during its motion from mean to extreme positions is

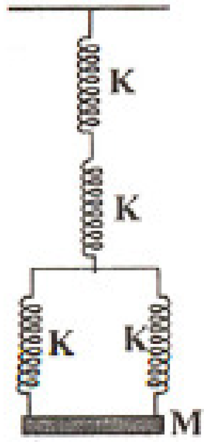
1) $\pi^2mn^2A^2$ 2) $2\pi^2mn^2A^2$ 3) $\frac{\pi^2mn^2A^2}{2}$ 4) zero

117. Two simple pendulums of length 100m and 121m start swinging together. They will swing together again after

1) the longer pendulum makes 10 oscillations 2) the shorter pendulum makes 10 oscillations

3) the longer pendulum makes 11 oscillations 4) the shorter pendulum makes 20 oscillations

118. The frequency of oscillation of the system shown in the figure will be



1) $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$ 2) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ 3) $\frac{1}{2\pi}\sqrt{\frac{k}{5M}}$ 4) $\frac{1}{2\pi}\sqrt{\frac{2k}{5M}}$

119. A spring whose unstretched lenght is l has a force constat k. The spring is cut into two pieces of unstretched lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, $k_1$and k_2 will be :

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

120. A particle performs simple harmonic motion with amplitude A. Its speed is trebled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is :

1) $\frac{A}{3}\sqrt{41}$ 2) 3A 3) $A\sqrt{3}$ 4) $\frac{7A}{3}$

CHEMISTRY

<u>SYLLABUS</u> : Atomic structure and Periodic table.

121. For a reaction $\Delta H = +29$ KJ mole^{-1} $\Delta S = -35$ JK^{-1} mole^{-1} at what temperature the reaction will be spontaneous

1) 828.7^0C 2) $828.7\ K$
3) Spontaneous at all temperature 4) Not possible

122. What is ΔG^0 for this reaction $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \rightleftharpoons NH_{3(g)}$ $Kp = 4.42\times10^4$ at 25^0C

1) -26.5 KJ mole^{-1} 2) -11.5 KJ mole^{-1} 3) -2.2 KJ mole^{-1} 4) -0.97 KJ mole^{-1}

123. What is the value of internal energy change (ΔU) at 27^0C of a gaseous reaction $2A_{2(g)} + 5B_{2(g)} \longrightarrow 2A_2B_{5(g)}$ (Heat change at constant pressure is $-50700\ J$)

1) $-50700\ J$ 2) $-63171\ J$ 3) $-38229\ J$ 4) $+38229\ J$

124. The Haber's process for production of ammonia involves the equilibrium $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ Assuming ΔH^0 and ΔS^0 for the reaction do not change with temperature which of statements is true $\left(\Delta H^0 = -95\ KJ\ and\ \Delta S^0 = -190\ JK^{-1}\right)$

1) Ammonia dissociates spontaneously below 500 K
2) Ammonia dissociates spontaneously above 500 K
3) Ammonia dissociates at all temperature
4) Ammonia does not dissociates at any temperature

125. What is the sign of ΔG^0 and the values of K for an electro chemical cell for which $E^0_{Cell} = 0.80\,Volt$

1) $\Delta G = -ve \quad K > 1$
2) $\Delta G^0 = +ve \quad K > 1$
3) $\Delta G = +ve \quad K < 1$
4) $\Delta G = -ve \quad K < 1$

126. Two moles of an ideal gas expanded isothermally and reversibly from 1L to 10L at 300 K. What is the enthalpy change?

1) 4.98 KJ 2) 11.47 KJ 3) – 11.47 KJ 4) 0 KJ

127. Although the dissolution of a NH_4Cl in water is an endothermic reaction, it is spontaneous because

1) $\Delta H = +Ve, \quad \Delta S = -Ve$
2) $\Delta H = +Ve, \quad \Delta S = 0$
3) $\Delta H = +Ve, \quad T\Delta S < \Delta H$
4) $\Delta H = +Ve, \quad \Delta S = +Ve \text{ and } \Delta H < T\Delta S$

128. For the reaction $Ag_2O_{(g)} \rightarrow 2Ag_{(g)} + \frac{1}{2}O_{2(g)}$ which one the following is true

1) $\Delta H = \Delta U$ 2) $\Delta H < \Delta U$ 3) $\Delta H > \Delta U$ 4) $\Delta H = \frac{1}{2}\Delta U$

129. The heat of combustion of methane is –880 KJ mole^{-1}.If 3.2 gr of methane is burnt the heat evolved is

1) 88 KJ 2) 264 KJ 3) 176 KJ 4) 440 KJ

130. If enthalpy of vapourization of water is 186.5 KJ/mole the entropy of vapourization will be:

1) 0.5 2) 1.0 3) 1.5 4) 2.0

131. Which of the following statement is true about photochemical smog

1) it is reducing in nature
2) it is formed in winter
3) it is a sulfurous smog
4) components of the smog, NO and O_3 irritate the nose and throat

132. SO_2 as pollutant can be controlled by

I using solar energy, nuclear energy, hydro electric energy
II low sulphur fuels, natural gas
III desulphonation of high sulphur coal and oil before buring by FGD
IV using water under high pressure

1) Both I and II 2) Both I and III 3) I, II, IV 4) I, II, III

133. Consider the following equilibrium $HbO_2 + CO \rightleftarrows HbCO + O_2 \quad HbCO = 3\% \text{ to } 4\%$ oxygen carrying capacity of blood is

1) increased
2) remains unchanged
3) decreased
4) cant be predicted

134. Consider the following diseases from which human being are suffered

I-Asthama II-Dyspepsia III-Bronchitis IV-emphysema

Diseases due to SO_2 are

1) I,II, and IV 2) II,III and IV 3) I, II and III 4) Both I and IV

135. Match list I with list II and select the correct answer using the codes given below the lists

	List –I (pollutant)		List –II Source
A	Micro organisms	1	Chemical fertilizers
B	Plant nutrients	2	Abandoned coalmines
C	Sediments	3	Domestic sewage
D	Mineral acids	4	Erosion of soil by strip mining
		5	Detergents

1) $A \rightarrow 1, B \rightarrow 3, C \rightarrow 2, D \rightarrow 4$
2) $A \rightarrow 2, B \rightarrow 5, C \rightarrow 3, D \rightarrow 1$
3) $A \rightarrow 3, B \rightarrow 1, C \rightarrow 4, D \rightarrow 2$
4) $A \rightarrow 4, B \rightarrow 2, C \rightarrow 1, D \rightarrow 5$

136. The chemical entilies present in thermosphere of the atmosphere are
1) O^{+2}, O^{+}, NO^{+} 2) O_3 3) N_2, O_2, CO_2, H_2O 4) O_3, O_2^{+}, O_2

137. BOD is connected with
1) microbes and organic matter 2) organic matter
3) microbes 4) none of these

138. Which of the following is not involve in the formation of photo chemical smog
1) Hydrocarbon 2) NO 3) SO_2 4) O_3

139. Hydrated barium peroxide treated with CO_2 products are
1) BaO, CO, O_2 2) $BaCO_3, O_2$ 3) $BaCO_3, H_2O_2$ 4) Ba, C, O_2

140. Which compounds using for H_2O_2 as stabilizer to check it's decomposition
1) H_3PO_4 2) $NaOH$ 3) Na_2CO_3 4) $CaCO_3$

141. Formula of hyperol is
1) $10v\ of\ H_2O_2$ 2) $H_2O_2 + C_2H_5OH$ 3) $H_2O_2 + C_6H_5OH$ 4) $\left[CO(NH_2)_2 .H_2O_2\right]$

142. Which of the following compound used in the synthesis of sodium perborate, percarbonate which are used in high quality detergents
1) H_2O 2) D_2O 3) H_2O_2 4) D_2O_2

143. The P^H of D_2O and H_2O at $298K$ is
1) 7,7 2) 7.35,5 3) 7,6.85 4) 6.85,7.35

144. The formula of pyrogallol is
1) $C_6H_5(OH)_3$ 2) $C_6H_4(OH)_2$ 3) $C_6H_3(OH)_3$ 4) C_6H_5OH

145. A metal on combustion in excess air forms x, x upon hydrolysis with water yields H_2O_2 and O_2 along with another product. The metal is
1) Li 2) Mg 3) Rb 4) Na

146. Very pure (99.9) can be made by which of the following processes
1) reaction of methane with steam
2) mixing natural hydrocarbons of high molecular weight
3) electrolysis of water
4) reaction of salt like hydrides with water

147. A substance X is a compound of an element of group IA. The substance X gives a violet colour in flame test. X is
1) $LiCl$ 2) $NaCl$ 3) KCl 4) none of these

148. Find out 'Z' in the following sequence of reaction $Na \xrightarrow{Air} x \xrightarrow{Maisture\ in\ air} y \xrightarrow{Cu} z$
1) Na_2CO_3 2) $NaOH$ 3) Na_2O_2 4) Na_2O

149. Which one of the following order represents the correct sequence of the increasing basic nature of the given oxides?
1) $K_2O < Na_2O < Al_2O_3 < MgO$ 2) $Al_2O_3 < MgO < Na_2O < K_2O$
3) $MgO < K_2O < Al_2O_3 < Na_2O$ 4) $Na_2O < K_2O < MgO < Al_2O_3$

150. Raw material used in solvay process
1) $NaOH, NH_3, CaCO_3$ 2) $NaCl(Aq), NH_3, CaCO_3$
3) $Brine + C + NH_3$ 4) $NaOH + C + NH_3$

151. The conductivities of Alkali metal halides in aqueous solution increase from Li to Cs due to
1) Increase in extent of hydration of ions
2) Increase in sizes of hydrated ions
3) Decrease in the mobilities of hydrated ions
4) Increase in the mobilities of hydrated ions

152. $Li\ NO_3 \xrightarrow{HEAT} ?$

1) O_2 2) NO_2 3) $O_2 + NO_2 + Li_2O$ 4) None of these

153. When gypsum is heated to 120^0C the moles of H_2O molecules remains with $CaSO_4$ is

1) 0.5 2) 1 3) 1.5 4) 2

154. Sedimentary rocks laid down under water mainly contain

1) CaO 2) $Ca(OH)_2$ 3) $CaCO_3$ 4) $CaSO_4$

155. Chemical A is used for water softening to remove temporary hardness. A reacts with Na_2CO_3 to generate caustic soda. When CO_2 is bubbled through A,it turns cloudly.What is the chemical formula of A

1) $CaCO_3$ 2) CaO 3) $Ca(OH)_2$ 4) $Ca(HCO_3)_2$

156. The more acidic compound in water is

1) $AlCl_3$ 2) $BeCl_2$ 3) $FeCl_3$ 4) None of these

157. $BCl_3 + LiAIH_4 \rightarrow A + LiCI + AICI_3$

$A + H_2O \rightarrow B + H_2,\ B \xrightarrow{Red\ heat} C.$ **In this raction sequence A,B and C compounds respectively are**

1) B_2H_6, B_2O_2, B 2) B_2H_6, H_3BO_3, B_2O_3 3) B_2H_6, H_3BO_3, B 4) HBF_4, H_3BO_3, B_2O_3

158. Which of the following is a lewis acid

1) $AlCl_3$ 2) $MgCl_2$ 3) $CaCl_2$ 4) $BaCl_2$

159. A mixture of boron trichloride and hydrogen is subjected to silent electric discharge to form $\underline{A}$ and HCl. $\underline{A}$ is mixed with NH_3 and heated to 200^0c to form ' $\underline{B}$ .The formula' $\underline{B}$ 'is

1) H_3BO_3 2) B_2O_3 3) $B_3N_3H_6$ 4) B_2H_6

160. Aluminum reacts with concentrated HCl and conc $NaOH$ to liberate the gases………………respectively.

1) $H_2\ and\ O_2$ 2) $O_2\ and\ H_2$ 3) $H_2\ and\ H_2$ 4) $O_2\ and\ O_2$

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SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR EAMCET
Time: 3 Hours

EAMCET UNIT-3

Date: 22-04-2020
Max Marks : 160

KEY SHEET

MATHS-A

1) **3**	2) **4**	3) **3**	4) **2**	5) **2**	6) **1**	7) **1**	8) **1**	9) **2**	10) **3**
11) **2**	12) **3**	13) **4**	14) **3**	15) **4**	16) **3**	17) **2**	18) **1**	19) **2**	20) **1**
21) **1**	22) **2**	23) **1**	24) **2**	25) **1**	26) **3**	27) **3**	28) **3**	29) **1**	30) **2**
31) **3**	32) **2**	33) **4**	34) **1**	35) **3**	36) **2**	37) **3**	38) **2**	39) **3**	40) **3**

MATHS-B

41) **1**	42) **4**	43) **1**	44) **2**	45) **3**	46) **1**	47) **3**	48) **4**	49) **3**	50) **4**
51) **4**	52) **2**	53) **1**	54) **2**	55) **3**	56) **1**	57) **3**	58) **4**	59) **2**	60) **1**
61) **4**	62) **2**	63) **1**	64) **3**	65) **4**	66) **1**	67) **4**	68) **2**	69) **4**	70) **1**
71) **3**	72) **1**	73) **2**	74) **2**	75) **1**	76) **4**	77) **4**	78) **1**	79) **1**	80) **3**

PHYSICS

81) **2**	82) **3**	83) **4**	84) **2**	85) **2**	86) **2**	87) **3**	88) **3**	89) **1**	90) **1**
91) **2**	92) **1**	93) **2**	94) **3**	95) **2**	96) **3**	97) **1**	98) **2**	99) **3**	100) **3**
101) **4**	102) **1**	103) **1**	104) **3**	105) **2**	106) **3**	107) **1**	108) **1**	109) **1**	110) **2**
111) **2**	112) **4**	113) **4**	114) **4**	115) **2**	116) **1**	117) **1**	118) **4**	119) **3**	120) **4**

CHEMISTRY

121) **4**	122) **1**	123) **3**	124) **1**	125) **1**	126) **4**	127) **4**	128) **3**	129) **3**	130) **1**
131) **4**	132) **4**	133) **3**	134) **1**	135) **3**	136) **1**	137) **1**	138) **3**	139) **3**	140) **1**
141) **4**	142) **3**	143) **2**	144) **3**	145) **3**	146) **4**	147) **3**	148) **1**	149) **2**	150) **2**
151) **4**	152) **3**	153) **1**	154) **3**	155) **3**	156) **3**	157) **2**	158) **1**	159) **3**	160) **3**

HINTS & SOLUTIONS

MATHS-A

1. $x \in Z, 7-x \ge x-3, 7-x > 0, x-3 \ge 0$

2. $f(x) = \dfrac{1}{\sqrt{\{\sin x\} + \{\sin(\pi + x)\}}}$

$= \dfrac{1}{\sqrt{\{\sin x\} + \{-\sin x\}}}$

Now $\{\sin x\}+\{-\sin x\}=\begin{cases}0 & \sin x \text{ is an integer}\\ 1 & \sin x \text{ is not an integer}\end{cases}$

For $f(x)$ to get defined $\{\sin x\}+\{-\sin x\}\neq 0$

$\Rightarrow \sin x \neq$ nteger $\Rightarrow \sin x \neq \pm 1, 0 \Rightarrow x \neq \frac{n\pi}{2}, n \in I$

Hence, the domain is R- $\left\{\frac{n\pi}{2} / n \in I\right\}$

3. $f(x)=(-1)^x$ is defined when x is an integer

$\therefore$ Domain = Z, range = $\{-1,1\}$

4. $\frac{1}{\mathrm{x}}-1<0$

5. $f(x)$ is defined if

$-1 \leq \log_{16}^{x^2} \leq 1 \Rightarrow 16^{-1} \leq x^2 \leq 16^1$

6. $x+\frac{1}{x} \geq 2$

7. $f(7)+f(-7)=-10 \Rightarrow f(7)=-17$

$\Rightarrow f(7)+17\cos x=-17+17\cos x$ which has the range $[-34, 0]$

8. Since, $A=\begin{bmatrix} a & p \\ b & q \\ c & r \end{bmatrix}$, and $A^T=\begin{bmatrix} a & b & c \\ p & q & r \end{bmatrix}$

$$AA^T=\begin{bmatrix} a & p \\ b & q \\ c & r \end{bmatrix}\begin{bmatrix} a & b & c \\ p & q & r \end{bmatrix}$$

$$=\begin{bmatrix} a^2+p^2 & ab+pq & ac+pr \\ ab+qp & b^2+q^2 & bc+qr \\ ac+pr & bc+qr & c^2+r^2 \end{bmatrix}$$

9. Since, $E(\theta)=\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

$$E(\alpha)=\begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$$

and $E(\beta)=\begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix}$

$$E(\alpha).E(\beta)=\begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}\begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix}$$

$$=\begin{bmatrix} \cos\alpha\cos\beta-\sin\alpha\sin\beta & \cos\alpha\sin\beta+\sin\alpha\cos\beta \\ -\sin\alpha\cos\beta-\cos\alpha\sin\beta & -\sin\alpha\sin\beta+\cos\alpha\cos\beta \end{bmatrix}$$

$$=\begin{bmatrix} \cos(\alpha+\beta) & \sin(\alpha+\beta) \\ -\sin(\alpha+\beta) & \cos(\alpha+\beta) \end{bmatrix}$$

$\therefore E(\alpha).E(\beta)=E(\alpha+\beta)$

10. $\begin{bmatrix} 0 & 2y & z \\ x & y & -z \\ x & -y & z \end{bmatrix}' \begin{bmatrix} 0 & 2y & z \\ x & y & -z \\ x & -y & z \end{bmatrix} = 1$

$\Rightarrow \begin{bmatrix} 0+x^2+x^2 & 0+xy-xy & 0-xz+xz \\ 0+yx-yx & 4y^2+y^2+y^2 & 2yz-yz-yz \\ 0-zx+zx & 2yz-yz-yz & z^2+z^2+z^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$\Rightarrow \begin{bmatrix} 2x^2 & 0 & 0 \\ 0 & 6y^2 & 0 \\ 0 & 0 & 3z^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

On comparing the corresponding elements, we have

$2x^2 = 1,\ 6y^2 = 1,\ 3z^2 = 1 \Rightarrow x^2 = \frac{1}{2},$

$y^2 = \frac{1}{6},\ z^2 = \frac{1}{3}$

$\Rightarrow x = \pm\frac{1}{\sqrt{2}},\ y = \pm\frac{1}{\sqrt{6}},\ z = \pm\frac{1}{\sqrt{3}}$

11. $A+B = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} + \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}$

$A-B = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} - \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 0 & 1 \end{bmatrix}$

$A^2 = A.A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 0+1 & 0+1 \\ 0+1 & 1+1 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$

and $B^2 = B.B = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0-1 & 0+0 \\ 0+0 & -1+0 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

$\therefore A^2 - B^2 = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} - \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$

and $(A+B)(A-B) = \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} 0 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0+0 & 0+0 \\ 0+0 & 4+1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 5 \end{bmatrix}$

hence, $(A+B)(A-B) \neq A^2 - B^2$

12. $\because |adj(A)| = |A|^{n-1}$

$|A| = 14$

$|adj(A)| = (|A|)^2 = (14)^2$

13. $\begin{bmatrix} a & i \\ i & b \end{bmatrix} . \begin{bmatrix} a & i \\ i & b \end{bmatrix} = \begin{bmatrix} a^2-1 & (a+b)i \\ (a+b)i & b^2-1 \end{bmatrix}$

$\therefore a^2 - 1 = a, a+b = 1$

$a = \frac{1\pm\sqrt{5}}{2}, b = \frac{1\pm\sqrt{5}}{2}$

14. take $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = (a+b+c)(a+bx+ck^2)(a+bk^2+ck)$

Then K is equal to by option verification

15. Let $\Delta = \begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix}$

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

$$= abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right) \begin{vmatrix} 1 & 1 & 1 \\ \frac{1}{b} & \frac{1}{b}+1 & \frac{1}{b} \\ \frac{1}{c} & \frac{1}{c} & \frac{1}{c}+1 \end{vmatrix}$$

$$= abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$$

16. $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix}$

$$\therefore |A| = 1\begin{vmatrix} 1 & 2 \\ 0 & 4 \end{vmatrix} - 0\begin{vmatrix} 0 & 1 \\ 0 & 4 \end{vmatrix} + 0\begin{vmatrix} 0 & 1 \\ 1 & 2 \end{vmatrix}$$

$$= 1(1\times 4 - 0\times 2) = 4$$

$$\therefore 27|A| = 27\times 4 = 108$$

Now, $3A = 3\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 0 & 3 \\ 0 & 3 & 6 \\ 0 & 0 & 12 \end{bmatrix}$

$$\therefore |3A| = \begin{vmatrix} 3 & 0 & 3 \\ 0 & 3 & 6 \\ 0 & 0 & 12 \end{vmatrix}$$

$$|3A| = 3\begin{vmatrix} 3 & 6 \\ 0 & 12 \end{vmatrix} - 0\begin{vmatrix} 0 & 3 \\ 0 & 12 \end{vmatrix} + 0\begin{vmatrix} 0 & 3 \\ 3 & 6 \end{vmatrix} = 3(3\times 12 - 0\times 6)$$

$$\Rightarrow |3A| = 3(36) = 108$$

$$|3A| = 27|A|$$

17. $\begin{vmatrix} x+4 & 2x & 2x \\ 2x & x+4 & 2x \\ 2x & 2x & x+4 \end{vmatrix} = \begin{vmatrix} 5x+4 & 2x & 2x \\ 5x+4 & x+4 & 2x \\ 5x+4 & 2x & x+4 \end{vmatrix}$

$$= (5x+4)\begin{vmatrix} 1 & 2x & 2x \\ 1 & x+4 & 2x \\ 1 & 2x & x+4 \end{vmatrix}$$

$$=(5x+4)\begin{vmatrix}1 & 2x & 2x\\ 0 & -x+4 & 0\\ 0 & 0 & -x+4\end{vmatrix}$$

$$=(5x+4)\{1(4-x)(4-x)\}$$

$$=(5x+4)(4-x)^2$$

18. $$\begin{vmatrix}x & x^2 & 1+px^3\\ y & y^2 & 1+py^3\\ z & z^2 & 1+pz^3\end{vmatrix}=\begin{vmatrix}x & x^2 & 1\\ y & y^2 & 1\\ z & z^2 & 1\end{vmatrix}+\begin{vmatrix}x & x^2 & px^2\\ y & y^2 & py^3\\ z & z^2 & pz^3\end{vmatrix}$$

$$=\begin{vmatrix}1 & x & x^2\\ 1 & y & y^2\\ 1 & z & z^2\end{vmatrix}+pxyz\begin{vmatrix}1 & x & x^2\\ 1 & y & y^2\\ 1 & z & z^2\end{vmatrix}$$

$$=(1+pxyz)\begin{vmatrix}1 & x & x^2\\ 1 & y & y^2\\ 1 & z & z^2\end{vmatrix}=(1+pxyz)\begin{vmatrix}1 & x & x^2\\ 0 & y-x & y^2-x^2\\ 0 & z-x & z^2-x^2\end{vmatrix}$$

$$=(1+pxyz)\left[(y-x)(z+x)(z+x)-(y-x)(z-x)(y+x)\right]$$

$$=(1+pxyz)\left[(y-x)(z-x)(z-y)=(1+pxyz)(x-y)(y-z)(z-x)\right]$$

19. $$\Delta=\begin{vmatrix}x-p & p & q\\ p-x & x & q\\ 0 & q & x\end{vmatrix}=(x-p)\begin{vmatrix}1 & p & q\\ -1 & x & q\\ 0 & q & x\end{vmatrix}$$

$$\Delta=(x-p)\left(px+x^2-2q^2\right)=(x-p)\left(x^2+px-2q^2\right)$$

20. We have $\begin{vmatrix}x+\alpha & \beta & \gamma\\ \gamma & x+\beta & \alpha\\ \alpha & \beta & x+\gamma\end{vmatrix}=0$

$$\Rightarrow (x+\alpha+\beta+\gamma)\begin{vmatrix}1 & \beta & \gamma\\ 1 & x+\beta & \alpha\\ 1 & \beta & x+\gamma\end{vmatrix}=0$$

$$\Rightarrow (x+\alpha+\beta+\gamma)\begin{vmatrix}1 & \beta & \gamma\\ 0 & x & \alpha-\gamma\\ 0 & 0 & x\end{vmatrix}=0$$

$$\Rightarrow (x+\alpha+\beta+\gamma)\left(x^2-0\right)=0$$

$$\Rightarrow x=0 \ \ or \ \ x=-(\alpha+\beta+\gamma)$$

21. $$f(x)=\left(1+\sin^2 x+\cos^2 x+4\sin 2x\right)\begin{vmatrix}1 & \cos^2 x & 4\sin 2x\\ 1 & 1+\cos^2 x & 4\sin 2x\\ 1 & \cos^2 x & 1+4\sin 2x\end{vmatrix}$$

$$f(x)=2(1+2\sin 2x)$$

$$\max f(x)=6$$

$$\min f(x)=-2$$

22. Let $\alpha=s-a, \beta-s-b, \gamma=s-c$, then determinant

$$= \begin{vmatrix} (\beta+\gamma)^2 & \alpha^2 & \alpha^2 \\ \beta^2 & (\gamma+\alpha)^2 & \beta^2 \\ \gamma^2 & \gamma^2 & (\alpha+\beta)^2 \end{vmatrix} = 2\alpha\beta\gamma(\alpha+\beta+\gamma)^2$$

$= 2(s-a)(s-b)(s-c)s^3 \Rightarrow k = 2$

23. Since, $\alpha+\beta+\gamma = 0$

$$\therefore \Delta = \begin{vmatrix} \alpha+\beta+\gamma & \beta & \gamma \\ \alpha+\beta+\gamma & \gamma & \alpha \\ \alpha+\beta+\gamma & \alpha & \beta \end{vmatrix} = \begin{vmatrix} 0 & \beta & \gamma \\ 0 & \gamma & \alpha \\ 0 & \alpha & \beta \end{vmatrix} = 0$$

24. $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}$

$$f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ 0 & 0 & a+x \end{vmatrix} = (a+x)(a^2+ax)$$

$\Rightarrow f(x) = a(a+x)^2$

$\Rightarrow f(2x) - f(x) = ax(2a+3x)$

25. $|A| = \begin{vmatrix} x+1 & -3 & 4 \\ -5 & x+2 & 2 \\ 4 & 1 & x-6 \end{vmatrix} = 0$

$\Rightarrow (x+1)(x^2-4x-12-2)+3(-5x+30-8)+4(-5-4x-8)=0$

$\Rightarrow x = 0, \dfrac{3\pm\sqrt{205}}{2}$

26. $R_1 \to R_1 + R_3 - 2R_2$

$$f(x) = \begin{vmatrix} a+c-2b & 0 & 0 \\ x+b & x+3 & x+2 \\ x+c & x+4 & x+3 \end{vmatrix}$$

$= (a+c-2b)\left((x+3)^2 - (x+2)(x+4)\right)$

$= x^2+6x+9-x^2-6x-8 = 1$

$f(x) = 1 \Rightarrow f(50) = 1$

27. $\begin{vmatrix} x & \dfrac{x(x-1)}{2} & \dfrac{x(x-1)(x-2)}{6} \\ y & \dfrac{y(y-1)}{2} & \dfrac{y(y-1)(y-2)}{6} \\ z & \dfrac{z(z-1)}{2} & \dfrac{z(z-1)(z-2)}{6} \end{vmatrix} = \dfrac{xyz}{12}\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$

$R_1 \to R_1 - R_2$ and $R_2 \to R_2 - R_3$

28. D simplifies to $-4(2t+1) = 0$

29. $D = \cos\theta - \cos^2\theta + 6 \neq 0$

Since $D \neq 0 \Rightarrow$ Only trivial solution is possible

30. $D=\begin{vmatrix}1 & -2 & 1\\ 2 & 1 & -2\\ 1 & 3 & -3\end{vmatrix}$ which vanishes; hence for atleast one solution $D_1=D_2=D_3=0$

$\therefore D_1=\begin{vmatrix}a & -2 & 1\\ b & 1 & -2\\ c & 3 & -3\end{vmatrix}=0$

$\Rightarrow a-b+c=0$

31. Put $k=1$ and solve

32. For non-zero solution $\begin{vmatrix}1 & 2a & a\\ 1 & 3b & b\\ 1 & 4c & c\end{vmatrix}=0$

33. $X=\frac{1}{2}(B-A)=\frac{1}{2}\begin{bmatrix}-5 & 1\\ 5 & 7\end{bmatrix}$

34. Since $(AB)^{'}=B^{'}A^{'}$, the statement $(AB)^{'}=A^{'}B^{'}$ is not correct.

35. $AA^{-1}=I$

$\Rightarrow |AA^{-1}|=|I|=1$

Hence $|A||A^{-1}|=1$

$\Rightarrow |A^{-1}|=\frac{1}{|A|}$

$\Rightarrow (B)$ is correct

36. $A\,adjA=|A|I........(i)$

$(AB)(adjAB)=|AB|I_n$

Consider $(AB)(adjB.adjA)=A(B\ adj\ B)adj\ A$ (associativity)

$=A|B|I_nAdjA$

$(AB)(adj.B.adjA)=|B||A|I_n$

Or $|AB|I_n...........(ii)$

From equations (i) and (ii) $adj(AB)=(adjB).(adjA)$

37. We have $|A|=\begin{vmatrix}x+\lambda & x & x\\ x & x+\lambda & x\\ x & x & x+\lambda\end{vmatrix}$

$=\begin{vmatrix}3x+\lambda & x & x\\ 3x+\lambda & x+\lambda & x\\ 3x+\lambda & x & x+\lambda\end{vmatrix}=(3x+\lambda)\begin{vmatrix}1 & x & x\\ 1 & x+\lambda & x\\ 1 & x & x+\lambda\end{vmatrix}$

$=(3x+\lambda)\begin{vmatrix}1 & x & x\\ 0 & \lambda & 0\\ 0 & 0 & \lambda\end{vmatrix}=\lambda^2(3x+\lambda)$

[Take $3x+\lambda$ common and use $R_2\to R_2-R_1, R_3\to R_3-R_1$]

Thus, A^{-1} will exist if $\lambda\neq 0$ and $3x+\lambda\neq 0.$

38. $(KI_n)adj(KI_n)=|KI_n|I_n$ [Using $A(adjA)=|A|I$]

$adj(KI_n)=K^{n-1}I_n$

$\left|adj\left(KI_n\right)\right| = K^{n(n-1)}$

39. $|adjA| = |A|^{n-1}$ ....(i)

Also $A.adjA = |A| I_n$

$A \to KA$

$(KA)adj(KA) = |KA| I_n$

$(KA)adj(KA) = K^n |A| I_n$

$A.adj(KA) = K^{n-1}(adj\,A)A$

$adj(KA) = K^{n-1}(adjA)$

40. A is nilpotent if $A^m = 0$ and $A^{m-1} \neq 0$ and the order of nilpotency is m.

General form of a null matrix is $\begin{bmatrix} 0 & 0 \\ a & 0 \end{bmatrix}$

MATHS-B

41. $\lim\limits_{x\to\alpha} \dfrac{\tan a(x-\alpha)^2}{a(x-\alpha)^2} \times a = a$

42. $e^{\lim\limits_{x\to\alpha}\left(\frac{\sin x - \sin a}{\sin a}\right).\frac{1}{x-a}}$

$= e^{\lim\limits_{x\to\alpha}\cos x.}$ (LH rule) $= e^{\cos a}$

43. $\lim\limits_{x\to\infty}\left[\sqrt{x+\sqrt{x+x}} - \sqrt{x}\right]$

$= \lim\limits_{x\to\infty} \dfrac{x+\sqrt{x+\sqrt{x}} - \sqrt{x}}{\sqrt{x+\sqrt{x+\sqrt{x}}} + \sqrt{x}}$

$= \lim\limits_{x\to\infty} \dfrac{\sqrt{x+\sqrt{x}}}{\sqrt{x+\sqrt{x+\sqrt{x}}} + \sqrt{x}}$

$= \lim\limits_{x\to\infty} \dfrac{\sqrt{x}\left(1+\frac{1}{\sqrt{x}}\right)^{1/2}}{\sqrt{x}\left[\left(1+\frac{1}{\sqrt{x}}\sqrt{1+\frac{1}{\sqrt{x}}}\right)^{1/2} + 1\right]}$

$= \dfrac{1}{1+1} = \dfrac{1}{2}$

44. $\lim\limits_{x\to\infty}\sqrt{\dfrac{x+\sin x}{x-\cos x}} = \lim\limits_{x\to\infty}\sqrt{\dfrac{1+\frac{\sin x}{x}}{1-\frac{\cos x}{x}}} = \sqrt{\dfrac{1+0}{1-0}} = 1$

45. $= \lim\limits_{n\to\infty} \dfrac{1.2+2.3+3.4+.......+n(n+1)}{n^3}$

$= \lim\limits_{n\to\infty} \dfrac{\sum n(n+1)}{n^3} = \lim\limits_{n\to\infty} \dfrac{\sum n^2 + \sum n}{n^3}$

$= \lim\limits_{n\to\infty} \dfrac{1}{n^3}\left[\dfrac{n(n+1)(2n+1)}{6} + \dfrac{n(n+1)}{2}\right]$

$$= \lim_{n\to\infty}\left[\frac{1}{6}\left(1+\frac{1}{n}\right)\left(2+\frac{1}{n}\right)+\frac{1}{2}.\left(\frac{1}{n}+\frac{1}{n^2}\right)\right]$$

$$= \frac{1}{6}\times 1\times 2=\frac{1}{3}$$

46. $\lim_{x\to 0}\frac{1-\cos^3 x}{x\sin x\cos x}$

$$= \lim_{x\to 0}\frac{(1-\cos x)(1+\cos^2 x+\cos x)}{x\sin x\cos x}$$

$$= \lim_{x\to 0}\frac{2\sin^2\frac{x}{2}(1+\cos^2 x+\cos x)}{2x\sin\frac{x}{2}\cos\frac{x}{2}\cos x}$$

$$= \lim_{x\to 0}\frac{1}{2}\frac{\sin\frac{x}{2}}{\frac{x}{2}}.\frac{1+\cos^2 x+\cos x}{\cos\frac{x}{2}.\cos x}$$

$$= \frac{1}{2}.1.\frac{3}{1}=\frac{3}{2}$$

47. $\lim_{n\to\infty}\frac{n(2n+1)^2}{(n+2)(n^2+3n-1)}$

$$=\lim_{n\to\infty}\frac{\left(2+\frac{1}{n}\right)^2}{\left(1+\frac{2}{n}\right)\left(1+\frac{3}{n}-\frac{1}{n^2}\right)}$$

$$=\frac{(2+0)^2}{(1+0)(1+0+0)}=4$$

48. $\lim_{x\to\infty}\frac{(x+1)^{10}+(x+2)^{10}+.....+(x+100)^{10}}{x^{10}+10^{10}}$

$$=\lim_{x\to\infty}\frac{x^{10}\left[\left(1+\frac{1}{x}\right)^{10}+\left(1+\frac{2}{x}\right)^{10}+....+\left(1+\frac{100}{x}\right)^{10}\right]}{x^{10}\left[1+\frac{10^{10}}{x^{10}}\right]}$$

49. $\lim_{x\to 0}\frac{\sqrt{1-\cos 2x}}{x}=\lim_{x\to 0}\sqrt{2}\frac{|\sin x|}{x}=\lim_{x\to 0^+}\sqrt{2}\left[\frac{\sin(0+h)}{h}\right]=\sqrt{2}=\lim_{x\to 0^-}\sqrt{2}\left[\frac{|\sin(0-h)|}{(-h)}\right]=-\sqrt{2}$

Here R.H.L. is $\sqrt{2}$ and L.H.L. is $-\sqrt{2}$.

$\therefore$ Limit does not exist.

50. Given limit is $\frac{2\sin^2 x/2}{x\log(1+x)}=\frac{1}{2}\frac{\lim_{x\to 0}\left(\frac{\sin x/2}{x/2}\right)^2}{\lim_{x\to 0}\log(1+x)^{\frac{1}{x}}}=\frac{1}{2}$

51. $\lim_{x\to 0}\frac{1-\cos 2x}{x^2}\times\frac{3+\cos x}{1}\times\frac{x}{\tan 4x}$ =2

52. $\lim_{\theta\to 0}\dfrac{\dfrac{\sin\theta}{\cos\theta}-\sin\theta}{\theta^3}=\lim_{\theta\to 0}\left(\dfrac{\dfrac{\sin\theta}{\cos\theta}}{\theta}\right)\left(\dfrac{1-\cos\theta}{\theta^2}\right)$

53. Using L- Hospital Rule

54. $\lim_{x\to 0}\dfrac{e^{\sin x}\left(e^{x-\sin x}-1\right)}{2(x-\sin x)}=\dfrac{1}{2}$

55. Given limit is

$\lim_{x\to 0}\dfrac{8}{x^8}\left(1-\cos\dfrac{x^2}{2}\right)\left(1-\cos\dfrac{x^2}{4}\right)=32\dfrac{1}{16}\dfrac{1}{64}=\dfrac{1}{32}$

56. Since f(x) is continuous at x=0

$\underset{x\to 0}{Lt}\, f(x)=f(0)\Rightarrow \underset{x\to 0}{Lt}\dfrac{3\sin\pi x}{5x}=2k$

$k=\dfrac{3\pi}{10}$

57. Note that f is continuous everywhere except possibly at $x = 0$. For f to be continuous at $x = 0$,

$1=f(0)=\lim_{x\to 0}\dfrac{x(1+a\cos x)-b\sin x}{x^3}\left(\dfrac{0}{0}\text{ from}\right)$

$=\lim_{x\to 0}\dfrac{(1+a\cos x)-xa\sin x-b\cos x}{3x^3}\quad =\lim_{x\to 0}\dfrac{1+(a-b)\cos x-xa\sin x}{3x^2}$

This limit will exist only if $1+(a-b)=0$.

$=\lim_{x\to 0}\dfrac{-(a-b)\sin x-ax\cos x-a\sin x}{6x}\ =\dfrac{1}{6}\lim_{x\to 0}\left[(b-2a)\dfrac{\sin x}{x}-a\cos x\right]\ =\dfrac{1}{6}[b-3a]$

$\Rightarrow\quad b-3a=6$

Solving $a-b=-1$ and $b-3a=6$, we get $b=-3/2$ and $a=-5/2$.

58. $K\log 2\log 3=f(0)$

$=\lim_{x\to 0}f(x)=\lim_{x\to 0}\dfrac{72^x-9^x-8^x+1}{\sqrt{2}-\sqrt{1+\cos x}}$

$=\lim_{x\to 0}\dfrac{9^x-1}{x}.\dfrac{8^x-1}{x}\dfrac{16(x/4)^4}{\sqrt{2}.2\sin^2 x/4}$

$=\dfrac{16}{2\sqrt{2}}\log 9\log 8$

$=\dfrac{8}{\sqrt{2}}6\log 3\log 2=24\sqrt{2}\log 3\log 2$

Thus $K=24\sqrt{2}$.

59. $f(0)=\underset{x\to 0+}{Lt}\, f(x)=\underset{x\to 0}{Lt}\dfrac{\left(x+bx^2\right)^{1/2}-x^{1/2}}{bx^{3/2}}=\underset{x\to 0}{Lt}\dfrac{x+bx^2-x}{bx^{3/2}\left(\left(x+bx^2\right)^{1/2}+x^{1/2}\right)}$

$\Rightarrow c=\underset{x\to 0}{Lt}\dfrac{bx^{1/2}}{bx^{1/2}\left((1+bx)^{1/2}+1\right)}=\dfrac{1}{2}$

$f(0)=\underset{x\to 0-}{Lt}\, f(x)=\underset{x\to 0}{Lt}\dfrac{\sin(a+1)x+\sin x}{x}=\underset{x\to 0}{Lt}\dfrac{\cos(a+1)x(a+1)+\cos x}{1}$

$c=a+1+1\Rightarrow a=c-2=\dfrac{1}{2}-2=\dfrac{-3}{2}$

60. We have, $f(x)=\begin{cases}\dfrac{\log(1+2ax)-\log(1-bx)}{x}, & \text{if } x\neq 0\\ k, & \text{if } x=0\end{cases}$

$f(x)$ is continuous at x = 2.

$\therefore \quad \lim_{x\to 0} f(x)=f(0)$

$\Rightarrow \lim_{x\to 0}\dfrac{\log(1+2ax)-\log(1-bx)}{x}=k \quad [\because f(0)=k]$

$\Rightarrow \lim_{x\to 0}\dfrac{\log(1+2ax).2a}{2ax}-\lim_{x\to 0}\dfrac{\log(1-bx).(-b)}{-bx}=k$

$\Rightarrow 2a+b=k \quad \left[\because \lim_{x\to 0}\dfrac{\log(1+x)}{x}=1\right]$

61. $\dfrac{dy}{dx}=-\dfrac{(2x+y)}{x+6y}$

$\Rightarrow \dfrac{d^2y}{dx^2}=\dfrac{-22(x^2+xy+3y^2)}{(x+6y)^3}$

$\Rightarrow (x+6y)^3.\dfrac{d^2y}{dx^2}=-22(1)$

62. Given $y=3e^2-x$

$f(x)=x^y=x^{3e^2}-x$

$\log f(x)=(3e^2-x)\log x$ diff w.r.t to x

$\dfrac{1}{f(x)}f'(x)=\dfrac{3e^2-x}{x}-\log x$

Now $f'(x)=0$

$3e^2-x=x.\log x$

$\therefore x=e^2$

63. $y=\cos^{-1}\left(\dfrac{9-x^2}{9+x^2}\right)=\cos^{-1}\left(\dfrac{1-\left(\frac{x}{3}\right)^2}{1+\left(\frac{x}{3}\right)^2}\right)=2\tan^{-1}\left(\dfrac{x}{3}\right), \quad if\ 0\le x<\infty$

$=-2\tan^{-1}\left(\dfrac{x}{3}\right), \quad if\ -\infty<x<0$

Hence $y'(x)=\begin{cases}\dfrac{2}{1+\left(\frac{x}{3}\right)^2}\dfrac{1}{3} & if\ 0<x<\infty\\ \dfrac{-2}{1+\left(\frac{x}{3}\right)^2}\dfrac{1}{3}, & if\ -\infty<x<0\end{cases}$

Hence $y'(-1)=\dfrac{-3}{5}$

64. $g(x)=f^{-1}(x)\Rightarrow f[g(x)]=x$

$\Rightarrow f'[g(x)].g'(x)=1$

65. $y=\tan^{-1}\left[\frac{8\sin x\cos x}{\cos^2 x-7\sin^2 x}\right]=\tan^{-1}\left(\frac{8\tan x}{1-7\tan^2 x}\right)$

$y=\tan^{-1}\left[\frac{7\tan x+\tan x}{1-7\tan x.\tan x}\right]=\tan^{-1}(7\tan x)+x$

66. If $x=0 \quad then\ y=0$

$e^{xy}+x.e^{xy}\left[x.\frac{dy}{dx}+y\right]=\frac{dy}{dx}+2\sin x\cos x$

$\left(\frac{dy}{dx}\right)_{(0,0)}=1$

67. $(x-3)\sin y=4\cos y$ and then differentiate

68. $\frac{dy}{dx}=\frac{(dy/dt)}{(dx/dt)}$

69. Differentiating the given expression, we get $3x^2-4xy^2-4x^2y.y'+5+y'=0$

at $x=1$, we have $3-4.1.1-4.1.1.y'+5+y'(1)=0$

$4-3y'(1)=0\Rightarrow y'(1)=4/3$

Differentiating again, we have $6x-4y^2-8xy.y'-8xy.y'-4x^2(y')^2-4x^2y.y''+y''=0$

Putting $x=1,\ y=1\ and\ y'(1)=4/3$, we get $6-4-8\left(\frac{4}{3}\right)-8\left(\frac{4}{3}\right)-4\left(\frac{16}{9}\right)-3y''(1)=0$

$y''(1)=-8.\frac{22}{7}$

70. $\lim_{y\to 0}\frac{f(3+h^2)-f(3-h^2)}{2h^2}$

$=\frac{1}{2}\lim_{h\to 0}\frac{f(3+h^2)-f(3)}{h^2}$

$=\frac{1}{2}f'(3)=2/2=1$

71. $y=\tan^{-1}\left(\frac{1-2\log x}{1+2\log x}\right)+\tan^{-1}\left(\frac{3+2\log x}{1-6\log x}\right)$

$=\pi/4-\tan^{-1}(2\log x)+\tan^{-1}3+\tan^{-1}(2\log x)$

$=\pi/4-\tan^{-1}3$

Thus $\frac{dy}{dx}=0\ and\ so\ \frac{d^2y}{dx^2}\ is\ also\ zero$

72. $\frac{dy}{dy}=f'(u)\frac{du}{dx},\ where\ u=\frac{3x+4}{5x+6}$

But $\frac{du}{dx}=\frac{3(5x+6)-(3x+4)5}{(5x+6)^2}=-\frac{2}{(5x-6)^2}$

$Thus\ \frac{dy}{dx}=-2\tan\left(\frac{3x+4}{5x+6}\right)^2\frac{1}{(5x+6)^2}$

73. $y=\tan^{-1}\sqrt{\frac{2\sin^2 x/2}{2\cos^2 x/2}}=\tan^{-1}\tan(x/2)=x/2$

Hence $\frac{dy}{dx}=\frac{1}{2}$

74. $\left(\frac{dx}{dt}\right)=2\cos t-2\cos 2t=2\left[2\sin\left(3t/2\right)\sin t/2\right]$ and

$\left(\frac{dy}{dt}\right)=-2\sin t+2\sin 2t=2\left[2\sin\left(3t/2\right)\cos t/2\right]$

Hence $\left(\frac{dy}{dt}\right)=\cot\left(t/2\right)\ and\ \left(\frac{d^2y}{dx^2}\right)=-\frac{1}{2}\cos ec^2\left(t/2\right)\times\frac{dt}{dx}$

$\therefore\left(\frac{d^2y}{dx^2}\right)=-\frac{1}{2}\cos ec^2\left(t/2\right)\times\frac{1}{4\sin 3t/2\sin t/2}$ and

$\left.\frac{d^2y}{dx^2}\right|_{t=\pi/2}=\left(-\frac{1}{2}\right)=\left(\sqrt{2}\right)^2\times\frac{1}{4\times(1/2)}=-\frac{1}{2}$

75. $\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}$

$=\frac{\cos\left(x/2\right)+\sin\left(x/2\right)+\cos\left(x/2\right)-\sin\left(x/2\right)}{\cos\left(x/2\right)+\sin\left(x/2\right)-\cos\left(x/2\right)+\sin\left(x/2\right)}$

$=\frac{\cos\left(x/2\right)}{\sin\left(x/2\right)}=\cot\frac{x}{2}$

$\therefore y=\cot^{-1}\left[\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right]=\frac{x}{2}$

76. $\frac{dy}{dx}=\frac{dy/d\theta}{dx/d\theta}=\frac{3\sin^2\theta\cos\theta}{-\sin\theta}=\frac{-3}{2}\sin 2\theta$

$\frac{d^2y}{dx^2}=\frac{-3}{2}\cos 2\theta\ 2\frac{d\theta}{dx}=-3\cos 2\theta\left(\frac{-1}{\sin\theta}\right)=\frac{3\cos 2\theta}{\sin\theta}$

$\left(\frac{dy}{dx}\right)^2+y\frac{d^2y}{dx^2}$ **at** $\theta=\pi/2$ is - 3

77. $\frac{dx}{d\theta}=-\sin\theta,\frac{dy}{dx}=3\sin^2\theta\cos\theta$ so that $\frac{dy}{d\theta}=-\sin\theta\cos\theta$. Differentiating again, we have

$\frac{d^2y}{dx^2}=-3\cos\theta\frac{d\theta}{dx}=\frac{3\cos 2\theta}{\sin\theta}$

$\left(\frac{dy}{dx}\right)^2+y\frac{d^2y}{dx^2}=9\sin^2\theta\cos^2\theta+\sin^3\theta\frac{3\cos 2\theta}{\sin\theta}$

$=9\sin^2\theta\cos^2\theta+3\sin^2\theta\cos 2\theta$

78. Put $x=\cos\theta$ so $y=\sin^{-1}\left(\tan\theta/2\right)$ and $\frac{dy}{dx}=\frac{dy}{d\theta}.\frac{d\theta}{dx}=\frac{1}{4\sin\left(\theta/2\right)\cos^2\left(\theta/2\right)\sqrt{\cos\theta}}$

when $x=\cos\theta=1/2$, we have $\theta=\pi/3$

so $y'(1/2)=\frac{-2\sqrt{2}}{3}$

79. Put $x=\tan\theta$ so $u=\tan^{-1}\frac{\sqrt{1+x^2}-1}{x}=\frac{1}{2}\tan^{-1}x$

Put $x=\sin\theta$ so $v=\tan^{-1}\frac{2x\sqrt{1-x^2}}{1-2x^2}=2\sin^{-1}x$

$\frac{du}{dv}=\frac{1}{2\left(1+x^2\right)}\left(\frac{\sqrt{1-x^2}}{2}\right)\Rightarrow\left.\frac{du}{dv}\right|_{x=0}=\frac{1}{4}$

80. Put $x=\sin(\cos\theta)$ so $y=\sin^{-1}\tan\theta/2$. Thus $\frac{dy}{dx}=\left(\frac{1}{2}\sec^2\theta/2\right)\left(-\frac{1}{\sin\theta(\cos\theta)}\right)$

$\Rightarrow y'(0)=-1$

PHYSICS

81. $I=\frac{2}{5}mR^2$

$=\frac{2}{5}\left[\frac{4}{3}\pi R^3\rho\right]R^2$

$=\frac{176}{105}R^5\rho$

82. $t=\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}\left(1+\frac{K^2}{R^2}\right)}$

$t\alpha\sqrt{1+\frac{K^2}{R^2}}$

83. $a_{com}=\frac{F}{m+2m}=\frac{F}{3m}$

$x_{com}=\frac{1}{2}a_{com}t^2=\frac{Ft^2}{6m}$

$x_{com}=\frac{m(x)+2m(x')}{m+2m}$

$\frac{Ft^2}{6m}=\frac{x+2x'}{3}$

$x'=\frac{Ft^2}{4m}-\frac{x}{2}$

84. KE of ball in position B

$=mg(R-r)$

But $\frac{K_R}{K_T}=\frac{2}{5}$

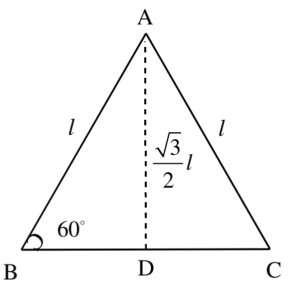
$K_T=\frac{5}{7}mg(R-r)$

$\frac{1}{2}mV^2=\frac{5}{7}mg(R-r)$

$V=\sqrt{\frac{10g(R-r)}{7}}$

$w=\frac{V}{R-r}=\sqrt{\frac{10g}{7(R-r)}}$

85.



$I = I_1 + I_2 + I_3$

I_1 and I_2 moment of inertia of AB and AC

I_3 $M.I$ of 3rd rod BC

$I_1 = I_2 = \frac{ml^2}{12} + \frac{ml^2}{4} = \frac{ml^2}{3}$

$I_3 = I_{\text{pointD}} + m(AD)^2$

$= \frac{ml^2}{12} + m\left(\frac{\sqrt{3}l}{2}\right)^2$

$= \frac{10ml^2}{12}$

$I = \frac{ml^2}{3} + \frac{ml^2}{3} + \frac{10ml^2}{12}$

$= \frac{3ml^2}{2} = 3Kg - m^2$

86. At equilibrium $\sum F = \odot$

$Kx_0 + \left[\frac{Al}{2}\sigma g\right] - Mg = \odot$

$x_0 = \frac{Mg}{K}\left[1 - \frac{LA\sigma}{2M}\right]$

87. Diagonal $\sqrt{3}a = 2R$

$a = \frac{2R}{\sqrt{3}}$

Mass of cube $M' = \frac{2M}{\sqrt{3}\pi}$

M.I of the cube about the given axis

$I = \frac{M'a^2}{6}$

$I = \frac{\frac{2M}{\sqrt{3}\pi} \times \frac{4R^2}{3}}{6} = \frac{4MR^2}{9\sqrt{3}\pi}$

88. $I_{remaing} = I_{Total} - I_{removed}$

$= \frac{mr^2}{2} - \frac{19mr^2}{512}$

$= \frac{237}{512}mr^2$

89. $x_{shift} = \frac{A_2 d}{A_1 - A_2}$

$= \frac{\frac{\pi R^2}{4} \times \frac{R}{\sqrt{2}}}{4R^2 - \frac{\pi R^2}{4}}$

$= \frac{\pi R}{\sqrt{2}(16 - \pi)}$

90. $I = 6\, I_{oneside}$

$$=6\left[\frac{m(2L)^2}{12}+mr^2\right]$$

Where $r=\sqrt{3}l$

$I=20mL^2$

91. $Mg\frac{L}{2}=\frac{1}{2}I\omega^2$

$$Mg\frac{L}{2}=\frac{1}{2}\frac{ML^2}{3}\omega^2$$

$$\omega=\sqrt{\frac{3g}{L}}$$

$V=r\omega$

$V=\sqrt{3gL}$

92. $x=A\cos\omega t$

$$V=\frac{dx}{dt}=-A\omega\sin\omega t$$

$a=-A\omega^2\cos\omega t$

$a_{\max}=A\omega^2$

$T_{\max}=I\ \alpha_{\max}$

$$=I\frac{a_{\max}}{R}$$

$$=\frac{1}{2}MR^2\times\frac{A\omega^2}{R}$$

$$T_{\max}=\frac{1}{2}MAR\omega^2$$

93. $g=\frac{GM}{R^2}=\frac{G\rho\frac{4}{3}\pi R^3}{R^2}$

$$g=G\rho\frac{4}{3}\pi R$$

$$T\alpha\frac{1}{\sqrt{g}}$$

$g\alpha R$ $\quad \frac{T_1}{T_2}=\sqrt{\frac{g_2}{g_1}}=\sqrt{\frac{R_2}{R_1}}$

$$\frac{2}{T_2}=\sqrt{\frac{4R_1}{R_1}}$$

$T_2=1\sec ond$

94. At separation 'd'

$$\frac{1}{2}m_1v_1^2+\frac{1}{2}m_1v_1^2=\frac{Gm_1m_2}{d}$$

From law of conservation of linear momentum

$m_1v_1=m_2v_2$

From (1) and (2)

$V_1=\sqrt{\frac{2GM_2^2}{d(m_1+m_2)}}$ and

$V_2 = \sqrt{\dfrac{2GM_1^2}{d(m_1+m_2)}}$

Relative velocity

$V_{rel} = V_1 + V_2$

95. potential due to sphere at point $A, V_A = \dfrac{-GM}{2R}$

Potential due to sphere at point $C, V_c = \dfrac{-3}{2}\dfrac{GM}{R}$

Work done $W = +\left[V_A - V_C\right] \rightarrow (1)$

$W = \dfrac{1}{2}mv^2 \rightarrow (2)$

From (1) and (2) $V = \sqrt{\dfrac{2GM}{R}}$

96. Orbital speed, $V = \sqrt{\dfrac{GM}{R+h}}$

Kinetic energy = $\dfrac{1}{2}mv^2$

$\Rightarrow \dfrac{KE_1}{KE_1} = \left[\dfrac{V_1}{V_2}\right]^2 = \dfrac{R+h_2}{R+h_1} = \dfrac{R+3R}{R+R} = \dfrac{4R}{2R} = \dfrac{2}{1}$

97. Total energy of a satellite, $E = \dfrac{-GMm}{2r}$

Work done in shifting, $W = E_f - E_i$

$$W = +\frac{GMm}{2R}\left[\frac{1}{2} - \frac{1}{3}\right]$$

$$W = +\frac{gRm}{12}$$

$$W = \frac{10 \times 6400 \times 10^3 \times 2 \times 10^3}{12}$$

$$W = 1.066 \times 10^{10} J$$

98. Orbit speed $V_0 = \sqrt{\dfrac{GM}{R+h}}$

Given $V_0 = \dfrac{1}{2}V_e = \dfrac{1}{2}\sqrt{\dfrac{2GM}{R}}$

$\Rightarrow \sqrt{\dfrac{GM}{R+h}} = \dfrac{1}{2}\sqrt{\dfrac{2GM}{R}}$

$\Rightarrow \dfrac{1}{R+h} = \dfrac{1}{2R}$

$\Rightarrow h = r = 6400 Km$

99. Time period, $T^2 = \dfrac{4\pi^2 R_2^3}{GM}$

Acceleration due to gravity

$g = \dfrac{GM}{R_1^2}$

But
$$GM = \frac{4\pi^2 R_2^3}{T^2}$$
$$\Rightarrow g = \frac{4\pi^2 R_2^3}{R_1^2 T^2}$$

100. From conservation of angular momentum

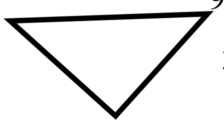
$$L_a = L_p$$
$$mr_1v_1 = mr_2v_2$$
$$V_1 = \frac{r_2v_2}{r_1} = \frac{1.5\times10^7\times5\times10^3}{0.5\times10^7}$$
$$1.5\times10^4 m/s$$

101.

$$\frac{GM_e}{x^2} = \frac{GM_m}{(d-x)^2}$$
$$\frac{81M_m}{x^2} = \frac{M_m}{(d-x)^2}$$
$$\frac{9}{x} = \frac{1}{d-x}$$
$$x = \frac{9d}{10}$$

102. Due to 90 Kg, at'p'

$$E_1 = \frac{G(90)}{3^2} = 10G$$



Due to 160 Kg,

$$E_2 = \frac{G(160)}{4^2} = 10G$$

Resultant field,

$$E = \sqrt{E_1^2 + E_2^2 + 2E_1E_2}\cos 90^0$$
$$E = 10\sqrt{2}GNKg^{-1}$$

103. $g_\varphi = g - R\omega^2$ at equator

$$\frac{3}{5}g = g - R\omega^2$$
$$R\omega^2 = g - \frac{3g}{5} = \frac{2g}{5}$$
$$\omega = \sqrt{\frac{2g}{5R}}$$

104. ANS-3

Force = weight suspended + weight of $\frac{3L}{4}$ of wire

$$= W_1 + \frac{3W}{4}$$

Stress = $\frac{force}{area}$

105. ANS-2

Change in pressure due to placing of mass on piston is $\Delta p = \frac{Mg}{A}$

From bulk modulus definition $K = \frac{-dp}{dV/V}$

$\left|\frac{dV}{V}\right| = \frac{\Delta p}{K} = \frac{Mg}{AK}$

Form $V = \frac{4}{3}\pi r^3$

$\frac{dV}{V} = \frac{3dR}{R} \Rightarrow \frac{dR}{R} = \frac{1}{3}\frac{dV}{V} = \frac{Mg}{3AK}$

106. ANS-3

Cross –sectional area of the section is $A' = \frac{A}{\cos\theta}$

Shearing stress = $\frac{F\sin\theta}{A'} = \frac{F\sin 2\theta}{2A}$

107. ANS-1

In case (a) let Y be Young's modulus of the material of the wire. If a is its area of cross section then we can write

$Y = \frac{F/a}{l/L}\frac{F/a}{l/L} = \frac{WL}{al}(\therefore F = W)$

Increase in length of wire $l = \frac{WL}{aY}$

Since each segment is of length L/2 we have $Y = \frac{W(L/2)}{al'}$

Increase in length of wire of one side of pulley $l' = \frac{1}{2}\frac{WL}{aY} = \frac{1}{2}$

Therefore increase in length of both the segments of the wire $l' + l' = l/2 + l/2 = l$

So the increase in length remains the same

108. ANS-1

The volumetric strain $\frac{\delta v}{v} = -\frac{\rho}{B}$,

Where $p = \rho gh$ then - $-\frac{\delta v}{v} = \frac{pgh}{B}$

Since the volume of the sphere is $v = \frac{4}{3}\pi r^3$

We have $\frac{\delta v}{v} = \frac{\rho gh}{B}$ using eqs (I) and (ii) , we have $\frac{\delta r}{r} = \frac{\rho gh}{3B}$

109. ANS-1

Pressure at the surface of the ocean = P_0 ,the atmospheric pressure

Pressure at a depth = nP_0

$\therefore$ Increase in pressure $(\Delta P) = nP_0 - P_0 = (n-1)P_0$

Let v be the volume of a certain mass m of water at the surface, so that $M = \rho V$ .The decrease in volume under pressure ΔP is

$\Delta V = \frac{V\Delta P}{B}$

$\therefore$ volume of the same mass M of water at the given depth is

$V' = V - \Delta V = V - \frac{V\Delta P}{B} = V\left(1 - \frac{\Delta P}{B}\right) = \frac{V}{B}(B - \Delta P)$

Density of water at that depth is

$$\rho' = \frac{M}{V'} = \frac{\rho V}{V'} = \frac{\rho V}{\frac{V}{B}(B - \Delta p)}$$

$$\frac{\rho B}{B - \Delta p} = \frac{\rho B}{B - (n-1)\, p_0}$$

110. ANS-2

Poisson's ratio is defined as

$$\sigma = \frac{\Delta d / d}{\Delta l / l} \; or \; \frac{\Delta l}{l} = \frac{\Delta d / d}{\sigma}$$

Where d is the diameter and l is the length of the wire. The area of cross section is

$$A = \pi^2 r = \frac{\pi d^2}{4}$$

Differentiating, we have

$$\frac{\Delta A}{A} = 2\frac{\Delta d}{d}$$

$$\frac{\Delta l}{l} = \frac{1\%}{0.4} = 2.5\%$$

$$\sigma = 0.4$$

111. ANS-2

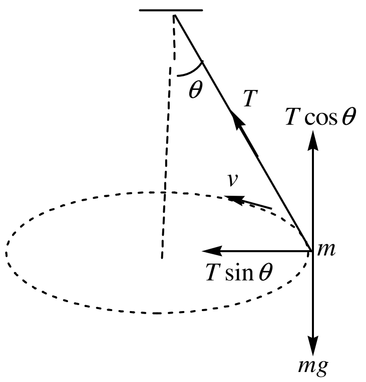
For vertical equilibrium

$$T\cos\theta = mg$$

If L is the original length of the wire, the increase in length is

$$l = \frac{TL}{AY}$$

Strain $\frac{l}{L} = \frac{T}{AY} = \frac{mg}{AY\cos\theta}$



112. ANS-4

$$P_0 + (50 + h)0.8 \times 10 = P_0 + 50 \times 1 \times 10$$

0.8h = 10 cm

$$h = \frac{10}{0.8} = \frac{100}{8} = \frac{25}{2} = 12.5\text{cm}.$$

113. y = A sin ωt

$$T \to 4A$$

$$T + T/4 \to 4A + A = 5A$$

114. $V = \sqrt{144 - 16X^2}$

$$V = 4\sqrt{3^2 - X^2}$$

compare with $V = \omega\sqrt{A^2 - X^2}$

$a_{max} = \omega^2 A$

115. $y_1 = \sin\frac{\pi}{6}\sin\omega t + \cos\frac{\pi}{6}\cos\omega t$

$y_1 = \cos\left(\omega t - \frac{\pi}{6}\right)$

$y_2 = \sin\frac{\pi}{3}\sin\omega t + \cos\frac{\pi}{3}\cos\omega t$

$= \cos\left(\omega t - \frac{\pi}{3}\right)$

116. $KE_{avg} = \frac{\frac{1}{2}m\omega^2 A^2}{2} = \frac{1}{4}m4\pi^2 n^2 A^2$

117. $t_{sp} = t_{lp}$

$(n+1)T_{sp} = n(t_{lp})$

$(n+1)\sqrt{l_{SP}} = n\sqrt{l_{LP}}$

118. $n = \frac{1}{2\pi}\sqrt{\frac{k_{eff}}{m}} = \frac{1}{k_{eff}} = \frac{1}{2k} + \frac{1}{k} + \frac{1}{k}$

119. $k_1 = \frac{C}{\ell_1}$

$k_2 = \frac{C}{\ell_2}$

$\frac{k_1}{k_2} = \frac{C\ell_2}{\ell_1 C}\ell_2 = \frac{\ell_2}{n\ell_2} = \frac{1}{n}$

120. $V_{max} = A\omega$

$v = \omega\sqrt{A^2 - x^2}$

at $x = 2A/3$

$v = \omega\sqrt{A^2 - \frac{4A^2}{9}}$

$v = \frac{\omega A\sqrt{5}}{3}$

For new amplitude

at $x = 2A/3$

$v' = 3\times v$

$v' = \omega A\sqrt{5}$

as ω is same

$\omega A\sqrt{5} = \omega\sqrt{A'^2 - \frac{4A^2}{9}} \Rightarrow 5A^2 = A'^2 - \frac{4A^2}{9}$

$A'^2 = \frac{49A^2}{9} \Rightarrow A' = \frac{7A}{3}$

CHEMISTRY

121. $\Delta G = \Delta H - T\Delta S$
$\Delta H = +Ve \quad \Delta S = -Ve$ then $\Delta G = +Ve$ at all temperature

122. $\Delta G^\circ = -2.303\, RT \log Kp$
$= -2.303 \times 8.314 \times 298 \log\left(4.42 \times 10^4\right)$
$= -26.5\ KJ\ mole^{-1}$

123. $\Delta H = \Delta U + \Delta n_g RT$
$-50700 = \Delta U + (-5)8.314 \times 300$
$\Delta U = -38229\ J$

124. $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
$= -95 \times 1000 - 500 \times (-190)$
$= -95000 + 95000 = 0$
Thus NH_3 will dissociate below 500 K because $\Delta G^\circ = -Ve$

125. $\Delta G^\circ = -nFE^\circ_{cell} \qquad \Delta G^\circ = -2.303\ RT\ \log K$

126. Isothermal process $\Delta T = 0$
$\Delta H = nCp.\Delta T$
$\Delta H = 0$

127. The reaction to be spontaneous $\Delta G = -Ve$
$\Delta G = \Delta H - T\Delta S$
If ΔH & ΔS are +Ve
$\Delta H < T\Delta S$ in order to be reaction spontaneous

128. $\Delta H = \Delta U + \Delta n\ RT$
$\Delta n = \frac{1}{2} - 0 = \frac{1}{2}$
Thus $\Delta H > \Delta U$

129. $CH_4\,(1\,mole)\,16gr \rightarrow$ Heat of combustion 880KJ
$3.2\ gr \rightarrow \qquad x$
$x = \frac{3.2 \times 880}{16} = 176\ KJ$

130. $\Delta S_{vap} = \frac{\Delta H_{vap}}{T_{B.P}} = \frac{186.5}{373} = \frac{1}{2} = 0.5$

131. $Ni(OH)_2 \rightleftarrows Ni^{+2} + 2OH^-$
S 2S
$4S3 = 2 \times 10^{-15}$
$S = 0.58 \times 10^{-4}$
$AgCN \rightleftarrows Ag^+ + CN^-$
S S
$ksp = s^2$
$s = \sqrt{6 \times 10^{-17}}$
$= 7.8 \times 10^{-9}$
$\therefore Ni(OH)_2$ is more soluble than $AgCN$

132. Ionic product is greater than ksp

133. buffer solution is the solution whose
PH value does no change

134. $ksp\ Mg(OH)_2 = [Mg^{+2}][OH^-]^2$

$1.2\times10^{-11} = 0.1[OH^-]^2$

$[OH^-]^2 = 1.2\times10^{-10}$

$[OH^-] = 1.0954\times10^{-5}M$

$POH = -\log[1.0954\times10^{-5}]$

$POH = 4.96$

$PH = 14 - 4.96$

$= 9.04$

135. Photochemical smog occurs
in warm, dry and sunny climate.
it has high concentration of NO, NO_2 *and* O_3.
their low concentration causes
irritation in nose and throat and their
high concentration causes headache, chest pain,
cough and difficulty in breathing

136. Between 10 and 50 km above sad level
Lies stratosphere : correct
Troposphere is dusty zone of air, excess of
water vapour and cloud formation
also takes place in this: correct
troposphere contains N_2, O_2, O_3
and little water vapours: correct

137. O_2 carrying capacity of blood is decreased

138. ozone does not absorbs
infrared radication at all.
It absorbs uv radiation coming from
Sun in the upper atmosphere
and acts as an umbrella thus
protecting human being living on earth

139. hydroxyl apatite is
$3Ca_3(PO_4)_2.Ca(OH)_2$
Fluoride converts it into fluor
Apatite $3Ca_3(PO_4)_2.CaF_2$

140. Thermosphere is the fourth layer
Of the earth atmosphere and is
Located above the mesosphere.
The high temperature in the
thermosphere can cause molecules to
ionize (O^{+2}, O^+, NO^+)

141. Eutrophication causes reduction
In dissolved oxygen

142. Minamata is caused by mercury poisoning

143. photochemical smog does not involve SO_2

144. Weight of $CaCO_3\ in 50 gram$
of water $= 6\times0.001 = 6\times10^{-3}\ gram$
weight of $CaCO_3\ in\ 10^6\ gram$

of water $=\dfrac{10^6\times6\times10^{-3}}{56}=120\,gram$

$D.H=120\,ppm$

145. The exhausted cation exchange
resins are regenerated by passing dilute
H_2SO_4 or dilute HCl through it and
exhausted anion exchange
resins area regenerated by passing dilute
$NaOH\,(or)\,Na_2CO_3$

146. $BaO_2+CO_2+H_2O\rightarrow BaCO_3\downarrow+H_2O_2$

147. Li $\rightarrow$ Crimson red
Na $\rightarrow$ Golden yellow
K$\rightarrow$ Lilac blue (violet)

148. $2Na+\frac{1}{2}O_2\xrightarrow{Air}Na_2O\xrightarrow[air]{moisture\ in}2NaOH\xrightarrow{CO_2}Na_2CO_3$

149. Metalic oxides are basic in nature as metallic nature increases basicity also increases

150. Raw material used in Solvay's process are Brine, Lime stone, NH_3

151. The conductivities of alkali metal halides in aq. Solutions increases from Li to Cs. This is due ti decrease in mobilities of hydrated ions

152. $4LiNO_3\xrightarrow{\Delta}2Li_2O+4NO_2+O_2$ Conceptual

153. $CaSO_4.2H_2O\xrightarrow{120^0C}CaSO_4\frac{1}{2}H_2O+\frac{3}{2}H_2O$

154. Sedimentory rocks laid down under water mainly contains $CaCO_3$

155. $CaCO_3$ is used for water softening to remove temporary hardness

156. $feCl_3$ is more acidic compound in aqueous solutions

157. $4BCl_3+3LiAH_4\rightarrow\dfrac{2B_2H_6}{A}+3LiCl+3AlCl_3$

$B_2H_6+6H_2O\rightarrow\dfrac{2H_3BO_3}{B}+6H_2$

$4H_3BO_3\xrightarrow{435k}H_2B_4O_7\xrightarrow{red\ hot}B_2O_3$

158. Lawis acids : Molecules with vacant orbitals can act as Lewis acid

159. $2BCl_3+6H_2\xrightarrow{Ga\ Al\ Catalyst}B_2H_6+6HCl$

$B_2H_6+NH_3\xrightarrow{200^0C}B_3N_3H_6$ (Borazole)

160. $2A\ell+6Conc\,Hcl\rightarrow2Alcl_3+3H_2$

$2A\ell+2NaoH+6H_2O\rightarrow2Na\left[Al(OH)_4\right]+3H_2O$