FUNCTIONS

LONG ANSWER QUESTIONS :

***1. Let $f:A\to B, g:B\to C$ be bijections. Then show that $gof:A\to C$ is a bijection **(Mar-09,18, May-06,08,10,12)**

***2. Let $f:A\to B, g:B\to C$ be bijections. Then show that $(gof)^{-1}=f^{-1}og^{-1}$ **(Mar-06,10,11,14, 19,May-09,11)**

***3. Let $f:A\to B$ be a bijection. Then show that $fof^{-1}=I_B$ and $f^{-1}of=I_A$ **(Ts MAR-19,Mar-07,12,15,17, May-05,07)**

***4. Let $f:A\to B$, I_A and I_B be Identity functions on A and B respectively. Then show that $foI_A=f=I_Bof$ **(Mar-13, May-05,08),Ts-Mar-18**

***5. Let $f:A\to B$ be a bijection.Then show that f is a bijection if and only if there exists a function $g:B\to A$ such that $fog=I_B$ and $gof=I_A$ and in this case, $g=f^{-1}$

***6. I) If $f:R\to R, g:R\to R$ are defined by $f(x)=4x-1$ and $g(x)=x^2+2$ then find

(i)$(gof)(x)$ ii) $(gof)\left(\frac{a+1}{4}\right)$ iii) $fof(x)$ iv) $go(fof)(0)$

II) Let $A=\{1,2,3\}, B=\{a,b,c\}, C=\{p,q,r\}$. If $f:A\to B, g:B\to C$ are defined by $f=\{(1,a),(2,c),(3,b)\}$, $g=\{(a,q),(b,r),(c,p)\}$ then show that $f^{-1}og^{-1}=(gof)^{-1}$

***7. Let $f=\{(1,a),(2,c),(4,d),(3,b)\}$ and $g^{-1}=\{(2,a),(4,b),(1,c),(3,d)\}$, then show that $(gof)^{-1}=f^{-1}og^{-1}$. **(Ts-Mar-15)**

***8. If $f:Q\to Q$ is defined by $f(x)=5x+4\ \forall x\in Q$ then show that f is a bijection and find f^{-1}. **(Mar-10),Ts-Mar-17**

**9. Let $f:A\to B$, $g:B\to C$ and $h:C\to D$. Then show that $ho(gof)=(hog)of$.

**10. If the function f is defined by $f(x)=\begin{cases}x+2, & x>1\\ 2, & -1\le x\le 1\\ x-1, & -3<x<-1\end{cases}$, then find the values of

(a) $f(3)$ (b) $f(0)$ (c) $f(-1.5)$ (d) $f(2)+f(-2)$ (e) $f(-5)$

**11. If the function f is defined by $f(x)=\begin{cases}3x-2, & x>3\\ x^2-2, & -2\le x\le 2\\ 2x+1, & x<-3\end{cases}$

Then find the values of

$f(4)$ (**Mar-14**), $f(2.5)$ (**Mar-14**), $f(-2)$, $f(-4)$, $f(0)$, $f(-7)$

VERY SHORT ANSWER QUESTIONS :

12. Find the domain of the following real valued functions

i) $f(x)=\frac{1}{6x-x^2-5}$ (TS MAR-19) ii) $f(x)=\sqrt{x^2-1}+\frac{1}{\sqrt{x^2-3x+2}}$

iii) $f(x)=\frac{1}{\sqrt{|x|-x}}$ iv) $f(x)=\sqrt{x+2}+\frac{1}{\log_{10}(1-x)}$

v) $f(x)=\frac{\sqrt{3+x}+\sqrt{3-x}}{x}$ **(Mar-07)** vi) $f(x)=\sqrt{4x-x^2}$ **(May-10),Ts-Mar-18**

vii) $f(x)=\log\left(x^2-4x+3\right)$ **(Mar-08, 10, May-07)**

viii) $f(x)=\sqrt{x^2-25}$ **(Mar-12,18)** ix) $f(x)=\log\left(x-[x]\right)$

x) $f(x)=\frac{1}{\left(x^2-1\right)(x+3)}$ **(Mar-14)** xi) $f(x)=\frac{1}{\log(2-x)}$

xii) $f(x)=\frac{1}{\sqrt{x^2-a^2}}(a>0)$ **(Mar-15)**

13. If $f=\{(1,2),(2,-3),(3,-1)\}$ then find

i) 2f ii) $2+f$ iii) f^2 iv) $\sqrt{f}$ **(Mar-08,12)**

14. If $f=\{(4,5),(5,6),(6,-4)\}$ and $g=\{(4,-4),(6,5),(8,5)\}$ then find

i) $f+g$ (Ts mar2017) ii) $f-g$ iii) $2f+4g$

iv) $f+4$ v) fg

vi) f/g vii) $|f|$ viii) $\sqrt{f}$ ix) f^2 x) f^3

15. If f *and* g are real valued functions defined by $f(x)=2x-1$ and $g(x)=x^2$ then find

i) $(3f-2g)(x)$ ii) $(fg)(x)$ iii) $\left(\frac{\sqrt{f}}{g}\right)(x)$ iv) $(f+g+2)(x)$ **(Mar-09)**

16. If $f:R\to R,\ g:R\to R$ are defined by $f(x)=3x-1,\ g(x)=x^2+1$ then find

i) $fof\left(x^2+1\right)$ ii) $fog(2)$ **(Mar-18)** iii) $gof(2a-3)$

17. Find the range of the following real valued functions

i) $\log|4-x^2|$ ii) $\frac{x^2-4}{x-2}$

18. If $f(x)=2, g(x)=x^2, h(x)=2x$ for all $x\in R$, then find $\left(fo(goh)(x)\right)$ (Ts mar2017)

19. Find the inverse of the following functions

i) If $a,b\in R, f:R\to R$ defined by $f(x)=ax+b(a\neq 0)$ **(Mar-13),Ts-Mar-18**

ii) $f:R\to(0,\infty)$ defined by $f(x)=5^x$ **(Mar-06,11, 15)**

iii) $f:(0,\infty)\to R$ defined by $f(x)=\log_2 x$

20. If $A=\left\{0,\frac{\pi}{6},\frac{\pi}{4},\frac{\pi}{3},\frac{\pi}{2}\right\}$ and $f:A\to B$ is a surjection defined by $f(x)=\cos x$ then find B.

(Ts mar2017) **(Mar-11,Jun-11)**

21. If $A=\{-2,-1,0,1,2\}$ and $f:A\to B$ is a surjection defined by $f(x)=x^2+x+1$, then find B. **(Mar-17,19,May-10)**

22. If $f(x)=\frac{x+1}{x-1}(x\neq 1)$ then find i) $(fofof)(x)$ ii) $(fofofof)(x)$

23. Find the domain and range of the following real valued functions

i) $f(x)=\frac{x}{1+x^2}$ ii) $f(x)=\sqrt{9-x^2}$ **(TS- Mar -15,Mar-17)**

iii) $f(x)=|x|+|1+x|$ iv) $f(x)=\frac{2+x}{2-x}$

24. If the function $f:R\to R$ defined by $f(x)=\dfrac{3^x+3^{-x}}{2}$, then show that
$f(x+y)+f(x-y)=2f(x)f(y)$

25. If $f:R\to R, g:R\to R$ defined by $f(x)=3x-2, g(x)=x^2+1$, then find
i) $(gof^{-1})(2)$ ii) $(gof)(x-1)$ iii) $(fog)(2)$ **(Mar-13)**

26. Define the following functions and write an example for each
i) One-One (Injection) ii) Onto (Surjection) iii) Even and Odd iv) Bijection

27. If $f:N\to N$ is defined as $f(x)=2x+3$, Is 'f' onto? Explain with reason. **(May-08)**

28. If $f:R\to R$ defined by $f(x)=\dfrac{2x+1}{3}$, then this function is injection or not ? justify.
(Ts-Mar-15)

29. (i)If $f:R\to R$ is defined by $f(x)=\dfrac{1-x^2}{1+x^2}$, then show that $f(\tan\theta)=\cos 2\theta$
(ii) If $f:R-\{\pm 1\}\to R$ is defined by $f(x)=\log\left|\dfrac{1+x}{1-x}\right|$ then show that $f\left(\dfrac{2x}{1+x^2}\right)=2f(x)$

30. If $f(x)=\cos(\log x)$, then show that $f\left(\dfrac{1}{x}\right)f\left(\dfrac{1}{y}\right)-\dfrac{1}{2}\left(f\left(\dfrac{x}{y}\right)+f(xy)\right)=0$

31. If $f(x)=\dfrac{1}{x}$, $g(x)=\sqrt{x}$ for all $x\in(0,\infty)$ then find $(gof)(x)$

32. If $f:R-\{0\}\to R$ is defined by $f(x)=x^3-\dfrac{1}{x^3}$, then show that $f(x)+f(1/x)=0$

33. Prove that the real valued function $f(x)=\dfrac{x}{e^x-1}+\dfrac{x}{2}+1$ is an even funciton on $R-\{0\}$.

34. If $A=\{1,2,3,4\}$ and $f:A\to R$ is a function defined by $f(x)=\dfrac{x^2-x+1}{x+1}$, then find the range of 'f'.

35. If the function $f:\{-1,1\}\to\{0,2\}$, defined by $f(x)=ax+b$ is a surjection, then find a and b.

36. If $f(x)=\dfrac{\cos^2 x+\sin^4 x}{\sin^2 x+\cos^4 x}$ $\forall x\in R$ then show that $f(2012)=1$.

37. If $f:R\to R$ is defined as $f(x+y)=f(x)+f(y)$ $\forall x,y\in R$ and $f(1)=7$, then find
$\sum_{r=1}^{n} f(r)$.

38. If $2^x+2^y=2$, then find the domain of 'x'.

39. If $f(x)=2x-1, g(x)=\dfrac{x+1}{2}$ *for all* $x\in R$ *then find* i) $(gof)(x)$ **(MAR-19)**
ii) $(fog)(x)$ **(i&ii TS-MAR-19)**

MATHEMATICAL INDUCTION

LONG ANSWER QUESTIONS :

***1. Show that $1^2+\left(1^2+2^2\right)+\left(1^2+2^2+3^2\right)+....$ upto n terms $=\frac{n(n+1)^2(n+2)}{12}$, $\forall n\in N$ **(Mar-09,12, May-09)**

***2. Show that $\frac{1^3}{1}+\frac{1^3+2^3}{1+3}+\frac{1^3+2^3+3^3}{1+3+5}+....$ upto n terms $=\frac{n}{24}\left[2n^2+9n+13\right]$ **(Mar-05,07,14)**

***3. Show that $\forall n\in N, \frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+....$ upto n terms $=\frac{n}{3n+1}$ **(Mar-06,11, May-11)**

***4. Show that $2.3+3.4+4.5+....$ upto n terms $=\frac{n\left(n^2+6n+11\right)}{3}$ $\forall n\in N$ **(Mar-13, May-06)**

***5. Show that $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+...+\frac{1}{(2n-1)(2n+1)}=\frac{n}{2n+1}$, $\forall n\in N$ **(Mar-18)**

***6. Show that $1.2.3+2.3.4+3.4.5+....$ upto n terms $=\frac{n(n+1)(n+2)(n+3)}{4}$, $\forall n\in N$ (Ts mar2017) **(Ts-Mar-15)**

***7. Prove by Mathematical induction, for all $n\in N$

$a+(a+d)+(a+2d)+.....$ upto n terms $=\frac{n}{2}[2a+(n-1)d]$ **(Mar-10)**

***8 Prove by Mathematical induction, for all $n\in N$

$a+ar+ar^2+.....upto\ \ n\ \ terms=\frac{a(r^n-1)}{(r-1)}, r\neq 1$ **(Mar-11,19)**

***9. Show that $49^n+16n-1$ divisible by 64 for all positive intergers n. **(Mar-17,May-05),Ts-Mar-18**

***10. Show that 4^n-3n-1 divisible by 9 for all positive intergers n **.** **(May-05)**

***11. Show that $3.5^{2n+1}+2^{3n+1}$ is divisible by 17, $\forall n\in N$. **(May-08,10,12)**

***12. Use mathematical induction $2.4^{2n+1}+3^{3n+1}$ is divisible by 11

***13. Use mathematical induction to prove the statement,

$\left(1+\frac{3}{1}\right)\left(1+\frac{5}{4}\right)\left(1+\frac{7}{9}\right).....\left(1+\frac{2n+1}{n^2}\right)=(n+1)^2$. **(TS-MAR-19)** **(Mar-15)**

**14. Use mathematical induction to prove the statement,

$\sum_{k=1}^{n}(2k-1)^2=\frac{n(2n-1)(2n+1)}{3}$ for all $n\in N$

**15. Use mathematical induction to prove the statement,

$4^3+8^3+12^3+.....$ upto n terms $=16n^2(n+1)^2$.

**16. Use mathematical induction to prove the statement

$2+3.2+4.2^2+.....$ up to n terms $=n.2^n$, $\forall n\in N$. **(May-07)**

*17. i) Using mathematical induction, show that x^m+y^m is divisible by $x+y$, if 'm' is an odd natural number and x, y are natural numbers.

ii) If x and y are natural numbers and $x\neq y$, using mathematical induction, show that x^n-y^n is divisible by $x-y, \forall n\in N$.

MATRICES

LONG ANSWER QUESTIONS :

***1. *If* $A=\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}$ is a non-singular matrix, then show that A is invertible and $A^{-1}=\frac{adjA}{\det A}$

(Mar-07,17, June-10),Ts-Mar-18-SAQ

***2. Show that $\begin{vmatrix} b+c & c+a & a+b \\ c+a & a+b & b+c \\ a+b & b+c & c+a \end{vmatrix} = 2\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ **(Oct-96,Mar-15)**

***3. If $\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix}=0$ and $\begin{vmatrix} a & a^2 & 1 \\ b & b^2 & 1 \\ c & c^2 & 1 \end{vmatrix}\neq 0$ then show that abc = -1 **(Mar-04,14)**

***4. Show that $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}^2 = \begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ac-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix} = \left(a^3+b^3+c^3-3abc\right)^2$

(Mar-01,12,19,May-09),Ts-Mar-18

***5. Show that $\begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix} = (a-b)(b-c)(c-a)(ab+bc+ca)$ **(Mar-09,17)**

***6. Show that $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3$ **(Mar-11,May-11)**

***7. Show that $\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix} = 2(a+b+c)^3$ **(Ts-19,Mar-10,18,Jun-10)**

***8. Show that $\begin{vmatrix} b+c & c+a & a+b \\ a+b & b+c & c+a \\ a & b & c \end{vmatrix} = a^3+b^3+c^3-3abc$ **(Mar-08, May-07)**

***9. Show that $\begin{vmatrix} a^2+2a & 2a+1 & 1 \\ 2a+1 & a+2 & 1 \\ 3 & 3 & 1 \end{vmatrix} = (a-1)^3$ **(Mar-07,13)**

***10. Show that $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} = abc(a-b)(b-c)(c-a)$.

***11. Show that $\begin{vmatrix} 1 & a & a^2-bc \\ 1 & b & b^2-ca \\ 1 & c & c^2-ab \end{vmatrix} = 0$.

***12. Solve the following simultaneous linear equations by using Cramer's rule **(Mar-12,15,May-09)**
Matrix inversion **(March-13, May-11,12)**
and Gauss -Jordan method **(Mar-09,10,14 May-10)**

(i) $3x+4y+5z=18,\ 2x-y+8z=13,\ 5x-2y+7z=20$ **(Ts--MAR-19,Mar-08,12,13,May-09)**

(ii) $x+y+z=9,\ 2x+5y+7z=52,\ 2x+y-z=0$ **(Mar-07,09,17, May-10,11)**

(iii) $2x-y+3z=9,\ x+y+z=6,\ x-y+z=2$ **(Mar-10, 14,18),(Ts-Mar-17)**

iv) $x-y+3z=5,\ 4x+2y-z=0,\ -x+3y+z=5$ **(Ts-Mar-15,MAR-19)**

v) $x+y+z=1, 2x+2y+3z=6, x+4y+9z=3$ **(Ts-May-16)**

vi) $2x-y+3z=8, -x+2y+z=4, 3x+y-4z=0$ **(Ts-Mar-18)**

***13. Examine whether the following system of equations is consistent or inconsistent. If consistent find the complete solutions.

i) $x+y+z=4,\ 2x+5y-2z=3,\ x+7y-7z=5$

ii) $x+y+z=3,\ 2x+2y-z=3,\ x+y-z=1$ **(Jun-02)**

iii) $x+y+z=6,\ x-y+z=2,\ 2x-y+3z=9$ **(Mar-05,11)**

iv) $x+y+z=1,\ 2x+y+z=2,\ x+2y+2z=1$ **(TS-Mar-15)**

14. If $A=\begin{bmatrix} 1 & -2 & 1 \\ 0 & 1 & -1 \\ 3 & -1 & 1 \end{bmatrix}$ then find A^3-3A^2-A-3I **(TS-MAR-19-SAQ) (Mar-2011)

**15. Show that $\begin{vmatrix} -2a & a+b & c+a \\ a+b & -2b & b+c \\ c+a & c+b & -2c \end{vmatrix} = 4(a+b)(b+c)(c+a)$

**16. By using Gaus-Jordan method, show that the following system has no solution $2x+4y-z=0, x+2y+2z=5, 3x+6y-7z=2$

SHORT ANSWER QUESTIONS :

***17. If $A=\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ then show that for all positive integers 'n', $A^n=\begin{bmatrix} \cos n\theta & \sin n\theta \\ -\sin n\theta & \cos n\theta \end{bmatrix}$ **(Nov-1998)**

***18. If $A=\begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ then for any integer $n\geq 1$ show that $A^n=\begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$

***19. If $\theta-\phi=\frac{\pi}{2}$, then show that $\begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}\begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix}=0$ **(Mar-04, May-09,12)**

***20. If $3A=\begin{bmatrix}1 & 2 & 2\\ 2 & 1 & -2\\ -2 & 2 & -1\end{bmatrix}$ then show that $A^{-1}=A^{T}$ **(Mar-09, 14)**

***21. If $A=\begin{bmatrix}2 & -1 & 2\\ 1 & 3 & -4\end{bmatrix}$, $B=\begin{bmatrix}1 & -2\\ -3 & 0\\ 5 & 4\end{bmatrix}$ then verify that $(AB)^{|}=B^{|}A^{|}$ **(March-13)**

***22. Show that $\begin{vmatrix}y+z & x & x\\ y & z+x & y\\ z & z & x+y\end{vmatrix}=4xyz$

***23. Find the value of x, if $\begin{vmatrix}x-2 & 2x-3 & 3x-4\\ x-4 & 2x-9 & 3x-16\\ x-8 & 2x-27 & 3x-64\end{vmatrix}=0$ **(Mar-06, Ts-Mar-15)**

***24. Show that $\begin{vmatrix}1 & a & a^2\\ 1 & b & b^2\\ 1 & c & c^2\end{vmatrix}=(a-b)(b-c)(c-a)$ (Ts mar2017) **(Mar-05)**

***25. If $A=\begin{bmatrix}2 & 1 & 2\\ 1 & 0 & 1\\ 2 & 2 & 1\end{bmatrix}$ Find the adjoint and inverse of A. **(Mar-05,08)**

***26. If $A=\begin{bmatrix}1 & 2 & 1\\ 3 & 2 & 3\\ 1 & 1 & 2\end{bmatrix}$ then find A^{-1} (Ts mar2017) **(Mar-12)**

***27. If $I=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ and $E=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}$ then show that $(aI+bE)^{3}=a^{3}I+3a^{2}bE$ **(Mar-10,15,Jun-05)**

***28. If $A=\begin{bmatrix}\mathbf{7} & \mathbf{-2}\\ \mathbf{-1} & \mathbf{2}\\ \mathbf{5} & \mathbf{3}\end{bmatrix}$ and $B=\begin{bmatrix}\mathbf{-2} & \mathbf{-1}\\ \mathbf{4} & \mathbf{2}\\ \mathbf{-1} & \mathbf{0}\end{bmatrix}$ then find AB^{1} and BA^{1} **(Mar-18)**

***29. If $A=\begin{bmatrix}3 & -3 & 4\\ 2 & -3 & 4\\ 0 & -1 & 1\end{bmatrix}$, then show that $A^{-1}=A^{3}$.

***30. Show that $\begin{vmatrix}bc & b+c & 1\\ ca & c+a & 1\\ ab & a+b & 1\end{vmatrix}=(a-b)(b-c)(c-a)$.

**31. If $A=\begin{bmatrix}1 & 4 & 7\\ 2 & 5 & 8\end{bmatrix}$, $B=\begin{bmatrix}-3 & 4 & 0\\ 4 & -2 & -1\end{bmatrix}$ then prove that $(A+B)^{T}=A^{T}+B^{T}$

32. If $A=\begin{bmatrix}2 & -4\\ -5 & 3\end{bmatrix}$ Find $A+A^{|}$, $A.A^{|}$. **(May-07)

33. If A and B are invertible then show that AB is also invertible and $(AB)^{-1}=B^{-1}A^{-1}$ **(Jun-03)

34. If $A=\begin{bmatrix}1 & 2 & 2\\ 2 & 1 & 2\\ 2 & 2 & 1\end{bmatrix}$ then show that $A^2-4A-5I=O$. (Ts mar2017) **(Mar-17)

*35. For any nxn matrix. A prove that A can be uniquely expressed as a sum of a symmetric matrix and a skew symmetric matrix.

*36. Show that the determinant of skew-symmetric matrix of order 3 is always zero.

37*. If $A=\begin{bmatrix}-1 & -2 & -2\\ 2 & 1 & -2\\ 2 & -2 & 1\end{bmatrix}$ then show that the adjoint of A is $3A^{1}.Find\ \ A^{-1}$ **(MAR-19)**

VERY SHORT ANSWER QUESTIONS:

38. If $A=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$ $B=\begin{bmatrix}3 & 8\\ 7 & 2\end{bmatrix}$ and 2X + A = B then find X. **(Mar-95,11,13,15)**

39. If $A=\begin{pmatrix}1 & 2 & 3\\ 3 & 2 & 1\end{pmatrix}$ and $B=\begin{pmatrix}3 & 2 & 1\\ 1 & 2 & 3\end{pmatrix}$ find 3B - 2A (TS-MAR-19) **(Mar-12)**

40. If $\begin{bmatrix}x-3 & 2y-8\\ z+2 & 6\end{bmatrix}=\begin{bmatrix}5 & 2\\ -2 & a-4\end{bmatrix}$, find x, y, z and a **(MAR-19)**

41. Define trace of a matrix and find the trace of A, if $A=\begin{bmatrix}1 & 2 & -\frac{1}{2}\\ 0 & -1 & 2\\ -\frac{1}{2} & 2 & 1\end{bmatrix}$ **(Jun-10)**

42. Define symmetric matrix and skew-symmetric matrix **(Mar-05, Jun-05, May-07)**

43. If $A=\begin{bmatrix}-1 & 2 & 3\\ 2 & 5 & 6\\ 3 & x & 7\end{bmatrix}$ is a symmetric matrix, find x **(Mar-05)**

44. If $A=\begin{bmatrix}0 & 2 & 1\\ -2 & 0 & -2\\ -1 & x & 0\end{bmatrix}$ is a skew-symmetric matrix, find the value of x **(May-11)**

45. If $A=\begin{bmatrix}1 & 0 & 0\\ 2 & 3 & 4\\ 5 & -6 & x\end{bmatrix}$ and det A = 45, then find x **(Mar-03,07, May-09)**

46. Find the inverse of the matrix $\begin{bmatrix} \mathbf{1} & \mathbf{2} \\ \mathbf{3} & \mathbf{-5} \end{bmatrix}$ **(Mar-18)**

47. Define symmetric matrix. Give one example of order 3x3 **(Mar-18)**

48. Find the determinant of $\begin{pmatrix} 1^2 & 2^2 & 3^2 \\ 2^2 & 3^2 & 4^2 \\ 3^2 & 4^2 & 5^2 \end{pmatrix}$ **(Mar-10)**

49. If ω is a complex (non - real) cube root of unity, then show that $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix} = 0$ **(Mar-11,14)**

50. If $A=\begin{pmatrix} -2 & 1 \\ 5 & 0 \\ -1 & 4 \end{pmatrix}$ and $B=\begin{pmatrix} -2 & 3 & 1 \\ 4 & 0 & 2 \end{pmatrix}$, then find $2A+B^T$ and $3B^T - A$. **(Mar-10)**

51. If $A=\begin{pmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \end{pmatrix}$ and $B=\begin{pmatrix} -3 & 4 & 0 \\ 4 & -2 & -1 \end{pmatrix}$ then show that $(A+B)^T = A^T + B^T$ **(May-09)**

52. If $A=\begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$ then show that $AA^1 = A^1A = I$ **(Mar-07)**

53. Find the adjoint and the inverse of the matrix $\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ **(Mar-09,13)**

54. If $A=\begin{bmatrix} 2 & 4 \\ -1 & k \end{bmatrix}$ and $A^2 = 0$ find the value of k. **(Mar-05,14,17, May-11),Ts-Mar-18**

55. If $A=\begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$, find A^2 **(Mar-08)**

56. If $A=\begin{bmatrix} i & 0 \\ 0 & -i \end{bmatrix}$, then show that $A^2 = -I\ (i^2 = -1)$

57. Solve the following system of homogeneous equations **(Ts-Mar-16)**
$x - y + z = 0, x + 2y - z = 0, 2x + y + 3z = 0$

58. Define triangular matrix

59. Find the rank of each of the following matrices

i) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ **(Mar 08,Jun-10),Ts-Mar-18** ii) $\begin{bmatrix} 1 & 4 & -1 \\ 2 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$ iii) $\begin{bmatrix} 1 & 2 & 1 \\ -1 & 0 & 2 \\ 0 & 1 & -1 \end{bmatrix}$ **(Mar-12)**

iv) $\begin{bmatrix} 1 & 2 & 0 & -1 \\ 3 & 4 & 1 & 2 \\ -2 & 3 & 2 & 5 \end{bmatrix}$ v) $\begin{bmatrix} 1 & 0 & -4 \\ 2 & -1 & 3 \end{bmatrix}$ vi) $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ **(TS-Mar-15, MAR-19)**

60. If $A=\begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}, a^2+b^2+c^2+d^2=1$ then find the inverse of A.

61. Construct a 3×2 matrix whose elements are defined by $a_{ij}=\frac{1}{2}|i-3j|$ **(TS-Mar-15,Mar-17)**

62. For any square matrix A, show that $AA^{|}$ is symmetric. **(Mar-15)**

63. Write the definitions of singular and non-singular matrices and give examples.

64. A certain book shop has 10 dozen Chemistry books, 8 dozen Physics books, 10 dozen Economics books. Their selling prices are Rs. 80, Rs.60 and Rs. 40 each respectively. Using matrix algebra, find the total value of the books in the shop.

65. If $A=\begin{bmatrix} 3 & 2 & -1 \\ 2 & -2 & 0 \\ 1 & 3 & 1 \end{bmatrix}, B=\begin{bmatrix} -3 & -1 & 0 \\ 2 & 1 & 3 \\ 4 & -1 & 2 \end{bmatrix}$ and $X=A+B$ then find X. **(Ts-Mar-17)**

66. If $A=\begin{bmatrix} -1 & 2 \\ 0 & 1 \end{bmatrix}$ then find AA^1 **(Ts-Mar-17)**

67. If $A=\begin{bmatrix} 2 & 0 & 1 \\ -1 & 1 & 5 \end{bmatrix}, B=\begin{bmatrix} -1 & 1 & 0 \\ 0 & 1 & -2 \end{bmatrix}$ *then find* $(AB^T)^T$ **(Ts-Mar-19)**

ADDITION OF VECTORS

SHORT ANSWER QUESTIONS:

***1. Let A B C D E F be a regular hexagon with centre 'O'. Show that **AB** + **AC** + **AD** + **AE** + **AF** = 3**AD** = 6**AO**. **(May-09,11, Mar-15)**

***2. In ΔABC, if 'O' is the circumcentre and H is the orthocentre, then show that
i) **OA** + **OB** + **OC** = **OH** ii) **HA** + **HB** + **HC** = 2 **HO**

***3. If the points whose position vectors are 3 **i** - 2 **j** - **k**, 2 **i** + 3 **j** - 4 **k**, - **i** + **j** + 2 **k** and 4 **i** + 5 **j** + λ **k** are coplanar, then show that $\lambda=\frac{-146}{17}$

***4. **a, b, c** are non-coplanar vectors. Prove that the following four points are coplanar
i) -**a** + 4**b** - 3**c**, 3**a** + 2**b** - 5**c**, -3**a** + 8**b** - 5**c**, -3**a** + 2**b** + **c** **(May-10,Mar-18),Ts-Mar-18**
ii) 6**a** + 2**b** - **c**, 2**a** - **b** + 3**c**, -**a** + 2**b** - 4**c**, -12**a** - **b** -3**c** **(Ts-Mar-15,Mar-17)**

***5. If $\bar{i},\bar{j},\bar{k}$ are unit vectors along the positive directions of the coordinate axes, then show that the four points $4\bar{i}+5\bar{j}+\bar{k}$, $-\bar{j}-\bar{k}, 3\bar{i}+9\bar{j}+4\bar{k}$ and $-4\bar{i}+4\bar{j}+4\bar{k}$ are coplanar. **(Mar-14)**

***6. In the two dimensional plane, prove by using vector method, the equation of the line whose intercepts on the axes are 'a' and 'b' is $\frac{x}{a}+\frac{y}{b}=1$ **(May-05)**

7. Show that the line joining the pair of points 6a** - 4**b** + 4**c**, -4**c** and the line joining the pair of points -**a** - 2**b** - 3**c**, **a** + 2**b** - 5**c** intersect at the point -4**c** when **a, b, c** are non-coplanar vectors **(AP MAR-2019)**

8. If $\bar{a},\bar{b},\bar{c}$, are non coplanar find the point of intersection of the line passing through the points $2\bar{a}+3\bar{b}-\bar{c}, 3\bar{a}+4\bar{b}-2\bar{c}$ with the line joining the points $\bar{a}-2\bar{b}+3\bar{c}$, $\bar{a}-6\bar{b}+6\bar{c}$ **(Ts-Mar-17,19)

9. Find the vector equation of the plane passing through points 4i** - 3**j** - **k**, 3**i** + 7**j** - 10**k** and 2**i** + 5**j** - 7**k** and show that the point **i** + 2**j** - 3**k** lies in the plane. **(Mar-13)**

**10. Find the vector equation of the line parallel to the vector $2\bar{i}-\bar{j}+2\bar{k}$ and passing through the point A whose position vector is $3\bar{i}+\bar{j}-\bar{k}$. If P is a point on this line such that AP=15 then find the position vector of P.

**11. Let $\bar{a},\bar{b}$ be non-collinear vectors. If $\bar{\alpha}=(x+4y)\bar{a}+(2x+y+1)\bar{b}$ and $\bar{\beta}=(y-2x+2)\bar{a}+(2x-3y-1)\bar{b}$ are such that $3\bar{\alpha}=2\bar{\beta}$ then find x *and* y.

**12. If $\bar{a}+\bar{b}+\bar{c}=\alpha\bar{d}$, $\bar{b}+\bar{c}+\bar{d}=\beta\bar{a}$ and $\bar{a},\bar{b},\bar{c}$ are non-coplanar vectors, then show that $\bar{a}+\bar{b}+\bar{c}+\bar{d}=0$

**13. If $\bar{a},\bar{b},\bar{c}$ are non-coplanar vectors, then test for the collinerarity of the following points whose position vectors are given by

i) $\bar{a}-2\bar{b}+3\bar{c}$, $2\bar{a}+3\bar{b}-4\bar{c}$, $-7\bar{b}+10\bar{c}$

ii) $3\bar{a}-4\bar{b}+3\bar{c}$, $-4\bar{a}+5\bar{b}-6\bar{c}$, $4\bar{a}-7\bar{b}+6\bar{c}$

iii) $2\bar{a}+5\bar{b}-4\bar{c},\bar{a}+4\bar{b}-3\bar{c},4\bar{a}+7\bar{b}-6\bar{c}$

VERY SHORT ANSWER QUESTIONS :

14. (i) Find the unit vector in the direction of vector $\bar{a}=2i+3j+k$. **(Mar-14)**
(ii) Let **a** = 2**i** + 4**j** - 5**k**, **b** = **i** + **j** + **k** and **c** = **j** + 2**k**. Find the unit vector in the opposite direction of **a** + **b** + **c** **(Ts-MAR-19)** **(Mar-09,10,12, 15,19)**
(iii) Let $\bar{a}=\bar{i}+2\bar{j}+3\bar{k},\bar{b}=3\bar{i}+\bar{j}$ .find the unit vector in the direction of $\bar{a}+\bar{b}$ **(Ts-Mar-16)**

15. Show that the points whose position vectors are -2**a** + 3**b** + 5**c**, **a** + 2**b** + 3**c**, 7**a** - **c** are collinear when **a, b, c** are non-coplanar vectors.

16. If the position vectors of the points A, B and C are -2 **i** + **j** - **k**, -4**i** + 2**j** + 2**k** and 6**i** - 3**j** - 13**k** respectively and **AB** = λ **AC**, then find the value of λ **(Mar-11)**

17. If the vectors $-3\vec{i}+4\vec{j}+\lambda\vec{k}$ and $\mu\vec{i}+8\vec{j}+6\vec{k}$ are collinear vectors, then find λ *and* μ. **(Mar-14,18, May-10)**

18. If $\bar{a}=2\bar{i}+5\bar{j}+\bar{k}$ and $\bar{b}=4\bar{i}+m\bar{j}+n\bar{k}$ are collinear vectors then find the values of m and n **(Jun-11),Ts-Mar-15,17,18**

19. If **OA** = **i** + **j** + **k**, **AB** = 3**i** - 2**j** + **k**, **BC** = **i** + 2**j**-2**k** and **CD** = 2**i** + **j** + 3**k**, then find the vector **OD** **(Mar-13,Ts-Mar-15,19)**

20. OABC is a parallelogram. If **OA** = **a** and **OC** = **c**, then find the vector equation of the side BC. **(Mar-09)**

21. Find the equation of the plane which passes through the points $2\bar{i}+4\bar{j}+2\bar{k}$, $2\bar{i}+3\bar{j}+5\bar{k}$ and parallel to the vector $3\bar{i}-2\bar{j}+\bar{k}$ **(Mar-12)**

22. Find the vector equation of the line joining the points 2**i** + **j** + 3**k** and -4**i** + 3**j** - **k**. **(Mar-11),Ts-Mar-18**

23. Find the vector equation of the line passing through the point $2\bar{i}+3\bar{j}+\bar{k}$ and parallel to the vector $4\bar{i}-2\bar{j}+3\bar{k}$. (Ts mar2017) **(Jun-10, Mar-15)**

24. Find the vector equation of the plane passing through the points.
$\bar{i}-2\bar{j}+5\bar{k}$, $-5\bar{j}-\bar{k}$ and $-3\bar{i}+5\bar{j}$ **(Mar-17,19)**

25. If $\bar{a},\bar{b},\bar{c}$ are the position vectors of the vertices A,B and C respectively of ΔABC then find the vector equations of the median through the vertex A. **(Mar-04,13,May-08)**

26. Is the triangle formed by the vectors 3**i** + 5**j** + 2**k**, 2**i** - 3**j** - 5**k** and -5**i** - 2**j** + **3k** equilateral?

27. Find the vector equation of the plane passing through the points (0, 0, 0), (0, 5, 0), and (2, 0, 1). **(Mar-18)**

28. ABCDE is a pentagon. If the sum of the vecotrs $\overline{AB}, \overline{AE}, \overline{BC}, \overline{DC}, \overline{ED}$ *and* $\overline{AC}$ is $\lambda\,\overline{AC}$ then find the value of λ.

29. If α, β and γ are the angles made by the vector $3i - 6j + 2k$ with the positive directions of the coordinate axes then find $\cos\alpha, \cos\beta$ and $\cos\gamma$. **(Mar-17)**

PRODUCT OF VECTORS

LONG ANSWER QUESTIONS :

***1. i)Find the shortest distance between the skew lines **r** = (6**i** + 2**j** + 2 **k**) + t (**i** - 2**j** + 2 **k**) and **r** = (-4 **i** - **k**) + s (3**i** - 2**j** - 2**k**) where s, t are scalars(Ts mar2017) **(Mar-08,09)**

. ii)If $A=(1,-2,-1), B=(4,0,-3), C=(1,2,-1)$ and $D=(2,-4,-5)$, find the distance between AB and CD. **(TS-MAR-19)** **(Mar-07,12, 14,17)**

***2. Let **a, b, c** be three vectors. Then show that

i) $(\bar{a}\times\bar{b})\times\bar{c} = (\bar{a}.\bar{c})\bar{b} - (\bar{b}.\bar{c})\bar{a}$ ii) $\bar{a}\times(\bar{b}\times\bar{c}) = (\bar{a}.\bar{c})\bar{b} - (\bar{a}.\bar{b})\bar{c}$

(May-06,09, Mar-15)

***3. Find the equation of the plane passing to the points A=(2,3,-1), B=(4,5,2) and C=(3,6,5). **(Mar-10,11)**

***4. A line makes angles $\theta_1, \theta_2, \theta_3$ and θ_4 with the diagonals of a cube. Show that

$$\cos^2\theta_1 + \cos^2\theta_2 + \cos^2\theta_3 + \cos^2\theta_4 = \frac{4}{3}$$

***5. Show that in any triangle the altitudes are concurrent. **(Mar-13)**

***6. Find the vector equation of the plane passing through the intersection of the planes $\bar{r}.(\bar{i}+\bar{j}+\bar{k}) = 6$ and $\bar{r}.(2\bar{i}+3\bar{j}+4\bar{k}) = -5$ and the point $(1,1,1)$

7. If $\bar{a} = \bar{i} - 2\bar{j} + 3\bar{k}, \bar{b} = 2\bar{i} + \bar{j} + \bar{k}, \bar{c} = \bar{i} + \bar{j} + 2\bar{k}$ then find $\left|(\bar{a}\times\bar{b})\times\bar{c}\right|$ *and* $\left|\bar{a}\times(\bar{b}\times\bar{c})\right|$ **(Ts-Mar-18)

**8. If $\bar{a} = \bar{i} - 2\bar{j} + \bar{k}, \bar{b} = 2\bar{i} + \bar{j} + \bar{k}, \bar{c} = \bar{i} + 2\bar{j} - \bar{k}$, find $\bar{a}\times(\bar{b}\times\bar{c})$ and $\left|(\bar{a}\times\bar{b})\times\bar{c}\right|$

9. If $a = 2i + j - 3k, b = i - 2j + k, c = -i + j - 4k$ and $d = i + j + k$, then compute $\left|(a\times b)\times(c\times d)\right|$ **(Ts-Mar-15)

10. **a, b, c are non-zero vectors and **a** is perpendicular to both **b** and **c**.

If |**a**| = 2, |**b**| = 3, |**c**| = 4 and (**b, c**) = $\frac{2\pi}{3}$, then find |[**a b c**]| **(May-08)**

11. If [b c d**] + [**c a d**] + [**a b d**] = [**a b c**], then show that the points with position vectors **a, b, c** and **d** are coplanar.

*12. For any four vectors $\bar{a}, \bar{b}, \bar{c}$ *and* $\bar{d}$, prove that **(Mar-18)**

$$(\bar{a}\times\bar{b})\times(\bar{c}\times\bar{d}) = [\bar{a}\,\bar{c}\,\bar{d}]\bar{b} - [\bar{b}\,\bar{c}\,\bar{d}]\bar{a} \text{ and } (\bar{a}\times\bar{b})\times(\bar{c}\times\bar{d}) = [\bar{a}\,\bar{b}\,\bar{d}]\bar{c} - [\bar{a}\,\bar{b}\,\bar{c}]\bar{d}$$

*13. Show that the volume of a tetrahedron with $\bar{a}, \bar{b}$ and $\bar{c}$ **as coterminous edges is** $\frac{1}{6}|[\bar{a}\ \bar{b}\ \bar{c}]|$ **(MAR-19)**

SHORT ANSWER QUESTIONS :

***14. Prove that the smaller angle θ between any two diagonals of a cube is given by $\cos\theta = \frac{1}{3}$ **(Mar-10,May-10, Jun-11)**

***15. Find the unit vector perpendicular to the plane passing through the points $(1,2,3)$, $(2,-1,1)$ and $(1,2,-4)$. **(May-10,Mar-17)**

***16. Find the area of the triangle whose vertices are $A(1,2,3)$, $B(2,3,1)$ and $C(3,1,2)$ **(Mar-08, 14)**

***17. Find a unit vector perpendicular to the plane determined by the points $P(1,-1,2)$, $Q(2,0,-1)$ and $R(0,2,1)$

***18. If **a** = 2**i** + 3**j** + 4**k**, **b** = **i** + **j** - **k** and **c** = **i** - **j** + **k**, then compute $\bar{a}\times(\bar{b}\times\bar{c})$ and verify that it is perpendicular to $\bar{a}$. **(TS-MAR-19)**

***19. Find the volume of the tetrahedron whose vertices are (1, 2, 1), (3, 2, 5), (2, -1, 0) and (-1, 0, 1). **(May-07, Ts-Mar-15)**

20. Find the volume of the parallelopiped whose coterminus edges are represented by the vectors ***2i-3j+k, i-j+2k and 2i+j-k.

***21. Determine λ, for which the volume of the parallelopiped having coterminus edges **i** + **j**, 3**i** - **j** and 3**j** + λ **k** is 16 cubic units **(May-05)**

***22. Find the volume of the tetrahedron having the edges **i** + **j** + **k**, **i** - **j** and **i** + 2 **j** + **k** **(May-09)**

***23. If **a**=**i**-2**j**-3**k**,**b**=2**i**+**j**-**k** and **c** =**i**+3**j**-2**k**,verify that $\mathbf{a}\times(\mathbf{b}\times\mathbf{c}) \neq (\mathbf{a}\times\mathbf{b})\times\mathbf{c}$. **(Mar-08, May-11)**

***24. **a** = 3**i** - **j** + 2**k**, **b** = -**i** + 3**j** + 2**k**, **c** = 4**i** + 5**j** - 2**k** and **d** = **i** + 3**j** + 5**k**, then compute the following i) $(\bar{a}\times\bar{b})\times(\bar{c}\times\bar{d})$ and ii) $(\bar{a}\times\bar{b}).\bar{c}-(\bar{a}\times\bar{d}).\bar{b}$

***25. Find λ. in order that the four points $A(3,2,1), B(4,\lambda,5), C(4,2,-2)$ *and* $D(6,5,-1)$ be coplanar. **(Ts-Mar-16)**

***26. If $\bar{a} = 2\bar{i} + \bar{j} - \bar{k}$, $\bar{b} = -\bar{i} + 2\bar{j} - 4\bar{k}$, $\bar{c} = \bar{i} + \bar{j} + \bar{k}$ thenfind $(\bar{a}\times\bar{b}).(\bar{b}\times\bar{c})$ **(Mar-,15),Ts-Mar-17**

***27. Show that angle in a semi circle is a right angle **(May-08)**

***28. If **a** + **b** + **c** = **0**, |**a**| = 3, |**b**| = 5 and |**c**| = 7, then find the angle between **a** and **b**.

***29. Let **a**=4**i** + 5**j**- **k**, **b**=**i** - 4**j** + 5**k** and **c**=3**i** + **j** - **k**. Find the vector which is perpendicular to both **a** and **b** whose magnitude is twenty one times the magnitude of **c**.

**30. Show that for any two vectors $\bar{a}$ and $\bar{b}$, $|\bar{a}\times\bar{b}|^2 = (\bar{a}.\bar{a})(\bar{b}.\bar{b}) - (\bar{a}.\bar{b})^2 = \bar{a}^2\bar{b}^2 - (\bar{a}.\bar{b})^2$

31. Show that the points (5, -1, 1), (7, -4, 7), (1, -6, 10) and (-1, -3, 4) are the vertices of a rhombus by vectors **(Mar-13)

32. Let $\bar{a}$ and $\bar{b}$ be vectors, satisfying $|\bar{a}| = |\bar{b}| = 5$ and $(\bar{a}, \bar{b}) = 45^0$. Find the area of the triangle having $\bar{a} - 2\bar{b}$ and $3\bar{a} + 2\bar{b}$ as two of its sides **(Mar-08,18)

**33. Find the vector having magnitude $\sqrt{6}$ units and perpendicular to both $2\bar{i} - \bar{k}$ and $3\bar{j} - \bar{i} - \bar{k}$

34. For any three vectors **a, b, c prove that **[b × c c × a a × b] =** $\left[\bar{a}\ \bar{b}\ \bar{c}\right]^2$

35. Let **a, b and **c** be unit vectors such that **b** is not parallel to c and $\bar{a} \times (\bar{b} \times \bar{c}) = \frac{1}{2}\bar{b}$. Find the angles made by **a** with each of **b** and **c.**

**36. $\bar{A} = (1, a, a^2), \bar{B} = (1, b, b^2)$ and $\bar{c} = (1, c, c^2)$ are non-coplanar vectors and

$\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix} = 0$, then show that a b c + 1 = 0

**37. $\bar{a}, \bar{b}$ and $\bar{c}$ are non-zero and non-collinear vectors and $\theta \neq \{0, \pi\}$ is the angle between $\bar{b}$ and $\bar{c}$. If $(\bar{a} \times \bar{b}) \times \bar{c} = \frac{1}{3}|\bar{b}||\bar{c}|\bar{a}$, then find $\sin\theta$

**38. If $\bar{a} = 2\bar{i} + \bar{j} - 3\bar{k}, \bar{b} = \bar{i} - 2\bar{j} + \bar{k}, \bar{c} = -\bar{i} + \bar{j} - 4\bar{k}$ and $\bar{d} = \bar{i} + \bar{j} + \bar{k}$ then compute $|(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d})|$

**39. For any two vectors $\bar{a}$ and $\bar{b}$. Then show that

$(1 + |\bar{a}|^2)(1 + |\bar{b}|^2) = |1 - \bar{a}.\bar{b}|^2 + |\bar{a} + \bar{b} + \bar{a} \times \bar{b}|^2$ **(Ts-Mar-18)**

*40. Show that the points $2\bar{i} - \bar{j} + \bar{k}, \bar{i} - 3\bar{j} - 5\bar{k}$ and $3\bar{i} - 4\bar{j} - 4\bar{k}$ are the vertices of a right angled triangle. Also find the other angles.

*41. Show that for any four vectors **a, b, c** and **d** $(\bar{a} \times \bar{b}).(\bar{c} \times \bar{d}) = \begin{vmatrix} \bar{a}.\bar{c} & \bar{a}.\bar{d} \\ \bar{b}.\bar{c} & \bar{b}.\bar{d} \end{vmatrix}$

and in particular $(\bar{a} \times \bar{b})^2 = \bar{a}^2\ \bar{b}^2 - (\bar{a}.\bar{b})^2$

*42. Show that in any triangle, the perpendicular bisectors of the sides are concurrent.

*43. If **a, b, c** are unit vectors such that **a** is perpendicular to the plane of **b, c** and the angle between **b** and **c** is $\frac{\pi}{3}$, then find $|\bar{a} + \bar{b} + \bar{c}|$

*44. If **a** = (1, -1, -6), **b** = (1, -3, 4) and **c** = (2, -5, 3), then compute the following
i) **a**. (**b** × **c**) ii) **a** × (**b** × **c**) iii) (**a** × **b**) × **c**

VERY SHORT ANSWER QUESTIONS :

45. If **a** = **i** + 2**j** - 3**k** and **b** = 3 **i** - **j** + 2**k,** then show that **a** + **b** and **a** - **b** are perpendicular to each other. **(May-11, Mar-15)**

46. If the vectors $\lambda\bar{i}-3\bar{j}+5\bar{k}$ and $2\lambda\bar{i}-\lambda\bar{j}-\bar{k}$ are pependicular to each other, find λ **(MAR-19)**

47. If $4\bar{i}+\frac{2p}{3}\bar{j}+p\bar{k}$ is parallel to the vector $\bar{i}+2\bar{j}+3\bar{k}$, find p **(Mar-11)**

48. Find the angle between the vectors $i+2j+3k$ and $3i-j+2k$.**(Mar-10,14,Ts-Mar-17,18)**

49. Find the cartesian equation of the plane through the point $A(2,-1,-4)$ and parallel to the plane $4x-12y-3z-7=0$

50. Find the angle between the planes **r**. (2**i** - **j** + 2 **k**) = 3 and **r**. (3**i** +6 **j** + **k**) = 4.

51. Find the area of the parallelogram having $2\bar{i}-3\bar{j}$ and $3\bar{i}-\bar{k}$ as adjacent sides. **(May 12, Ts-Mar-15)**

52. Let **a** = **i** + **j** + **k** and **b** = 2 **i** + 3 **j** + **k** find
i) The projection vector of **b** and **a** and its magnitude
ii) The vector components of **b** in the direction of **a** and perpendicular to **a**

53. If $\bar{a}=\bar{i}-\bar{j}-\bar{k}\ and\ \bar{b}=2\bar{i}-3\bar{j}+\bar{k}$ then find the projection vector of $\bar{b}\,on\,\bar{a}$ **(Mar-17)**

54. If **a** =2**i**+2**j**-3**k** , **b** = 3**i** - **j** + 2**k**, then find the angle between 2**a** + **b** and **a** + 2**b**

55. If |**a**| = 2, |**b**| = 3 and |**c**| = 4 and each of **a, b, c** is perpendicular to the sum of the other two vectors, then find the magnitude of **a** + **b** + **c**

56. Find the unit vector perpendicular to the plane determined by the vectors
$\bar{a}=4\bar{i}+3\bar{j}-\bar{k},\ \bar{b}=2\bar{i}-6\bar{j}-3\bar{k}$ **(May-09)**

57. If $\bar{a}=2i-j+k$ and $\bar{b}=i-3j-5k$, then find $\left|\bar{a}\times\bar{b}\right|$ **(Mar-13)**

58. If **a** = 2**i** - 3**j** + 5**k** , **b** = -**i** + 4**j** + 2**k** then find $\bar{a}\times\bar{b}$ and unit vector perpendicular to both **a** and **b.**

59. Let **a** =2**i**-**j**+**k** and **b** = 3**i**+4 **j**-**k**. If θ is the angle between **a** and **b**, then find $\sin\theta$

60. For any vector **a**, show that $\left|\bar{a}\times\bar{i}\right|^2+\left|\bar{a}\times\bar{j}\right|^2+\left|\bar{a}\times\bar{k}\right|^2=2\left|\bar{a}\right|^2$

61. If $\left|\bar{p}\right|=2,\left|\bar{q}\right|=3$ and $\left(\bar{p},\bar{q}\right)=\frac{\pi}{6}$, then find $\left|\bar{p}\times\bar{q}\right|^2$

62. Compute $\bar{a}\times\left(\bar{b}+\bar{c}\right)+\bar{b}\times\left(\bar{c}+\bar{a}\right)+\bar{c}\times\left(\bar{a}+\bar{b}\right)$

63. Find the area of the parallelogram having $\bar{a}=2\bar{j}-\bar{k}$ and $\bar{b}=-\bar{i}+\bar{k}$ as adjacent sides

64. Find the area of the parallelogram whose diagonals are $3\bar{i}+\bar{j}-2\bar{k}$ and $\bar{i}-3\bar{j}+4\bar{k}$

65. If the vectors **a** = 2**i** - **j** + **k**, **b** = **i** + 2**j** - 3**k** and **c** = 3**i** + p **j** + 5**k** are coplanar, then find **p**

66. Show that $\bar{i}\times\left(\bar{a}\times\bar{i}\right)+\bar{j}\times\left(\bar{a}\times\bar{j}\right)+\bar{k}\times\left(\bar{a}\times\bar{k}\right)=2\bar{a}$ for any vector $\bar{a}$

67. Prove that for any three vectors **a, b, c, [b + c c + a a + b] = 2 [a b c]**

68. Compute $\left[\bar{i}-\bar{j}\quad\bar{j}-\bar{k}\quad\bar{k}-\bar{i}\right]$

69. Let **b**=2**i**+**j**-**k**,**c**=**i**+3**k**.If **a** is a unit vector then find the maximum value of [**a b c**]

70. If $\frac{1}{2}\left|\bar{e_1}-\bar{e_2}\right|=\sin\lambda\theta$ where $\bar{e_1}$ and $\bar{e_2}$ are unit vectors including an angle θ, show that $\lambda=\frac{1}{2}$.

71. Find the distance of a points $(2,5,-3)$ from the plane $\bar{r}.\left(6\bar{i}-3\bar{j}+2\bar{k}\right)=4$ **(Ts-May-16)**

72. If $\bar{a}=2\bar{i}-3\bar{j}+\bar{k}$ *and* $\bar{b}=a\bar{i}+4\bar{j}-2\bar{k}$ then find $\left(\bar{a}+\bar{b}\right)\times\left(\bar{a}-\bar{b}\right)$ **(Ts-Mar-18)**

73. Find the equation of the plane passing through the points(3,-2,1) and perpendicular to the vector(4,7,-4) **(TS MAR-19)**

TRIGNOMETRY UPTO TRANSFORMATIONS

LONG ANSWER QUESTIONS :

***1. In triangle ABC, prove that $\cos\frac{A}{2}+\cos\frac{B}{2}+\cos\frac{C}{2}=4\cos\frac{\pi-A}{4}\cos\frac{\pi-B}{4}\cos\frac{\pi-C}{4}$ **(Mar-07,10, May-07)**

***2. If A,B,C are angles of a triangle, then prove that

$$\sin^2\frac{A}{2}+\sin^2\frac{B}{2}-\sin^2\frac{C}{2}=1-2\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$$ **(May-06,11)**

***3. If $A+B+C=\pi$, then prove that

$$\cos^2\frac{A}{2}+\cos^2\frac{B}{2}-\cos^2\frac{C}{2}=2\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$$ **(May-10)**

***4. If A,B,C are angles in a triangle, then prove that

$$\cos A+\cos B-\cos C=-1+4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$$ **(TS-MAR-19) (May-06)**

***5. If A,B,C are angles in a triangle, then prove that

$$\sin\frac{A}{2}+\sin\frac{B}{2}+\sin\frac{C}{2}=1+4\sin\frac{\pi-A}{4}.\sin\frac{\pi-B}{4}.\sin\frac{\pi-C}{4}$$ **(Mar-11,14)**

***6. If $A+B+C=180^0$, then prove that

$$\cos^2\frac{A}{2}+\cos^2\frac{B}{2}+\cos^2\frac{C}{2}=2\left(1+\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}\right)$$ **(Mar-12,15, TS-Mar-15)**

***7. If A,B,C are angles in a triangle, then prove that

$$\cos A+\cos B+\cos C=1+4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$$ **(May-09,Mar-18)**

***8. In triangle ABC, prove that

$$\cos\frac{A}{2}+\cos\frac{B}{2}-\cos\frac{C}{2}=4\cos\frac{\pi+A}{4}\cos\frac{\pi+B}{4}\cos\frac{\pi-C}{4}$$ **(Mar-05)**

***9. If $A+B+C+S$ then prove that

$$\sin(S-A)+\sin(S-B)+\sin c=4\cos\frac{S-A}{2}\cos\frac{S-B}{2}\sin\frac{c}{2}$$ **(Ts-Mar-17)**

***10. If $A+B+C=2S$, then prove that

$\cos(S-A)+\cos(S-B)+\cos C=-1+4\cos\frac{S-A}{2}\cos\frac{S-B}{2}\cos\frac{C}{2}$ **(TS-MAR-17)**

***11. If $A+B+C=2S$, then prove that **(Ts-Mar-18)**

$\cos(S-A)+\cos(S-B)+\cos(S-C)+\cos S=4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

***12. Suppose $(\alpha-\beta)$ is not an odd multiple of $\frac{\pi}{2}$, m is a non zero real number such that $m\neq -1$ and $\frac{\sin(\alpha+\beta)}{\cos(\alpha-\beta)}=\frac{1-m}{1+m}$. Then prove that $\tan\left(\frac{\pi}{4}-\alpha\right)=m.\tan\left(\frac{\pi}{4}+\beta\right)$

***13. If $A+B+C=\frac{3\pi}{2}$, prove that $Cos2A+\cos 2B+\cos 2C=1-4\sin A\sin B\sin C$ **(Mar-13)**

***14. If none of A,B,A+B is an integral multiple of π, then prove that

$\frac{1-\cos A+\cos B-\cos(A+B)}{1+\cos A-\cos B-\cos(A+B)}=\tan\frac{A}{2}\cot\frac{B}{2}$

**15. In triangle ABC, prove that

$\sin\frac{A}{2}+\sin\frac{B}{2}-\sin\frac{C}{2}=-1+4\cos\frac{\pi-A}{4}\cos\frac{\pi-B}{4}\sin\frac{\pi-C}{4}$

**16. If A,B,C are angles in a triangle, then prove that

$\sin 2A-\sin 2B+\sin 2C=4\cos A\sin B\cos C$

17. If $A+B+C=180^0$ then show that $\cos 2A+\cos 2B+\cos 2C=-4\cos A\cos B\cos C-1$ **(Mar-17)

*18. If $A+B+C=90^0$ then show that

(i) $\sin^2 A+\sin^2 B+\sin^2 C=1-2\sin A\sin B\sin C$

(ii) $\sin 2A+\sin 2B+\sin 2C=4\cos A\cos B\cos C$

*19. If $A+B+C=0^0$, then prove that $\cos^2 A+\cos^2 B+\cos^2 C=1+2\cos A\cos B\cos C$

*20. If A,B,C are angles in a triangle, then prove that

$\sin A+\sin B+\sin C=4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

*21. If $A+B+C=270^0$, then prove that $\cos^2 A+\cos^2 B-\cos^2 C=-2\cos A\cos B\sin C$

*22. If $A+B+C+D=360^0$, prove that $\cos 2A+\cos 2B+\cos 2C+\cos 2D=4\cos(A+B)\cos(A+C)\cos(A+D)$

*23. If $A+B+C=0$ then prove that that $\sin 2A+\sin 2B+\sin 2C=-4\sin A\sin B\sin C$ **(MAR-19)**

SHORT ANSWER QUESTIONS :

***24. If $A+B=45^0$, then prove that

i) $(1+\tan A)(1+\tan B)=2$ **(May-11)**

ii) $(\cot A-1)(\cot B-1)=2$ **(Mar-07, May-09)**

iii) If $A-B=\frac{3\pi}{4}$, then show that $(1-TanA)(1+TanB)=2$

***25. Prove that $\frac{Tan\theta+\sec\theta-1}{Tan\theta-\sec\theta+1}=\frac{1+\sin\theta}{\cos\theta}$ **(Mar-14)**

***26. Prove that $\left(1+\cos\frac{\pi}{10}\right)\left(1+\cos\frac{3\pi}{10}\right)\left(1+\cos\frac{7\pi}{10}\right)\left(1+\cos\frac{9\pi}{10}\right)=\frac{1}{16}$ **TS -MAR-19 (Mar-15,19)**

***27. If A is not an integral multiple of π, prove that $\cos A.\cos 2A.\cos 4A.\cos 8A=\frac{\sin 16A}{16\sin A}$ and hence deduce that $\cos\frac{2\pi}{15}.\cos\frac{4\pi}{15}.\cos\frac{8\pi}{15}.\cos\frac{16\pi}{15}=\frac{1}{16}$ **(Mar-09,12)**

***28. Let ABC be a triangle such that $\cot A+\cot B+\cot C=\sqrt{3}$. then prove that ABC is an equilateral triangle.

***29. Prove that $\tan 70^0-\tan 20^0=2\tan 50^0$

***30. For $A\in R$, prove that i) $\sin A.\sin(60+A)\sin(60-A)=\frac{1}{4}\sin 3A$

ii) $\cos A.\cos(60+A)\cos(60-A)=\frac{1}{4}\cos 3A$ and hence deduce that

iii) $\sin 20^0\sin 40^0\sin 60^0\sin 80^0=\frac{3}{16}$ iv) $\cos\frac{\pi}{9}\cos\frac{2\pi}{9}\cos\frac{3\pi}{9}\cos\frac{4\pi}{9}=\frac{1}{16}$

***31. If 3A is not an odd multiple of $\frac{\pi}{2}$, prove that $\tan A.\tan(60+A).\tan(60-A)=\tan 3A$ and hence find the value of $\tan 6^0\tan 42^0\tan 66^0\tan 78^0$

***32. i) Prove that $\sin^4\frac{\pi}{8}+\sin^4\frac{3\pi}{8}+\sin^4\frac{5\pi}{8}+\sin^4\frac{7\pi}{8}=\frac{3}{2}$

ii) Prove that $\cos^4\frac{\pi}{8}+\cos^4\frac{3\pi}{8}+\cos^4\frac{5\pi}{8}+\cos^4\frac{7\pi}{8}=\frac{3}{2}$ **(May-16)**

iii) Show that $\cos^2\left(\frac{\pi}{10}\right)+\cos^2\left(\frac{2\pi}{5}\right)+\cos^2\left(\frac{3\pi}{5}\right)+\cos^2\left(\frac{9\pi}{10}\right)=2$

***33. Prove the following

i) $\cos\frac{2\pi}{7}.\cos\frac{4\pi}{7}.\cos\frac{8\pi}{7}=\frac{1}{8}$ ii) $\cos\frac{\pi}{11}.\cos\frac{2\pi}{11}.\cos\frac{3\pi}{11}.\cos\frac{4\pi}{11}.\cos\frac{5\pi}{11}=\frac{1}{32}$

***34. Prove that $\sin\frac{\pi}{5}\sin\frac{2\pi}{5}\sin\frac{3\pi}{5}\sin\frac{4\pi}{5}=\frac{5}{16}$ **(Mar-13)**

***35. If A is not an integral multiple of $\frac{\pi}{2}$ then prove that **(Mar-18)**

i) $\tan A+\cot A=2\,cosec\,2A$ and

ii) $\cot A-\tan A=2\cot 2A$

**36. If none of the denominators is zero then prove that

$$\left(\frac{\cos A+\cos B}{\sin A-\sin B}\right)^n+\left(\frac{\sin A+\sin B}{\cos A-\cos B}\right)^n=\begin{cases}2\cot^n\left(\frac{A-B}{2}\right); n\ is\ even\\ 0\ ; n\ is\ odd\end{cases}$$

**37. If $\sec(\theta+\alpha)+\sec(\theta-\alpha)=2\sec\theta$ and $\cos\alpha\neq 1$, then show that $\cos\theta=\pm\sqrt{2}\cos\frac{\alpha}{2}$

**38. If $\cos x+\cos y=\frac{4}{5}$ and $\cos x-\cos y=\frac{2}{7}$ find the value of $14\tan\frac{x-y}{2}+5\cot\frac{x+y}{2}$

**39. Prove that $\cos^2 76^0+\cos^2 16^0-\cos 76^0\cos 16^0=\frac{3}{4}$

40. Prove that $\sqrt{3}\,\text{cosec}\,20^0-\sec 20^0=4$ **(Mar-17)

****41.** If A is not integral multiple of $\frac{\pi}{2}$, prove that

i. $\tan A+\cot A=2\,\text{cosec}\,2A$ **ii.** $\cot A-\tan A=2\cot 2A$

****42.** If none of 2A and 3A is an odd multiple of $\frac{\pi}{2}$, then prove that

$\tan 3A\tan 2A\tan A=\tan 3A-\tan 2A-\tan A$

*43. If $0<A<B<\frac{\pi}{4}, \sin(A+B)=\frac{24}{25}, \cos(A-B)=\frac{4}{5}$, find the value of $\tan 2A$

(TS-Mar-15)

*44. Prove that i) $\sin 18^0=\frac{\sqrt{5}-1}{4}$ **(May-10)** ii) $\cos 36^0=\frac{\sqrt{5}+1}{4}$

*45. Prove that $\sin^2(\alpha-45)^0+\sin^2(\alpha+15)^0-\sin^2(\alpha-15)^0=\frac{1}{2}$

*46. If $\cos n\alpha\neq 0$ and $\cos\frac{\alpha}{2}\neq 0$, then show that

$$\frac{\sin(n+1)\alpha-\sin(n-1)\alpha}{\cos(n+1)\alpha+2\cos n\alpha+\cos(n-1)\alpha}=\tan\frac{\alpha}{2}$$

VERY SHORT ANSWER QUESTIONS :

47. If $\cos\theta+\sin\theta=\sqrt{2}\cos\theta$, prove that $\cos\theta-\sin\theta=\sqrt{2}\sin\theta$ **(Mar-09,Jun-11)**

48 If $3\sin\theta+4\cos\theta=5$, then find the value of $4\sin\theta-3\cos\theta$ **(Mar-12)**

49. Prove that $\cot\frac{\pi}{20}.\cot\frac{3\pi}{20}.\cot\frac{5\pi}{20}.\cot\frac{7\pi}{20}.\cot\frac{9\pi}{20}=1$ **(Mar-05)**

50. Find the period of the following functions

i) $f(x)=\tan 5x$ ii) $f(x)=\cos\left(\frac{4x+9}{5}\right)$ **(Mar-05, 14, May-10)**

iii) $f(x)=|\sin x|$, iv) $f(x)=\cos^4 x$

v) $f(x)=2\sin\frac{\pi x}{4}+3\cos\frac{\pi x}{3}$

vi) $f(x)=\tan\left(x+4x+9x+\ldots+n^2x\right)$ (n is any positive integer). **(Mar-15, Ts-Mar-15)**

vii) $f(x)=\cos(3x+5)+7$

51. Prove that $\cos 12^0 + \cos 84^0 + \cos 132^0 + \cos 156^0 = -\frac{1}{2}$

52 Prove that $\cos 100^0 \cos 40^0 + \sin 100^0 \sin 40^0 = \frac{1}{2}$

53. Find the value of $\cos 42^0 + \cos 78^0 + \cos 162^0$ **(May-11)**

54. Find the value of $\sin 34^0 + \cos 64^0 - \cos 4^0$ **(May-14)**

55. Find the maximum and minimum values of the following functions over R

i) $f(x) = 7\cos x - 24\sin x + 5$

ii) $f(x) = \sin 2x - \cos 2x$

iii) $\cos\left(x + \frac{\pi}{3}\right) + 2\sqrt{2}\sin\left(x + \frac{\pi}{3}\right) - 3$ **(Mar-09)**

iv) $f(x) = 13\cos x + 3\sqrt{3}\sin x - 4$ (Ts mar2017) **(Mar-17)**

v) $f(x) = 3\sin x - 4\cos x$ **(Mar-14)**

56. Find the value of

i) $\sin^2 82\frac{1}{2}^0 - \sin^2 22\frac{1}{2}^0$ **(Ts MAR-17,19)** ii) $\cos^2 112\frac{1}{2}^0 - \sin^2 52\frac{1}{2}^0$

iii) $\sin^2 52\frac{1}{2}^0 - \sin^2 22\frac{1}{2}^0$

57. Prove that $\frac{1}{\sin 10^0} - \frac{\sqrt{3}}{\cos 10^0} = 4$ **(Ts-Mar-18-SAQ)**

58. If $\sec\theta + \tan\theta = \frac{2}{3}$, find the value of $\sin\theta$ and determine the quadrant in which θ lies.

59. Show that $\cos^4\alpha + 2\cos^2\alpha\left(1 - \frac{1}{\sec^2\alpha}\right) = 1 - \sin^4\alpha$

60. Prove that $(\tan\theta + \cot\theta)^2 = \sec^2\theta + \cos ec^2\theta = \sec^2\theta.\cos ec^2\theta$

61. If $\frac{2\sin\theta}{1 + \cos\theta + \sin\theta} = x$, find the value of $\frac{1 - \cos\theta + \sin\theta}{1 + \sin\theta}$

62. i) If $\tan 20^0 = p$, then prove that $\frac{\tan 610^0 + \tan 700^0}{\tan 560^0 - \tan 470^0} = \frac{1 - p^2}{1 + p^2}$

ii) If $Tan20^0 = \lambda$, then show that $\frac{Tan160^0 - Tan110^0}{1 + Tan160^0 Tan110^0} = \frac{1 - \lambda^2}{2\lambda}$

63. i) Draw the graph of $y = \tan x$ in between $\left[0, \frac{\pi}{4}\right]$

ii) Draw the graph of $y = \cos^2 x$ in $[0, \pi]$

iii) Draw the graph of $y = \sin 2x$ in $(0, \pi)$

iv) Draw the graph of $y = \sin x$ between - π and π taking four values on X-axis.**(May-14)**

64. If θ is not an integral multiple of $\frac{\pi}{2}$, prove that $\tan\theta + 2\tan 2\theta + 4\tan 4\theta + 8\cot 8\theta = \cot\theta$ **(MAR-19)**

65. Prove that $4\left(\cos 66^0 + \sin 84^0\right) = \sqrt{3} + \sqrt{15}$

66. Prove that $\cos 20^0 \cos 40^0 - \sin 5^0 \sin 25^0 = \frac{\sqrt{3}+1}{4}$

67. If A, B, C are angles of a triangle and if none of them is equal to $\frac{\pi}{2}$, then prove that $\tan A + \tan B + \tan c = \tan A \tan B \tan C$

68. If $\sin\theta = -\frac{1}{3}$ and θ does not lie in the third quadrant. Find the value of $\cos\theta$, $\cot\theta$ **TS-MAR-19(Mar-13)**

69. Find the cosine function whose period is 7 **(Mar-13)**

70. Find a sine function whose period is $\frac{2}{3}$

71. Prove that $\frac{\cos 9^0 + \sin 9^0}{\cos 9^0 - \sin 9^0} = \cot 36^0$ **(Mar-11, 15),Ts-Mar-18**

72. If $\sin\alpha = \frac{3}{5}$, where $\frac{\pi}{2} < \alpha < \pi$, evaluate $\cos 3\alpha$ and $\tan 2\alpha$. **(TS-Mar-15)**

73. If $\cos\theta = -\frac{5}{13}$ and $\frac{\pi}{2} < \theta < \pi$ then find $\sin 2\theta$.

74. For what values of x in the first quadrant $\frac{2\tan x}{1-\tan^2 x}$ is positive?

75. If $0 < \theta < \frac{\pi}{8}$, show that $\sqrt{2+\sqrt{2+\sqrt{2+2\cos 4\theta}}} = 2\cos\frac{\theta}{2}$

76. Prove that $\tan\alpha = \frac{\sin 2\alpha}{1+\cos 2\alpha}$ and hence deduce the values of $\tan 15^0$ and $\tan 22\frac{1}{2}^0$

77. If $\cos\theta = t\left(0 < t < 1\right)$ and θ does not lies in the first quadrant find the values of $\sin\theta$ *and* $Tan\theta$ **(Mar-17)**

78. If $\sin\theta = \frac{4}{5}$ and θ is not in the first quadrant the find the value of $\cos\theta$ **(Ts-Mar-17,MAR-19)**

79. Prove that $\cos 48^0.\cos 12^0 = \frac{3+\sqrt{5}}{8}$ **(Ts-Mar-17)**

80. Eleminate θ, from $x = a\cos^3\theta, y = b\sin^3\theta$ **(Ts-Mar-16)**

81. Find the value of $Sin\mathbf{330^0}Cos\mathbf{120^0} + Cos\mathbf{210^0}Sin\mathbf{300^0}$ **(Mar-18)**

82 Find the extreme values of $Cos\mathbf{2}x + Cos^2 x$ **(Mar-18)**

83. Prove that $Sin\mathbf{50^0} - Sin\mathbf{70^0} + Sin\mathbf{10^0} = \mathbf{0}$ **(Ts-Mar-18)**

TRIGONOMETRIC EQUATIONS

SHORT ANSWER QUESTIONS :

***1. Solve the following and write the general solution

i) $2\cos^2\theta - \sqrt{3}\sin\theta + 1 = 0$ **(May-09),** ii) $\sqrt{2}\left(\sin x + \cos x\right) = \sqrt{3}$ **(May-12, Mar-15)**

iii) $\tan\theta + 3\cot\theta = 5\sec\theta$

***2. If $\tan(\pi\cos\theta)=\cot(\pi\sin\theta)$, then prove that $\cos\left(\theta-\frac{\pi}{4}\right)=\pm\frac{1}{2\sqrt{2}}$

***3. If $\tan p\theta=\cot q\theta$, and $p\neq -q$ then show that the solutions are in A.P. with common difference $\frac{\pi}{p+q}$.

***4. If θ_1,θ_2 are solutions of the equation $a\cos 2\theta+b\sin 2\theta=c$, $\tan\theta_1\neq\tan\theta_2$ and $a+c\neq 0$, then find the values of

i) $\tan\theta_1+\tan\theta_2$ **(Ts-Mar-19),** ii) $\tan\theta_1.\tan\theta_2$ **(Ts-Mar-15,19)** (iii) $\tan(\theta_1+\theta_2)$ (**May-10)**

***5. If α,β are solutions of the Equation

$aCos\theta+bSin\theta=c \quad a,b,c\in R \ and \ a^2+b^2>0, Cos\alpha\neq Cos\beta, Sin\alpha\neq Sin\beta,$ then show that

$i) Sin\alpha+Sin\beta=\frac{2bc}{a^2+b^2}$ $\qquad ii) Sin\alpha.Sin\beta=\frac{c^2-a^2}{a^2+b^2}$

$iii) Cos\alpha+Cos\beta=\frac{2ac}{a^2+b^2}$ $\quad iv) Cos\alpha.Cos\beta=\frac{c^2-b^2}{a^2+b^2}$

***6. Solve i) $\sin 2x-\cos 2x=\sin x-\cos x$

ii) $\sin x+\sqrt{3}\cos x=\sqrt{2}$ (**Mar-10),Ts-Mar-18**

iii) $1+\sin^2\theta=3\sin\theta\cos\theta$ **(Mar-11,17),Ts-Mar-17**

***7. If $0<\theta<\pi$, solve $\cos\theta.\cos 2\theta\cos 3\theta=\frac{1}{4}$ **(Mar-12)**

***8. Solve the equation $\cot^2 x-\left(\sqrt{3}+1\right)\cot x+\sqrt{3}=0;\ \left(0<x<\frac{\pi}{2}\right)$ **(Mar-12,14)**

***9. Find all values of x in $(-\pi,\pi)$ satisfying the equation $8^{1+\cos x+\cos^2 x+.....}=4^3$ **(Mar-09)**

***10. Solve $4\,sin\,x\ sin\,2x\ sin\,4x\ =\ sin\,3x$ **(Mar-13)**

***11. Solve the equation $\sqrt{3}Sin\theta-Cos\theta=\sqrt{2}$ **(Mar-18)**

**12. If x is acute and $\sin\left(x+10^0\right)=\cos\left(3x-68^0\right)$ find x.

**13. Find the general solution of the equations $\cos ec\theta=-2, \cot\theta=-\sqrt{3}$

**14. Solve $Tan\theta+Sec\theta=\sqrt{3}, \quad 0\leq\theta\leq 2\pi$.

**15. Solve $Cos3x+Cos2x=Sin\frac{3x}{2}+Sin\frac{x}{2}$ $\qquad 0\leq x\leq 2\pi$

**16. Solve and write the general solution of the equation $4\cos^2\theta+\sqrt{3}=2\left(\sqrt{3}+1\right)\cos\theta$

**17. If $x+y=\frac{2\pi}{3}$ and $\sin x+\sin y=\frac{3}{2}$ then find x and y

**18. Solve $\sin 3\alpha=4\sin\alpha\ \sin(x+\alpha)\sin(x-\alpha)$ where $\alpha\neq n\pi, n\in z$

19. Given $p \neq \pm q$. showt that the solution of $\cos p\theta + \cos q\theta = 0$ from two serieseach of which is in A.P.Also.find the common difference of eanch A.P. **(MAR-19)

INVERSE TRIGONOMETRIC FUNCTIONS

SHORT ANSWER QUESTIONS :

***1. Prove that i) $Tan^{-1}\frac{1}{2} + Tan^{-1}\frac{1}{5} + Tan^{-1}\frac{1}{8} = \frac{\pi}{4}$

(Mar-11,15,17,19,May-06,10,11),Ts-Mar-18)

ii) Prove that $Tan^{-1}\frac{3}{4} + Tan^{-1}\frac{3}{5} - Tan^{-1}\frac{8}{19} = \frac{\pi}{4}$

***2. Prove that i) $Sin^{-1}\frac{4}{5} + Sin^{-1}\frac{5}{13} + Sin^{-1}\left(\frac{16}{65}\right) = \frac{\pi}{2}$ **(Mar-18)**

ii) $Sin^{-1}\frac{4}{5} + 2Tan^{-1}\frac{1}{3} = \frac{\pi}{2}$ **(Mar-10), Ts-Mar-15**

iii) $\sin^{-1}\frac{3}{5} + \sin^{-1}\frac{8}{17} = \cos^{-1}\frac{36}{85}$ **(TS-MAR-19)** **(May-09)**

iv) $2Sin^{-1}\left(\frac{3}{5}\right) - Cos^{-1}\frac{5}{13} = Cos^{-1}\left(\frac{323}{325}\right)$ **(Mar-14)**

***3. Find the value of $\tan\left[\cos^{-1}\frac{4}{5} + \tan^{-1}\frac{2}{3}\right]$ **(Mar-12)**

***4. Prove that $Sin^{-1}\left(\frac{4}{5}\right) + Sin^{-1}\left(\frac{7}{25}\right) = Sin^{-1}\left(\frac{117}{125}\right)$ **(Mar-13)**

***5. If $Sin^{-1}x + Sin^{-1}y + Sin^{-1}z = \pi$, then prove that $x\sqrt{1-x^2} + y\sqrt{1-y^2} + z\sqrt{1-z^2} = 2xyz$

(Mar-06, May-05)

***6. If $Cos^{-1}p + Cos^{-1}q + Cos^{-1}r = \pi$, then prove that $p^2 + q^2 + r^2 + 2pqr = 1$

***7. i) If $Tan^{-1}x + Tan^{-1}y + Tan^{-1}z = \pi$, then prove that $x + y + z = xyz$

ii) If $Tan^{-1}x + Tan^{-1}y + Tan^{-1}z = \frac{\pi}{2}$, then prove that $xy + yz + zx = 1$

***8. If $Cos^{-1}\frac{p}{a} + Cos^{-1}\frac{q}{b} = \alpha$, then prove that $\frac{p^2}{a^2} - \frac{2pq}{ab}.\cos\alpha + \frac{q^2}{b^2} = \sin^2\alpha$

***9. Solve the following equations for x.

i) $3Sin^{-1}\frac{2x}{1+x^2} - 4Cos^{-1}\frac{1-x^2}{1+x^2} + 2Tan^{-1}\frac{2x}{1-x^2} = \frac{\pi}{3}$ **(Mar-09)**

ii) $Tan^{-1}\frac{x-1}{x-2} + Tan^{-1}\frac{x+1}{x+2} = \frac{\pi}{4}$

***10. Prove that $\cos\left[Tan^{-1}\left\{\sin\left(Cot^{-1}x\right)\right\}\right] = \sqrt{\frac{x^2+1}{x^2+2}}$

***11. Show that $\sec^2\left(Tan^{-1}2\right)+\cos ec^2\left(Cot^{-1}2\right)=10$

**12. Find the value of $\tan\left(2Tan^{-1}\left(\frac{1}{5}\right)-\frac{\pi}{4}\right)$

**13. Prove that $\tan\left(\frac{\pi}{4}+\frac{1}{2}Cos^{-1}\frac{a}{b}\right)+\tan\left(\frac{\pi}{4}-\frac{1}{2}Cos^{-1}\frac{a}{b}\right)=\frac{2b}{a}$

**14. Prove that $\sin^{-1}\left(\frac{3}{5}\right)+\cos^{-1}\left(\frac{12}{13}\right)=\cos^{-1}\left(\frac{33}{65}\right)$

**15. Prove that $Cot^{-1}9+Co\sec^{-1}\frac{\sqrt{41}}{4}=\frac{\pi}{4}$

**16. Prove that $\cos\left[2Tan^{-1}\frac{1}{7}\right]=\sin\left[4Tan^{-1}\frac{1}{3}\right]$.

17. Prove that $\sin\left[\cot^{-1}\frac{2x}{1-x^2}+\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right]=1$ **(Mar-04)

**18. Solve $\tan^{-1}\left[\frac{1}{2x+1}\right]+\tan^{-1}\left[\frac{1}{4x+1}\right]=\tan^{-1}\left[\frac{2}{x^2}\right]$

19. Prove that $\cos^{-1}\frac{4}{5}+\sin^{-1}\frac{3}{\sqrt{34}}=\tan^{-1}\left(\frac{27}{11}\right)$ **(May-13)

20. Show that $\cot\left(\sin^{-1}\sqrt{\frac{13}{17}}\right)=\sin\left(\tan^{-1}\frac{2}{3}\right)$ **(Ts-Mar-17)

*21. If $sin^{-1}x+sin^{-1}y+sin^{-1}z=\pi$ then prove that

$x^4+y^4+z^4+4x^2y^2z^2=2\left(x^2y^2+y^2z^2+z^2x^2\right)$

*22. (i) Solve arc $\sin\left(\frac{5}{x}\right)+arc\sin\frac{12}{x}=\frac{\pi}{2}\ (x>0)$

(ii) Solve $\sin^{-1}x+\sin^{-1}2x=\frac{\pi}{3}$

HYPERBOLIC FUNCTIONS

VERY SHORT ANSWER QUESTIONS :

1. If $\cosh x=\frac{5}{2}$, find the values of (i) $\cosh(2x)$ and (ii) $\sinh(2x)$ **(Mar-,11),Ts-Mar-17,19**
2. If $\sinh x=\frac{3}{4}$, find $\cosh(2x)$ and $\sinh(2x)$ **(May-09,Mar-12,14)**
3. If $\cosh x=\sec\theta$ then prove that $\tanh^2 x/2=\tan^2\theta/2$ **(Mar-13)**
4. For $x,y\in R$ i) $\sinh(x+y)=\sinh x\cosh y+\cosh x\sinh y$

   ii) $\cosh(x+y)=\cosh x\cosh y+\sinh x\sinh y$

5. Prove that

i) $(\cosh x - \sinh x)^n = \cosh(nx) - \sinh(nx)$, for any $n \in R$ **(Mar-06,07, Ts-Mar-15)**

ii) $(\cosh x + \sinh x)^n = \cosh(nx) + \sinh(nx)$, for any $n \in R$ **(Ts-Mar-18)**

6. For any $x \in R$, Prove that $\cosh^4 x - \sinh^4 x = \cosh(2x)$

7. *If* $\theta \in \left(\frac{-\pi}{4}, \frac{\pi}{4}\right)$ *and* $x = \log\left[\cot\left(\frac{\pi}{4} + \theta\right)\right]$, prove that $\sinh x = -\tan 2\theta$ and $\cosh x = \sec 2\theta$

8. If $u = \log_e\left(\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)\right)$ and if $\cos\theta > 0$, then prove that coshu = secθ.

9. Prove that $\tanh(x-y) = \frac{\tanh x - \tanh y}{1 - \tanh x.\tanh y}$

10. Prove that $\frac{\cosh x}{1-\tanh x} + \frac{\sinh x}{1-\coth x} = \sinh x + \cosh x$, for $x \neq 0$.

11. Theorem : for $x \in (-1,1)$, $\tanh^{-1}(x) = \frac{1}{2}\log_e\left(\frac{1+x}{1-x}\right)$

12. Show that $\tanh^{-1}\left(\frac{1}{2}\right) = \frac{1}{2}\log_e 3$ **(Mar-05,07,15,17,19May-05,07)**

13. If $\sinh x = 5$, show that $x = \log_e\left(5 + \sqrt{26}\right)$

14. If $\sinh x = 3$ then show that $x = \log\left(3 + \sqrt{10}\right)$ **(Ts-Mar-16)**

15. For any $x \in R$ then show that $Cosh2x = 2Cosh^2 x - 1$ **(Mar-18)**

PROPERTIES OF TRIANGLES

LONG ANSWER QUESTIONS :

***1. If a = 13, b = 14, c = 15, show that $R = \frac{65}{8}, r = 4, r_1 = \frac{21}{2}, r_2 = 12$ and $r_3 = 14$ **(Mar-14,15,19 May-10, Jun-11)**

***2. i) If $r_1 = 2, r_2 = 3, r_3 = 6$ and $r = 1$, Prove that $a = 3, b = 4$ and $c = 5$ **(Mar-09, TS-Mar-15)**

ii) In ΔABC, if $r_1 = 8, r_2 = 12, r_3 = 24$, find a, b, c **(Mar-17)**

***3. Show that $\frac{r_1}{bc} + \frac{r_2}{ca} + \frac{r_3}{ab} = \frac{1}{r} - \frac{1}{2R}$ **(May-09)**

***4. (i) Show that $r + r_1 + r_2 - r_3 = 4R\cos C$ **(Mar-12)**

(ii) Show that $r + r_3 + r_1 - r_2 = 4R\cos B$ **(Mar-13,18)**

***5. In ΔABC, prove that $r_1 + r_2 + r_3 - r = 4R$ **(Mar-06)**

***6. If P_1, P_2, P_3 are the altitudes drawn from vertices A, B, C to the opposite sides of a triangle respectively, then show that

i) $\frac{1}{P_1}+\frac{1}{P_2}+\frac{1}{P_3}=\frac{1}{r}$ ii) $P_1P_2P_3=\frac{(abc)^2}{8R^3}=\frac{8\Delta^3}{abc}$ **(Mar-10),Ts-Mar-18**

***7. Show that $\frac{ab-r_1r_2}{r_3}=\frac{bc-r_2r_3}{r_1}=\frac{ca-r_3r_1}{r_2}$ **(Mar-08, May-08)**

***8. Show that $\cos^2\frac{A}{2}+\cos^2\frac{B}{2}+\cos^2\frac{C}{2}=2+\frac{r}{2R}$ **(Mar-05)**

***9. If $r:R:r_1=2:5:12$, then prove that the triangle is right angled at A. **(May-07,09)**

***10. Prove that $a^3\cos(B-C)+b^3\cos(C-A)+c^3\cos(A-B)=3abc$

***11. Show that $a\cos^2\frac{A}{2}+b\cos^2\frac{B}{2}+c\cos^2\frac{C}{2}=s+\frac{\Delta}{R}$ **(Mar-09)**

**12. Show that i) $a=(r_2+r_3)\sqrt{\frac{rr_1}{r_2r_3}}$ ii) $\Delta=r_1r_2\sqrt{\frac{4R-r_1-r_2}{r_1+r_2}}$

**13. In ΔABC show that $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}=2R$ where R is the circumradius

**14. If $\cos A+\cos B+\cos C=3/2$, then show that the triangle is equilateral

**15. Prove that $\frac{\cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}}{\cot A+\cot B+\cot C}=\frac{(a+b+c)^2}{a^2+b^2+c^2}$

**16. Prove that $\frac{r_1(r_2+r_3)}{\sqrt{r_1r_2+r_2r_3+r_3r_1}}=a$

**17. If $a^2+b^2+c^2=8R^2$, then prove that the triangle is right angled.

**18. In ΔABC, show that i) $b^2=c^2+a^2-2ca\cos B$ ii) $c^2=a^2+b^2-2ab\cos C$

iii) $a^2=b^2+c^2-2bc\cos A$

**19. The angle of elevation of the top point P of the vertical tower PQ of height *h* from a point A is 45^0 and from a point B is 60^0, where B is a point at a distance 30 meters from the point A measured along the line AB which makes an angle 30^0 with AQ. Find the height of the tower.

*20. A lamp post is situated at the middle point M of the side AC of a triangular plot ABC with BC= 7m, CA= 8m and AB= 9m. Lamp post subtends an angle 15^0 at the point B. Find the height of the lamp post.

*21. The upper $\frac{3}{4}$ th portion of a vertical pole subtends an angle $\tan^{-1}\frac{3}{5}$ at a point in the horizontal plane through its foot and at a distance 40m from the foot. Given that the vertical pole is at a height less than 100m from the ground, find its height.

*22. AB is a vertical pole with B at the ground level and A at the top. A man finds that the angle of elevation of the point A from a certain point C on the ground is 60^0. He moves away from the pole along the line BC to a point D such that CD= 7m. From D, the angle of elevation of the point A is 45^0. Find the height of the pole.

PROPERTIES OF TRIANGLES

SHORT ANSWER QUESTIONS :

***23. If i) $a=(b-c)\sec\theta$, prove that $\tan\theta=\frac{2\sqrt{bc}}{b-c}\sin\frac{A}{2}$ **(Mar-10,11,18)**

ii) $a=(b+c)\cos\theta$, prove that $\sin\theta=\frac{2\sqrt{bc}}{b+c}\cos\frac{A}{2}$ **(MAR-19,May-11)**

iii) $\sin\theta=\frac{a}{b+c}$, prove that $\cos\theta=\frac{2\sqrt{bc}}{b+c}\cos\frac{A}{2}$ **(Mar-11,12, May-11)**

***24. $\cot A+\cot B+\cot C=\frac{a^2+b^2+c^2}{4\Delta}$ **(Mar-10, May-12), Ts-Mar-15,18**

***25. Show that $\frac{\cos A}{a}+\frac{\cos B}{b}+\frac{\cos C}{c}=\frac{a^2+b^2+c^2}{2abc}$ **(May-10)**

***26. Show that $\frac{1}{r^2}+\frac{1}{r_1^2}+\frac{1}{r_2^2}+\frac{1}{r_3^2}=\frac{a^2+b^2+c^2}{\Delta^2}$ **(Ts-Mar-17,19-LAQ)**

***27. Show that $\cos A+\cos B+\cos C=1+\frac{r}{R}$

***28. In a ΔABC show that $\frac{b^2-c^2}{a^2}=\frac{\sin(B-C)}{\sin(B+C)}$. **(Mar-15)**

***29. Prove that $\cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}=\frac{s^2}{\Delta}$

***30. In ΔABC, if $\frac{1}{a+c}+\frac{1}{b+c}=\frac{3}{a+b+c}$, show that $C=60^0$ **(Ts-Mar-17,19)**

***31. If $C=60^0$, then show that i) $\frac{a}{b+c}+\frac{b}{c+a}=1$ ii) $\frac{b}{c^2-a^2}+\frac{a}{c^2-b^2}=0$

***32. Show that in ΔABC, $a=b\cos C+c\cos B$ **(May-09)**

***33. Show that in ΔABC, $\tan\left(\frac{B-C}{2}\right)=\frac{b-c}{b+c}\cot\frac{A}{2}$ **(May-08)**

***34. Show that $(b-c)^2\cos^2\frac{A}{2}+(b+c)^2\sin^2\frac{A}{2}=a^2$ **(May-08)**

35. Show that $a^2\cot A+b^2\cot B+c^2\cot C=\frac{abc}{R}$ **(Mar-14)

**36. If p_1, p_2, p_3 are the altitudes of the vertices A, B, C of a triangle respectively, show that

$\frac{1}{p_1^2}+\frac{1}{p_2^2}+\frac{1}{p_3^2}=\frac{\cot A+\cot B+\cot C}{\Delta}$ **(Mar-13)**

**37. If $a:b:c=7:8:9$, find $\cos A:\cos B:\cos C$

**38. If $\cot\frac{A}{2},\cot\frac{B}{2},\cot\frac{C}{2}$ are in A.P., then prove that a, b, c are in A.P.

**39. If $(r_2-r_1)(r_3-r_1)=2r_2r_3$. Show that $A=90^0$

**40. If $\frac{a^2+b^2}{a^2-b^2}=\frac{\sin C}{\sin(A-B)}$, prove that ΔABC is a right angled.

*41. Show that $b^2\sin 2C+c^2\sin 2B=2bc\sin A$.

*42. Show that $(a+b+c)\left(\tan\frac{A}{2}+\tan\frac{B}{2}\right)=2c\cot\frac{C}{2}$.

*43. Prove that $\tan\frac{A}{2}+\tan\frac{B}{2}+\tan\frac{C}{2}=\frac{bc+ca+ab-s^2}{\Delta}$

*44. If $\cot\frac{A}{2}:\cot\frac{B}{2}:\cot\frac{C}{2}=3:5:7$, show that $a:b:c=6:5:4$ **(Mar-17)**

*45. If $\sin^2\frac{A}{2},\sin^2\frac{B}{2},\sin^2\frac{C}{2}$ are in H.P., then show that a, b, c are in H.P.

PROPERTIES OF TRIANGLES

(NOT GIVEN IN EXAMS BUT THE QUESTIONS USEFUL TO SOLVE LAQ'S & SAQ'S)

46. In an equilateral triangle, find the value of r/R.

47. If the lengths of the sides of a triangle are 3, 4, 5, find the circumradius of the triangle

48. In ΔABC, show that $\sum(b+c)\cos A=2s$

49. If the sides of a triangle are 13, 14, 15, then find the circum diameter

50. In ΔABC, if $(a+b+c)(b+c-a)=3bc$, find A **(Mar-08)**

51. In ΔABC, find $b\cos^2\frac{C}{2}+c\cos^2\frac{B}{2}$ (**Mar-10,12)**

52. If $\tan\frac{A}{2}=\frac{5}{6}$ and $\tan\frac{C}{2}=\frac{2}{5}$, determine the relation between a, b, c **(May-05)**

53. If $\cot\frac{A}{2}=\frac{b+c}{a}$, find angle B

54. In ΔABC, express $\sum r_1\cot\left(\frac{A}{2}\right)$ in terms of s. **(May-06,11)**

55. Show that $\frac{c-b\cos A}{b-c\cos A}=\frac{\cos B}{\cos C}5$

56. If $a=\sqrt{3}+1 cms.,\angle B=30^0,\angle C=45^0$, then find c

57. If a = 26 cms., b = 30 cms. and $\cos C=\frac{63}{65}$, then find c. **(Mar-11)**

58. If $a=6,\ b=5,\ c=9$ then find angle A. **(May-10)**

59. If $a=4,\ b=5,\ c=7$ then find $\cos\frac{B}{2}$

60. If the angles are in the ratio 1 : 5 : 6, then find the ratio of its sides **(May-07)**

61. Prove that $\frac{a^2+b^2-c^2}{c^2+a^2-b^2}=\frac{\tan B}{\tan C}$

62. Prove that $(b-a\cos C)\sin A = a\cos A\sin C$ **(Mar-06)**

63. If $\frac{a}{\cos A}=\frac{b}{\cos B}=\frac{c}{\cos C}$, then show that ΔABC is equilateral **(Mar-09)**

64. In ΔABC, prove that $\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}=\frac{1}{r}$

65. Show that $r\,r_1\,r_2\,r_3=\Delta^2$

66. In $\Delta ABC, \Delta = 6$ sq.cm and s = 1.5 cm., find r.

67. If $rr_2 = r_1r_3$, then find B

68. If $A=90^0$, show that $2(r+R)=b+c$

69. Show that $\Sigma\frac{r_1}{(s-b)(s-c)}=\frac{3}{r}$

70. Show that $a^2\sin 2C + c^2\sin 2A = 4\Delta$

71. If $a\cos A = b\cos B$, prove that the triangle is either isosceles or right angled.

JUNIOR IPE IMPORTANT QUESTION BANK
MATHEMATICS – IB

BLUE PRINT		
S.NO	NAME OF THE CHAPTER	WEIGHTAGE MARKS
CO-ORDINATE GEOMETRY		
1.	Locus	04 (4)
2.	Transformation of axes	04 (4)
3.	Straight line	15 (7+4+2+2)
4.	Pair of straight lines	14 (7+7)
3D GEOMETRY		
5.	3D – coordinates	02 (2)
6.	Direction Cosines & Direction Ratios	07 (7)
7.	The Plane	02 (2)
CALCULUS		
8.	Limits & Continuity	08 (4+2+2)
9.	Differentiation	15 (7+4+2+2)
10.	Errors – Approximations	02 (2)
11.	Tangent & Normal	11 (7+4)
12.	Rate measure	04 (4)
13.	Rolle's & Lagrange's Theorems	02 (2)
14.	Maxima & Minima	07 (7)
Total marks		97

QUESTION BANK ANALYSIS									
S.NO	TOPIC NAME	LAQ			SAQ			VSAQ	TOTAL
		***	**	*	***	**	*		
CO-ORDINATE GEOMETRY									
1	LOCUS				11	1	3		15
2	TRANSFORMATIONS OF AXES				6	1	3		10
3	STRAIGHT LINES	13		3	14	2	13	39	84
4	PAIR OF STRAIGHT LINES	13	5	5					23
3D GEOMETRY									
5	3D CO-ORDINATES							15	15
6	DIRECTION COSINES & DIRECTION RATIOS	4	2	2					8
7	PLANES							13	13
CALCULUS									
8	LIMITS							42	42
9	CONTINUITY				4	1	3		8
10	DIFFERENTIATIONS	7	7	2	7	7	7	49	86
11	ERRORS & APPROXIMATIONS							17	17
12	TANGENT & NORMALS	10	6	3	9	2	7		37
13	RATE MEASURE				8	2	5		15
14	ROLLE'S & LAGRANGE'S THEOREMS							15	15
15	MAXIMA & MINIMA	5	3	6				1	15
16	INCREASING AND DECREASING FUNCTIONS						1	2	3
	SUBTOTAL	52	23	21	60	16	41	193	406
	TOTAL	96			117				

LOCUS

SHORT ANSWER QUESTIONS :

1.*** A(1,2), B(2,-3)andC(-2,3) are three points. A point 'P' moves such that $PA^2 + PB^2 = 2PC^2$. Show that the equation to the locus of P is 7x–7y+4=0.(TS-Mar-19) (Mar-11,17) (May-07,09)

2.*** Find the equation of locus of P, if the ratio of the distance from P to (5, -4) and (7, 6) is 2 : 3. **(May-08, July-01,Mar-14)**

3.*** A (5, 3) and B (3, -2) are two fixed points. Find the equation of locus of P, so that the area of triangle PAB is 9 sq.units. **(Mar-06,09,19,Ts-Mar-15,17)**

4.*** A (2,3), B(-3,4) are two given points. Find the equation of locus of P so that the area of ΔPAB is 8.5 sq.units. **(Mar-11)**

5.*** Find the equation of locus of a point, the difference of whose distances from (-5, 0) and (5, 0) is 8. **(Mar-04, May-06)**

6.*** Find the equation of locus of P, if A = (2, 3), B = (2, -3) and PA + PB = 8. **(Mar-03,08,15,18)**

7.*** Find the equation of locus of P, if the line segment joining (2, 3) and (-1, 5) subtends a right angle at P. **(May-12, Mar-05,13)**

8.*** The ends of the hypotenuse of a right angled triangle are (0, 6) and (6, 0). Find the equation of locus of its third vertex. **(May-10, Mar-08)**

9.*** Find the equation of the locus of a point P such that the distance of P from the origin is twice the distance of P from A(1,2). **(Jun-05,Mar-12)**

10.*** Find the equation of locus of P, if A=(4,0), B=(-4,0) and $|PA - PB| = 4$. **(May-13, Mar-07)**

11.*** Find the locus of the third vertex of a right angle traingle, the ends of whose hypotenuse are (4,0) and (0,4) **(Ts-Mar-18)**

12.** Find the equation of locus of a point, the sum of whose distances from (0, 2) and (0, -2) is 6 units. **(Mar-10,Ts-Mar-16)**

13.* Find the equation of locus of a point P, if the distance of P from A (3, 0) is twice the distance of P from B (-3, 0).

14.* Find the equation of the locus of a point P such that $PA^2 + PB^2 = 2c^2$ where $A = (a,0), B = (-a,0)$, and $0 < |a| < |c|$.

15*. If the distance from P to the points $17x^2 - 16xy + 17y^2 = 225$ are in the ratio 2:3 then find the equation of locus of P. **(May-14,Mar-16)**

TRANSFORMATION OF AXES

SHORT ANSWER QUESTIONS :

1.*** When the origin is shifted to the point (2,3), the transformed equation of a curve is $x^2 + 3xy - 2y^2 + 17x - 7y - 11 = 0$. Find the original equation of the curve. **(Mar-09,10,11 May-09,Ts-Mar-16)**

2.*** When the axes are rotated through an angle $\frac{\pi}{4}$, find the transformed equation of $3x^2 + 10xy + 3y^2 = 9$.(Ts mar2017) **(Jun-05,May-08,12, Mar-17)**

3.*** When the axes are rotated through an angle $\frac{\pi}{6}$, find the transformed equation of $x^2 + 2\sqrt{3}xy - y^2 = 2a^2$. **(May-06,13,Mar-07,12,15),Ts-Mar-18**

4.*** When the axes are rotated through an angle 45°, the transformed equation of a curve is $17x^2 - 16xy + 17y^2 = 225$. Find the original equation of the curve. **(May-10, Mar-08,Ts-Mar-15)**

5.*** Show that the axes are to be rotated through an angle of $\frac{1}{2}Tan^{-1}\left(\frac{2h}{a-b}\right)$ so as to remove the xy term from the equation $ax^2+2hxy+by^2=0$, if $a \neq b$ and through the angle $\frac{\pi}{4}$, if a = b. **(Mar-06,13)**

6.*** When the axes are rotated through an angle α, find the transformed equation of $x\cos\alpha + y\sin\alpha = p$. **(TS-Mar-19)** **(May-07, Mar-14)**

7.** When the origin is shifted to (-1,2) by the translation of axes, find the transformed equation of $x^2+y^2+2x-4y+1=0$. **(Mar-18)**

8.* When the origin is shifted to the point (-1,2), the transformed equation of a curve is $x^2+2y^2+16=0$. Find the original equation of the curve.

9.* When the origin is shifted to the point (-1,2), the transformed equation of a curve is $2x^2+y^2-4x+4y=0$. Find original equation **(Mar-16)**

10.* When the origin is shifted to the point (3,4), and transformed equation is $x^2 + y^2 = 4$. Find original equation **(MAR-19)**

STRAIGHT LINES

LONG ANSWER QUESTIONS :

1***. Find the circumcentre of the triangle with the vertices(-2, 3), (2, -1) and (4, 0). **(Mar-11,17)**

2***. Find the circumcentre of the triangle whose vertices are (1, 3), (0, -2) and (-3, 1).**(Mar-18)**

3***. Find the orthocentre of the triangle with the vertices(-2,-1), (6,-1) and (2,5). **(Mar-04,07,15)**

4***. Find the orthocentre of the triangle with the vertices(-5,-7), (13, 2) and (-5, 6). **(Mar-12,16)**

5***. Find the circumcentre of the triangle whose vertices are (1, 3), (-3, 5) and (5, 1).**(Ts-Mar-18)**

6***. Find the circumcentre of the triangle whose sides are $3x-y-5=0, x+2y-4=0$ and $5x+3y+1=0$. **(Jun-05,Mar-06)**

7***. Find the circumcentre of the triangle whose sides are $x+y+2=0, 5x-y-2=0$, and $x-2y+5=0$. **(Mar-14)**

8***. Find the orthocentre of the triangle formed by the lines $x+2y=0, 4x+3y-5=0$ and $3x+y=0$. **(Mar-10)**

9***. If the equations of the sides of a triangle are $7x+y-10=0$, $x-2y+5=0$ and $x+y+2=0$. Find the orthocentre of the triangle. **(May-09),TS-Mar-15**

10***. If Q(h,k) is the image of the point P (x_1, y_1) w.r.t. the straight line ax + by + c = 0. Then $(h-x_1):a=(k-y_1):b=-2(ax_1+by_1+c):a^2+b^2$ **(or)** $\frac{h-x_1}{a}=\frac{k-y_1}{b}=\frac{-2(ax_1+by_1+c)}{a^2+b^2}$ and find the image of (1, -2) w.r.t. The straight line 2x-3y+5=0. **(Mar-13,19, May-04)**

11***. If Q(h, k) is the foot of the perpendicular from P(x_1, y_1) on the line ax + by + c = 0, then prove that $(h-x_1):a=(k-y_1):b=-(ax_1+by_1+c):a^2+b^2$ (or) $\frac{h-x_1}{a}=\frac{k-y_1}{b}=\frac{-(ax_1+by_1+c)}{a^2+b^2}$. Also find the foot of the perpendicular from (-1,3) on the line 5x – y – 18=0. **(May-07)**

12***. If p and q are the lengths of the perpendiculars from the origin to the straight lines $x\sec\alpha + y\operatorname{cosec}\alpha = a$ and $x\cos\alpha - y\sin\alpha = a\cos 2\alpha$, prove that $4p^2+q^2=a^2$ **(Mar-08)**

13***. Find the equations of the straight lines passing through the point of intersection of the lines 3x+2y+4=0,2x+5y=1 and whose distance from (2,-1) is 2. **(May-09,Mar-09)**

14*. Show that the origin is with in the triangle whose angular points are (2, 1) (3, -2) and (-4, -1)

15*. Find the equation of the straight lines passing through (1,2) and making an angle of 60^0 with the line $\sqrt{3}x + y + 2 = 0$. **(Board Paper)**

16*. Find the orthocentre of the triangle with the vertices (5,-2) (-1,2) and (1,4) **(TS-Mar-17,19)**

SHORT ANSWER QUESTIONS :

17.*** Transform the equation $\sqrt{3}x + y = 4$ into (a) slope-intercept form (b) intercept form and (c) normal form. **(Mar-04, 08)**

18.*** Transform the equation $\frac{x}{a} + \frac{y}{b} = 1$ into the normal form when a>0 and b>0.If the perpendicular distance of straight line from the origin is p, deduce that $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$.**(Jun-04,May-08,Mar-07)**

19.*** A straight line through $Q\left(\sqrt{3}, 2\right)$ makes an angle $\pi / 6$ with the positive direction of the X-axis. If the straight line intersects the line $\sqrt{3}x - 4y + 8 = 0$ at P, find the distance PQ. **(TS-Mar-19) (Mar-04)**

20.*** A straight line through $Q(2,3)$ makes an angle $\frac{3\pi}{4}$ with the negative direction of the X-axis. If the straight line intersects the line $x + y - 7 = 0$ at P, find the distance PQ.

21.*** Find the points on the line $3x - 4y - 1 = 0$ which are at a distance of 5 units from the point (3,2) **(Mar-15,16)**

22.*** Find the value of k, if the angle between the straight lines $4x - y + 7 = 0$ and $kx - 5y - 9 = 0$ is 45^0. **(Mar-12)**

23.*** Find the values of k, if the angle between the straight lines $kx + y + 9 = 0$ and $3x - y + 4 = 0$ is $\frac{\pi}{4}$.

24.*** Find the equations of the straight lines passing through the point (-3, 2) and making an angle of 45° with the straight line 3x – y + 4 = 0. **(Mar-09)**

25.*** Find the equation of straight line making non-zero equal intercepts on the coordinate axes passing through the point of intersection of lines 2x – 5y + 1= 0 and x – 3y–4 =0.**(Mar-06)**

26.*** Find the point on the line $3x + y + 4 = 0$ which is equidistant from the points (-5,6) and (3,2) **(Mar-13)**

27.*** A triangle of area 24 sq. units is formed by a straight line and the co-ordinate axes in the first quadrant. Find the equation of that straight line if it passes through (3,4) **(May-07)**

28.*** (i) Find the value of k, if the lines $2x - 3y + k = 0, 3x - 4y - 13 = 0$ and $8x - 11y - 33 = 0$ are concurrent. **(Mar-05),Ts-Mar-18**

(ii) Find the value of p, if the lines $3x + 4y = 5, 2x + 3y = 4$ and $px + 4y = 6$ are concurrent **(Mar-17)**

29.*** If the straight lines $ax + by + c = 0, bx + cy + a = 0$ and $cx + ay + b = 0$ are concurrent, then prove that $a^3 + b^3 + c^3 = 3abc$. **(MAR-19)**

30.*** Show that the lines $\mathbf{2x + y - 3 = 0, 3x + 2y - 2 = 0}$ *and* $\mathbf{2x - 3y - 23 = 0}$ are concurrent and find the point of concurrency. **(Mar-18)**

31.** If $3a + 2b + 4c = 0$, then show that the equation $ax + by + c = 0$ represents a family of concurrent straight lines and find the point of concurrency. **(May-10)**

32.** Find the equation of the line perpendicular to the line $3x + 4y + 6 = 0$ and making an intercept -4 on the X-axis. **(Mar-10)**

33.* Find the equation of the straight line parallel to the line 3x + 4y = 7 and passing through the point of intersection of the lines x - 2y – 3 = 0 and x + 3y - 6 = 0.

34.* Find the equation of the straight line perpendicular to the line $2x + 3y = 0$ and passing through the point of intersection of the lines $x + 3y - 1 = 0$ and $x - 2y + 4 = 0$.

35*. Find the value of 'a' if the distances of the points (2, 3) and (-4, a) from the straight line $3x + 4y - 8 = 0$ are equal.

36*. Find the equations of the straight lines passing through (1, 3) and (i) parallel to (ii) perpendicular to the line passing through the points (3, -5) and (-6, 1)

37.* Find the angles of the triangle whose sides are $x + y - 4 = 0$, $2x + y - 6 = 0$ and $5x + 3y - 15 = 0$ **(May-07)**

38.* Line 'L' has intercepts a and b on the axes of cooridnates. When the axes are rotated through a given angle, keeping the origin fixed, the same line 'L' has intercepts p and q on the transformed axes prove that $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{p^2} + \frac{1}{q^2}$

39.* $A(10,4), B(-4,9)$ and $C(-2,-1)$ are the vertices of a triangle. Find the equations of

i) $\overline{AB}$ ii) The median through A

iii) the altitude through B iv) the perpendicular bisector of the side $\overline{AB}$

40.* A variable stright line drawn through the point of intersection of stright lines $\frac{x}{a} + \frac{y}{b} = 1$ and $\frac{x}{b} + \frac{y}{a} = 1$ meets the co-ordinate axes at A and B. Show that the locus of the mid point of $\overline{AB}$ is $2(a+b)xy = ab(x+y)$. **(May-05)**

41.* The length of the perpendicular from the point $P(x_0, y_0)$ to the straight line $ax + by + c = 0$ is $\frac{|ax_0 + by_0 + c|}{\sqrt{a^2 + b^2}}$.

42.* A(-1, 1), B(5,3) are opposite vertices of a square in the XY-plane. Find the equation of the other diagonal (not passing through A, B) of the square.

43* Transform the equation $4x - 3y + 12 = 0$ in to (i) slope intercept form (ii) intercept form (iii) normal form **(May-14,16)**

44.* A straight line with slope 1 passes through Q(-3,5) and meets the straight line x+y-6=0 at P. Find the distance PQ. **(TS-Mar-15)**

45.* $x - 3y - 5 = 0$ is perpendicular bisector of the line joining the points A & B. If A=(-1,-3), Find the coordinates of B.(Ts mar2017)

VERY SHORT ANSWER QUESTIONS:

46. Prove that the points (1,11), (2,15) and (-3, -5) are collinear and find the equation of the stright line containing them.

47. Find the condition for the points $(a,0), (h,k)$ and $(0,b)$ where $ab \neq 0$ to be collinear.**(Mar-10)**

48. Transform the equations into normal form.

i) $x + y + 1 = 0$ **(Mar-17,May-10),Ts-Mar-18** ii) $x + y - 2 = 0$ **(Mar-12)**

49. If the area of the triangle formed by the straight lines x=0, y= 0 and 3x + 4y = a (a > 0) is 6. Find the value of 'a'. **(May-07, Mar-09)**

50. If the product of the intercepts made by the straight line $x\tan\alpha + y\sec\alpha = 1\left(0 \le \alpha < \frac{\pi}{2}\right)$ on the co-ordinate axes is equal to $\sin\alpha$, find α.

51. Find the area of the triangle formed by the straight line x – 4y + 2 = 0 with the coordinate axes.

52. Find the equation of the straight line passing through (-4, 5) and cutting off equal nonzero intercepts on the coordinate axes. **(May-08,10, Mar 2007,)Ts-Mar-15**

53. Find the equation of the straight line passing through the point (3, -4) and making X and Y-intercepts which are in the ratio 2 : 3. **(Mar-2008)**

54. Find the equation of the straight line passing through the points $\left(at_1^2, 2at_1\right)$ and $\left(at_2^2, 2at_2\right)$ **(Mar-2014)**

55. Find the length of the perpendicular drawn from the point (-2, -3) to the straight line 5x–2y+4=0.

56. Find the distance between the parallel straight lines 5x–3y–4=0, 10x–6y–9=0 **(Mar-2009)**

57. Find the equation of straight line passing through the point (5, 4) and parallel to the line $2x + 3y + 7 = 0$. **(Mar-13)**

58. Find the value of y, if the line joining (3,y) and (2,7) is parallel to the line joining the points (-1,4) and (0,6).(Ts mar2017) **(Mar-08,14-SAQ)**

59. Find the value of k, if the straight lines $6x - 10y + 3 = 0$ and $kx - 5y + 8 = 0$ are parallel.

60. Find the value of p, if the straight lines $3x + 7y - 1 = 0$ and $7x - py + 3 = 0$are mutually perpendicular. **(TS-Mar-19)**

61. Find the equation of the straight line passing through (2, 3) and making non-zero intercepts on the co-ordinate axes whose sum is zero. **(Mar-12)**

62. Find the equation of the straight line passing through (-2, 4) and making non-zero intercepts on the co-ordinate axes whose sum is zero. **(May-09, Mar-15)**

63. Find the equations of the straight lines passing through the origin and making equal angles with the co-ordinate axes. **(Ts MAR-17)** **(May-05)**

64. Find the value of P, if the straight lines $x + p = 0$, $y + 2 = 0$, $3x + 2y + 5 = 0$ are concurrent. **(Mar-13)**

65. If $2x-3y-5=0$ is the perpendicular bisector of the line segment joining (3, -4) and (α, β), find $\alpha+\beta$. **(Mar-11)**

66. Find the value of k, if the straight lines $y-3kx+4=0$ and $(2k-1)x-(8k-1)y-6=0$ are perpendicular. **(Mar-10)**

67. If θ is the angle between the lines $\frac{x}{a}+\frac{y}{b}=1, \frac{x}{b}+\frac{y}{a}=1$ then find the value of $\sin\theta$ (a>b) **(May-09)**

68. Transform the equation $(2+5k)x-3(1+2k)y+(2-k)=0$ into the form $L_1+\lambda L_2=0$ and find the point of concurrency of the family of straight lines.

69. Find the ratio in which the straight line $2x+3y-20=0$ divides the join of the points (2, 3) and (2, 10).

70. If a portion of a straight line intercepted between the axes of coordinates is bisected $(2p, 2q)$ at write the equation of the straight line.

71. Find the foot of the perpendicular drawn from (4, 1) upon the straight line $3x-4y+12=0$.

72. Find the orthocenter of the triangle whose sides are given by $4x-7y+10=0, x+y=5$ and $7x+4y=15$

73. Find the incentre of the triangle whose sides are $x=1, y=1$ and $x+y=1$.

74. If a, b, c are in arithmetic progression, then show that the equation $ax+by+c=0$ represents a family of concurrent lines and find the point of concurrency.

75. Find the ratio in which the straight line $2x+3y=5$ divides the join of the points (0, 0) and (-2, 1). **(Mar-14)**

76. Find the value of 'P' if the lines $4x-3y-7=0, 2x+py+2=0$ and $6x+5y-1=0$ are concurrent. **(May-14)**

77. Find the area of the triangle formed by the straight line $3x-4y+12=0$ with the coordinate axes. **(Mar-15)**

78. Find the equation of the straight line perpendicular to the line 5x-3y+1=0 and passing through the point (4,-3). **(TS-Mar-15)**

79. Find the perpendicular distance from the point (3,4) to the straight line $3x-4y+10=0$ **(Mar-16,May-15)**

80. Find the slopes of the lines x+y=0 and x-y=0 **(Mar-17)**

81. Find the value of x if the slope of the line passing through (2,5) and (x,3) is 2. **(Mar-18),Ts-Mar-18**

82. Find the sum of the squares of the intercepts of the line $\mathbf{4x-3y=12}$ on the axis of co-ordinates. **(Mar-18)**

83. Find the angle which the straight line $y=\sqrt{3}x-4$ makes with the y-axis **(AP,TS-Mar-19)**

84. Find the distance between the parallel straight lines $3x+4y-3=0$ and $6x+8y-1=0$ **(AP-Mar-19)**

PAIR OF STRAIGHT LINES

LONGANSWER QUESTIONS

1.*** Find the values of k, if the lines joining the origin to the points of intersection of the curve $2x^2-2xy+3y^2+2x-y-1=0$ and the line x + 2y = k are mutually perpendicular. **(Jun-05, May-07,10,Mar-05,06,11,12,17,19)Ts-Mar-15,19**

2.*** Find the angle between the lines joining the origin to the points of intersection of the curve $x^2+2xy+y^2+2x+2y-5=0$ and the line $3x-y+1=0$. **(May-11,June-04,Mar-07,09,13,16)**

3.*** Show that the lines joining the origin to the points of intersection of the curve $x^2-xy+y^2+3x+3y-2=0$ and the straight line $x-y-\sqrt{2}=0$ are mutually perpendicular. **(Mar-08,12,15),Ts-Mar-18**

4.*** Find the condition for the lines joining the origin to the points of intersection of the circle $x^2+y^2=a^2$ and the line $lx+my=1$ to coincide. **(TS-MAR-17)**

5.*** Find the condition for the chord $lx+my+1=0$ of the circle $x^2+y^2=a^2$ (whose center is the origin) to subtend a right angle at the origin. **(Mar-14)**

6.*** Let the equation $ax^2+2hxy+by^2=0$ represents a pair of straight lines. Then the angle θ between the lines is given by $\cos\theta=\dfrac{a+b}{\sqrt{(a-b)^2+4h^2}}$. **(Mar-11),Ts-Mar-18**

7.*** Show that the product of the perpendicular distances from a point (α,β) to the pair of straight lines $ax^2+2hxy+by^2=0$ is $\dfrac{\left|a\alpha^2+2h\alpha\beta+b\beta^2\right|}{\sqrt{(a-b)^2+4h^2}}$ **(May-07,08,11,Mar-04,07)**

8.*** If the equation $ax^2+2hxy+by^2=0$ represents a pair of distinct (i.e., intersecting) lines, then the combined equation of the pair of bisectors of the angles between these lines is $h(x^2-y^2)=(a-b)xy$ **(May-09,Mar-09,18)**

9.*** Show that the area of the triangle formed by the lines $ax^2+2hxy+by^2=0$ and $lx+my+n=0$ is $\frac{n^2\sqrt{h^2-ab}}{|am^2-2hlm+bl^2|}$ sq.units. **(TS MAR-17,19)** **(May-10,Mar-13,17)**

10.*** If the equation $S=ax^2+2hxy+by^2+2gx+2fy+c=0$ represents a pair of parallel straight lines, then show that $(i)\,h^2=ab$ $(ii)\,af^2=bg^2$ and (iii) the distance between the parallel lines is $2\sqrt{\frac{g^2-ac}{a(a+b)}}=2\sqrt{\frac{f^2-bc}{b(a+b)}}$. **(Mar-06,10,12,15,19)**

11.*** If the second degree equation $S=ax^2+2hxy+by^2+2gx+2fy+c=0$ in two variables x and y represents a pair of straight lines, then

i) $abc+2fgh-af^2-bg^2-ch^2=0$ and ii) $h^2\geq ab, g^2\geq ac$ *and* $f^2\geq bc$ **(Mar-12,14,16)**

12.*** Find the centroid and area of the triangle formed by the lines $12x^2-20xy+7y^2=0$ and $2x-3y+4=0$. **(Mar-05)**

13.*** Find the angle between the straight lines joining the origin to the points of intersection of the curve $\mathbf{7x^2-4xy+8y^2+2x-4y-8=0}$ with the straight line $\mathbf{3x-y=2}$ **(Mar-18)**

14.** Show that the straight lines represented by $(x+2a)^2-3y^2=0$ and $x=a$ form an equilateral triangle.

15.** Show that the pairs of straight lines $6x^2-5xy-6y^2=0$ and $6x^2-5xy-6y^2+x+5y-1=0$ forms a square.

16**. If the equation $\lambda x^2-10xy+12y^2+5x-16y-3=0$ represents a pair of straight lines then find λ **(May-09)**

17.** Show that the product of the perpendicular distances from the origin to the pair of straight lines represented by $ax^2+2hxy+by^2+2gx+2fy+c=0$ is $\frac{|c|}{\sqrt{(a-b)^2+4h^2}}$

18.** Show that the equation $2x^2-13xy-7y^2+x+23y-6=0$ represents a pair of straight lines. Also find the angle between them and the coordinates of the point of intersection of the lines. **(Mar-04)**

19.* Show that the straight lines represented by $3x^2+48xy+23y^2=0$ and $3x-2y+13=0$ form an equilateral triangle of area $\frac{13}{\sqrt{3}}$ sq.units.

20.* Show that the lines represented by $(lx+my)^2-3(mx-ly)^2=0$ *and* $lx+my+n=0$ forms an equilateral triangle with area $\frac{n^2}{\sqrt{3}(l^2+m^2)}$ square units. **(Ts-Mar-15)**

21.* If (α,β) is the centroid of the triangle formed by the lines $ax^2+2hxy+by^2=0$ and $lx+my=1$, prove that $\frac{\alpha}{bl-hm}=\frac{\beta}{am-hl}=\frac{2}{3(bl^2-2hlm+am^2)}$.

22.* Find the value of k, if the equation $2x^2+kxy-6y^2+3x+y+1=0$ represents a pair of straight lines. Find the point of intersection of the lines and the angle between the straight lines for this value of 'k'.

23*. Find the centroid and the area of the triangle formed by the following lines

i) $2y^2 - xy - 6x^2 = 0; x + y + 4 = 0$

ii) $3x^2 - 4xy + y^2 = 0; 2x - y = 6$

3D – GEOMETRY

VERY SHORT ANSWER QUESTIONS

1. Find the centroid of the triangle whose vertices are (5,4,6),(1,-1,3) and (4,3,2). **(Mar-04)**

2. Find the coordinates of the vertex 'C' of ΔABC if its centroid is the origin and the vertices A, B are (1, 1,1) and (-2,4,1) respectively. **(Mar-16)**,**Ts-Mar-15**

3. Find the centroid of the tetrahedron whose vertices are $(2,3,-4),(-3,3,-2),(-1,4,2),(3,5,1)$

4. If (3, 2, -1), (4, 1, 1) and (6, 2, 5) are three vertices and (4, 2, 2) is the centroid of a tetrahedron, find the fourth vertex. **(Mar-09,14,15,17)**

5. Show that the points $A(3,-2,4), B(1,1,1), C(-1,4,-2)$ are collinear.

6. Show that the points A(1, 2, 3), B(7, 0, 1), C (–2, 3, 4) are collinear **(Mar–13)**

7. Find the fourth vertex of the parallelogram whose consecutive vertices are (2,4,-1), (3,6,-1) and (4,5,1). **(TS MAR-17)** **(Jun-03, Mar-11)**

8. Find the ratio in which YZ – plane divides the line joining A (2, 4, 5) and B(3, 5, -4). Also find the point of intersection. **(May-10)**

9. Find x, if the distance between (5, -1,7) and (x, 5, 1) is 9 units. **(May-2011,MAR-19)**

10. Show that the points (1,2,3) , (2,3,1) and (3,1,2) form an equilateral triangle. **(Mar-18)**

11. If H, G, S and I respectively denotes orthocentre, centroid, circumcentre and in-centre of a triangle formed by the points (1, 2, 3) (2,3,1) and (3,1,2) then find H,G,S,I

12. Show that the points A(-4,9,6), B(-1,6,6) and C(0,7,10) form a rightangled isosceles triangle.

13. If the point (1,2,3) is changes to the point (2,3,1) through translation of axes. find the new origin

14. Find the ratio in which the point P(5,4,-6) divides the line segment joining the points A(3,2,-4) and B(9,8,-10) . Also,find the harmonic conjugate of P.

15. Find the ratio in which XZ plane divides the lines joining $A(-2,3,4)$ and $B(1,2,3)$ **(May-14),Ts-Mar-18,19**

DIRECTION COSINES AND DIRECTION RATIOS

LONG ANSWER QUESTIONS :

1.*** If a ray makes the angles α, β, γ and δ with four diagonals of a cube then find $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta$. **(Jun-05, May-08, Mar-05,08)**

2.*** Find the angle between the lines whose direction cosines satisfy the equations
$l + m + n = 0$, $l^2 + m^2 - n^2 = 0$ **(TS-MAR-19)** **(Jun-04, May-07,Mar-07,11,13,17,19)**

3.*** Find the angle between the lines whose direction cosines are given by the equations
$3l + m + 5n = 0$ and $6mn - 2nl + 5lm = 0$ **(May-06,10, Mar-06,09,10),Ts-Mar-15**

4.*** Show that direction cosines of two lines which are connected by the relations $l + m + n = 0$ and $2mn + 3nl - 5lm = 0$ are perpendicular to each other. **(Mar-12,16)**

5.** Find the angle between two diagonals of a cube. **(Mar-15),Ts-Mar-18**

6.** Find the direction cosines of two lines which are connected by the relations *l+m+n=0 and mn-2nl-2lm=0* **(Ts-Mar-17)**

7.* Find the direction cosines of two lines which are connected by the relations *l-5m+3n=0 and* $7l^2 + 5m^2 - 3n^2 = 0$. **(May-07,Mar-18),Ts-Mar-16**

8.* The vertices of triangle are A(1,4,2),B(-2,1,2).C(2,3-4)).Find $\angle A, \angle B, \angle C$. **(Mar-14)**

THE PLANE

VERY SHORT ANSWER QUESTIONS

1. Find the angle between the planes x + 2y + 2z – 5 = 0 and 3x + 3y + 2z – 8 = 0. **(Mar-09, TS-Mar-15,17)**
2. Find the angle between the planes 2x - y +z = 6 and x + y + 2z = 7. **(Mar-11,15,17)**
3. Find the equation of the plane whose intercepts on X, Y, Z - axes are 1, 2,4 respectively. **(Mar-10)**
4. Transform the equation 4x - 4y + 2z + 5=0 into intercept form. **(Mar-12)**
5. Find the intercepts of the plane 4x + 3y – 2z + 2 = 0 on the coordinate axes. **(Mar-18,19),Ts-Mar-18**
6. Find the direction cosines of the normal to the plane x+2y+2z-4=0. **(Mar-13)**
7. Reduce the equation x + 2y – 3z – 6 = 0 of the plane in to the normal form.(TS-Mar-19)(Mar-14,16)
8. Find the equation of the plane passing through the point (1,1,1) and parallel to the plane x + 2y + 3z – 7 =0. **(May-09,10,11)**
9. Find the equation of the plane passing through the point (-2,1,3) and having (3,-5,4)as direction ratios of its normal. **(Mar-11)**
10. Find the equation to the plane parallel to the ZX-plane and passing through (0, 4,4).
11. Find the midpoint of the line joining the points (1,2,3) and (-2, 4, 2) **(May-12)**
12. Find the equation of the plane passing through the points (2,0,1) and (3,-3,4) and perpendicular to x-2y+z=6 **(May-09,10,11)**
13. Find the equation of the plane passing through (2,3,4) and perpendicular to X-axis.

LIMITS

VERY SHORT ANSWER QUESTIONS

1. Find $\lim_{x\to 0}\left(\frac{\sqrt{1+x}-1}{x}\right)$. **(May-10,Mar-04,07,14)**
2. Find $\lim_{x\to 0}\left(\frac{3^x-1}{\sqrt{1+x}-1}\right)$. **(Mar-05)**
3. Compute $\lim_{x\to 0}\left(\frac{e^x-1}{\sqrt{1+x}-1}\right)$. **(Mar-09),Ts-Mar-15**
4. Compute $\lim_{x\to 0}\frac{a^x-1}{b^x-1}$ $(a>0,\ b>0,\ b\neq 1)$ TS-MAR-19 **(Jun-02,Mar-02,08,13,15)**
5. Find $\lim_{x\to 0}\frac{\sin(a+bx)-\sin(a-bx)}{x}$ **(May-09,Mar-05,12)**

6. Find $\lim_{x \to 0}\left(\frac{\cos ax - \cos bx}{x^2}\right)$. **(Mar-04,07)**

7. Find $\lim_{x \to \infty}\left(\sqrt{x^2+x}-x\right)$. **(Mar-08,09,10,11)**

8. Find $\lim_{x \to \frac{\pi}{2}} \frac{\cos x}{\left(x-\frac{\pi}{2}\right)}$ **(Jun-05, Mar-08),Ts-Mar-18**

9. Compute $\underset{x \to 0}{Lt} \frac{1-\cos 2mx}{\sin^2 nx} (m,n \in Z)$ **(Mar-10)**

10. Find $\lim_{x \to \infty} \frac{11x^3-3x+4}{13x^3-5x^2-7}$ **(May-07,Mar-14,18)**

11. Evaluate $\underset{x \to 1}{Lt} \frac{\sin(x-1)}{x^2-1}$ **(May-06)**

12. Compute $\lim_{x \to 0} \frac{\sqrt[3]{1+x}-\sqrt[3]{1-x}}{x}$. **(May-06)**

13. Find $\lim_{x \to a} \frac{\sin(x-a)\tan^2(x-a)}{\left(x^2-a^2\right)^2}$. **(Mar-06,11)**

14. Compute $\underset{x \to a}{Lt}\left[\frac{x\sin a - a\sin x}{x-a}\right]$ **(Mar-16,19-LAQ)**

15. Show that $\lim_{x \to 2^-} \frac{|x-2|}{x-2} = -1$. **(Jun-04)**

16. show that $\lim_{x \to 0^+}\left(\frac{2|x|}{x}+x+1\right) = 3$. **(May-08, Mar-15)**

17. Find $\lim_{x \to \infty} \frac{8|x|+3x}{3|x|-2x}$. (Ts mar2017) **(May-09,10, Mar-12)**

18. Compute $\lim_{x \to 2} \frac{\left(2x^2-7x-4\right)}{(2x-1)\left(\sqrt{x}-2\right)}$. **(May-07)**

19. Compute $\underset{x \to 0}{Lt} \frac{e^{3+x}-e^3}{x}$ **(Mar-19)**

20. Compute $\underset{x \to 0}{Lt} \frac{\log_e(1+5x)}{x}$ **(TS-Mar-19)**

21. Compute $\underset{x \to 0}{Lt} \frac{e^{3x}-1}{x}$ **(Mar-18)**

22. Compute $\lim_{x \to 2+}([x]+x)$ and $\lim_{x \to 2-}([x]+x)$.

23. Find $\lim_{x \to -\infty}\left(\frac{2x+3}{\sqrt{x^2-1}}\right)$

24. Compute $\lim_{x\to 2}\left(\frac{x-2}{x^3-8}\right)$

25. Compute $\lim_{x\to 2}\left(\frac{1}{x-2}-\frac{4}{x^2-4}\right)$.

26. Compute $\lim_{x\to\infty}\left(\sqrt{x+1}-\sqrt{x}\right)$.

27. Compute $\lim_{x\to 0}\frac{1-\cos mx}{1-\cos nx}, n\neq 0$.

28. Show that $\lim_{x\to 3}\frac{x-3}{\sqrt{|x^2-9|}}=0$

29. Compute $\lim_{x\to a}\frac{\tan(x-a)}{x^2-a^2}$ **(TS-Mar-15)**

30. Compute $\lim_{x\to\infty}\frac{x^2-\sin x}{x^2-2}$

31. Show that $\lim_{x\to 0}\frac{|x|}{x}$ does not exist.

32. Compute $\lim_{x\to 0}\frac{\sin ax}{x\cos x}$

33. Compute $\lim_{x\to 0}\frac{\sin ax}{\sin bx}, b\neq 0, a\neq b$ **(Ts-Mar-18)**

34. Evaluate $\lim_{x\to 0}\frac{\log_e x}{x-1}$

35. Compute $\lim_{x\to 0}\frac{e^x-\sin x-1}{x}$ **(Mar-13)**

36. Compute $\lim_{x\to 0}\frac{x(e^x-1)}{1-\cos x}$ **(May-14)**

37. Compute $\lim_{x\to\infty}\frac{x^2+5x+2}{2x^2-5x+1}$ **(May-14,Mar-17)**

38. Evaluate $\lim_{x\to 0} x^2\sin\frac{1}{x}$ **(TS-Mar-17)**

39. compute $\lim_{x\to 0}\frac{e^{7x}-1}{x}$ **(Mar-17)**

40. compute $\lim_{x\to 3}\left[\frac{x^2-8x+15}{x^2-9}\right]$ **(Mar-16)**

41. Compute $\lim_{x\to 0}\frac{\sin(\pi\cos^2 x)}{x^2}$

42.compute $\lim_{x\to 3}\left[\frac{x^2+3x+2}{x^2-6x+9}\right]$ **(Mar-19)**

CONTINUITY

SHORT ANSWER QUESTIONS

1.*** Show that $f(x)=\begin{cases}\dfrac{\cos ax-\cos bx}{x^2} & if\ x\neq 0\\ \dfrac{1}{2}\left(b^2-a^2\right) & if\ x=0\end{cases}$ where a and b are real constants, is continuous at x = 0. **(May-06, Mar-09),(Ts-Mar-17)**

2.*** Is 'f' defined by $f(x)=\begin{cases}\dfrac{\sin 2x}{x}, if\ x\neq 0\\ 1 \quad , if\ x=0\end{cases}$ continuous at x = 0 ? **(May-10, Mar-06,09)**

3.*** Check the continuity of 'f' given by $f(x)=\begin{cases}\left(x^2-9\right)/\left(x^2-2x-3\right) if\ 0<x<5\ and\ x\neq 3\\ 1.5 \quad , if\ x=3\end{cases}$ at the point x = 3. **(Mar-11,13,14,15)**

4.*** Check the continuity of the following function at 2.

$$f(x)=\begin{cases}\dfrac{1}{2}\left(x^2-4\right) if\ 0<x<2\\ 0 \quad if\ x=2\\ 2-8x^{-3} \quad if\ x>2\end{cases}$$ **(TS-MAR-19) (Mar-17)**

5.** If 'f'given by $f(x)=\begin{cases}k^2x-k & if\ x\geq 1\\ 2 & if\ x<1\end{cases}$, is a continuous function on R, then find the values of k. **(Ts-Mar-15)**

6.* Find real constants a, b so that the funciton *f* given by **(Mar-18),Ts-Mar-18**

$$f(x)=\begin{cases}\sin x \quad if\ x\leq 0\\ x^2+a\ if\ 0<x<1\\ bx+3\ if\ 1\leq x\leq 3\\ -3 \quad if\ x>3\end{cases}$$ is continuous on **R.**

7.* Is the function f, defined by $f(x)=\begin{cases}x^2\ if\ x\leq 1\\ x\ if\ x>1\end{cases}$ continuous on R?

8.* Show that f, given by $f(x)=\dfrac{x-|x|}{x}\left(x\neq 0\right)$ is continuous on $R-\{0\}$

DIFFERENTIATION

LONGANSWER QUESTIONS

1.*** If $\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$ *then show that* $\dfrac{dy}{dx}=\sqrt{\dfrac{1-y^2}{1-x^2}}$. **(Mar,08,11),Ts-Mar-17**

2.*** If $y=Tan^{-1}\left[\dfrac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right]$ for $0<|x|<1$, find $\dfrac{dy}{dx}$ **(Mar-04,09,10,12,16),Ts-Mar-18**

3.*** If $y=x^{\tan x}+(\sin x)^{\cos x}$, find $\dfrac{dy}{dx}$. **(May -06, Mar-07,11,14,18)**

4.*** Find the derivative of $(\sin x)^{\log x} + x^{\sin x}$ with respective x. **(Mar-13,17, Ts-Mar-15)**

5.*** If $x^y + y^x = a^b$ then show that $\frac{dy}{dx} = -\left[\frac{yx^{y-1} + y^x \log y}{x^y \log x + xy^{x-1}}\right]$. **(Mar-11,Ts-Mar-16)**

6.*** If $y = x\sqrt{a^2+x^2} + a^2 \log\left(x + \sqrt{a^2+x^2}\right)$ then prove that $\frac{dy}{dx} = 2\sqrt{a^2+x^2}$ **(Mar-08,09,15,19)**

7.*** If $a > 0, b > 0$ and $0 < x < \pi$ and $f(x) = \left(a^2 - b^2\right)^{-1/2} \cos^{-1}\left(\frac{a\cos x + b}{a + b\cos x}\right)$ then $f'(x) = (a + b\cos x)^{-1}$ **(May-09)**

8.** If $x = \frac{3at}{1+t^3}, y = \frac{3at^2}{1+t^3}$. Find $\frac{dy}{dx}$ **(Board paper)**

9**. If $f(x) = S\text{in}^{-1}\sqrt{\frac{x-\beta}{\alpha-\beta}}$ *and* $g(x) = Tan^{-1}\sqrt{\frac{x-\beta}{\alpha-x}}$ *then* show that $f'(x) = g'(x)(\beta < x < \alpha)$. **(Mar-06)**

10.** If $y = Tan^{-1}\left(\frac{2x}{1-x^2}\right) + Tan^{-1}\left(\frac{3x-x^3}{1-3x^2}\right) - Tan^{-1}\left(\frac{4x-4x^3}{1-6x^2+x^4}\right)$ then show that $\frac{dy}{dx} = \frac{1}{1+x^2}$. **(May-07)**

11.** Find the derivative of $f(x) = Tan^{-1}\left(\frac{2x}{1-x^2}\right)$ w.r .to $g(x) = Sin^{-1}\left(\frac{2x}{1+x^2}\right)$ **(Mar-04)**

12.** If $x^y = y^x$ then show that $\frac{dy}{dx} = \frac{y(x\log y - y)}{x(y\log x - x)}$.

13.** If $x^{\log y} = \log x$ then show that $\frac{dy}{dx} = \frac{y}{x}\frac{[1 - \log x \log y]}{\log_x^2}$ **(TS-Mar-19)**

14.** If $ax^2 + 2hxy + by^2 = 1$ then prove that $\frac{d^2y}{dx^2} = \frac{h^2 - ab}{(hx+by)^3}$

15.* Find $\frac{dy}{dx}$ of the function $y = \frac{(1-2x)^{\frac{2}{3}}(1+3x)^{\frac{-3}{4}}}{(1-6x)^{\frac{5}{6}}(1+7x)^{\frac{-6}{7}}}$ **(May-10)**

16.* Find derivative of the $\sin^{-1}\left(\frac{b + a\sin x}{a + b\sin x}\right)(a > 0, b > 0)$

SHORT ANSWER QUESTIONS

17.*** Find the derivative of the following functions from the first principles w.r.to x.

i) $\cos^2 x$ (TS-MAR-19) **(May-08,Jun-04)** ii) $\tan 2x$ **(May-11,Mar-05)**

iii) $\sqrt{x+1}$ **(May-12,Jun-05)** iv) $\sec 3x$ **(Mar-08,12,16)**

v) $\cos(ax)$ **(Mar-09,11,13)** vi) $\sin 2x$ **(May-10,Mar-18)**

vii) $x\sin x$ **(May-09,Mar-10,15),Ts-Mar-18** viii) $\log x$

ix) $ax^2 + bx + c$ x) a^x xi) x^3 **(TS-Mar-15)**

xii) $\cot x$ **(Mar-17,19)**

18.*** If $x^y = e^{x-y}$, then show that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$. **(Mar-07,08)**

19.*** If $\sin y = x\sin(a+y)$, then show that $\frac{dy}{dx} = \frac{\sin^2(a+y)}{\sin a}$ (a *is not a multiple of* π) **(Mar-11)**

20.*** If $f(x) = Tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$, $g(x) = Tan^{-1}x$ then differentiate $f(x)$ w.r.to $g(x)$ **(May-09)**

21.*** If $y = x^y$ then show that $\frac{dy}{dx} = \frac{y^2}{x(1-\log y)} = \frac{y^2}{x(1-y\log x)}$. **(Mar-04)**

22.*** Find $\frac{dy}{dx}$ for the functions, $x = a(\cos t + t\sin t)$, $y = a(\sin t - t\cos t)$. **(May-08,Ts-Mar-16)**

23*** If $x^{2/3} + y^{2/3} = a^{2/3}$ then $\frac{dy}{dx} = -\sqrt[3]{\frac{y}{x}}$

24.** If $y = a\cos x + (b+2x)\sin x$, then show that $y'' + y = 4\cos x$ **(May-07)**

25.** If $x = 3\cos t - 2\cos^3 t, y = 3\sin t - 2\sin^3 t,$, then find $\frac{dy}{dx}$. **(Mar-10)**

26.** If $x = a(t-\sin t), y = a(1+\cos t)$ then find $\frac{d^2y}{dx^2}$.

27.** Find derivative of $\tan^{-1}\left[\frac{3a^2x - x^3}{a(a^2-3x^2)}\right]$

28.** If $y = \sin^{-1}\left[\frac{2^{x+1}}{1+4^x}\right]$ then find $\frac{dy}{dx}$

29.** If $y^x = x^{\sin y}$ then find $\frac{dy}{dx}$

30.** If $y = \log(4x^2 - 9)$ then find y^{11}

31.* If $x = a\left[\cos t + \log\left(\tan\left(\frac{t}{2}\right)\right)\right], y = a\sin t$ then find $\frac{dy}{dx}$

32.* Find $\frac{dy}{dx}$ of the functions $x = a\left(\frac{1-t^2}{1+t^2}\right), y = \frac{2bt}{1+t^2}$

33.* If $y = Tan^{-1}\sqrt{\frac{1-x}{1+x}}$ $(|x|<1)$, then find $\frac{dy}{dx}$.

34.* If $f(x) = \sqrt{\frac{1+x^2}{1-x^2}}$ $(|x|<1)$ then find $f'(x)$

35.* If $ay^4 = (x+b)^5$ then ST $5yy^{11} = \left(y^1\right)^2$ **(Ts MAR-17)**

36.* Show that $f(x) = |x|$ is differentiable at any $x \neq 0$ and is not differentiable at 0.

37.* Check the differentiability of function $f(x)=\begin{cases}3+x & x>0\\ 3-x & x<0\end{cases}$ at 0

VERY SHORT ANSWER QUESTIONS

38. If $y=ax^{n+1}+bx^{-n}$ *then* $P.T\ x^2\ y''=n(n+1)y$. **(May-10,Mar-06)**

39. If $y=\sec\left(\sqrt{\tan x}\right)$, then find $\frac{dy}{dx}$ **(May-07)**

40. Find the derivative of the function $f(x)=a^x.e^{x^2}$ **(May-08)**

41. If $f(x)=7^{x^3+3x}(x>0)$, then find $f^1(x)$. (Ts mar2017) **(May-05)**

42. If $x=\tan\left(e^{-y}\right)$, then show that $\frac{dy}{dx}=\frac{-e^y}{1+x^2}$. (Ts mar2017) **(Mar-05)**

43. If $f(x)=\log(\sec x+\tan x)$, then find $f^1(x)$. **(May-11,Mar-14)**

44. If $y=\left(Cot^{-1}x^3\right)^2$, then find $\frac{dy}{dx}$. **(May-09),Ts-Mar-18**

45. If $y=\log\left(\sin^{-1}\left(e^x\right)\right)$ then find $\frac{dy}{dx}$. **(Mar-10)**

46. If $f(x)=x^2 2^x\log x(x>0)$, then find $f'(x)$. **(May-10)**

47. If $y=\cos\left[\log(\cot x)\right]$ then find $\frac{dy}{dx}$. **(Mar-09)**

48. If $y=\log(\cosh 2x)$ then find $\frac{dy}{dx}$ **(Mar-12)**

49. Find $\frac{dy}{dx}$ if **(Mar–13)**

50. Find the derivative of $f(x)=\frac{ax+b}{cx+d}$ **(May-12)**

51. If y = $\sec^{-1}\left(\frac{1}{2x^2-1}\right)$ find $\frac{dy}{dx}$ **(Mar–13,17)**

52. If $y=\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ then find $\frac{dy}{dx}$ **(Mar-12, Ts-Mar-15)**

53. If $x=a\cos^3 t,\ y=a\sin^3 t,$ then find $\frac{dy}{dx}$ **(May-11,12)**

54. If $y=\log\left(\sin(\log x)\right)$, find $\frac{dy}{dx}$.

55. If $y=x^x$ then find $\frac{dy}{dx}$ **(Mar-11)**

56. If $x^3+y^3-3axy=0,$ find $\frac{dy}{dx}$. (**Apr-00)**

57. Find the derivative of the following functions w.r.to x.

i) $Cos^{-1}\left(4x^3-3x\right)$ **(Mar-14)** ii) $Tan^{-1}\sqrt{\frac{1-\cos x}{1+\cos x}}$ **(Jun-02)**

58. Differentiate $f(x)$ with respect to $g(x)$ if $f(x)=e^x,\ g(x)=\sqrt{x}$ **(Mar-03)**

59. Find the derivative of the following functions w.r.to x.

i) $Tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ **(Jun-03)** ii) $\tan^{-1}\left(\frac{1+x}{1-x}\right)$ **(May-12)**

60. If $f(x)=x e^x \sin x$, *then find* $f^1(x)$

61. If $y=ae^{nx}+be^{-nx}$ then prove that $y''=n^2y$. **(Mar-15)**

62. If $y=\sin(\log x)$, then find $\frac{dy}{dx}$ **(Mar-18)**

63. If $f(x)=1+x+x^2+.....+x^{100}$ then find $f^1(1)$. **(TS-Mar-19)**

64. If $y=e^{a\sin^{-1}x}$ then prove that $\frac{dy}{dx}=\frac{ay}{\sqrt{1-x^2}}$

65. Find the derivative of $20^{\log(\tan x)}$

66. Find the derivative of $f(x)=e^x(x^2+1)$ w.r.t x

67. If $f(x)=\frac{a-x}{a+x}$ then find $f'(x)$ **(Ts-Mar-18)**

68. If $y=\left(x^3+6x^2+12x-13\right)^{100}$ then find $\frac{dy}{dx}$

69. If $f(x)=\log_7(\log x)$ then find $f'(x)$

70. If $y=\frac{1}{ax^2+bx+c}$ then find $\frac{dy}{dx}$

71. If $y=\cos ec^{-1}(e^{2x+1})$, find $\frac{dy}{dx}$

72. If $y=\frac{1-\cos 2x}{1+\cos 2x}$ then find $\frac{dy}{dx}$

73. If $f(x)=\sinh^{-1}\left(\frac{3x}{4}\right)$ then find $f'(x)$

74. If $y=\sin^{-1}\left(3x-4x^3\right)$ then find $\frac{dy}{dx}$

75. If $y=\frac{\cos x}{\sin x+\cos x}$ then find $\frac{dy}{dx}$

76. If $x=at^2$, $y=2at$ find $\frac{dy}{dx}$

77. If $y=\sqrt{2x-3}+\sqrt{7-3x}$ then find $\frac{dy}{dx}$ **(TS-Mar-15)**

78. If $y=\text{Tan}^{-1}\left(\frac{2x}{1-x^2}\right)\left(|x|<1\right)$ then find $\frac{dy}{dx}$ **(Mar-15)**

79. If $y=\frac{2x+3}{4x+5}$ then find $\frac{dy}{dx}$ **(Mar--19)** **(May-15)**

80. Find the derivative of the function $f(x)=\left(x^2-3\right)\left(4x^3+1\right)$ **(May-15)**

81. If $y=\sin^{-1}(\cos x)$ then find $\frac{dy}{dx}$ **(TS-May-16)**

82. Find the derivative of the function $\tan^{-1}(\log x)$ **(Mar-19) (TS-May-15)**

83. Find the derivative of $5\sin x + e^x \log x$ **(Mar-17)**

84. If $2x^2 - 3xy + y^2 + x + 2y - 8 = 0$ find $\frac{dy}{dx}$

85. If $y = x^4 + \tan x$ then find y'' **(Mar-18)**

86. If $f(x) = \log(\tan e^x)$ *then find* $f^1(x)$ **(TS-Mar-19)**

ERRORS AND APPROXIMATIONS

VERY SHORT ANSWER QUESTIONS

1. Find Δy and dy if $y = x^2 + 3x + 6$. When x = 10, $\Delta x = 0.01$. **(Mar-05,11,14),Ts-Mar-15**

2. Find Δy and dy if $y = x^2 + x$, at x = 10, $\Delta x = 0.1$ **(Mar-15,17),Ts-Mar-17**

3. Find Δy and dy if $y = \frac{1}{x+2}$ when x = 8, $\Delta x = 0.02$

4. Find Δy and dy for $y = e^x + x$, when x = 5, $\Delta x = 0.02$

5. Find Δy and dy if $y = \cos x, x = 60^0$ and $\Delta x = 1^0$ **(TS-Mar-19)**

6. Find the approximate value of $\sqrt{82}$ **(May-09,Mar-13)**

7. Find the approximate value of $\cos(60^0 5^1)$ ($\because 1^0$=0.0174 radians)

8. Find the approximate value of $\sqrt[3]{65}$.

9. Find the approximate value of $\sqrt[3]{7.8}$

10. (i) If the increase in the side of a square is 4% . Then find the approximate percentage of increase in the area of square. **(Mar-18)**
    (ii) If the increase in the side of a square is 2% . Then find the approximate percentage of increase in the area of square. **(Ts-Mar-18)**

11. If the radius of a sphere is increased from 7cm to 7.02cm then find the approximate increase in the volume of the sphere

12. if $y = f(x) = kx^n$ show that the approximate relative error in y is n times the relative error in x where n and k are constants

13. The diameter of sphere is measured to be 40cm. If an error of 0.02cm is made in it. Then Find approximate errors in volume and surface area of the sphere.

14. The time t, of a complete oscillation of a simple pendulum of length '*l*' is given by the equation $t = 2\pi\sqrt{\frac{l}{g}}$ where 'g' is gravational constant. Find approximate percentage error in 't' when the perecentage of error in '*l*' is 1%.

15. Find Δy and dy if $y = 5x^2 + 6x + 6$. When x = 2, $\Delta x = 0.001$ **(Mar-16)**

16. Find relative error and percentage error of the vriable y **(Mar-19)**

17. Find the approximate value of $\sqrt[3]{999}$ **(Mar-19-SAQ)**

TANGENTS AND NORMALS

LONGANSWER QUESTIONS

1.*** If the tangent at any point P on the curve $x^m y^n = a^{m+n}\ (mn \neq 0)$ meets the coordinate axes in A and B then show that AP : BP is a constant. **(May-06,08,Mar-10)**

2.*** If the tangent at any point on the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ intersects the coordinate axes in A and B, then show that the length AB is a constant.
(May-10, Mar-06,07,08,13,14),Ts-Mar-15,19

3.*** Show that curves $y^2 = 4(x+1)$ and $y^2 = 36(9-x)$ intersect orthogonally.**(Mar-06,09,11)**

4.*** Find the angle between the curves $y^2 = 4x$ and $x^2 + y^2 = 5$ **(May-07,Mar-12,16)**

5.*** Find the angle between the curves $2y^2 - 9x = 0, 3x^2 + 4y = 0$ (in the 4th quadrant).**(May-09)**

6.*** At any point 't' on the curve x = a (t + sin t), y = a (1 – cos t), find the lengths of tangent, normal, subtangent and subnormal. **(Board paper)**

7.*** At a point (x_1, y_1) on the curve $x^3 + y^3 = 3axy$ show that the tangent is
$(x_1^2 - ay_1)x + (y_1^2 - ax_1)y = ax_1y_1$ **(Ts-Mar-17)**

8.*** Find the value of K so that the length of the sub-normal at any point on the curve $xy^k = a^{k+1}$ is a constant.

9.*** (i) Define the angle between two curves
(ii) Find the angle between the curves $xy = 2$ and $x^2 + 4y = 0$ **(May-11,Mar-17)**

10.*** Show that the equatin of the tangent to the curve $\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 2$ $(a \neq 0, b \neq 0)$ at the point (a,b) is $\frac{x}{a} + \frac{y}{b} = 2$ **(Ts-Mar-18)**

11.** Find the angle between the curves $y^2 = 8x, 4x^2 + y^2 = 32$ **(May-12,Mar-18)**

12.** Show that the curves $6x^2 - 5x + 2y = 0$ and $4x^2 + 8y^2 = 3$ touch each other at $\left(\frac{1}{2}, \frac{1}{2}\right)$
(Mar-10,15)

13.** Show that the equation of tangent at the point (x_1, y_1) on the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ is $xx_1^{-1/2} + yy_1^{-1/2} = a^{1/2}$ **(Jun-04)**

14.** Find the lengths of sub tangent,sub normal at a point t on the curve
$x = a(\cos t + t\sin t), y = a(\sin t - t\cos t)$ (Ts mar2017)

15.** Find the angle between the curves $x^2 y = 4, y = (x^2 + 4) = 8$.

16.** Show that the condition for the orthogonality of the curves $ax^2 + by^2 = 1$ and $a_1x^2 + b_1y^2 = 1$ is $\frac{1}{a} - \frac{1}{b} = \frac{1}{a_1} - \frac{1}{b_1}$. **(Mar-19)** **(Ts-Mar-16)**

17.* If the slope of the tangent to the curve $y = x\log x$ at a point on it is $\frac{3}{2}$, then find the equations of tangent and normal at that point.

18.* Show that the square of the length of subtangent at any point on the curve $by^2 = (x+a)^3 \ (b \neq 0)$ varies with the length of the subnormal at that point.

19.* Find the equations of the tangents to the curve $y = 3x^2 - x^3$, where it meets the X-axis.

SHORT ANSWER QUESTIONS

20.*** Show that the length of the subnormal at any point on the curve $y^2 = 4ax$ is a constant. **(May 09,Mar-05,11)**

21.*** Show that the length of the subtangent at any point on the curve $y = a^x \ (a > 0)$ is a constant. **(Mar-12)**

22.*** Find the lengths of normal and sub normal at a point on the curve $y = \frac{a}{2}\left(e^{\frac{a}{x}} + e^{\frac{-x}{a}}\right)$ **(Mar13)**

23.*** Find the equations of the tangent and normal to the curve $y = x^2 - 4x + 2$ at (4, 2) **(Mar-09)**

24.*** Show that at any point (x, y) on the curve $y = be^{x/a}$, the length of the sub-tangent is a constant and the length of the sub normal is $\frac{y^2}{a}$ **(Mar-10),Ts-Mar-18**

25.*** Find the equations of tangent and normal to the curve xy = 10 at (2, 5) . **(Mar-11,17)**

26.*** Find the equations of the tangent and normal to the curve $y = 5x^4$ at the point (1, 5). **(May-10)**

27.*** Show that the tangent at any point θ on the curve $x = C\sec\theta, y = C\tan\theta$ is $y\sin\theta = x - C\cos\theta$ **(TS-Mar-19)**

28.*** Find the angle between the curves $x + y + 2 = 0, x^2 + y^2 - 10y = 0$ **(Mar-14)**

29.** Find the equations of tangent and normal to the curve $y = x^3 + 4x^2$ at (-1, 3).

30.** Find the equations of tangent and normal to the curve $y^4 = ax^3$ at (a,a)

31.* Find the slope of the normal to the curve $x = a\cos^3\theta, y = a\sin^3\theta$ *at* $\theta = \frac{\pi}{4}$.

32.* Find the slope of the tangent to the curve $y = x^3 - 3x + 2$ at the point whose x-coordinate is 3.

33.* Find the points at which the tangent to the curve $y = x^3 - 3x^2 - 9x + 7$ is parallel to the x-axis.

34.* Show that the length of the subnormal at any point on the curve $xy = a^2$ varies as the cube of the ordinate of the point.

35.* Find the value of 'K' so that the length of the sub-normal of any point on the curve $y = a^{1-k}x^k$ is a constant **(May-16)**

36.* Find the lengths of the subtangent and subnormal at a point on the curve $y = b\sin\left(\frac{x}{a}\right)$ **(Mar-16)**

37.* Find the equations of tangent and normal to the curve $y = 2e^{-x/3}$ at the point where the curve meets the y-axis

RATE MEASURE

SHORT ANSWER QUESTIONS

1***. A particle is moving in a straight line so that after t seconds its distance is s (in cms) from a fixed point on the line is given by $s = f(t) = 8t + t^3$. Find
(i) the velocity at time t = 2sec (ii) the initial velocity (iii) acceleration at t = 2sec.
(Mar-15,17)

2***. The distance - time formula for the motion of a particle along a straight line $S = t^3 - 9t^2 + 24t - 18$ then find when and where the velocity is zero. **(Mar-12,19)**

3.*** A point P is moving on the curve $y = 2x^2$. The x co-ordinate of P is increasing at the rate of 4 units per second. Find the rate at which the y co-ordinate is increasing when the point is at (2, 8).
(May-08, Ts-Mar-16)

4***. A container in the shape of an inverted cone has height 12cm and radius 6cm at the top. If it is filled with water at the rate of $12cm^3$/sec., what is the rate of change in the height of water level when the tank is filled 8cm?

5***. The volume of a cube is increasing at a rate of 9 cubic centimeters per second. How fast is the surface area increasing when the length of the edge is 10 centimetres?
(Mar-13,16)(Ts-Mar-17)

6*** The volume of a cube is increasing at the rate of $8cm^3/\sec$. How fast is the surface area increasing when the length of an edge is 12 cm. **(Mar-14,15)**

7***. A stone is dropped into a quiet lake and ripples move in circles at the speed of 5cm/sec. At the instant when the radius of circular ripple is 8cm., how fast is the enclosed area increases?

8***. A balloon, which always remains spherical on inflation, is being inflated by pumping in 900cubic centimeters of gas per second. Find the rate at which the radius of balloon increases when the radius is 15cm.

9**. Suppose we have a rectangular acuarium with dimensions of length 8m, width 4m and height 3m. Suppose we are filling the tank with water at the rate of $0.4m^3$/sec. How fast is the height of water changing when the water level is 2.5m?

10**. The total cost *C(x)* in rupees associated with productions of *x* units of an item is given by $C(x) = 0.005x^3 - 0.02x^2 + 30x + 500$. Find the marginal cost when 3 units are produced.

11*. Find the average rate of change of $s = f(t) = 2t^2 + 3$ between t = 2 and t = 4.

12*. The radius of a circle is increasing at the rate of 0.7cm/sec. What is the rate of increase of its circumference.

13*. The radius of an air bubble is increasing at the rate of $\frac{1}{2}$ cm/sec. At what rate is the volume of the bubble increasing when the radius is 1 cm?

14*. A particle is moving along a line according to $s = f(t) = 4t^3 - 3t^2 + 5t - 1$ where s is measured in meters and t is measured in seconds. Find the velocity and acceleration at time t. At what time the acceleration is zero. **Mar-18,(Ts-Mar-15,18)**

15.* A container in the shape of an inverted cone has height 4m and 8 radius 6m at the top. If it is filled with water at the rate of $2m^3$/min., how fast is the hegihtof the water changing when the level is 4m
TS-Mar-19

ROLLE'S AND LAGRANGE'S THEOREMS

VERY SHORT ANSWER QUESTIONS

1. State Rolle's theorem

2. State Lagrange's theorem

3. Let $f(x) = (x-1)(x-2)(x-3)$. Prove that there is more than one 'c' in $(1,3)$ such that $f'(c) = 0$ **(Mar-13)**

4. Find the value of 'c' in Rolle's theorem for the function $y = f(x) = x^2 + 4$ on [-3, 3]. **(Mar-17),Ts-Mar-15,19**

5. Find the value of 'c' from Rolle's theorem for the function $f(x) = x^2 - 1$ on $[-1,1]$ **(Mar-14)**

6. It is given that Rolle's theorem holds for the function $f(x) = x^3 + bx^2 + ax$ on [1, 3] with . $c = 2 + \frac{1}{\sqrt{3}}$. Find the values of *a* and *b*.

7. Verify Rolle's theorem for the function $f(x) = \sin x - \sin 2x$ on $[0, \pi]$

8. Verify the Rolle's theorem for the function $(x^2 - 1)(x - 2)$ on [-1, 2]. Find the point in the interval where the derivate vanishes.

9. Verify Rolle's theroem for the function $f(x) = x(x+3)e^{-x/2}$ on $[-3, 0]$ **(Mar-18)**

10. Show that there is no real number 'k' for which the equation $x^2 - 3x + k = 0$ has two distinct roots in [0, 1]

11. Find 'c', so that $f'(c) = \frac{f(b) - f(c)}{b - a}$ in the following cases:

(i) $f(x) = x^2 - 3x - 1; a = \frac{-11}{7}, b = \frac{13}{7}$ (ii) $f(x) = e^x; a = 0, b = 1$

12. Verify the conditions of the Lagrange's mean value theorem for the following functions. In each case find a point 'c' in the interval as stated by the theorem.

(i) $x^2 - 1$ on [2,3] **(Mar-16),Ts-Mar-18** (ii) $\sin x - \sin 2x$ on $[0, \pi]$

(iii) $\log x$ on [1,2]

13. Find a point on the graph of the curve $y = x^3$ where the tangent is parallel to chord joining the points (1, 1) and (3, 27).

14 Verify Rolle's theorem for the function $f(x) = \log(x^2 + 2) - \log 3$ on $[-1,1]$ **(Mar-15)**

15. Verify Rolle's theorem for the function $f(x) = x^2 - 5x + 6$ **on** $[-3,8]$ **(Ts-Mar-17)**

INCREASING & DECREASING FUNCTIONS

SHORT ANSWER QUESTION

1.*Determine the intervals in which $f(x) = \frac{2}{(x-1)} + 18x \forall x \in R \setminus \{0\}$ is strictly increasing and decreasing. **(Ts-Mar-15)**

VERY SHORT ANSWER QUESTION

2. Define strictly increasing and strictly decreasing function on an interval **(May-14)**

3. Determine the intervals in which the function $\sqrt{(25 - 4x^2)}$ is strictly increasing and decreasing.

MAXIMA AND MINIMA

LONGANSWER QUESTIONS

1.*** If the curved surface of right circular cylinder inscribed in a sphere of radius '*r*' is maximum, show the height of the cylinder is $\sqrt{2}r$. **(May-10,Jun-04,Mar-04,08),Ts-Mar-16**

2.*** From a rectangular sheet of dimensions 30cm $\times$ 80cm. four equal squares of side x cm. are removed at the corners, and the sides are then turned up so as to form an open rectangular box. Find the value of x, so that the volume of the box is the greatest. **(Mar-09,14,16),Ts-Mar-18**

3.*** A window is in the shape of a rectangle surmounted by a semicircle. If the perimeter of the window is 20ft., find the maximum area.(Ts mar2017) **(May-09),Ts-Mar-15**

4.*** A wire of length '*l*' is cut into two parts which are bent respectively in the form of a square and a circle. What are the lengths of the pieces of the wire respectively so that the sum of the areas is the least. **(Mar-11,17)**

5.*** Find two positive integers whose sum is 16 and the sum of whose square is minimum. (**Mar-18)**

6**. Find two positive numbers whose sum is 15 so that the sum of their squares is minimum.

7**. A manufacturer can sell *x* items at a price of rupees (5 - *x*/100) each. The cost price of *x* items is Rs. (*x*/5 + 500). Find the number of items that the manufacturer should sell to earn maximum profits.

8**. Prove that the radius of the right circular cylinder of greatest curved surface area which can be inscribed in a given cone is half of that of the cone.

9*. Find the absolute maximum and absolute minimum of $f(x) = 8x^3 + 81x^2 - 42x - 8$ on [-8, 2].

10.* Find the absolute maximum value and the absolute minimum value of the function $f(x) = x + \sin 2x$ in $[0, \pi]$ **(May-07)**

11.* Find the maximum area of the rectangle that can be formed with fixed perimeter 20.(TS-Mar-2019)

12*. Find two positive integers x and y such that $x + y = 60$ and xy^3 is maximum **(May-14, Mar-15)**

13.* The profit function $f(x)$ of a company selling x items per day is given by $p(x) = x(150 - x) - 1600$ .Find the number of items that the company should sell to get maximum profit. Also find the maximu, profit. **(Ts-Mar-16)**

14.* Find the points of local extrema and local extrema for the function $f(x) = \cos 4x$ *defined on* $(0, \frac{\pi}{2})$ **(Mar-19)**

VSAQS

1 . Find the absolute extremum of $f(x) = x^2$ *defined on* $[-2, 2]$ **(Mar-19)**

ADDITIONAL QUESTIONS
INCREASING AND DECREASING FUNCTIONS

1. Find the intervals on which $f(x) = x^2 - 3x + 8$ is increasing or decreasing ?

2. Find the intervals on which the function $f(x) = x^3 + 5x^2 - 8x + 1$ is a strictly increasing function.

3. Find the intervals on which $f(x) = x^x$ $(x > 0)$ is increasing and decreasing.

4. Find the intervals on which $f(x) = xe^x$ is strictly increasing (or) strictly decreasing.

5. At what points the slopes of the tangents to the curve $y = \frac{x^3}{6} - \frac{3x^2}{2} + \frac{11x}{2} + 12$ increase ?

***

JUNIOR IPE IMPORTANT QUESTION BANK

JUNIOR - PHYSICS

QUESTION BANK ANALYSIS

S.NO	NAME OF THE CHAPTER	LAQ			SAQ			VSAQ	TOTAL
		***	**	*	***	**	*		
1	Physical World	-	-	-	-	-	-	4	4
2	Units and Measurements	-	-	-	-	-	-	12	12
3	Motion in Straight line	-	-	-	4	2	6	4	16
4	Motion in a Plane	-	-	-	6	3	4	10	23
5	Laws of Motion	1	-	-	3	2	2	13	21
6	Work Energy and Power	3	-	-	2	3	1	8	17
7	Systems of Particles and Rotational Motion	-	1	-	5	2	4	7	19
8	Oscillations	3	-	-	-	1	2	9	15
9	Gravitation	-	1	2	4	1	1	8	17
10	Mechanical Properties of Solids	-	1	-	2	5	-	6	14
11	Mechanical Properties of Fluids	-	1	-	5	1	4	14	25
12	Thermal Properties of Matter	1	1	-	4	2	1	26	35
13	Thermodynamics	2	-	-	4	3	-	12	21
14	Kinetic Theory of gases	-	-	1	2	4	-	10	17
SUB TOTAL		10	5	3	41	29	25	143	256
TOTAL		18			95				

PHYSICAL WORLD

VSAQ

01. What are the fundamental forces in nature?

02. What is the discovery of C.V. Raman? **(Mar-19,May-14,18,),Ts-Mar-17,18**

03. What is the contribution of S. Chandra Sekhar to Physics? **(Mar-13,15,17),Ts-Mar-15,19**

04. Whcih of the following has symmetry
a) Acceleration due to gravity.
b) Law of gravitation

UNITS AND MEASUREMENTS

VSAQ

01. Distinguish between accuracy and precision. **(Mar-13,15),Ts-Mar-15**

02. What are the different types of errors that can occur in a measurement?

03. Distinguish between fundamental units and derived units. **(May-14)**

04. What is dimensional analysis?

05. Express unified atomic mass unit in kg. **(TS-MAR-19)**

06. How can systematic errors be minimised or eliminated? **(Mar-14,17,18),Ts-Mar-17**

07. The velocity of a body is given by $v = At^2 + Bt + C$. If v and t are expressed in SI, what are the units of A, B and C ? **(May-07)**

08. State the number of significant figures in the following:
(a) 6729 (b) 0.024 (c) 0.08240 (d) 6.032 (e) 4.7×10^8

09. The measured mass and volume of a body are 2.42g and $4.7cm^3$ respectively with possible errors 0.01g and $0.1cm^3$. Find the maximum error in density.

10. The error in measurement of radius of a sphere is 1%. What is the error in the measurement of volume? **(AP-Mar-19)**

11. The percentage error in the mass and speed are 2% and 3% respectively. What is the maximum error in kinetic energy calculated using these quantities?

12. What are the significant numbers? Write the number of significant digits in the measurement of 0.002308. **(Ts-Mar-18)**

MOTION IN A STRAIGHT LINE (SAQS)

01.*** Derive the equation $x = v_0t + \frac{1}{2}at^2$ using graphical method where the terms have usual meaning **(TS-MAR-19) (May-11)**

02.*** Explain the terms the average velocity and instantaneous velocity. When are they equal? **(MAR-19)**

03.*** A ball is thrown vertically upwards with a velocity of $20ms^{-1}$ from the top of a multistorey building. The height of the point from where the ball is thrown is 25.0m from the ground. (a) How high will the ball rise? and (b) how long will it be before the ball hits the ground? Take . $g = 10ms^{-2}$ (actual value is $9.8ms^{-1}$). **(Mar-15),Ts-Mar-15**

04.*** A man runs across the roof of a tall building and jumps horizontally on to the (lower) roof of an adjacent building. If his speed is 9 m/s and the horizontal distance between the building is 10m and the height difference between the roofs is 9m, will he be able to land on the next building (Take g=10 m/s^2) **(Ts-Mar-18)**

05.** A car travels the first third of a distance with a speed of $10 kmph$, the second third at $20 kmph$ and the last third at $60 kmph$. What is its mean speed over the entire distance?

(Mar-18)

06.** A bullet moving with a speed of $150 ms^{-1}$ strikes a tree and penetrates 3.5cm before stopping. What is the magnitude of its retardation in the tree and the time taken for it to stop after striking the tree?

07.* A particle moves in a straight line with uniform accleration. Its velocity at time t = 0 is V_1 and at time t = t is V_2. The average velocity of the particle in this time interval is $\frac{V_1+V_2}{2}$.

Is this correct? Substantiate your answer.

08.* A parachutist flying in an aeroplane jumps when it is at a height of 3 km above ground. He opens his parachute when he is about 1 km above ground. Describe his motion. **(Ts-Mar-17)**

09.* Can the velocity of an object be in a direction other than the direction of acceleration of the object ? If so, give an example

10.* A ball is dropped from the roof of a tall building and simultaneously another ball is thrown horizontally with some velocity from the same roof. Which ball lands first? Explain your answer.

11.* A motorist drives north for 30 min at 85 km/h and then stops for 15 min. He continues travelling north and covers 130 km in 2 hours. What is his total displacement and average velocity?

12.*. Aman walks an straigt road from his home to a market 2.5 km away with a speed $5 km\, h^{-1}$. Finding the market is closed, he instantly turns and walks back home with a speed of $7.5 km\, h^{-1}$. What is the a)magnitude of average velocity and b)average speed of the man over the time interval 0 to 50 minutes **(MAR-19)**

VSAQ

12. The states of motion and rest are relative. Explain.

13. How is average velocity different from instantaneous velocity? **(Mar-13)**

14. Give an example, where, the velocity of an object is zero but its acceleration is not zero.

(Mar-13)

15. A vehicle travels half the distance L with speed v_1 and the other half with speed v_2. What is the average speed?

MOTION IN A PLANE

SAQ :

01.*** State parallelogram law of vectors. Derive an expression for the magnitude and direction of the resultant vector. **(May-05,06,09,10,Mar-05,09,10,14),TsMar-17**

02.*** Show that the trajectory of an object thrown at certain angle with the horizontal is a parabola. **(May-14,15,Mar-09,17,18), Ts-Mar-15,18**

03.*** Show that the maximum height and range of a projectile are $\frac{U^2 \sin^2\theta}{2g}$ and $\frac{U^2 \sin 2\theta}{g}$ respectively. Where the terms have their regular meanings. **(Mar-12)**

04.*** Show that the maximum height reached by a projectile launched at an angle of 45^0 is one quarter of its range. **(Mar-14)**

05.*** Define unit vector, null vector and position vector. **(May-97,Sep-2000,Mar-08)**

06.*** If $\left|\vec{a}+\vec{b}\right| = \left|\vec{a}-\vec{b}\right|$ prove that the angle between $\vec{a}$ and $\vec{b}$ is 90^0. **(Ts-Mar-18-VSAQ)**

07.** Show that a boat must move at an angle 90^0 with respect to river water in order to cross the river in minimum time?

08.** A bird holds a fruit in its beak and flies parallel to the ground. It lets go of the fruit at some height. Describe the trajectory of the fruit as it falls to the ground as seen by

(a) the bird (b) a person in the ground.

09.** What is relative motion. Explain it?

10* If the trajectory of a body is parabolic in one reference frame, can it be parabolic in another reference frame that moves at constant velocity with respect to the first reference frame? If the trajectory can be other than parabolic, what else it can be?

11* A particle is projected from the ground with some initial velocity making an angle of 45^0 with the horizontal. It reaches a height of 7.5m above the ground while it travels a horizontal distance of 10m from the point of projection. Find the initial speed of projection. ($g = 10m/s^2$)

12* A force 2i+j-k newton acts on a body which is initially at rest. At the end of 20 seconds the velocity of the body is 4i+2j-2k ms^{-1}. What is the mass of the body?

13*.O is the point on the ground shosen as origin.Abody first suppers a displacement of 10 $\sqrt{2}m$ North-East ,next 10m North and finnaly 10 $\sqrt{2}m$ North-West.How for is it from the origin?(TS-Mar-19)

VSAQ :

14. The vertical component of a vector is equal to its horizontal component. What is the angle made by the vector with x-axis? **(Mar-19)**

15. Two forces of magnitudes 3 units and 5 units act at 60^0 with each other. What is the magnitude of their resultant? **(Mar-15,17)**

16 When two right angled vectors of magnitude 7 units and 24 units combine, what is the magnitude of their resultant? **(May-14,Mar-18)**

17. $A = \bar{i} + \bar{j}$. What is the angle between the vector and x-axis. **(Mar-13,14),Ts-Mar-17**

18. If $\overline{P} = 2\hat{i} + 4\hat{j} + 14\hat{k}$ and $\overline{Q} = 4\hat{i} + 4\hat{j} + 10\hat{k}$ find the magnitude of $\overline{P} + \overline{Q}$. **(Ts-Mar-15)**

19. What is the accelertion of a projectile at the top of its trajectory? **(TS-Mar-19)**

20. Can a vector of magnitude zero have a nonzero components?

21. A vector **v** makes an angle e with the horizontal. The vector is rotated through an angle e. Does this rotation change the vector **v.**

22. Wind is blowing from the south at $5ms^{-1}$. To a cyclist it appears to blowing from the east at $5ms^{-1}$. Find the velocity of the cyclist.

23 A person walking at 4 m/s finds rain drops falling slantwise in to his face with a speed of 4 m/s at an angle of 30^0 with the vertical. Show that the actual speed of the rain drops is 4 m/s.

LAWS OF MOTION *(LAQ)*

01.*** a) State Newton's second law of motion. Hence derive the equation of motion F=ma from it **(Mar-17,19-SAQ),Ts-Mar-18-SAQ**

b) A body is moving along a circular path such that its speed always remains constant. Should there be a force acting on the body? **(Mar-13)**

SAQ

02.*** Mention the methods used to decrease friction. **(May-08,11,Mar-09,14,18)**

03.*** Why is pulling the lawn roller preferred to pushing it? **(May-10,Mar-06,08,10)**

04.*** Explain advantages and disadvantages of friction. **(Mar-06,15),Ts-Mar-15,17**

05.** Why are shock absorbers used in motor cycles and cars?

06.** Define the terms momentum and impulse. State and explain the law of conservation of linear momentum. Give examples.

07.* State the laws of rolling friction.

08.* Explain the terms limiting friction, dynamic friction and rolling friction.

VSAQ

09. What is inertia? What gives the measure of inertia? **(Mar-14,19),Ts-Mar-17**

10.When a bullet is fired from a gun, the gun gives a kick in the backward direction. Explain.**(Mar-15)**

11. Why does a heavy rifle not recoil as strongly as a light rifle using the same cartridges?

12. If a bomb at rest explodes into two pieces, the pieces must travel in opposite directions. Explain. **(Ts-Mar-15)**

13. Define force. What are the basic forces in nature?

14. Can the coefficient of friction be greater than one? **(Ts-Mar-18)**

15. Why does the car with a flattened tyre stop sooner than the one with inflated tyres? **(May-11)**

16. A horse has to pull harder during the start of the motion than later. Explain.**(May-09,Mar-13,18)**

17. What happens to the coefficient of friction, if the weight of the body is doubled? **(Ts-Mar-19) (May-14)**

18. Calculate the time needed for a net force of 5N change the velocity of a 10 kg mass by 2 m/s.

19. A constant force acting on a body of mass 3.0 kg changes its speed from 2.0 ms^{-1} to 3.5 ms^{-1} in 25 s. The direction of motion of the body remains unchange. What is the magnitude and direction on the force?

20. A batsman deflects a ball by an angle of 45^0 without changing its initial speed which is equal to 54 km/h.What is the impulse imparted to the ball?

21. A batsman hits back a ball straight in the direction of the bowler without changing its initial speed of 12 ms^{-1}. If the mass of the ball is 0.15 kg. determine the impulse imparted to the ball. (Assume linear motion of the ball) **(Mar-17)**

WORK, ENERGY AND POWER

LAQ

01.*** a) State and prove law of conservation of energy in case of freely falling body.

(May-09,11,Mar-05,06,09,11,13,15,18),Ts-Mar-17,19

b) A machine gun fires 360 bullets per minute and each bullet travels with a velocity of 600 ms^{-1} . If the mass of each bullet is 5gm. Find the power of the machine gun. **(Mar-14)**

c).Calculate the power of the pump required to lift 600kg of water per minute from a well of 25m deep.**(TS-Mar-19)**

02.*** Develop the notions of work and kinetic energy and show that it leads to work-energy theorem. **(Mar-14,17),Ts-Mar-15**

03.*** What are collisions? Explain the possible types of collisions? Develop the theory of one dimensional elastic collision, **(May-14,Mar-05,06,19),Ts-Mar-18**

the relative velocity of appraoch of two colliding bodies before collision is equal to the relative velocity of separation after collision. A body freely falling from a certain height 'h' after striking a smooth floor rebounds to a height h/2. What is coefficient of restitution between the floor and the body? **(Ts-Mar-18)**

SAQ

04.*** Show that in the case of one dimensional elastic collision, the relative velocity of approach of two colliding bodies before collision is equal to the relative velocity of separation after collision.

(Mar-05,06, May-08)

05.*** What is potential energy? Derive an expression for the gravitational potential energy.

06.** Show that two equal masses undergo elastic collision will move at right angles after collision, if the second body initially at rest.

07.** Distinguish between conservative and non-conservative forces with one example each.

08.* * A pump is required to lift 600kg of water per minute from a well 25m deep and to eject it with a speed of $50 ms^{-1}$.Calculate the power required to perform the above task ?**TS-(Mar-19) (Mar-15)**

09.* Explain the law of conservation of energy?

VSAQ

10. State the conditions under which a force does no work. **(Ts-Mar-15)**

11. Define: Work, Power and Energy. State their SI units.

12. State the relation between the kinetic energy and momentum of a body. **(Mar-11)**

13. State the sign of work done by a force in the following.

(a) work done by a man in lifting a bucket out of a well by means of rope tied to the bucket.

(b) work done by gravitational force in the above case.

14. State the sign of the work done by a force in the following.

(a) work done by friction on a body sliding down an inclined plane.

(b) work done by gravitational force in the above case.

15. State the sign of work done by a force in the following
(a) Work done by an applied force on a body moving on a rough horizontal plane with uniform velocity.
(b) Work done by the resistive force of air on a vibrating pendulum in bringing it to rest.

16. Which physical quantity remains constant
(i) in an elastic collision (ii) in an inelastic collision?

17. A body freely falling from a certain height 'h', after striking a smooth floor rebounds and rises to a height h/2. What is the coefficient of restitution between the floor and the body?

SYSTEMS OF PARTICLES AND ROTATIONAL MOTION

LAQ

01.** State and prove the principle of conservation of angular momentum. Explain the principle of conservation of angular momentum with examples. **(Mar-08)**

SAQ

02.*** Distinguish between centre of mass and centre of gravity **(Mar-13,14,15,17,18),Ts-Mar-15**

03.*** Define angular acceleration and torque. Establish the relation between angular acceleration and torque. **(AP-Mar-19)** **(Ts-Mar-18)**

04.*** Define vector product. Explain the properties of vector product with two examples.
(Mar-11,15),Ts-Mar-15,17,19

05.*** Define angular velocity(ω). Derive $V = r\omega$. **(AP-MAR-19,May-14),Ts-Mar-17**

06.*** Find the center of mass of three particles at the vertices of an equilateral triangle. The masses of the particles are 100 gram, 150 gram and 200 gram respectively. Each side of the equilateral triangle is 0.5m long. **(Mar-18),Ts-Mar-18**

06.** Explain about the centre of mass of earth-moon system and its rotation around the sun.

07.** Find torque of a force $7\bar{i} + 3\bar{j} - 5\bar{k}$ about the origin,The force acts on a paricle whose position vector is $\bar{i} - \bar{j} + \bar{k}$. **(Mar-14)**

08.* Derive expressions for the final velocity and total energy of a body rolling without slipping.

09.* State and prove parallel axes theorem. **(Mar-07,10, May-08,10,12)**

10.* State and prove perpendicular axes theorem. **(Mar-06, 09,11, May-08,11,12)**

11.* Find the scalar and vector products of two vectors $a = \left(3\hat{i} - 4\hat{j} + 5\hat{k}\right)$ and $b = \left(-2\hat{i} + \hat{j} - 3\hat{k}\right)$

VSAQ

12. Is it necessary that a mass should be present at the centre of mass of any system?
(Mar-11,May-11,12,14)

13. Why are spokes provided in a bicycle wheel? **(May-14)**

14. We cannot open or close the door by applying force at the hinges. Why?

15. By spinning eggs on a table top, how will you distinguish a hard boiled egg from a raw egg?
(Mar-13)

16. If the polar ice caps of the earth were to melt, what would the effect of the length of the day be?

17. Why is it easier to balance a bicycle in motion?

18. What is the moment of inertia of a rod of mass M. Length l about an axis perpendicular to it through one end? **(TS-Mar-19)**

OSCILLATIONS

LAQ

01.*** a) Show that the motion of a simple pendulum is simple harmonic and hence derive an equation for its time period. What is seconds pendulum? **(May-09,10,11,Mar,13,14,15,17), TS-Mar-15,17,18**

Calculate the change in the length of a simple pendulum of length 1m, when its period of oscillation changes from 2sec to 1.5 sec **(Ts-Mar-18)**

b) Find the length of a simple pendulum which ticks seconds. ($g = 9.8ms^{-2}$)

(Mar-17,18),TS-Mar-17

02.***a)Define simple harmonic motion. Show that the motion of (point) projection of a particle performing uniform circular motion, on any diameter, is simple harmonic.**(Ts-Mar-19) (May-14,Mar-09,10,18,19)**

b)On an aaverage a human heart is found to beat 75 times in a minute.Calculate its frequency and period.**(AP-Mar-19**)

c).A mas of 2kg is a attached to spring of force contant 200 Nm^{-1}.Find its time period **(Ts-Mar-19)**

03.*** Derive the equation for the kinetic energy and potential energy of a simple harmonic oscillator and show that the total energy of a particle in simple harmonic motion is constant at any point on its path.

SAQ

04.** Obtain an equation for the frequency of oscillation of spring of force constant k to which a mass m is attached.

05.* Derive expressions for displacement, velocity and accelaration of a particle executing SHM.

06.* Define simple harmonic motion? Give two examples.

VSAQ

07. Give two examples of periodic motion which are not oscillatory.

08. The displacement in S.H.M. is given by y = asin(20t + 4). What is the displacement when it is increased by $2\pi / \omega$?

09. A girl is swinging seated in a swing. What is the effect on the frequencey of oscillation if she stands?

10. The bob of a simple pendulum is a hollow sphere filled with water. How will the period of oscillation change, if the water begins to drain out of the hollow sphere?

11. Will a pendulum clock gain or lose time when taken to the top of a mountain?

12. A pendulum clock gives correct time at the equator. Will it gain or lose time, if it is taken to the poles? If so, why ?

13. What happens to the time period of a simple pendulum kept inside a lift, When the lift

(i) Moves up with acceleration 'a' ? (ii) Moves down with acceleration 'a'?

14. What are physical quantities having maximum value at the mean position in SHM?

15. What are physical quantities having maximum value at the extreme position in SHM?

GRAVITATION

LAQ :

01.** Derive an expression for the variation of acceleration due to gravity
(a) above and (b) below the surface of the Earth.

02.* Define gravitational potential energy and derive an expression for it associated with two particles of masses m_1 and m_2.

03.* State Newton's Law of Gravitation. Explain how the value of the Gravitational constant (G) can be determined by Cavendish method.

SAQ :

04.*** What is escape velocity? Obtain an expression for it. **(TS MA-19,Mar-05,07,08,09,10,13,15,18,19)**

05.*** What is orbital velocity? Obtain an expression for it. **(May-10,14,Mar-11,14,17)**

06.*** What is a geostationary satellite? State its uses. **(Mar-12),Ts-Mar-15,18**

07.*** State Kepler's laws of planetary motion. **(Ts-Mar-17)**

08.** Derive the relation between acceleration due to gravity(g) at the surface of a planet and Gravitational constant(G). **(May-12)**

09. * How does the acceleration due to gravity(g) change for the same values of height (h) and depth(d).

VSAQ :

10. State the units and dimensions of the universal gravitational constant (G).

11. State the vector form of Newtons law of gravitation.

12. As we go from one planet to another, how will
a) the mass and b) the weight of a body change?

13. Give the equation for the value of g at a depth 'd' from the surface of Earth. What is the value of 'g' at the centre of Earth?

14. What are the factors that make 'g' the least at the equator and maximum at the poles?

15. "Hydrogen is an abundance around the sun but not around earth". Explain. **(May-11)**

16. What is the time period of revolution of geostationary satellite? Does it rotate from West to East or from East to West?

17. What are polar satellites?

MECHANICAL PROPERTIES OF SOLIDS

LAQ :

01.** Define Hooke's law of elasticity and describe an experiment to determine the Young's modulus of the material of a wire. **(Mar-05,06,07,11)**

SAQ :

02.*** Describe the behaviour of a wire under gradually increasing load.

(May-08,11, Mar-05,06,07,11,13,15,17,18), Ts-Mar-15,17,18

03.*** Explain the concept of Elastic Potential Energy in a stretched wire and hence obtain the expression for it. **(TS-Mar-19)** **(Mar-14)**

04.** Define Hooke's law of elasticity, proportionality, permanent set and breaking stress.

05.** Define modulus of elasticity, stress, strain and Poisson's ratio.

06.** Define Young's modulus, Bulk modulus and shear modulus.

07.** Define stress and explain the types of stress. **(Mar-19)**

08.** Define strain and explain the types of strain.

VSAQ :

09. State Hooke's law of elasticity. **(May-09)**

10. State the examples of nearly perfect elastic and plastic bodies.

11. A copper wire of 1 mm diameter is stretched by applying a force of 10N. Find the stress in the wire

12. A tungsten wire of length 20 cm is stretched by 0.1 cm. Find the strain on the wire.

13. If an iron wire is stretched by 1%, what is the strain on the wire? **(May 11)**

14. A steel wire of length 20 cm is stretched to increase its length by 0.2 cm . Find the lateral strain in the wire if the Poisson's ratio for steel is 0.19 **(Mar-09)**

MECHANICAL PROPERTIES OF FLUIDS

LAQ :

01.** State Bernoulli's principle. From conservation of energy in a fluid flow through a tube, arrive at Bernoulli's equation. Give an application of Bernoulli's theorem. **(Mar 10)**

SAQ :

02.*** Explain Surface Tension and Surface energy. **(Mar-13)**

03.*** Explain dynamic lift with examples.

04.*** What is Torricelli's law? Explain how the speed of efflux is determined with an experiment.

05.*** Explain how surface tension can be measured experimentally?

06.*** Explain hydraulic lift and hydraulic brakes.

07.** What is Reynold's number? What is it's significance?

08.* What is atmospheric pressure and how is it determined using Barometer?

09.* What is gauge pressure and how is a manometer used for measuring pressure differences?

10.* What is hydrostatic paradox? **(TS-Mar-19- VSAQ)**

11.* What is Venturimeter? Explain how it is used?

VSAQ :

12. Define average pressure. Mention its units and dimensional formula. **(Mar-17)**

13. Define Viscosity. What are it's units and dimensions? **(Mar-12)**

14. What is the principle behind the carburetor of an automobile **(Mar-15,19),Ts-Mar17,18)**

15. What is magnus effect? **(TS-Mar-19)** **(Mar-15)**

16. Why are drops and bubbles spherical? **(Mar-09,14,17,18)**

17. Give the expression for the excess pressure in a liquid drop. **(Ts-Mar-17)**

18. Give the expression for the excess pressure in an air bubble inside the liquid. **(Mar-19)**

19. Give the expression for the soap bubble in air.

20. What are water proofing agents and water wetting agents? What do they do?

21. What is angle of contact? What are its values for pure water and mercury? **(May-14)**

22. If the diameter of a soap bubble is 10mm and its surface tension is 0.04N/m,find the excess pressure inside the bubble. **(Mar-14),Ts-Mar-18**

23. Mention any two applications of Bernoulli's theorem. **(Mar-18),Ts-Mar-15**

24. The density of the atmosphere at sea level is $1.29 kg/m^2$. Assume that it does not change with altitude. Then how high would the atmosphere extend?

25. Calculate the work done in blowing a soap bubble of diameter 0.6cm against the surface tension force. (Surface tension of soap solution $= 2.5\times10^{-2} Nm^{-1}$)

THERMAL PROPERTIES OF MATTER

LAQ :

01.*** State and explain Newton's law of cooling. State the conditions under which Newton's law of cooling is applicable. A body cools down from 60^0C to 50^0C in 5 minutes and to 40^0C in another 8 minutes. Find the temperature of the surroundings. **(Mar-11)**

02.** Explain thermal conductivity and coefficient of thermal conductivity. A copper bar of thermal conductivity 401 W/(mK) has one end at 104^0C and the other end at 24^0C. The length of the bar is 0.10m and the cross sectional area is $1.0\times10^{-6}m^2$. What is the rate of heat conduction, along the bar?

SAQ :

03.*** In what way is the anomalous behaviour of water advantageous to aquatic animals? **(May-09,Mar-14,17,18)**

04.*** Pendulum clocks generally go fast in winter and slow in summer. Why? (Ts MAR-17,19)

05.*** Write a short note on triple point of water. **(Mar-13)**

06.*** Explain conduction, convection and radiation with examples. **(Mar-15,19,Ts-Mar-15,18)**

07.** Explain Celsius and Fahrenheit scales of temperature. Obtain the relation between Celsius and Fahrenheit scales of temperature.

08.** A body cools from 60^0C to 40^0C in 7 minutes. What will be its temperature after next 7 minutes if the temperature of its surroundings is 10^0C ?

09.* State Boyle's law and Charle's law. Hence, derive ideal gas equation.

VSAQ :

10. Distinguish between heat and temperature. **(Ts-Mar-15)**

11. Why gaps are left between rails on a railway track? **(Mar-17,19)**

12. What are the lower and upper fixing points in Celsius and Fahrenheit scales? **(MAR-19May-14)**

13. Do the values of coefficients of expansion differ, when the temperatures are measured on Centigrade scale or on Fahrenheit scale?

14. Can a substance contract on heating? Give an example. **(Mar-11,12,18)**

15. What is latent heat of fusion?

16. What is latent heat of vapourisation? **(Mar-13)**

17. What is specific gas constant? Is it same for all gases?
18. What are the units and dimensions of specific gas constant? **(Mar-14)**
19. Why utensils are coated black? Why the bottom of the utensils are made of copper? **(Ts-Mar-18)**
20. State Wien's displacement law? **(Mar-17)**
21. Ventilators are provided in rooms just below the roof. Why? **(Mar-14)**
22. What is thermal resistance of a conductor? On what factors does it depend?
23. State the units and dimensions of coefficient of convection.
24. Define emissive power and emissivity.
25. What is greenhouse effect? Explain global warming? **(Mar-13,15)**
26. Define absorptive power of a body. What is the absorptive power of a perfect black body? **(May-14)**
27. State Newton's law of cooling?
28. State the conditions under which Newton's law of cooling is applicable.
29. The roof of buildings are often painted white during summer. Why? **(Ts-Mar-15,17)**
30. What is the temperature for which the readings on Kelvin and Fahrenhelt scales are same?
31. Find the increase in temperature of aluminium rod if its length is to be increased by 1%.
    [α for aluminium is $25\times10^{-6}\ ^0C^{-1}$] **(Mar-15)**
32. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the iron ring are 5.243 m and 5.231 m respectively at 27^0C . To what temperature should the ring be heated so as to fit the rim of the wheel?
33. Why is it easier to perfom the skating on the snow. **(Ts-Mar-17)**
34. Why do liquids have no linear and areal expanssions? **(Ts-Mar-19)**
35. If the maximum intensity of ration for a black body is found at 1.45 μ m.What is the tempertaure of a radiating body(Wiens constant = $2.9\times10^{-3}\ mK$) **(Ts-Mar-19)**

THERMODYNAMICS

LAQ :

01.*** Explain reversible and irreversible processes. Describe the working of Carnot engine. Obtain an expression for the efficiency. **(Mar-14,17,18),Ts-Mar-15,17,19**

02.*** State second law of thermodynamics. How is heat engine different from a refrigerator. **(May-08,14,Mar-13,15,19),Ts-Mar-18**

SAQ :

03.*** Derive a relation between the two specific heat capacities of gas on the basis of first law of thermodynamics. **(May-05,06,09,11)**

04.*** State and explain first law of thermodynamics.

05.*** Explain qualitatively the working of a heat engine. **(Mar-08)**

06.*** Compare isothermal and an adiabatic process.

07.** Obtain an expression for the work done by an ideal gas during isothermal change.

08.** Obtain an expression for the work done by an ideal gas during adiabatic change and explain.

09.** Define two principle specific heats of a gas. Which is greater and why?

VSAQ :

10. Define Thermal equilibrium. How does it lead to Zeroth law of Thermodynamics?

11. Define Calorie. What is the relation between calorie and mechanical equivalent of heat?

12. What thermodynamic variables can be defined by

    a) Zeroth law b) First law

13. Define specific heat capacity of the substance. On factors does it depend?

14. Define molar specific heat capacity.

15. For a solid, what is the total energy of an oscillator?

16. Why does the brake drum of an automobile get heated up while moving down at constant speed?

17. Can a room be cooled by leaving the door of an electric refrigerator open?

18. A thermos flask containing a liquid is shaken vigorously. What happens to its temperature?

19. A sound wave is sent into a gas pipe. Does its internal energy change?

20. How much will be the internal energy change in

    i) isothermal process ii) adiabatic process

21. What are the values of specific heat capacity in

    a) adiabatic system b) Isothermal system **(Mar-11,May-11)**

KINETIC THEORY OF GASES

LAQ :

01.* Derive an expression for the Pressure of an ideal gas in a container from Kinetic theory and hence give Kinetic interpretation of temperature.

SAQ :

02.*** How specific heat capacity of Mono atomic, diatomic and Poly atomic gases can be explained on the basis of law of equipartition of energy ? **(Mar-13)**

03.*** Four molecules of a gas have speeds 1, 2, 3 and 4km/s. Find rms speed of the gas molecule

04.** Explain the kinetic interpretation of temperature.

05.** Explain the concept of absolute zero of temperature on the basis of kinetic theory.

06.** What is the ratio of r.m.s. speed of Oxygen and Hydrogen molecules at the same temperature **(May-14)**

07.** If a gas has 'f' degrees of freedom, find the ratio of C_p and C_v.

VSAQ :

08. Define mean free path. **(Mar-15,17,18,19), Ts-Mar-15,17**

09. Name two prominent phenomena which provide conclusive evidence of molecular motion.
10. When does a real gas behave like an ideal gas? **(TS MAR-19) (Mar-14,19)**
11. State Boyle's Law and Charles Law. **(Mar-18),Ts-Mar-15**
12. State Dalton's law of partial pressures. **(Mar-14),Ts-Mar-17,18**
13. Explain the concept of degrees of freedom for molecules of a gas.
14. What is the expression between pressure and kinetic energy of a gas molecule? **(Mar-15,17)**
15. When pressure increases by 2%. What is the percentage decreases in the volume of a gas. Assuming Boyle's law is obeyed.
16. What is the law of equipartition of energy? **(Ts-Mar-17)**
17. **If the absolute temperature** of a gass increased to 3 times ,what will be the increase in RMS velocity of ths gass molecule? **(Ts-Mar-19)**

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JUNIOR IPE IMPORTANT QUESTION BANK

CHEMISTRY

BLUE PRINT

S.NO	NAME OF UNIT / CHAPTER	MARKS	LAQ	SAQ	VSAQ
1	Atomic Structure	8	8	-	-
2	Classification of elements and periodicity in properties	8	8	-	-
3	Chemical bonding and Molecular structure	8	8 (or)	4+4(OR)	-
			-	4	2+2
4	States of Matter – gases and Liquids	6	-	4	2
5	Stoichiometry	6	-	4	2
6	Thermo Dynamics	4		4(OR)	2+2
7	Chemical Equilibrium and Acids- Bases	6		4	2
8	Hydrogen and its compounds	4	-	4	
9	Alkali and Alkaline earth metals	4	-	4 (or)	2+2
10	Group – 13 Elements	4	-	4 (or)	2+2
11	Group – 14 Elements	4	-	4 (or)	2+2
12	Environmental Chemistry	4	-	-	2+2
13	Organic Chemistry – some basic principles and techniques	10	8	-	2
			-	4+4	2
	Total	76			

QUESTIONS BANK ANALYSIS

S.NO.	TOPIC	LAQ			SAQ			VSAQ	TOTAL
		***	**	*	***	**	*		
1	Atomic Structure	2	5	-	-	-	-	-	7
2	Classification of elements and periodicity in properties	3	-	-	1	2	6	-	12
3	Chemical bonding and Molecular structure	2	1	1	4	4	3	11	26
4	States of Matter – gases and Liquids	-	-	-	3	4	5	24	36
5	Stoichiometry	-	-	-	2	1	12	24	39
6	Thermo Dynamics	-	-	-	3	8	1	11	23
7	Chemical Equilibrium and Acids- Bases	4	-	-	2	5	3	22	36
8	Hydrogen and its compounds	-	-	-	3	2	2	12	19
9	Alkali and Alkaline earth metals(S-Block elements)	-	-	-	3	2	3	22	30
10	Group – IIIA Elements	-	-	-	2	2	2	15	21
11	Group – IVA Elements	-	-	-	2	1	3	22	28
12	Environmental Chemistry	-	-	-	-	-	-	24	24
13	Organic Chemistry – some basic principles and techniques	4	1	-	6	3	4	17	35
	TOTAL	15	7	1	31	34	44	204	336
	GRAND TOTAL	23			109				

ATOMIC STRUCTURE

LONG ANSWER QUESTIONS

01.*** What are the postulates of Bohr's model of hydrogen atom? **(Mar-19)**
Discuss the importance of this model to explain various series of line spectra in hydrogen atom ?
(**Mar-01,03,04,05,06,08,09,11,12,13,15,17,18),Ts-Mar-17,18**

02.*** How are the quantum numbers n, 1 and m,s arrived at? Explain the significance of these quantum numbers.? (**Jun-02,04,06,May-07,Sep-08,Mar-02,09,10,14),Ts-Mar-15,17,19**

03.** Define atomic orbital. Explain the shapes of s, p and d orbitals with the help of diagrams.?

04.** (a) Explain the difference between emission and absorption spectra.? **(Mar-15)**
(b) Explain (i) Aufbau Principle (ii) Hund's Rule (iii) Pauli's Principle? **(Mar-19)**

05.** (a) Explain the dual behavior of matter. Discuss its significance to microscopic particles like electrons?
(b) Explain briefly the Planck's quantum theory?

06.** (a) Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength associated with the electron revolving around the orbit?
(b) Explain photoelectric effect?
(c) Advantages and Limitations of Bohr's theory (**Mar-13,15**)
(d) What will be the wavelength of a ball of mass 0.1kg moving with a velocity of $10ms^{-1}$ (**Mar-11)**

07**. a) Explain Heisenberg's Uncertainty principle?
b)A golf ball has a mass of 40g, and a speed of 45m/s. If speed can be measured with in accuracy of 2%, calculate the uncertainty in the position.
c) Explain the difference between line spectrum and band spectrum

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

LONG ANSWER QUESTIONS

01.*** Define IE_1 and IE_2. Why is $IE_2 > IE_1$ for a given atom? Discuss the factors that effect IE of an element? **(Sep-2000,Mar-2000,04,Jun-04,06,08,09,May-09,Mar-12,13),Ts-Mar-17,19**

02.*** What is a periodic property? How the following properties vary in a group and in a period ? Explain
(a) Atomic radius (b) IE (c) EN (d) Electron gain enthalpy or electron affinity
(e) Nature of oxides
(Jul-01,May-07,12, Jun-05,06,Sep-08,Mar-03,07,11,14,15,18),Ts-Mar-15,18

03.*** Write an essay on s,p,d and f- block elements. **(Mar-05,Jun-11,Mar-17,19)**

SHORT ANSWER QUESTIONS

04.*** Give any four characteristic properties of transition elements

05.** Electron affinity of chlorine is more than that of fluorine - explain

06.** What is lanthanide contraction ? What are its consequences?

07.* Explain (i) Electronegativity (ii) Electron affinity?

08.* Write a note on (i) Atomic radius (ii) Metallic radius (iii) Covalent radius

09.* Give the outer orbit general electronic configuration of
a. Noble gases
b. Representative elements
c. Transition elements
d. Inner transition elements

10.* IE_1 of Na is less than that of Mg but IE_2 of Na is higher than that of Mg explain.

11.* Which element of 3rd period has the highest IE_1 ? Explain the variation of IE_1 in this period.

12.* What is diagonal relationship ? Give a pair of elements having diagonal relationship. Why do they show this relation ?

CHEMICAL BONDING

LONG ANSWER QUESTIONS

01.*** What do you understand by Hybridisation? Explain different types of hybridization involving s and p orbitals. **(Jun-02,04,05,06, Sep-08, Mar-02,06,13,Ts-Mar-17)**

02.*** Give an account of VSEPR Theory, and its applications **(Sep-2000,May-07,Mar-04,05,07)**

03.** Give the Molecular Orbital Energy Diagram of (a) N_2 **(Ts-Mar-19-**SAQ) and (b) O_2 . Calculate the respective bond order. Write the magnetic nature of N_2 and O_2 molecules **(Mar-09,14),Ts-Mar-15**

04.* Explain the factors favourable for the formation of Ionic compounds **(Mar-01,08)**

SHORT ANSWER QUESTIONS

05.*** Explain the hybridization involved in PCl_5 molecule. **(Mar-12),Ts-Mar-15,18**

06.*** Even through nitrogen in ammonia is in sp^3 hybridization, the bond angle deviate from $109^0 28^1$ .Explain

07.*** Explain the hybridization involved in SF_6 molecule. **TS-MAR-19 (May-12,Mar-14,19-LAQ)**

08.*** What is Hybridization? Explain the structure of CH_4 on the basis of Hybridization. **(Mar-18)**

09.** Explain Fajan's rules and give suitable examples. **(Mar-15,19-LAQ)**

10.** Define Dipole moment. Write its applications.

a) NH_3 has a higher dipole moment compared to NF_3 . Whay ?

b) dipole moment observed for NF_3 and not BF_3 . whay ? **(Mar-2017)**

11.** What is Hydrogen bond Explain the different types of Hydrogen bonds with examples. **(Mar-17,18),Ts-Mar-18**

12.** Expain the structure of ethylene(C_2H_4) and acetylene(C_2H_2). **(Mar-15)**

13.* Explain the formation of Coordinate covalent bond with one example.

14.* Explain valence bond theory with example.

15.* Predict the shape of the following molecules by using VSEPR theory **(Mar-14)**

a) XeF_4 b) BrF_5 c) ClF_3 d) ICl_4^-

VERY SHORT ANSWER QUESTIONS

16. What is Octet rule?

17. Which of the two ions ca^{2+} or Zn^{2+} is more stable and why?

18. Cl^- ion is more stable than Cl atom-Why?

19. Why argon does not form Ar_2 molecule?

20. If A and B are two different atoms when does AB molecule become Covalent?

21. Why H_2O has higher BP than HF **(Jun-09,May-09,Mar-03,May-12)**

22. What type of bonds are present in NH_4Cl ? Write its structure **(Mar-04,May-12)**

23. Define bond angle and bond enthalpy ?

24. Define bond length and bond order ?

25. What is ment by localized orbitals?

26. How many sigma and pi bonds are present in

a) C_2H_2 b) C_2H_4

CHEMICAL EQUILIBRIUM AND ACIDS & BASES

LONG ANSWER QUESTIONS

01.*** What is Lechatlier's principle? Discuss briefly the factors which can influence the equilibrium.

02.*** Discuss the application of Lechaterlier's principle for the industrial synthesis of Ammonia and sulphur trioxide. **(Mar-10,12,13), Ts-Mar-15**

03.*** Explain the concept of Bronsted acids and Bronsted bases, Illustrate the answer with suitable examples. **(Ts-Mar-17)**

04.*** Explain Lewis acid-base theory with suitable example. Classify the following species into Lewis acids and Lewis bases and show these act as Lewis acid / base.

(a) OH^- (b) F^- (c) H^+ (d) BCl_3

SHORT ANSWER QUESTIONS

05.*** Derive the relation between K_C and K_P for equilibrium reaction **(Mar-13,15) TS-MAR-19**

a) $N_{2(g)} + 3H_{2(g)} \rightleftarrows 2NH_{3(g)}$ b) $2SO_{2(g)} + O_{2(g)} \rightleftarrows 2SO_{3(g)}$

06.*** Discuss the application of Lechaterlier's principle for the industrial synthesis of Ammonia by haber process **(Mar-18),Ts-Mar-18**

07.** a) What is a conjugate acid-base pair? Illustrate with examples. **(Mar-14,19)**
b) Write conjugated acid and bases for following species

i) H_2O **(Mar-18-VSAQ)** ii) NH_3 iii) HCO_3^- iv) HSO_4^- **(Mar-18-VSAQ)** v) OH^- vi) H_2O_2

08.** Define pH.. What is buffer solution? Derive Henderson- Hasselbalch equation for Calculating the pH of an acid buffer solution.

09.** How does the value of equilibrium constant predict the extent of reaction?

10.** Explain the term "Hydrolysis of salts" with examples. Discuss the pH of the following types of salt solutions.
(i) Salts of weak acid and strong base. (ii) Salts of strong acid and weak base.

11.** What are electron deficient compound. Explain why BF_3 acts a lewis acid **(May-14)**

12.* What is solubility product? Explain the common ion effect on solubility of ionic salts.

13.* Write notes on
(i) common ion effect
(ii) The relation between K_{sp} and solubility (S) of a sparingly soluble salt $BaSO_4$

14.* Define Ionic product of water. What is its value at room temperature. **(Mar-17),Ts-Mar-17**

VERY SHORT ANSWER QUESTIONS

15. What is homogeneous equilibrium? Write two homogeneous reactions. **(Mar-14,17),Ts-Mar-17**
16. What is heterogeneous equilibrium? Write two heterogeneous reactions **(Mar-17)**
17. Define equilibrium constant
18. Write the relation between K_P and K_C with example
19. Give two chemical equilibrium reactions for which $K_P = K_C$
20. What is conjugate Acid - Base pair? Give example
21. What is the value of K_W ? what are its units?
22. All bronsted bases are Lewis bases. Explain
23. All Lewis acids are not Bronsted acids .Why?
24. Give two examples of salts whose aqueous solutions are basic
25. Give two examples of salts whose aqueous solutions are acidic
26. Calculate the pH of 0.05M NaOH solution **(Mar-13)**
27. Calculate the pH of 0.05M H_2SO_4 solution **(Ts-Mar-15)**
28. Find the pH of 0.05 M $Ba(OH)_2$ aqueous solution **(Mar-13)**
29. Calculate the PH of 0.1M HCl solution? **(Mar-14)**
30. Calculate the PH of 10^{-8} M HCl solution?
31. Calculate the PH of 10^{-8} M NaOH solution?

32. What is degree of ionization. **(Ts-Mar-18)**
33. What are Lewis acid & base ? Give suitable example **(Mar-15)**
34. The concentration of hydrogen ion in a sample of soft drink is $3.8\times10^{-3}M$ .What is its P^H .
35. What is Bronsted base? Give an example (TS-MAR-2019)
36. What is the effect of pressure on a gaseous chemical equilibrium **(MAR-19)**

ORGANIC CHEMISTRY

LONG ANSWER QUESTIONS

01.*** Describe two methods of preparation of ethylene. Give equation for the reaction of ethylene with the following. **(Mar-02,04,11,14),Ts-Mar-18**
(a) Ozone **(Mar-19 SAQ)** (b) Hypohalous acid
(c) Cold and dil.alk. $KMnO_4$ **(Mar-19 SAQ)** (d) Heated with O_2 at high pressure

02.*** Give two methods of preparation of acetylene. How does it react with water and Ozone?

03.*** How does acetylene react with the following reagents? Give the corresponding equations and name the product formed in the reactions **(Sep-2000,Jun-02)**
(a) Acetic acid (b) Water(ap mar2017) (c) Hydrogen (d) Halogens
(e) Hydrogen halide (f) Ammonical $AgNO_3$ and Cu_2Cl_2

04.*** Describe any two methods of preparation of benzene ? Explain the halogenation, alkylation, acylation, nitration and sulphonation of benzene. **TS-MAr-19 (May-09,Mar-01,12,14,15,18)**

05.** Explain the following equations
a) Wurtz reaction **(Mar-17),Ts-Mar-15,17**
b)decarboxylationc) kolbe's electrolytic method **(Ts-Mar-15)**

SHORT ANSWER QUESTIONS

06.*** Complete the following reaction and name the product A,B and C.
$CaC_2 \xrightarrow{H_2O} A \xrightarrow{hot\ metal\ tube} B \xrightarrow{AlCl_3+CH_3Cl} C$ **(Mar-04,05),Ts-Mar-15**

07.*** Name the products A,B and C formed in the following reactions. Give the equations for the reactions.
Ethylene $\xrightarrow{Br_2/CCl_4} A \xrightarrow{Alc.KOH} B \xrightarrow{Br_2} C$ **(Mar-09), Ts-Mar-15**

08.*** What is substitution reaction? Explain any two substitution reactions of benzene. **(Mar-07,Sep-08)**

09.*** Which type of compounds react with Ozone? Explain with one example. **(Mar-02,03,04)**

10.*** Give two examples each for position and functional isomerism. **(Mar-02,05,13)**

11.*** What do you understand about Geometrical isomerism? Explain the Geometircal isomers of 2-butene. **(Mar-07,May-07)**

12.** Explain (i) Inductive effect (ii) Mesomeric effect (iii) Resonance effect with examples

13.** Explain the method of writing $E-Z$ configurations for Geometrical isomers taking $CHCl=CFBr$ as your example **(Mar-06)**

14.** Discuss Markownikov's rule and Kharash effect.

15.* What carcinogenicity? Explain with two examples.

16.* Explain a) Dumas method b) KJeldhal method

17.* What is polymerization? explain with one example. **(Ts-Mar-17)**

18.* Describe any two methods of preparation of Ethane. **(Mar-19)**

VERY SHORT ANSWER QUESTIONS

19. Write the reagents required for conversion of benzene to methyl benzene
20. How is nitrobenzene prepared **(Mar-17)**
21. Write the conformations of ethane
22. Write the structures of : Trichloroethanoic acid, Neopentane , P- nitrobenzaldehyde
23. Discuss Lassaigne's test
24. Explain the principle of chromatography
25. Explain the following

(a) Crystallisation(b) Distillation c) Stream Distillation d) Distillation under reduced pressure

26. How is ethylene prepared form ethyl alcohol? Write the reaction.

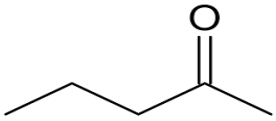
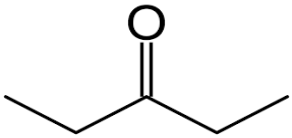
27. What is the product fromed when sodium propinoate is heated with soda lime.

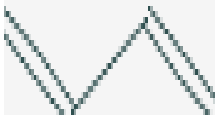
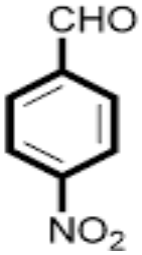
28. What is dehydrohalogenation? Write the equation for the formation of alkene from alkyl halide

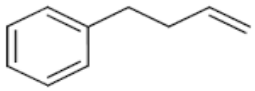
29. Write the IUPAC names of

(a) $CH_3-CH_2-CH_2-CH=CH_2$ **(Ts-Mar-18)** (b) $CH_3-\overset{\overset{0}{\|}}{C}-CH_3$ **(Ts-Mar-18)**

C) $CH_3-\overset{\overset{CH_3}{I}}{\underset{\underset{CH_3}{I}}{C}}-CH_2-\overset{\overset{CH_3}{I}}{\underset{\underset{CH_3}{I}}{C}}-CH_3$ D) $CH_3-\underset{\underset{OH}{I}}{CH}-CH_2-CH_2-CH_3$ **(Ts-Mar-15)**

E)  **(Mar-18)** F) 

G)  **(TS-Mar-19) (Mar-18)** H) 

I)  J) $CH_3-\underset{\underset{CH_3}{I}}{C}=CH-CH_3$ **(Ts-Mar-19)**

K). $I)\left(CH_3\right)_2C(C_2H_5)_2 \quad II)CH_3-CH_2-\underset{\underset{CH_2-CH_3}{1}}{CH}-CH_2-\underset{\underset{CH_3}{1}}{CH}-CH_2-CH_3$ **(Mar-19)**

30. Write the structural formula of the given compounds - **(Mar-14)**

(a) 3,4,4,5 - Tetramethyl heptane (b) 2-Methyl -1-butene

31. Write the structures of following compounds

(a) 2,4 dimethylpentane (b) 3-Ethyl-4,4-dimethylheptane

32. Write a short notes on a)Wurtz reaction **(Mar-17)** b)Fridel craft alkylation **(Ts-Mar-17)**

c)Fridel craft acylation

33. What is the type of hybridization of each carbon in the following compound? **(Mar-17)**

$HC \equiv C - CH = CH_2$

34. Write the following reaction with equation ?Polymerization of ethylene ? **(Mar-17)**

35. Write the functional isomers of organic compound C_3H_6O. **(Ts-Mar-17)**

STATES OF MATTER

SHORT ANSWER QUESTIONS

01.*** Write the postulates of Kinetic Molecular Theory of Gases.
(July-01,Jun-11,Mar-02,04,06,08,12,13),Ts-Mar-17,18

02.*** Deduce (a) Boyle's law and (b) Charle's law (c) Graham's law (d) Dalton's law (e) Kinetic Energy from Kinetic gas equation. **(Mar-03,05,07,08,11,12,15,19,Ts-Mar-15)**

03.*** State and explain Graham's law of Diffusion? Problems **(Mar-17)**
(Jun-02,04,05,06,Mar-03,11), Ts-Mar-18-VSAQ

04.** State and explain Dalton's law of partial pressures.? Problems **(Jun-10,Mar-01,03,07)**

05.** Define (a) RMS (b) average and (c) most probable speeds of gas molecules. Give their inter relationship.

06.** Find the RMS, most probable and average speeds of SO_2 at 27^0C

07.** Find the RMS, average and most probable speeds a of O_2 at 27^0C

08.* Derive Ideal gas equation. **TS-MAR-19** (**Mar-07**)

09.* Explain the physical significance of Vander Waals parameters.

10.* 360 cm^3 of CH_4 gas diffused through a porous membrane in 15 minutes, Under similar conditions,120cm^3 of another gas diffused in 10 minutes. Find the molar mass of the gas.**(Mar-18)**

11.* A neon-dioxygen mixture contains 70.6 g dioxygen and 167.5 g neon. If pressure of the mixture of gases in the cylinder is 25 bar. What is the partial pressure of dioxygen and neon in the mixture ?

12.* What is vapour pressure of liquid? How the vapour pressure of liquid is related to its boilling point?

VERY SHORT ANSWER QUESTIONS

13. What are Isotherms?
14. What are S T P conditions?
15. What is gram molar volume?
16. Why the gas constant 'R' is called universal gas constant
17. Which of the gases diffuses faster among N_2, O_2 and CH_4 Why? **(Mar-02,May-09),Ts-Mar-15**
18. How many times methane diffuses faster than sulphurdioxide?
19. Give the relation between the partial pressure of a gas and its mole fraction
20. What is aqueous tension?
21. What is Boltzmann's constant? Give its value **(Mar-12)**
22. What is R M S speed
23. What is compressibility factor?
24. What is Boyle Temperarure?
25. Why pressure cooker is used for cooking food on hills?
26. What is critical Temperarure? Give its value for CO_2
27. What is surface tension? **(Mar-18)**
28. What is coefficient of viscosity ? Give its units
29. Calculate Kinetic energy of 5 moles of nitrogen at 27^0 C ? **(Mar-13,15),Ts-Mar-17**
30. State Boyles law. Give its mathematical Expression

31. What are Isochores
32. What is Laminar flow of a liquid
33. Find the RMS speed of N_2 at 27^0C ?
34. Write the effect of temperature on surface tension and viscosity. Give reason to that. **(Mar-17)**
35. Calculte the kinetic engery of 4 moles of methane at- 73^0C **(TS-Mar-19)**
36. Calculte the ratio of kinetic energies of 3g of H_2 and 4g of o_2 at a given temperature.**(Mar-19)**

STOICHIOMETRY
SHORT ANSWER QUESTIONS

01.*** Balance the following redox equation by ion- electron method taking place in acidic medium.

A) $Cr_2O_7^{2-} + NO_2^- \rightarrow Cr^{3+} + NO_3^-$ **(Mar-04,05,May-07)**

B) $MnO_4^{-1} + SO_3^{-2} \rightarrow Mn^{2+} + SO_4^{-2}$ **(Jun-06,Sep-08,Mar-09,11)**

C) $H_2SO_4 + HBr \rightarrow SO_2 + Br$

D) $MnO_4^- + C_2O_4^{-2} \rightarrow Mn^{+2} + CO_2$

E) $Cr_2O_7^{-2} + SO_2 \rightarrow Cr^{+3} + SO_4^{-2}$ **(Mar-18)**

F) $MnO_4^- + SO_2 \rightarrow Mn^{+2} + HSO_4^-$ **(Ts-Mar-15)**

G) $Fe^{+2} + CrO_7^{2-} \rightarrow Fe^{+3} + Cr^{+3}$ **(Mar-15),Ts-Mar-18**

02.*** Determination of Empirical formula and molecular formula **(Jun-04,11,Mar-11)**

(a) A carbon compound contains 12.8%carbon, 2.1%hydrogen, 85.1% bromine. The molecular weight of the compound is 187.9. Calculate the molecular formula. **(Mar-17)**

(b) Chemical analysis of a carbon compound gave the following percentage composition by weight of the elements present, carbon = 10.06%, hydrogen= 0.84% chlorine=89.10%, calculate the empirical formula of the compound.

(c) Calculate the empirical formula of the compound having percentage composition potassium (K) =26.57, chromium (Cr) = 35.36, oxygen (O) =38.07 [Given the atomic weights of K, Cr, O as 39,52 and 16 respectively]

D) A compound having 4.07% hydrogen, 24.27% carbon and 71.65 % chlorine its molecular weight is 98.96 what are its emperical formula and molecular formula **(Ts-Mar-17,19)**

03.** Balance the following redox equation by ion-electron method taking place in basic medium.

(a) $MnO_4^- + I^- \rightarrow MnO_2 + I_2$ **(Mar-14,19)**

(b) $P_4 \xrightarrow{OH^-} PH_3 + H_2PO_2^-$

(c) $Cr(OH)_3 + IO_3^- \xrightarrow{OH^-} CrO_4^{2-} + I^-$

04.* Calculate the amount of 90% H_2SO_4 required for the preparation of 420kg HCl

$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

05.* When 50gm of a sample of sulphur was burnt in air 4% of the sample left over. Calculate the volume of air required at STP containing 21% oxygen by volume.

06.* Calculate the volume of 0.1N H_2SO_4 required to neutralize 200ml of 0.2N NaOH solution.

07.* Calculate the volume of 0.1M $KMnO_4$ required to react with 100ml of 0.1M $H_2C_2O_4 2H_2O$ solution in presence of H_2SO_4

08.* Explain the different types of redox reactions.

09.* Assign oxidation number to the underlined elements in each of the following species.

a) C_3O_2 **b)** $H_4P_2O_7$ **c)** $H_2S_4O_6$ **d)** Fe_3O_4 **e)** CaO_2

f) $NaBH_4$ **g)** $H_2S_2O_7$ **h)** $KAl(SO_4)_2 12H_2O$ I) $KMnO_4$ J) MnO_4^{-2}

k) H_2O_2 L) O_2F_2 **(Mar -15),Ts-Mar-15**

10.* Calculate the Gram Equivalent weights of $KMnO_4$ with different conditions.

11.* The density of 3M solution of $NaCl$ is 1.25g.mL^{-1}. Calculate molality of the solution.

12.* Calculate the mass of Na_2CO_3 required to prepare 250ml of 0.5N solution.

13.* How much minimum volume of CO at STP is needed to react completely with 0.112L of O_2 atm pressure and 127^0 to give CO_2.

14.* Balance of the following equation by the oxidation number method?

$MnO_4^{2-} + Cl_2 \rightarrow MnO_4^- + Cl^-$

15.* Define normality. 6.3 gms of oxalic acid is present in 500 ml of solution its normality is.

VERY SHORT ANSWER QUESTIONS

16. How many number of moles of glucose are present in 540 gms of glucose? **(Jun-10)**

17. Calculate the weight of 0.1 mole of sodium carbonate

18. Calculate the number of molecules present in $1.12\times10^{-7}cc$ of a gas at STP
(c.c.-cubic centimeters $= cm^3$)

19. What is a redox concept ? Give an example

20. What do you mean by significant figures?

21. The empirical formula of compound is CH_2O . Its molecular weight is 90. Calculate the molecular formula of the compound. **(Mar-13)**

22. What are the disproportionation reactions? Give examples.

23. What are comproportionation reactions? Give examples

24. What volume of CO_2 is obtained at STP by heating 4g of $CaCO_3$? **(Jun-09,Mar-12)**

25. How many significant figures are present in the following?
(a) 0.0025 (b) 208 (c) 5005 (d) 126.000 (e) 500.0 (f)2.0034

26. Round up the following up to three significant figures.
(a) 34.216 (b) 10.4107 (c) 0.04597 (d) 2808

27. What volume of H_2 at STP is required to reduce 0.795gm of CuO to give Cu and H_2O?

28. Calculate the volume of O_2 at STP required to completely burn 100ml of acetylene.

29. Calculate the equivalent weights of $Cr_2O_7^{2-}$ in Acid medium.

30. Calculate the oxidation number to the under lined elements.

(a) H_2SO_5 (b) $H_2S_2O_8$ (c) $\underline{Cr}O_5$ (d) Br_3O_8 (e) K_2MnO_4 (f) NaH_2PO_4

31. A solution is prepared by adding 2gm of a substance A to 18gm of water. Calculate the mass percent of the solute. **(TS-Mar-19)**

32. Calculate the molarity of NaOH in the solution prepared by dissolving 4gm in enough water to form 250ml of the solution. **(Mar-18)**

33. Define weight percentage

34. Define molarity, molality and molefraction

35. Calculate the equivalent weights of the following

a) H_2SO_4 b) $NaOH$ c) Na_2CO_3 d) $K_2Cr_2O_7$

36. How many numbers of $CaCO_3$ moles present in 200grams of $CaCO_3$? **(May-14)**

37. Calculate the oxidation number of 'Cr' in $K_2Cr_2O_7$. or $Cr_2O_7^{2-}$ **(Mar-17),Ts-Mar-17**

38. Calculate the oxidation number of Maganese (Mn) in MnO_4^- **(Ts-Mar-18)**

39. Calculate the amount of carbon dioxide that could be produced when one mole of carbon is burnt in 16 g of dioxygen **(MAR-19)**

THERMODYNAMICS

SHORT ANSWER QUESTIONS

01.*** State the first law of thermodynamics. Explain its mathematical notation.

02.*** State and explain the Hess's law of constant Heat summation.**(Mar-12,14,15,17,18),Ts-Mar-15,18,19**

03.*** Explain spontaneity of a process in terms of Gibbs energy

04.** State the second law of thermodynamics and explain it.

05.** What is entropy? Explain with examples. **(Ts-Mar-17)**

06.** Define heat capacity. What are C_P and C_V ? Show that $C_P - C_V = R$

07.** State the third law of thermodynamics.**(Mar-19-VSAQ)** What do you understand by it? **(Ts-Mar-17)**

08.** What is the enthalpy of reaction? Explain the standard enthalpy of a reaction.

09.** What is the standard enthalpy of formation explain with example.

10.** Define and explain the standard enthalpy of sublimation.

11.** Define and explain enthalpy of combustion.

12.* Derive the equation of W_{rev} in isothermal reversible process.

VERY SHORT ANSWER QUESTIONS

13. Define a system .Give an example

14. No heat is absorbed by the system from the surroundings, but work (w) is done on the system. What type of wall does the system have?

15. State the first law of the thermodynamics. **(Ts-Mar-18)**

16. What are intensive and extensive properties **(Mar-19)**

17. Give the equation that gives the relationship between ΔU and ΔH

18. Is increase of entropy the criterion for spontaneity . Why?

19. Explain the relationship between Gibbs energy change and equilibrium constant.

20. Enthalpy of combustion of carbon to CO_2 is –393.5 kJ mol^{-1}. Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas. **(Ts-Mar-15)**

21. Given $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$; $\Delta H^0 = -92.4$ kJ mol^{-1}

What is the standard enthalpy of formation of NH_3 gas?

22. Calculate the standard enthalpy of formation of $CH_3OH_{(l)}$ from the following data:

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)} \; ; \; \Delta_r H^0 = -726 \text{ kJ mol}^{-1}$$

$$C_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} \; ; \; \Delta_c H^0 = -393 \text{ kJ mol}^{-1}$$

$$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)} \; ; \; \Delta_f H^0 = -286 \text{ kJ mol}^{-1}.$$

23. The equilibrium constant for a reaction is 10. What will be the value of ΔG ?

R = 8.314 JK^{-1} mol^{-1}, T =300 K.

HYDROGEN AND ITS COMPOUNDS

SHORT ANSWER QUESTIONS

01.*** Discuss, with relevant chemical equations, various methods of preparing hydrogen peroxide, Which of these methods is useful to prepare D_2O_2 ? **(Sep-2000,Jun-06,May-07,Mar-02,05,07,11,12)**

02.*** Write the chemical reactions to justify that hydrogen peroxide can function as an oxidizing as well as reducing agent. **(Mar-03,04,06,08),Ts-Mar-18**

03.*** Explain the following with suitable examples **(Mar-14,19),Ts-Mar-17**

(a) electron-deficient hydrides **(Mar-1**9) (b) electron-precise hydrides.

c) electron rich hydrides d) Ionic hydrides **(Mar-1**9)

04.** Explain the terms hard water and soft water. Write a note on the (i) ion - exchange method and (ii) Calgon method for the removal of hardness of water. **Jun-02,Sep-08,15,Mar-18),Ts-Mar-15,19)**

05**. What is temporary and permanent hardness of water? Mention which ions causes the hardness of water. **(May-14,Mar-15)**

06.* Write a note on heavy water.

07.* Write a few lines on the utility of hydrogen as a fuel. **(Mar-13,17)**

VERY SHORT ANSWER QUESTIONS

08. Name the isotopes of hydrogen. What is the ratio of the masses of these isotopes?

09. Why is dihydrogen used in welding of high melting metals ?

10. Explain the term " SYNGAS".

11. What is meant by coal gasification ? Explain with relevant, balanced equation

12. What do you mean by autoprotolysis ? Give the equation to represent the autoprotolysis of water

13. Water behaves as an amphoteric substance in the Bronsted sense. How do you explain?

14. Mention any three uses of H_2O_2 ?

15. Why H_2O has a higher B.P than H_2S .

16. What is perhydrol and hyperol?

17. Calcute the strength of 10 volume solution of H_2O_2 ?

18. How many hydrogen bonded water molecules are associated in $CuSO_4.5H_2O$?

19. Define the term hydride ? How **they are classified.**

Alkali and Alkaline earth metals(S-BLOCK ELEMENTS)

SHORT ANSWER QUESTIONS

01.*** What do you know about Castner-Kellner process? Write the principle involved in it.

02.*** Given an account of the biological importance of Na^+ and K^+ ions. (**Mar-18-VSAQ),Ts-Mar-17**

03.*** Give an account of the biological importance of Mg^{2+} and Ca^{2+}

04.** Give an account of the properties of washing soda.

05.** What is Plaster of Paris? Write a short note on it. **(Mar-17),Ts-Mar-17**

06.* In what ways lithium shows similarities to magnesium in its chemical behaviour?

07.* Discuss the various reactions that occur in the Solvay process.

08.* Write a few lines about cement.

VERY SHORT ANSWER QUESTIONS

09. Write completely the electronic configurations of K and Rb

10. Lithium reacts with water less vigorously than sodium . Give your reasons **(Ts-Mar-18)**

11. Explain the biological importance of Magnesium & Calcium

12. What happens when magnesium metal is burnt in air ? **(Ts-Mar-15,18)**

13. Write a balanced equation for the formation of ammoniated II A metal ions from the metals in liquid ammonia.

14.Describe the importance of Plaster of Paris(Mar-18)(or)What is Plaster of Paris? write itsuses**(Mar-19**)

15. Write the average composition of Portland cement.

16. Describe the important uses of caustic soda. **(Mar-15)**

17. Describe the important uses of sodium carbonate

18. Describe the important uses of quick lime **(Mar-14)**

19. Why are alkali metals not found in the free state in nature **(Mar-13,17)**

20 Which is called milk of magnesia?Give its uses? **(Mar-15)**

21. Write the properties of Washing soda. **(Mar-14)**

22. Why are IA group elements called as alkali metals **(May-14)**

23. Why is gypsum added to cement? **(Ts-Mar-15,19)**

24. What happens,When calcium nitrate is strongly heated?

25. Give two uses of i) Lithium ii) Sodium

26. Whay kO_2 is paramagnetic and calculate oxdation state of K ?

27. Whay does the solubility of alkaline earth metal hydroxides in water increases down the group?

28. Whay does the solubility of alkaline earth metal carbonates and sulphates in water decreases down the group ?

29. Whay does potassium carbonate can't be prepared in solvay process ? **(Mar-19)**

30. Write any two uses of Mg metal . **(TS-Mar-19)**

GROUP-13 ELEMENTS

SHORT ANSWER QUESTIONS

01.*** Explain the structure of diborane.

(Sep-2000,Jun-04,06,May-07,Mar-2000,04,07,11,15,17,19),Ts-Mar-15,18

02.*** How does diborane react with (**May-12**)

(a) H_2O (b) CO (c) $N(CH_3)_3$ (d)NH_3

03.** Explain the structure of boric acid.

04.** Explain borax bead test with a suitable example. **(TS-Mar-19)** (**Mar-13,18**)

05.* Give two methods of preparation of diborane. **(Mar-14)**

06.* What are electron deficient compounds? Is BCl_3 an electron deficient species. Explain.

VERY SHORT ANSWER QUESTIONS

07. How do you explain higher stability of $TlCl$ than $TlCl_3$

08. Is boric acid a protic acid ? Explain.

09. Explain inertpair effect **(Mar-19)** **(Ts-Mar-17)**

10. What is the hybridization of B in diborane and borazine?

11. Give the formula of borazine . What is its common name? **(Ts-Mar-17)**

12. Give the formulae of (a) Borax (b) Colemanite

13. Sketch the structure of orthoboric acid
14. Write the structure of $AlCl_3$ as a dimer
15. Boron is unable to form BF_6^{-3} ion - explain
16. White fumes appear around the bottle of anhydrous $AlCl_3$ .Give reason ?
17. Al reacts with dil HNO_3 but not with con HNO_3 why ?
18. Give two uses of Aluminium ?
19. Metal borides having B^{10} are used as protective shield why ?
20. What happend when boric acid is heated ?
21. Explain why atomic radius of Ga is less than that of Al .

GROUP-14 ELEMENTS

SHORT ANSWER QUESTIONS

01.*** Explain the difference in properties of diamond and graphite on the basis of their structure. **(Jun-04,Mar-07),Ts-Mar-17)**

02.*** Why is diamond hard? **(Mar-11),Ts-Mar-15**

03.** What are silicones? How are they prepared? Give one example. What are their uses? **(Mar-15)**

04.* Write a note on (a) silicates (b) zeolites (c) Fullerenes

05.* What do you understand by (a) Allotropy**(Mar-19)** (b) Inert pair effect **(Mar-19)**(c) Catenation

06.* Explain the structure of silica. How does it react with (a) $NaOH$ (b) HF

VERY SHORT ANSWER QUESTIONS

07. Why is CO poisonous ? **(Mar-13,18)**
08. What is allotropy ? (**(Mar-19)**Give the crystalline allotropes of carbon **(Mar-13)**
09. How does graphite function as a lubricant **(Jun-11,Mar-17),Ts-Mar-15,19**
10. Graphite is a good conductor-explain **(Jun-09,Mar-09,10)**
11. Diamond has high melting point - explain
12. Write the use of ZSM-5 **(TS-Mar-19)**
13. C-C bond length in graphite is shorter than C-C bond length in diamond - explain
14. Diamond is used as precious stone - explain
15. SiF_6^{-2} is known while SiF_6^{-2} is not - explain
16. Name any two man made silicates. **(Mar-14)**
17. How is water gas or blue gas prepared? **(Mar-12,Mar-08,18)**
18. How is producer gas prepared?
19. What is use of dry ice? **(Mar-15)**
20. Give the use of CO_2 in Photosynthesis. **(Mar-14)**
21. Write the hybridisation of carbon in the following (a) CO_2 (b) Diamond (c) Graphite (d) Fullerene **(May-14),Ts-Mar-18-SAQ**
22. CCl_4 is not dissolved in water, but $SiCl_4$ dissolves why? give reason **(May-14)**
23. Give four uses of CO_2 .
24.*** What are metal carbonyles ?
25. What is the effect of water on tin ?
26.*** Explain the structure of silica ?
27. Sio_2 is solid while CO_2 is gas explain ?
28. Write any four uses of CO_2 gas.? **(Mar-17)**

ENVIRONMENTAL CHEMISTRY

VERY SHORT ANSWER QUESTIONS

01. What is chemical oxygen demand (COD) ? (Ts mar2017**)** **(Mar-14)**
02. a) What is Bio chemical oxygen demand (BOD) ? **(Mar-14),Ts-Mar-18,19**
    b) Give the possiable BOD values for clean water and poluted water .
03. Define Receptor? **(Mar-15)**
04. Name the major particulate pollutants present in Troposphere
05. a) What is Green house effect? It is caused by .....and ....gases **(Mar-14),Ts-Mar-15,18**
    b) Mention the harmful effects caused by Global warming . **(Mar-17)**
06. Which oxides cause acid rain ? and what is its *pH* value? **(TS-Mar-19)**
07. Name two adverse effects caused by acid rains **(Mar-18),Ts-Mar-15,17**
08. a) What is classical smog? and what is its chemical character (Oxidizing reducing)?
    b) What is photo chemical smog? and what is its chemical character (Oxidizing reducing)?
09. What is PAN ? What effect is caused by it
10. How is ozone formed in the stratosphere ?
11. Give the chemical equations involved in the ozone depletion by CF_2Cl_2
12. What is ozone hole ? Where was it first observed ?
13. Name three industrial chemicals that pollute water
14. What agrochemicals are responsible for water pollution ? **(Mar-19)**
15. Define the terms sink ,TLV & Receptor? **(Mar-15,17,18)**
16. What is Eutrophication?
17. What is pollutant, contaminant, speciation
18. Mention the harmful effects caused due to depletion of ozone layer **(Mar-15)**
19. What is Bio-amplification?
20. Define the term Green chemistry ?
21. What are smoke and mist ?
22. Define the term soil pollution ?
23. Explain the following terms
    i) Atmosphere ii) Biosphere iii) Hydrosphere iv) Lithiosphere v) Troposphere
    vi) Stratosphere
24. Name the common components of photo chemical smog? **(Mar-19)**

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