IMPORTANT 2 AND 3 MARKS FOR EASY REFERNCE

Show that $4x^2+4xy+y^2-6x-3y-4=0$ represents a pair of parallel lines.

Show that $2x^2+3xy-2y^2+3x+y+1=0$ represents a pair of perpendicular lines.

Find the separate equation of pair of straight lines $3x^2+2xy-y^2=0$

The slope of one of the straight lines $ax^2+2hxy+by^2=0$ is twice that of the other, show that $8h^2=9ab$.

The slope of one of the straight lines $ax^2+2hxy+by^2=0$ is three times the other, show that $3h^2=4ab$.

Separate the equation $5x^2+6xy+y^2=0$

Find the straight lines by separating the equations $2x^2+2xy+y^2=0$. If exists

Find the angle between the pair of straight lines $x^2-4xy+y^2=0$

Find the combined equation of the straight lines whose separate equations are $x-2y-3=0$ and $x+y+5=0$.

Show that the straight lines joining the origin to the point of intersection of 3x-2y+2=0 and $3x^2+5xy-2y^2+4x+5y=0$ are at right angles.

Find the distance between the parallel lines $12x+5y=7$ and $12x+5y+7=0$

Find the distance between the parallel lines $3x-4y+5=0$ and $6x-8y-15=0$.

Find the image of the point $(-2,3)$ about the line $x+2y-9=0$.

Find the family of straight lines (i) Perpendicular (ii) Parallel to $3x+4y-12=0$.

Find the length of the perpendicular and the co-ordinates of the foot of the perpendicular from $(-10,-2)$ to the line $x+y-2=0$

Show that the lines are $3x+2y+9=0$ and $12x+8y-15=0$ are parallel lines.

Find the equation of the straight line parallel to $5x-4y+3=0$ and having x-intercept 3.

Find the distance between the line $4x+3y+4=0$, and a point $(-2,4)$

Find the distance between the line $4x+3y+4=0$, and a point $(7,-3)$

Write the equation of the lines through the point $(1,-1)$ parallel to $x+3y-4=0$

Write the equation of the lines through the point $(1,-1)$ perpendicular to $3x+4y=6$

If $(-4,7)$ is one vertex of a rhombus and if the equation of one diagonal is $5x-y+7=0$, then find the equation of another diagonal.

If a line joining two points (3,0) and (5,2) is rotated about the point (3,0) in counter clockwise direction through an angle of 15°, then find the equation of the line in the new position

A car rental firm has charges Rs. 25 with 1.8 free kilometers, and Rs. 12 for every additional kilo meter. Find the equation realting the cost y to the number of kilometers x . Also find the cost to travel 15 K.m

Find the equation of the line through the intersection of the lines 3x+2y+5=0 and 3x-4y+6=0 and the point (1,1)

Find the points on the line x+y=5 , that lie at a distance 2 units from the line 4x+3y-12=0

Find the equation of the bisector of the acute angle between the lines 3x+4y+2=0 and 5x+12y-5=0

Find the nearest point on the line 2x+y=5 from the origin

Find the distance from a point (1,2) to the line 5x+12y-3=0

Find the distance between the two parallel lines 3x+4y=12 and 6x+8y+1=0

Find the equations of a parallel line and a perpendicualr line passing through the point (1,2) to the line 3x+4y=7

Find the locus of a point which moves such that its distance from the x axis is equal to the distance from the y axis

Find the path traced out by the point $\left(ct, \frac{c}{t}\right)$ **here t ≠ 0 is the parameter and c is a constant**

Find the Locus of a point P moves such that its distances from two fixed points A(1,0) and B(5,0) are always equal

If θ is a parameter, find the equation of the Locus of a moving point , whose coordinate are (asecθ, btanθ)

Find the value of k and b, if the points $P(-3,1)$ and $Q(2,b)$ lie on the locus of $x^2-5x+ky=0$.

If θ is a parameter, find the equation of the locus of a moving point, whose coordinates are $x=a\cos^3\theta, y=a\sin^3\theta$.

Find the locus of P, if for all values of α, the co-ordinates of a moving point P is $(9\cos\alpha\,,\,9\sin\alpha)$

Find the locus of P, if for all values of α, the co-ordinates of a moving point P is $(9\cos\alpha\,,\,6\sin\alpha)$

Find the points on the locus of points that are 3 units from x-axis and 5 units from the point $(5,1)$.

Find the expansion of $(2x+3)^5$

Evaluate 98^4

Find the middle term in the expansion of (x+y^6

Find the middle term in the expansionof (x+y)^7

Find the sum of the first n terms of the series $\frac{1}{1+\sqrt{2}}+\frac{1}{\sqrt{2}+\sqrt{3}}+\frac{1}{\sqrt{3}+\sqrt{4}}+\dots$

Find $\sum_{k=1}^{n} \frac{1}{k(k+1)}$.

If a, b, c are in geometric progression and if $a^{\frac{1}{x}} = b^{\frac{1}{y}} = c^{\frac{1}{z}}$, then prove that x, y, z are in arithmetic progression

What will Rs.500 amounts to in 10 years after its deposit in a bank which pays annual interest rate of 10% compounded annually?

Find the general term and sum to n terms of the sequence $1, \frac{4}{3}, \frac{7}{9}, \frac{10}{27}, \ldots$.

Compute the sum of first n terms of the series: $8 + 88 + 888 + 8888 + \cdots$

Compute the sum of first n terms of the series: $6 + 66 + 666 + 6666 + \cdots$

Find the sum up to the 17^{th} term of the series $\frac{1^3}{1} + \frac{1^3+2^3}{1+3} + \frac{1^3+2^3+3^3}{1+3+5} + \cdots$

Find the sum of the first 20-terms of the arithmetic progression having the sum of first 10 terms as 52 and the sum of the first 15 terms as 77.

A man repays an amount of Rs.3250 by paying Rs.20 in the first month and then increases the payment by Rs.15 per month. How long will it take him to clear the amount?

Show that the sum of $(m+n)^{th}$ and $(m-n)^{th}$ term of an AP. is equal to twice the m^{th} term.

Find the value of n, if the sum to n terms of the series $\sqrt{3} + \sqrt{75} + \sqrt{243} + \cdots$ is $435\sqrt{3}$.

Find the sum: $1 + \frac{4}{5} + \frac{7}{25} + \frac{10}{125} + \cdots$.

Find $\sum_{n=1}^{\infty} \frac{1}{n^2+5n+6}$.

If ${}^nC_{12} = {}^nC_9$ find ${}^{21}C_n$.

If ${}^{15}C_{2r-1} = {}^{15}C_{2r+4}$, find r.

If ${}^nP_r = 720$, and ${}^nC_r = 120$, find n, r.

Prove that ${}^{10}C_2 + 2 \times {}^{10}C_3 + {}^{10}C_4 = {}^{12}C_4$

Prove that ${}^{15}C_3 + 2 \times {}^{15}C_4 + {}^{15}C_5 = {}^{17}C_5$.

Find the number of strings of 4 letters that can be formed with the letters of the word EXAMINATION?.

A polygon has 90 diagonals. Find the number of its sides?

How many ways a committee of six persons from 10 persons can be chosen along with a chair person and a secretary?

In an examination a student has to answer 5 questions, out of 9 questions in which 2 are compulsory. In how many ways a student can answer the questions?

Determine the number of 5 card combinations out of a deck of 52 cards if there is exactly three aces in each combination.

How many triangles can be formed by 15 points, in which 7 of them lie on one line and the remaining 8 on another parallel line?

How many diagonals are there in a polygon with n sides?

If a set of m parallel lines intersect another set of n parallel lines (not parallel to the lines in the first set), then find the number of parallelograms formed in this lattice structure.

Out of 7 consonants and 4 vowels, how many strings of 3 consonants and 2 vowels can be formed?

A box of one dozen apple contains a rotten apple. If we are choosing 3 apples simultaneously, in how many ways, one can get only good apples.

Example 4.52 A Mathematics club has 15 members. In that 8 are girls. 6 of the members are to be selected for a competition and half of them should be girls. How many ways of these selections are possible?

Example 4.51 A salad at a certain restaurant consists of 4 of the following fruits: apple, banana, guava, pomegranate, grapes, papaya and pineapple. Find the total possible number of fruit salads.

How many diagonals are there in a polygon with n sides?

If ${}^{n}P_{r} = 11880$ and ${}^{n}C_{r} = 495$, Find n and r.

If ${}^{n}C_{4} = 495$, What is n?.

Find the value of ${}^{5}C_{2}$ and ${}^{7}C_{3}$

Evaluate the following: (i) ${}^{10}C_{3}$ (ii) ${}^{15}C_{13}$ (iii) ${}^{100}C_{99}$ (iv) ${}^{50}C_{50}$.

Find the distinct permutations of the letters of the word MISSISSIPPI?

How many strings can be formed from the letters of the word ARTICLE, so that vowels occupy the even places?

Determine the number of permutations of the letters of the word SIMPLE if all are taken at a time?

If ${}^{(n-1)}P_3 :{}^{n} P_4 = 1 : 10$, find n.

If ${}^{10}P_{r-1} = 2 \times {}^{6} P_r$, find r.

Suppose 8 people enter an event in a swimming meet. In how many ways could the gold, silver and bronze prizes be awarded?

Three men have 4 coats, 5 waist coats and 6 caps. In how many ways can they wear them?

Example 4.41 If the different permutations of all letters of the word BHASKARA are listed as in a dictionary, how many strings are there in this list before the first word starting with B?

Find the number of ways of arranging the letters of the word BANANA.

Example 4.37 Find the number of ways of arranging the letters of the word RAMANUJAN so that the relative positions of vowels and consonants are not changed.

Example 4.38 Three twins pose for a photograph standing in a line. How many arrangements are there (i). when there are no restrictions. (ii). when each person is standing next to his or her twin?

Example 4.39 How many numbers can be formed using the digits 1,2,3,4,2,1 such that, even digits occupies even place?

Evaluate: (i) ${}^{4}P_4$ (ii) ${}^{5}P_3$ (iii)${}^{8}P_4$ (iv) ${}^{6}P_5$.

If ${}^{(n+2)}P_4 = 42 \times {}^{n}P_2$, find n.

Find the value of

$$\text{(i) } 6! \quad \text{(ii) } 4!+5! \quad \text{(iii) } 3!-2! \quad \text{(iv) } 3!\times 4! \quad \text{(v) } \frac{12!}{9!\times 3!} \quad \text{(vi) } \frac{(n+3)!}{(n+1)!}$$

Evaluate $\frac{n!}{r!(n-r)!}$ when (i) $n=6, r=2$ (ii) $n=10, r=3$ (iii) For any n with $r=2$.

Find the value of n if (i) $(n+1)! = 20(n-1)!$ (ii) $\frac{1}{8!}+\frac{1}{9!}=\frac{n}{10!}$.

Prove that $\frac{(2n)!}{n!} = 2^n(1.3.5\cdots(2n-1))$.

What is the unit digit of the sum $2!+3!+4!+ \ldots + 22!$?

If $\frac{1}{7!}+\frac{1}{8!}=\frac{A}{9!}$ then find the value of A.

Prove that $\frac{(2n)!}{n!}=2^n(1.3.5\cdots(2n-1))$

Example 4.1 Suppose one girl or one boy has to be selected for a competition from a class comprising 17 boys and 29 girls. In how many different ways can this selection be made?

Example 4.2 Consider the 3 cities Chennai, Trichy and Tirunelveli. In order to reach Tirunelveli from Chennai, one has to pass through Trichy. There are 2 roads connecting Chennai with Trichy and there are 3 roads connecting Trichy with Tirunelveli. What are the total number of ways of travelling from Chennai to Tirunelveli?

Example 4.3 A School library has 75 books on Mathematics, 35 books on Physics. A student can choose only one book. In how many ways a student can choose a book on Mathematics or Physics?

Example 4.5 A person wants to buy a car. There are two brands of car available in the market and each brand has 3 variant models and each model comes in five different colours as in Figure 4.2 In how many ways she can choose a car to buy?

Example 4.6 A Woman wants to select one silk saree and one sungudi saree from a textile shop located at Kancheepuram. In that shop, there are 20 different varieties of silk sarees and 8 different varieties of sungudi sarees. In how many ways she can select her sarees?

Example 4.7 In a village, out of the total number of people, 80 percentage of the people own Coconut groves and 65 percent of the people own Paddy fields. What is the minimum percentage of people own both?

Eliminate θ from $a\cos\theta=b$ and $c\sin\theta=d$, where a,b,c,d are constants.

Identify the quadrant in which an angle of each given measure lies

(i) 25° (ii) 825° (iii) -55° (iv) 328° (v) -230°

For each given angle, find a coterminal angle with measure of θ such that $0^\circ\le\theta<360^\circ$

(i) 395° (ii) 525° (iii) 1150° (iv) -270° (v) -450°

Convert (i) 18° to radians (ii) -108° to radians.

Convert (i) $\frac{\pi}{5}$ radians to degrees (ii) 6 radians to degrees.

Find the length of an arc of a circle of radius 5 cm subtending a central angle measuring 15°.

Example 3.7 If the arcs of same lengths in two circles subtend central angles 30° and 80°, find the ratio of their radii.

Express each of the following angles in radian measure:

(i) 30° (ii) 135° (iii) −205° (iv) 150° (v) 330°.

Find the degree measure corresponding to the following radian measures

(i) $\frac{\pi}{3}$ (ii) $\frac{\pi}{9}$ (iii) $\frac{2\pi}{5}$ (iv) $\frac{7\pi}{3}$ (v) $\frac{10\pi}{9}$.

What must be the radius of a circular running path, around which an athlete must run 5 times in order to describe 1 km?

In a circle of diameter 40 cm, a chord is of length 20 cm. Find the length of the minor arc of the chord.

Find the degree measure of the angle subtended at the centre of circle of radius 100 cm by an arc of length 22 cm.

What is the length of the arc intercepted by a central angle of measure 41° in a circle of radius 10 ft?

If in two circles, arcs of the same length subtend angles 60° and 75° at the centre, find the ratio of their radii.

The perimeter of a certain sector of a circle is equal to the length of the arc of a semi-circle having the same radius. Express the angle of the sector in degrees, minutes and seconds.

An airplane propeller rotates 1000 times per minute. Find the number of degrees that a point on the edge of the propeller will rotate in 1 second.

A train is moving on a circular track of 1500 m radius at the rate of 66 km/hr. What angle will it turn in 20 seconds?

A circular metallic plate of radius 8 cm and thickness 6 mm is melted and molded into a pie (a sector of the circle with thickness) of radius 16 cm and thickness 4 mm. Find the angle of the sector.

Find the value of (i) $\sin 150°$ (ii) $\cos 135°$ (iii) $\tan 120°$.

Find the value of: i) $\sin 765°$ (ii) $\operatorname{cosec}(-1410°)$ (iii) $\cot\left(\frac{-15\pi}{4}\right)$.

Example 3.14 Determine whether the following functions are even, odd or neither.

(i) $\sin^2 x - 2\cos^2 x - \cos x$ (ii) $\sin(\cos(x))$ (iii) $\cos(\sin(x))$ (iv) $\sin x + \cos x$

Find the values of (i) $\sin(480^\circ)$ (ii) $\sin(-1110^\circ)$ (iii) $\cos(300^\circ)$ (iv) $\tan(1050^\circ)$ (v) $\cot(660^\circ)$ (vi) $\tan\left(\frac{19\pi}{3}\right)$ (vii) $\sin\left(-\frac{11\pi}{3}\right)$.

Find all the angles between 0° and 360° which satisfy the equation $\sin^2\theta = \frac{3}{4}$.

Find the values of (i) $\cos 15^\circ$ and (ii) $\tan 165^\circ$.

Prove that $\cos\left(\frac{3\pi}{4}+x\right) - \cos\left(\frac{3\pi}{4}-x\right) = -\sqrt{2}\sin x$

Example 3.18 Point $A(9, 12)$ rotates around the origin O in a plane through 60° in the anticlockwise direction to a new position B. Find the coordinates of the point B.

Expand (i) $\sin(A+B+C)$ (ii) $\tan(A+B+C)$

If $\tan x = \frac{n}{n+1}$ and $\tan y = \frac{1}{2n+1}$, find $\tan(x+y)$.

. Show that

(i) $\tan(45^\circ + A) = \frac{1+\tan A}{1-\tan A}$ (ii) $\tan(45^\circ - A) = \frac{1-\tan A}{1+\tan A}$.

Prove that $\cot(A+B) = \frac{\cot A \cot B - 1}{\cot A + \cot B}$.

Example 3.21 A foot ball player can kick a football from ground level with an initial velocity of 80 ft/second. Find the maximum horizontal distance the football travels and at what angle? (Take $g = 32$).

Find the value of $\sin\left(22\frac{1}{2}^\circ\right)$

Find the value of $\sin 2\theta$, when $\sin\theta = \frac{12}{13}$, θ lies in the first quadrant.

Prove that $\sin 4A = 4\sin A\cos^3 A - 4\cos A\sin^3 A$

Prove that $\frac{\sin\theta + \sin 2\theta}{1+\cos\theta+\cos 2\theta} = \tan\theta$

Prove that $1 - \frac{1}{2}\sin 2x = \frac{\sin^3 x + \cos^3 x}{\sin x + \cos x}$

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1. **Write the smallest equivalence relation on the set A = { 1,2,3,4}**
2. **Let the relation R be defined on N by a Rb if 2a+3b=30.**
   Write down the relation as a set of ordered pairs.
3. **Write the identity relation on a set A= {a,b,c}**
4. **If R = { (x,y) / x+2y =8} is a relation then Write the relation**
5. **If A = { 2,3,4} and B = { 1,3,7} and the Relation R ={ (x,y) / x,y x∈A and y∈B}**
6. **If R = { (2,3) , (2,7), (3,7) , (4,7) Find R^{-1}**
7. **The number of elements in the power set of a Null set**
8. **If A= {1,2,4} and B = { 2,4,5, } and C = {2,5} Find (A-B) x (B-C)**
9. **If A and B are two sets n(A) =20 , n(B)=25, n(AUB) =40 What is the value of n(A∩B)**
10. **If A and B are two sets such that n(A)=115 n(B) =326 n(A-B) =47 Find n (AUB)**
11. **The number of sub sets of a set containing n elements.**
12. **Given A = { 1,2,3,} and B = { 3,4,5} find AΔ B**

Solve $3|x-2|+7=19$ for x

Find the length of an arc of a circle of radius 5cm subtending a central angle measuring 15°

1. **Factorize $x^4+1=0$**
2. **Find all values of x for which** $\frac{x^3(x-1)}{x-2} > 0$
3. **Resolve in to partial fraction** $\frac{x}{(x+3)(x-4)}$
4. **Rationalize the denominator of** $\frac{\sqrt{5}}{(\sqrt{6}+\sqrt{2})}$
5. **Simplify** $(-1000)^{-2/3}$
6. **Evaluate** $\left\{\left[(256)^{-1/2}\right]^{-1/4}\right\}^3$
7. **Find the radius of the spherical tank whose volume is** $\frac{32\pi}{3}$
8. **Find the logarithm of 1728 to the base** $2\sqrt{3}$
9. **Prove that** $\log\frac{75}{16} - 2\log\frac{5}{9} + \log\frac{32}{243} = \log 2$
10. **Solve** $x^{\log_3 x} = 9$
11. **Solve** $\frac{x+1}{x+3} < 3$

12. Find all values of x that satisfies the inequality $\frac{2x-3}{(x-2)(x-4)} < 0$

13. Resolve in to partial fraction $\frac{1}{x^2-a^2}$

14. Resolve in to partial fraction $\frac{x}{(x-1)^3}$

15. Simplify $\left(3^{-6}\right)^{1/3}$

16. If the logarithm of 324 to base a is 4 then find a

17. Compute $\log_3 5 \log_{25} 27$

18. Compute $\log_9 27 - \log_{27} 9$

19. Prove that $\log\frac{a^2}{bc} + \log\frac{b^2}{ca} + \log\frac{c^2}{ab} = 0$

Volume 2

Find the area of the triangle whose vertices are (0, 0), (1, 2) and (4, 3).

Find the area of the triangle whose vertices are (– 2, – 3), (3, 2), and (– 1, – 8)

If (k, 2), (2, 4) and (3, 2) are vertices of the triangle of area 4 square units then determine the value of k.

If the area of the triangle with vertices (– 3, 0), (3, 0) and (0, k) is 9 square units, find the values of k .

Determine the values of a so that the $A = \begin{bmatrix} 7 & 3 \\ -2 & a \end{bmatrix}$ singular:

Determine the values of b so that the $B = \begin{bmatrix} b-1 & 2 & 3 \\ 3 & 1 & 2 \\ 1 & -2 & 4 \end{bmatrix}$ singular:

Show that the points (a, $b + c$), (b, $c + a$), and (c, $a + b$) are collinear.

Verify that $|AB| = |A|\,|B|$ if $A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ and $B = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

Determine the roots of the equation $\begin{vmatrix} 1 & 4 & 20 \\ 1 & -2 & 5 \\ 1 & 2x & 5x^2 \end{vmatrix} = 0.$

If A is a square matrix and $|A| = 2$, find the value of $|AA^T|$.

If A and B are square matrices of order 3 such that $|A| = -1$ and $|B| = 3$, find the value of $|3AB|$.

Without expanding, evaluate the following determinants :

(i) $\begin{vmatrix} 2 & 3 & 4 \\ 5 & 6 & 8 \\ 6x & 9x & 12x \end{vmatrix}$ (ii) $\begin{vmatrix} x+y & y+z & z+x \\ z & x & y \\ 1 & 1 & 1 \end{vmatrix}$

Find the value of x if $\begin{vmatrix} x-1 & x & x-2 \\ 0 & x-2 & x-3 \\ 0 & 0 & x-3 \end{vmatrix} = 0$

Evaluate $\begin{vmatrix} 2014 & 2017 & 0 \\ 2020 & 2023 & 1 \\ 2023 & 2026 & 0 \end{vmatrix}$

Compute $|A|$ using Sarrus rule if $A = \begin{bmatrix} 3 & 4 & 1 \\ 0 & -1 & 2 \\ 5 & -2 & 6 \end{bmatrix}$

Evaluate : (i) $\begin{vmatrix} 2 & 4 \\ -1 & 2 \end{vmatrix}$ (ii) $\begin{vmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{vmatrix}$.

For what value of x, the matrix $A = \begin{bmatrix} 0 & 1 & -2 \\ -1 & 0 & x^3 \\ 2 & -3 & 0 \end{bmatrix}$ is skew-symmetric.

If $\begin{bmatrix} 0 & p & 3 \\ 2 & q^2 & -1 \\ r & 1 & 0 \end{bmatrix}$ is skew-symmetric, find the values of p, q, and r.

If $A = \begin{bmatrix} 1 & a \\ 0 & 1 \end{bmatrix}$, then compute A^4.

If $A = \begin{bmatrix} 4 & 2 \\ -1 & x \end{bmatrix}$ and such that $(A-2I)(A-3I) = O$, find the value of x.

Simplify : $\sec\theta \begin{bmatrix} \sec\theta & \tan\theta \\ \tan\theta & \sec\theta \end{bmatrix} - \tan\theta \begin{bmatrix} \tan\theta & \sec\theta \\ \sec\theta & \tan\theta \end{bmatrix}$

What must be the matrix X, if $2X+\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}3 & 8\\ 7 & 2\end{bmatrix}$?

Find x, y, a, and b if $\begin{bmatrix}3x+4y & 6 & x-2y\\ a+b & 2a-b & -3\end{bmatrix}=\begin{bmatrix}2 & 6 & 4\\ 5 & -5 & -3\end{bmatrix}$

Find the area of the parallelogram whose two adjacent sides are determined by the vectors $\hat{i}+2\hat{j}+3\hat{k}$ and $3\hat{i}-2\hat{j}+\hat{k}$.

Find the area of the parallelogram whose adjacent sides are $\vec{a}=3\hat{i}+\hat{j}+4\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\hat{k}$

Find the angle between the vectors $2\hat{i}+\hat{j}-\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$ using vector product.

Find the magnitude of $\vec{a}\times\vec{b}$ if $\vec{a}=2\hat{i}+\hat{j}+3\hat{k}$ and $\vec{b}=3\hat{i}+5\hat{j}-2\hat{k}$

Show that $\vec{a}\times(\vec{b}+\vec{c})+\vec{b}\times(\vec{c}+\vec{a})+\vec{c}\times(\vec{a}+\vec{b})=\vec{0}$

For any two vectors $\vec{a}$ and $\vec{b}$, prove that $|\vec{a}\times\vec{b}|^2+(\vec{a}\cdot\vec{b})^2=|\vec{a}|^2\ |\vec{b}|^2$

Find $|\vec{a}\times\vec{b}|$, where $\vec{a}=3\hat{i}+4\hat{j}$ and $\vec{b}=\hat{i}+\hat{j}+\hat{k}$.

Find the value λ for which the vectors $\vec{a}$ and $\vec{b}$ are perpendicular, where $\vec{a}=2\hat{i}+\lambda\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}+3\hat{k}$

Find the value λ for which the vectors $\vec{a}$ and $\vec{b}$ are perpendicular, where $\vec{a}=2\hat{i}+4\hat{j}-\hat{k}$ and $\vec{b}=3\hat{i}-2\hat{j}+\lambda\hat{k}$.

Find the angle between the vectors $\hat{i}-\hat{j}$ and $\hat{j}-\hat{k}$.

Show that the vectors $-\hat{i}-2\hat{j}-6\hat{k}$, $2\hat{i}-\hat{j}+\hat{k}$, and $-\hat{i}+3\hat{j}+5\hat{k}$ form a right angled triangle.

If $|\vec{a}|=5$, $|\vec{b}|=6$, $|\vec{c}|=7$ and $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, find $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$

Find the projection of the vector $\hat{i}+3\hat{j}+7\hat{k}$ on the vector $2\hat{i}+6\hat{j}+3\hat{k}$.

For any vector $\vec{r}$ prove that $\vec{r}=(\vec{r}\cdot\hat{i})\hat{i}+(\vec{r}\cdot\hat{j})\hat{j}+(\vec{r}\cdot\hat{k})\hat{k}$.

If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$ prove that $\vec{a}$ and $\vec{b}$ are perpendicular.

Find $(\vec{a}+3\vec{b})\cdot(2\vec{a}-\vec{b})$ if $\vec{a}=\hat{i}+\hat{j}+2\hat{k}$ and $\vec{b}=3\hat{i}+2\hat{j}-\hat{k}$

If $\vec{a}=2\hat{i}+2\hat{j}+3\hat{k}$, $\vec{b}=-\hat{i}+2\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+\hat{j}$ be such that $\vec{a}+\lambda\vec{b}$ is perpendicular to $\vec{c}$ then find λ.

Can two events be mutually exclusive and independent simultaneously?

If A and B are two independent events such that $P(A \cup B) = 0.6$, $P(A) = 0.2$, find $P(B)$.

If A and B are two independent events such that $P(A) = 0.4$ and $P(A \cup B) = 0.9$. Find $P(B)$.

If $P(A) = 0.5$, $P(B) = 0.8$ and $P(B/A) = 0.8$, find $P(A/B)$ and $P(A \cup B)$

A die is rolled. If it shows an odd number, then find the probability of getting 5.

A die is thrown twice. Let A be the event, 'First die shows 5' and B be the event, 'second die shows 5'. Find $P(A \cup B)$.

Nine coins are tossed once, find the probability to get at least two heads.

Find the probability of getting the number 7, when a usual die is rolled.

What is the chance that (i) non-leap year (ii) leap year should have fifty three Sundays?

Find f'' if $f(x) = x \cos x$.

Find y''' if $y = \frac{1}{x}$.

Find y', y'' and y''' if $y = x^3 - 6x^2 - 5x + 3$.

Find $\frac{dy}{dx}$ if $x = a(t - \sin t), y = a(1 - \cos t)$.

Find $\frac{dy}{dx}$ if $x = at^2$; $y = 2at, \quad t \neq 0$.

Find $f'(x)$ if $f(x) = \cos^{-1}(4x^3 - 3x)$

Find the derivative of $y = \sqrt{x^2 + 4} \, . \sin^2 x \, .2^x$

Find $\frac{dy}{dx}$ if $x^2 + y^2 = 1$.

Differentiate 2^x.

Differentiate : $y = e^{\sin x}$

Differentiate : $y = (x^3 - 1)^{100}$

Differentiate : (i) $y = \sin(x^2)$ (ii) $y = \sin^2 x$

Find $F'(x)$ if $F(x) = \sqrt{x^2 + 1}$

If $f'(x) = 3x^2 - 4x + 5$ and $f(1) = 3$, then find $f(x)$

If $f'(x) = 4x - 5$ and $f(2) = 1$, find $f(x)$.

If $f'(x)=9x^2-6x$ and $f(0)=-3$, find $f(x)$.

$\int \frac{x^2-x+1}{x^3}dx$

$\int \cos 5x \sin 3x\, dx$

$\int \cos^3 x\, dx$

Evaluate : $\int \frac{1}{\sin^2 x \cos^2 x}dx$.

Evaluate : $\int \frac{\sin x}{1+\sin x}dx$.

Evaluate : $\int \sqrt{1+\cos 2x}\, dx$.

Evaluate : $\int (\tan x+\cot x)^2 dx$.

Evaluate : $\int \sqrt{1+\sin 2x}\, dx$.

Evaluate : (i) $\int a^x e^x dx$ (ii) $\int e^{x\log 2} e^x\, dx$.

Evaluate the following integrals :

(i) $\int 2x\sqrt{1+x^2}dx$ (ii) $\int e^{-x^2} x\, dx$ (iii) $\int \frac{\sin x}{1+\cos x}dx$

(iv) $\int \frac{1}{1+x^2}dx$ (v) $\int x(a-x)^8 dx$

Integrate the following with respect to x.

(i) $\int \tan x\, dx$ (ii) $\int \cot x\, dx$ (iii) $\int \operatorname{cosec} x\, dx$ (iv) $\int \sec x\, dx$

Evaluate the following integrals

(i) $\int xe^x dx$ (ii) $\int x\cos x\, dx$ (iii) $\int \log x\, dx$ (iv) $\int \sin^{-1} x\, dx$

Integrate the following with respect to x.

(i) $x^2 e^{5x}$ (ii) $x^3 \cos x$ (iii) $x^3 e^{-x}$

Evaluate the following integrals

(i) $\int e^{3x}\cos 2x\, dx$ (ii) $\int e^{-5x}\sin 3x\, dx$

Find the integrals of the following :

(1) (i) $\frac{1}{4-x^2}$ (ii) $\frac{1}{25-4x^2}$ (iii) $\frac{1}{9x^2-4}$

Integrate the following functions with respect to x :

(1) (i) $\sqrt{x^2+2x+10}$ (ii) $\sqrt{x^2-2x-3}$ (iii) $\sqrt{(6-x)(x-4)}$

Calculate $\lim_{x\to 3}(x^3-2x+6)$

Calculate $\lim_{x\to x_0}(5)$ for any real number x_0.

Compute (i) : $\lim_{x\to 8}(5x)$ (ii) $\lim_{x\to -2}\left(-\frac{3}{2}x\right)$.

Calculate $\lim_{x\to -1}(x^2-3)^{10}$.

Calculate $\lim_{x\to -2}(x^3-3x+6)\ (-x^2+15)$

Calculate $\lim_{x\to 3}\frac{(x^2-6x+5)}{x^3-8x+7}$.

Compute $\lim_{x\to 1}\frac{\sqrt{x}-1}{x-1}$.

Compute $\lim_{x\to 1}\frac{x^3-1}{x-1}$.

Calculate $\lim_{t\to 1}\frac{\sqrt{t}-1}{t-1}$

Find $\lim_{x\to 0}\frac{(2+x)^5-2^5}{x}$

Find the positive integer n so that $\lim_{x\to 3}\frac{x^n-3^n}{x-3}=27$

Show that

(i) $\lim_{n\to\infty}\frac{1+2+3+...+n}{3n^2+7n+2}=\frac{1}{6}$ (ii) $\lim_{n\to\infty}\frac{1^2+2^2+...+(3n)^2}{1+2+...+5n)(2n+3)}=\frac{9}{25}$

(iii) $\lim_{n\to\infty}\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+...+\frac{1}{n(n+1)}=1$

Evaluate $\lim_{x\to 0}x^2\sin\left(\frac{1}{x}\right)$

IMPORTANT 5 MARKS FOR REFERENCE

Prove that the straight lines joining the origin to the points of intersection of $3x^2+5xy-3y^2+2x+3y=0$ and $3x-2y-1=0$ are at right angles.

Show that the equation $4x^2+4xy+y^2-6x-3y-4=0$ represents a pair of parallel lines. Find the distance between them.

Find the value of k, if the following equation represents a pair of straight lines. Further, find whether these lines are parallel or intersecting, $12x^2+7xy-12y^2-x+7y+k=0$

Find p and q, if the following equation represents a pair of perpendicular lines
$6x^2+5xy-py^2+7x+qy-5=0$

Find the separate equation of the following pair of straight lines
$2x^2-xy-3y^2-6x+19y-20=0$

Example 6.38 If the equation $\lambda x^2-10xy+12y^2+5x-16y-3=0$ represents a pair of straight lines, find (i) the value of λ and the separate equations of the lines (ii) point of intersection of the lines (iii) angle between the lines

From the curve $y=x$, draw
(i) $y=-x$ (ii) $y=2x$ (iii) $y=x+1$ (iv) $y=\frac{1}{2}x+1$ (v) $2x+y+3=0$.

From the curve $y=|x|$, draw (i) $y=|x-1|+1$ (ii) $y=|x+1|-1$ (iii) $y=|x+2|-3$.

From the curve $y=\sin x$, draw $y=\sin|x|$ (Hint: $\sin(-x)=-\sin x$.)

If $f,g:\mathbb{R}\to\mathbb{R}$ are defined by $f(x)=|x|+x$ and $g(x)=|x|-x$, find $g\circ f$ and $f\circ g$.

If f,g,h are real valued functions defined on $\mathbb{R}$, then prove that $(f+g)\circ h=f\circ h+g\circ h$. What can you say about $f\circ(g+h)$? Justify your answer.

Let $f,g:\mathbb{R}\to\mathbb{R}$ be defined as $f(x)=2x-|x|$ and $g(x)=2x+|x|$. Find $f\circ g$.

Solve the linear inequalities and exhibit the solution set graphically:
$x+y\geq 3,\ 2x-y\leq 5,\ -x+2y\leq 3.$

Resolve into partial fractions.

$$\frac{2x^2+5x-11}{x^2+2x-3}$$

Resolve into partial fractions: $\dfrac{2x}{(x^2+1)(x-1)}$.

Resolve into partial fractions. $\dfrac{x+12}{(x+1)^2(x-2)}$

Prove that $\sqrt{3}$ is an irrational number.

Prove that $\sqrt{2}$ is not a rational number.

Find the principal solution and general solutions of the following:

(i) $\sin\theta = -\dfrac{1}{\sqrt{2}}$ (ii) $\cot\theta = \sqrt{3}$ (iii) $\tan\theta = -\dfrac{1}{\sqrt{3}}$.

Solve $\sqrt{3}\tan^2\theta + (\sqrt{3}-1)\tan\theta - 1 = 0$

Solve $\sqrt{3}\sin\theta - \cos\theta = \sqrt{2}$

Solve $\cos x + \sin x = \cos 2x + \sin 2x$

If $A+B+C = \dfrac{\pi}{2}$, prove the following

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

(ii) $\cos 2A + \cos 2B + \cos 2C = 1 + 4\sin A\sin B\cos C$.

If $A+B+C = 180°$, prove that

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

If $A+B+C=\pi$, prove that $\cos^2 A + \cos^2 B + \cos^2 C = 1 - 2\cos A\cos B\cos C$.

Example 3.40 Prove that

$\sin\dfrac{A}{2} + \sin\dfrac{B}{2} + \sin\dfrac{C}{2} = 1 + 4\sin\left(\dfrac{\pi-A}{4}\right)\sin\left(\dfrac{\pi-B}{4}\right)\sin\left(\dfrac{\pi-C}{4}\right)$, if $A+B+C=\pi$

Example 3.39 If $A+B+C=\pi$, prove the following

(i) $\cos A + \cos B + \cos C = 1 + 4\sin\left(\dfrac{A}{2}\right)\sin\left(\dfrac{B}{2}\right)\sin\left(\dfrac{C}{2}\right)$

(ii) $\sin\left(\dfrac{A}{2}\right)\sin\left(\dfrac{B}{2}\right)\sin\left(\dfrac{C}{2}\right) \leq \dfrac{1}{8}$

(iii) $1 < \cos A + \cos B + \cos C \leq \dfrac{3}{2}$

Show that $\sin 12°\sin 48°\sin 54° = \dfrac{1}{8}$.

Show that $\cos 10° \cos 30° \cos 50° \cos 70° = \frac{3}{16}$.

Solve by using Factor Theorem $\begin{vmatrix} x & a & a \\ a & x & a \\ a & a & x \end{vmatrix} = (x-a)^2(x+2a)$

Prove that $\begin{vmatrix} (q+r)^2 & p^2 & p^2 \\ q^2 & (p+r)^2 & q^2 \\ r^2 & r^2 & (p+q)^2 \end{vmatrix} = 2pqr(p+q+r)^2$

If a, b, c are all positive, and are p^{th}, q^{th} and r^{th} terms of a $G.P.$, show that $\begin{vmatrix} \log a & p & 1 \\ \log b & q & 1 \\ \log c & r & 1 \end{vmatrix} = 0.$

If $A = \begin{bmatrix} \frac{1}{2} & \alpha \\ 0 & \frac{1}{2} \end{bmatrix}$, prove that $\sum_{k=1}^{n} \det(A^k) = \frac{1}{3}\left(1 - \frac{1}{4^n}\right)$.

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

Solve by using Factor Theorem

$\begin{vmatrix} b+c & a & a^2 \\ c+a & b & b^2 \\ a+b & c & c^2 \end{vmatrix} = (a+b+c)(a-b)(b-c)(c-a).$

Prove that $\begin{vmatrix} 1 & x^2 & x^3 \\ 1 & y^2 & y^3 \\ 1 & z^2 & z \end{vmatrix} = (x-y)(y-z)(z-x)(xy+yz+zx)$

If a, b, c are p^{th}, q^{th} and r^{th} terms of an $A.P$, find the value of $\begin{vmatrix} a & b & c \\ p & q & r \\ 1 & 1 & 1 \end{vmatrix}$.

If $A = \begin{bmatrix} \frac{1}{2} & \alpha \\ 0 & \frac{1}{2} \end{bmatrix}$, prove that $\sum_{k=1}^{n} \det(A^k) = \frac{1}{3}\left(1 - \frac{1}{4^n}\right)$.

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

If A_i, B_i, C_i are the cofactors of a_i, b_i, c_i, respectively, $i = 1$ to 3 in

$$|A| = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \text{ show that } \begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix} = |A|^2$$

4. If one root of $k(x-1)^2 = 5x - 7$ is double the other root, show that $k = 2$ or -25.

5. If the difference of the roots of the equation $2x^2 - (a+1)x + a - 1 = 0$ is equal to their product, then prove that $a = 2$.

10. A and B are working on similar jobs but their annual salaries differ by more than Rs 6000. If B earns rupees 27000 per month, then what are the possibilities of A's salary per month?

Prove that $\dfrac{\cot(180^\circ+\theta)\sin(90^\circ-\theta)\cos(-\theta)}{\sin(270^\circ+\theta)\tan(-\theta)\text{cosec}(360^\circ+\theta)} = \cos^2\theta\cot\theta.$

If $\cos(\alpha-\beta)+\cos(\beta-\gamma)+\cos(\gamma-\alpha) = -\frac{3}{2}$, then prove that $\cos\alpha+\cos\beta+\cos\gamma = \sin\alpha+\sin\beta+\sin\gamma = 0.$

Prove that $(1+\tan 1^\circ)(1+\tan 2^\circ)(1+\tan 3^\circ)\ldots(1+\tan 44^\circ)$ is a multiple of 4.

If $\cos\theta = \frac{1}{2}\left(a+\frac{1}{a}\right)$, show that $\cos 3\theta = \frac{1}{2}\left(a^3+\frac{1}{a^3}\right)$.

Find the value of Sin 18° and hence find the value of Cos 36°

Find the value of sin $22\frac{1}{2}^o$ **and Cos** $22\frac{1}{2}^o$ **using these two results find the value of tan** $22\frac{1}{2}^o$

Find the values of $\tan(\alpha+\beta)$, given that $\cot\alpha = \frac{1}{2}, \alpha \in \left(\pi, \frac{3\pi}{2}\right)$ and $\sec\beta = -\frac{5}{3}, \beta \in \left(\frac{\pi}{2}, \pi\right)$.

Prove that $\dfrac{\cot(180^\circ+\theta)\sin(90^\circ-\theta)\cos(-\theta)}{\sin(270^\circ+\theta)\tan(-\theta)\text{cosec}(360^\circ+\theta)} = \cos^2\theta\cot\theta.$

If $\cot\theta(1+\sin\theta) = 4m$ and $\cot\theta(1-\sin\theta) = 4n$, then prove that $(m^2-n^2)^2 = mn$.

If $a^2+b^2 = 7ab$ Show that $\log\left(\frac{a+b}{2}\right) = \frac{1}{2}(\log a + \log b)$

Solve $\log_2 x - 3\log_{\frac{1}{2}} x$ **=6**

If $\frac{\log x}{y-z} = \frac{\log y}{z-x} = \frac{\log z}{x-y}$ then Prove that xyz = 1

Find the square roots of $7 - 4\sqrt{3}$

Simplify $\frac{1}{3-\sqrt{8}} - \frac{1}{\sqrt{8}-\sqrt{7}} + \frac{1}{\sqrt{7}-\sqrt{6}} - \frac{1}{\sqrt{6}-\sqrt{5}} + \frac{1}{\sqrt{5}-2}$

If $\log_2 x + \log_4 x + \log_{16} x = \frac{7}{2}$ **find the value of x**

Given that $\log_{10} 2 = 0.30103$ $\log_{10} 3 = 0.47712$ **Find the number of digits in** $2^8 3^{12}$

Solve $\log_8 x + \log_4 x + \log_2 x = 11$

Solve $\log_4 2^{8x} = 2^{\log_2 8}$

There are two identical urns containing respectively 6 black and 4 red balls, 2 black and 2 red balls. An urn is chosen at random and a ball is drawn from it. (i) find the probability that the ball is black (ii) if the ball is black, what is the probability that it is from the first urn?

The chances of *A, B* and *C* becoming manager of a certain company are 5 : 3 : 2. The probabilities that the office canteen will be improved if *A, B,* and *C* become managers are 0.4, 0.5 and 0.3 respectively. If the office canteen has been improved, what is the probability that *B* was appointed as the manager?

A consulting firm rents car from three agencies such that 50% from agency *L*, 30% from agency *M* and 20% from agency *N*. If 90% of the cars from *L*, 70% of cars from *M* and 60% of the cars from *N* are in good conditions (i) what is the probability that the firm will get a car in good condition? (ii) if a car is in good condition, what is probability that it has come from agency *N*?

A problem in Mathematics is given to three students whose chances of solving it are $\frac{1}{3}, \frac{1}{4},$ and $\frac{1}{5}$ (i) What is the probability that the problem is solved? (ii) What is the probability that exactly one of them will solve it?

A year is selected at random. What is the probability that
(i) it contains 53 Sundays (ii) it is a leap year which contains 53 Sundays

Suppose the chances of hitting a target by a person *X* is 3 times in 4 shots, by *Y* is 4 times in 5 shots, and by *Z* is 2 times in 3 shots. They fire simultaneously exactly one time. What is the probability that the target is damaged by exactly 2 hits?

A coin is tossed twice. Events *E* and *F* are defined as follows

E= Head on first toss, *F* = Head on second toss. Find

(i) $P(E \cup F)$ (ii) $P(E / F)$

(iii) $P(\overline{E} / F)$. (iv) Are the events *E* and *F* independent?

If A and B are independent then (i) $\overline{A}$ and $\overline{B}$ are independent.
(ii) A and $\overline{B}$ are independent. (iii) $\overline{A}$ and B are also independent.

The probability that a new railway bridge will get an award for its design is 0.48, the probability that it will get an award for the efficient use of materials is 0.36, and that it will get both awards is 0.2. What is the probability, that (i) it will get at least one of the two awards (ii) it will get only one of the awards.

State and Prove addition theorem on probability

State and prove Multiplication theorem on Probability

(i) The odds that the event A occurs is 5 to 7, find $P(A)$.

(ii) Suppose $P(B) = \frac{2}{5}$. Express the odds that the event B occurs.

Eight coins are tossed once, find the probability of getting
(i) exactly two tails (ii) at least two tails (iii) at most two tails

A bag contains 7 red and 4 black balls, 3 balls are drawn at random.
Find the probability that (i) all are red (ii) one red and 2 black.

Evaluate the following integrals

(i) $\int \frac{3x+5}{x^2+4x+7}dx$ (ii) $\int \frac{x+1}{x^2-3x+1}dx$ (iii) $\int \frac{2x+3}{\sqrt{x^2+x+1}}dx$ (iv) $\int \frac{5x-7}{\sqrt{3x-x^2-2}}dx$

Prove that

(i) $\int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}[a\sin bx - b\cos bx]+c$

(ii) $\int e^{ax}\cos bx\,dx = \frac{e^{ax}}{a^2+b^2}[a\cos bx + b\sin bx]+c$

Evaluate : $\int \tan^{-1}\left(\frac{2x}{1-x^2}\right)dx$

\

If $u = \tan^{-1}\frac{\sqrt{1+x^2}-1}{x}$ and $v = \tan^{-1}x$, find $\frac{du}{dv}$.

Find the derivative with $\tan^{-1}\left(\frac{\sin x}{1+\cos x}\right)$ with respect to $\tan^{-1}\left(\frac{\cos x}{1+\sin x}\right)$.

If $y=e^{\tan^{-1}x}$, show that $(1+x^2)y''+(2x-1)y'=0$

If $y=\frac{\sin^{-1}x}{\sqrt{1-x^2}}$, show that $(1-x^2)y_2-3xy_1-y=0$.

If $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ then prove that at $\theta=\frac{\pi}{2}, y''=\frac{1}{a}$.

If $\sin y = x\sin(a+y)$, then prove that $\frac{dy}{dx}=\frac{\sin^2(a+y)}{\sin a}$, $a\neq n\pi$.

If $y = (\cos^{-1}x)^2$, prove that $(1-x^2)\frac{d^2y}{dx^2}-x\frac{dy}{dx}-2=0$. Hence find y_2 when $x=0$

Do the limits of following functions exist as $x\to 0$? State reasons for your answer.

(i) $\frac{\sin|x|}{x}$ (ii) $\frac{\sin x}{|x|}$ (iii) $\frac{x\lfloor x\rfloor}{\sin|x|}$ (iv) $\frac{\sin\left(x-\lfloor x\rfloor\right)}{x-\lfloor x\rfloor}$.

PROVE THAT

(a) $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1$ (b) $\lim_{\theta\to 0}\frac{1-\cos\theta}{\theta}=0$.

PROVE THAT

$\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$.

Evaluate : $\lim_{x\to 3}\frac{x^2-9}{x-3}$ if it exists by finding $f(3^-)$ and $f(3^+)$.

Verify the existence of $\lim_{x\to 1} f(x)$, where $f(x)=\begin{cases}\frac{|x-1|}{x-1}, & \text{for } x\neq 1\\ 0, & \text{for } x=1\end{cases}$.

If $\vec{a},\vec{b}$ are unit vectors and θ is the angle between them, show that

(i) $\sin\frac{\theta}{2}=\frac{1}{2}|\vec{a}-\vec{b}|$ (ii) $\cos\frac{\theta}{2}=\frac{1}{2}|\vec{a}+\vec{b}|$ (iii) $\tan\frac{\theta}{2}=\frac{|\vec{a}-\vec{b}|}{|\vec{a}+\vec{b}|}$.

Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are such that $|\vec{a}| = 2$, $|\vec{b}| = 3, |\vec{c}| = 4$, and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Find $4\vec{a}\cdot\vec{b} + 3\vec{b}\cdot\vec{c} + 3\vec{c}\cdot\vec{a}$.

The position vectors of the points P, Q, R, S are $i + j + k$, $2\hat{i} + 5\hat{j}$, $3\hat{i} + 2\hat{j} - 3\hat{k}$, and $\hat{i} - 6\hat{j} - \hat{k}$ respectively. Prove that the line PQ and RS are parallel.

Show that the points A (1, 1, 1), B(1, 2, 3) and C(2, − 1, 1) are vertices of an isosceles triangle.

If D and E are the midpoints of the sides AB and AC of a triangle ABC, prove that $\overrightarrow{BE} + \overrightarrow{DC} = \frac{3}{2}\overrightarrow{BC}$.

If $ABCD$ is a quadrilateral and E and F are the midpoints of AC and BD respectively, then prove that $\overrightarrow{AB} + \overrightarrow{AD} + \overrightarrow{CB} + \overrightarrow{CD} = 4\overrightarrow{EF}$.

Let A, B, and C be the vertices of a triangle. Let D, E, and F be the midpoints of the sides BC, CA, and AB respectively. Show that $\overrightarrow{AD} + \overrightarrow{BE} + \overrightarrow{CF} = \vec{0}$.

Prove that the line segment joining the midpoints of two sides of a triangle is parallel to the third side whose length is half of the length of the third side.

Prove that the line segments joining the midpoints of the adjacent sides of a quadrilateral form a parallelogram.

The medians of a triangle are concurrent.

Let O be the origin. Let A and B be two points. Let P be the point which divides the line segment AB internally in the ratio $m : n$. If $\vec{a}$ and $\vec{b}$ are the position vectors of A and B, then the position vector $\overrightarrow{OP}$ of P

If $\vec{a}$ and $\vec{b}$ are vectors represented by two adjacent sides of a regular hexagon, then find the vectors represented by other sides.

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