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# CBSE Class XI Mathematics
# Sample Paper 01
# As per pattern issued by CBSE for ( 2023-24 )

**Maximum Marks : 80** **Time : 3 hrs.**

**General Instructions :**

**1. This Question Paper has 5 Sections A-E.**
**2. Section A has 20 MCQs carrying 1 mark each**
**3. Section B has 5 questions carrying 02 marks each.**
**4. Section C has 6 questions carrying 03 marks each.**
**5. Section D has 3 case based integrated units of assessment (04 marks each) with subparts of the values of 1, 1 and 2 marks each respectively.**
**6. Section E has 4 questions carrying 05 marks each.**
**7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2marks questions of Section E**
**8. Draw neat figures wherever required. Take π =22/7 wherever required if not stated.**

## SECTION A
## ( Question 1 to 20 carry 1 mark )

**Q1**. Which of the following is a null set?

| | |
|---|---|
| a)$\{x: x \in \mathbb{N}, 2x-1=3\}$ | b)$\{x: x \in \mathbb{N}, x^2 < 20\}$ |
| c) $\{x: x$ is an even prime greater than $2\}$ | d)$\{x: x \in \mathbb{Z}, 3x+7=1\}$ |

**Q2**. The value of $cos(36^0 - A)\, cos(36^0 + A) + cos(54^0 + A)\, cos(54^0 - A)$

| | |
|---|---|
| a)sin 3A | b) cos 2A |
| c)sin 2A | d) cos 3A |

**Q3**. Range of f(x)= $|x+1|$

| | |
|---|---|
| a)(- ∞,0) | b)[0, ∞) |
| c)(0, ∞) | d)R |

**Q4**.If R={(x, y) ; 2x + y = 8,X∈N,x≤4 } then range of R is

| | |
|---|---|
| a){0,1,2,3,4,5} | b) {0,2,4,6} |
| c){0,1,2,3,4} | d){0,1,2,3} |

**Q5**. If tan x= $-\frac{1}{\sqrt{5}}$ and x lies in the fourth quadrant then the value of cos x is

| | |
|---|---|
| a)$\frac{\sqrt{5}}{\sqrt{6}}$ | b) $\frac{2}{\sqrt{6}}$ |
| c)$\frac{1}{2}$ | d)$\frac{1}{\sqrt{6}}$ |

**Q6.** Find the modulus of $\frac{1}{i}$

| | |
|---|---|
| a)2 | b) -1 |
| c)1 | d)0 |

**Q7**. Let U={1,2,3.....40} ; A={x : x is divisible by 2 and 3} and B={x : x=$n^2$ ,n∈ N } then n(A) – n(B) is

| | |
|---|---|
| a)0 | b) 1 |
| c)2 | d)3 |

**Q8**. If a =1+i,then $a^2$

| | |
|---|---|
| a)1-i | b) 2i |
| c)1-$i^2$ | d)i-1 |

**Q9**. The angle between the x axis and the line joining the points (3,-1) and (4,-2) is

| | |
|---|---|
| a)$45^0$ | b)$135^0$ |
| c)$90^0$ | d)$180^0$ |

**Q10**. Find the sum to infinite terms for GP with a=1 and r= 1/3.

| | |
|---|---|
| a)2/3 | b) 3/2 |
| c)5/9 | d) 4/9 |

**Q11**. If x is a negative integer, then the solution set of -12x > 30 is

| | |
|---|---|
| a){-2,-1} | b){.....,-5,-4,-3} |
| c){.....,-5,-4,-3,-2} | d){.....,-2,-1,0,1.....} |

**Q12**. The third term of GP is 4 .The product of its first 5 terms will be

| | |
|---|---|
| a)$4^3$ | b) $4^4$ |
| c)$4^5$ | d)none of these |

**Q13**. In an examination there are 4 multiple choice questions and each question has 4 choices. Number of ways in which a student can fail to get all answers correct is

| | |
|---|---|
| a)256 | b) 254 |
| c)255 | d)63 |

**Q14**. Find x for $\frac{|x-2|}{x-2} \geq 0$

| | |
|---|---|
| a)$x \in [2, \infty)$ | b) $x \in (2, \infty)$ |
| c)$x \in (-\infty, 2)$ | d)$x \in (-\infty, 2]$ |

**Q15**. The line passing through the points(-4,5)and (-5,7)also passes through the point(l,m),then 2l+m+3 is

| | |
|---|---|
| a)1 | b) -1 |
| c)2 | d)0 |

**Q16**. The total number of terms in the expansion of $(x+a)^{51} - (x-a)^{51}$

| | |
|---|---|
| a)102 | b) 26 |
| c)25 | d)none of these |

**Q17**. In an examination a candidate has to pass in each of the five subject .In how many ways can he fail?

| | |
|---|---|
| a)5 | b) 10 |
| c)21 | d)31 |

**Q18**. A bag contain 4 Identical red balls and 3 identical black balls.The experiment consist of drawing one ball then putting it into the bag and again drawing a ball.Then possible outcome for this experiment is

| | |
|---|---|
| a){RR,BB} | b){RR,B,R,BB} |
| c){RB,BR} | d){RR,RB,BR,BB} |

**Q19**. **Assertion(A)**: Assertion (A) : If ${}^{2023}C_{2x-2} = {}^{2023}C_x$ , then sum of all positive values of $x$ is 677
**Reason (R)** : If ${}^{n}C_x = {}^{n}C_y$ then $x = y \; or \; x + y = n$

| | |
|---|---|
| a)Both assertion and reason are true and reason is the correct explanation of assertion | b)Both assertion and reason are true but reason is not the correct explanation of assertion |
| c)Assertion is true but reason is false. | d) Assertion is false but reason is true. |

**Q20**. **Assertion(A)**: $\lim_{x\to 0} \frac{\sin 3x}{\sin 4x} = \frac{3}{4}$
**Reason (R)**:$\lim_{x\to 0} \frac{\tan x}{x} = 1$

| | |
|---|---|
| a)Both assertion and reason are true and reason is the correct explanation of assertion | b)Both assertion and reason are true but reason is not the correct explanation of assertion |
| c)Assertion is true but reason is false. | d) Assertion is false but reason is true. |

## SECTION B
## ( Question 21 to 25 carry 2 mark )

**Q21.** Expand $\left(\frac{x}{2} - \frac{y}{3}\right)^4$ using binomial expansion.

**Q22**. A circular wire of radius 3 cm. is cut and bent so as to lie along a circumference of a hoop whose radius is 48 cm. Find the angle in degrees which is subtended at the centre of the hoop.

OR

Find the value of $tan\left(\frac{\pi}{8}\right)$

**Q23**. Find $\lim_{x\to 0} \frac{1-cos\,4x}{x^2}$

Or

Find derivative of f(x)= $\frac{x}{\sin x}$

**Q24**. Centroid of a triangle with vertices (a,1, 3), (– 2, b, – 5) and (4, 7, c), is origin. Find the values of a,b,c

**Q25.** Find the variance of first five whole numbers.

## SECTION C
## ( Question 26 to 31 carry 3 mark )

**Q26**.Find the domain and range of f(x) = $\sqrt{x^2 - 4}$

**Q27**.Find the equations of the lines through the point of intersection of the lines x – y + 1 = 0 and 2x – 3y +5 = 0 and whose distance from the point (3, 2) is 7/5.

OR

Prove that the points (0, – 1, – 7), (2, 1, – 9) and (6, 5, – 13) are collinear. Find the ratio in which the first point divides the join of the other two.

**Q28**. If $x + iy = \frac{a+ib}{a-ib}$ then prove that $x^2 + y^2 = 1$

**Q29**.Two finite sets have m and n elements respectively . The total number of subsets of first set is 56 more than the total number of subsets of the second set .Find the values of m and n.

OR

If X and Y are subsets of universal set U, then show that (i) $y \subset x \cup y$ (ii) $x \cap y \subset x$

**Q30**.Find the equation of the circle whose centre is on the line 2x – y = 3 and which passes through (3, –2)and (–2, 0).

**Q31**. If $tan\, x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$ ,find the value of sin x and cos x .Also find the values of $\sin\frac{x}{2}, \cos\frac{x}{2}, \tan\frac{x}{2}$.

**SECTION D**
**( Question 32 to 35 carry 4 mark )**

**Q32.** The parking lot of an IT park is in a triangular shape with two of its vertices B (2,3) and C (1,5). The third vertex A is the image of the point D (3,5) in the line BC.

Based on the above information, answer the following questions:

(i) Find the equation of the line passing through the point D and perpendicular to the line BC.

(ii) Find the coordinates of the foot of the perpendicular from the point D upon the line BC.

Hence, find the coordinates of the third vertex A of the triangular parking lot.

**Q33**. A survey is conducted to find the career choice of the students after class 12th. There are 100 students who opt for Engineering Courses, 50 want to make their career in medical and 100 students wish to continue in Arts. There are 10 students who go for both Engineering and Medical and 3 go for both Medical and Arts. There are 3 students that do not go for any further studies.


(a) Find the total number of students on which the survey is conducted.

(b) Find the number of students who go for only Engineering Course.

(c)Find the number of students who go for Engineering or Arts.

or

Find the number of students that go for medical or engineering.

**Q34**.Rakesh wishes to install 2 handpumps in his field for watering. He moves in the field while watering in such a way that sum of distances between the Rakesh and each handpump is always 26 metres. Also, the distance between handpumps is 10 metres.


Based on the above information, answer the following questions:

(a) Name the curve along which Rakesh moves.

(b) Find the equation of curve traced by Rakesh.

(c) Find the eccentricity of the curve along which Rakesh moves.

Or

Find the co-ordinates of handpumps.

**SECTION E**
**( Question 35 to 32 carry 5 mark )**

**Q35**.Find the solution set for $\left|\frac{x-3}{x+2}\right| \geq 4$

**Q36**.Prove that $cos^2 x + cos^2\left(x+\frac{\pi}{3}\right) + cos^2\left(x-\frac{\pi}{3}\right) = \frac{3}{2}$

**Q37**.Evaluate $\lim_{x\to\frac{\pi}{4}} \frac{tan^3 x - tan x}{cos\left(x+\frac{\pi}{4}\right)}$

Or

Find $\lim_{x\to 1} f(x)$ and $\lim_{x\to 2} f(x)$ for $f(x) = \begin{cases} x^2-1, x<1 \\ 2x+3, 1\leq x<2 \\ x^2+1, x\geq 2 \end{cases}$

**Q38**.Calculate the mean ,variance and standard deviation for the following data

| Classes | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 | 90-100 |
|---|---|---|---|---|---|---|---|
| Frequency | 3 | 7 | 12 | 15 | 8 | 3 | 2 |

**End**

## CBSE Class XI Mathematics Sample Paper 01 Answer key

**SECTION – A**

**( Question number 1 to 20 carry 1 marks each )**

| | |
|---|---|
| **Q1.** | **C** |
| **Q2.** | **B** |
| **Q3.** | **B** |
| **Q4.** | **C** |
| **Q5.** | **A** |
| **Q6.** | **B** |
| **Q7.** | **A** |
| **Q8.** | **B** |
| **Q9.** | **B** |
| **Q10.** | **B** |
| **Q11.** | **B** |
| **Q12.** | **C** |
| **Q13.** | **C** |
| **Q14.** | **B** |
| **Q15.** | **D** |
| **Q16.** | **B** |
| **Q17.** | **C** |
| **Q18.** | **D** |
| **Q19.** | **A** |
| **Q20.** | **B** |

**SECTION – B**

**( Question number 21 to 25 carry 2 marks each )**

**Q21.Expand** $\left(\frac{x}{2}-\frac{y}{3}\right)^4$

**Ans)** $$\frac{81x^4-216x^3y+216x^2y^2-96xy^3+16y^4}{1296}$$

**Q22.**Ans)

**Given that circular wire is of radius 3 cm, so when it is cut then its length = 2π × 3 = 6π cm. Again, it is being placed along a circular hoop of radius 48 cm. Here, s = 6π cm is the length of arc and r = 48 cm is the radius of the circle. Therefore, the angle θ, in radian, subtended by the arc at the centre of the circle is given by**

$$\theta=\frac{\text{Arc}}{\text{Radius}}=\frac{6\pi}{48}=\frac{\pi}{8}=22.5^\circ$$

**OR**

**Find the value of** $tan\left(\frac{\pi}{8}\right)$

**Ans)Refer NCERT Chapter 3 Example 27.**

**Q23.Find** $\lim_{x\to 0}\frac{1-\cos 4x}{x^2}$

**Ans)** $\lim_{x\to 0}\frac{1-\cos 4x}{x^2}$

$$\Rightarrow \lim_{x\to 0}\frac{1-\cos 4x}{x^2} = \lim_{x\to 0}\frac{2\sin^2 2x}{x^2}$$

$$\Rightarrow \lim_{x\to 0}\frac{1-\cos 4x}{x^2} = 2\lim_{x\to 0}\left(\frac{\sin 2x}{x}\right)^2$$

$$\Rightarrow \lim_{x\to 0}\frac{1-\cos 4x}{x^2} = 2\lim_{x\to 0}\left(\frac{\sin 2x}{2x}\right)^2 \times 2^2$$

$$\Rightarrow \lim_{x\to 0}\frac{1-\cos 4x}{x^2} = 2\times 1\times 4$$

**Or**

**Ans)** $f'(x) = \frac{\sin x - x\cos x}{\sin^2 x}$

**Q24.Centroid of a triangle with vertices (a,1, 3), (– 2, b, – 5) and (4, 7, c), is origin. Find the values of a,b,c .**

**Ans) For a triangle the coordinates of the centroid is given by the average of the coordinates of its vertices.**

$$\Rightarrow (0,0,0) = \left(\frac{a+(-2)+4}{3}, \frac{1+b+7}{3}, \frac{3+(-5)+c}{3}\right)$$

$$\Rightarrow \frac{a+2}{3} = 0, \therefore a = -2$$

$$\Rightarrow \frac{b+8}{3} = 0, \therefore b = -8$$

$$\Rightarrow \frac{c-2}{3} = 0, \therefore c = 2$$

**Q25.Find the variance of first five whole numbers.**

**Ans) Mean of the first 5 numbers = (1 + 2 + 3 + 4 + 5) / 5 = 3.**

**Therefore, Variance = ((1 – 3)2 + (2 – 3)2 + (3 – 3)2+(4 – 3)2+(5 – 3)2) / 5**

**= (4 + 1 + 0 + 1 + 4) / 5**

**= 10 / 5.**

## SECTION – C

**( Question number 26 to 31 carry 3 marks each )**

**Q26.Find the domain and range of f(x) = $\sqrt{x^2-4}$**

**Ans) Domain: All Real Numbers $\mathbb{R}$**
**Range: [2,∞)**

**Q27.**

**Ans)** Given equations are x – y + 1 = 0 .....(i)

And 2x – 3y + 5 = 0 .....(ii)

Solving equation (i) and equation (ii) we get

2x – 2y + 2 = 0
2x – 3y + 5 = 0
(–) (+) (–)
y – 3 = 0

∴ y = 3

From equation (i) we have

x – 3 + 1 = 0

⇒ x = 2

So, (2, 3) is the point of intersection of equation (i) and equation (ii).

Let m be the slope of the required line

∴ Equation of the line is y – 3 = m(x – 2)

⇒ y – 3 = mx – 2m

⇒ mx – y + 3 – 2m = 0

Since, the perpendicular distance from (3, 2) to the line is $\frac{7}{5}$

Then $\frac{7}{5} = \left|\frac{m(3)-2+3-2m}{\sqrt{m^2+1}}\right|$

Since, the perpendicular distance from (3, 2) to the line is $\frac{49}{25} = \frac{(3m-2+3-2m)^2}{m^2+1}$

$\Rightarrow \frac{49}{25} = \frac{(m+1)^2}{m^2+1}$

⇒ $49m^2 + 49 = 25m^2 + 50m + 25$

$\Rightarrow 49m^2 + 49 = 25m^2 + 50m + 25$

$\Rightarrow 49m^2 - 25m^2 - 50m + 49 - 25 = 0$

$\Rightarrow 24m^2 - 50m + 24 = 0$

$\Rightarrow 12m^2 - 25m + 12 = 0$

$\Rightarrow 12m^2 - 16m - 9m + 12 = 0$

$\Rightarrow 4m(3m - 4) - 3(3m - 4) = 0$

$\Rightarrow (3m - 4)(4m - 3) = 0$

$\Rightarrow 3m - 4 = 0$ and $4m - 3 = 0$

$\therefore m = \frac{4}{3}, \frac{3}{4}$

Equation of the line taking $m = \frac{4}{3}$ is

$y - 3 = \frac{4}{3}(x - 2)$

$\Rightarrow 3y - 9 = 4x - 8$

$\Rightarrow 4x - 3y + 1 = 0$

Equation of the line taking $m = \frac{3}{4}$ is

$y - 3 = \frac{3}{4}(x - 2)$

$\Rightarrow 4y - 12 = 3x - 6$

$\Rightarrow 3x - 4y + 6 = 0$

**Prove that the points (0, – 1, – 7), (2, 1, – 9) and (6, 5, – 13) are collinear. Find the ratio in which the first point divides the join of the other two.**

Given that three points $A(0, -1, -7), B(2, 1, -9)$ and $C(6, 5, -13)$ are collinear

Therefore we can write as

$AB = \sqrt{(2-0)^2 + (1-(-1))^2 + ((-9)-(-7))^2} = \sqrt{4+4+4} = 2\sqrt{3}$

$BC = \sqrt{(6-2)^2 + (5-1)^2 + ((-13)-(-9))^2} = \sqrt{16+16+16} = 4\sqrt{3}$

$AC = \sqrt{(6-0)^2 + (5-(-1))^2 + ((-13)-(-7))^2} = \sqrt{36+36+36} = 6\sqrt{3}$

$\Rightarrow AB + BC = AC$

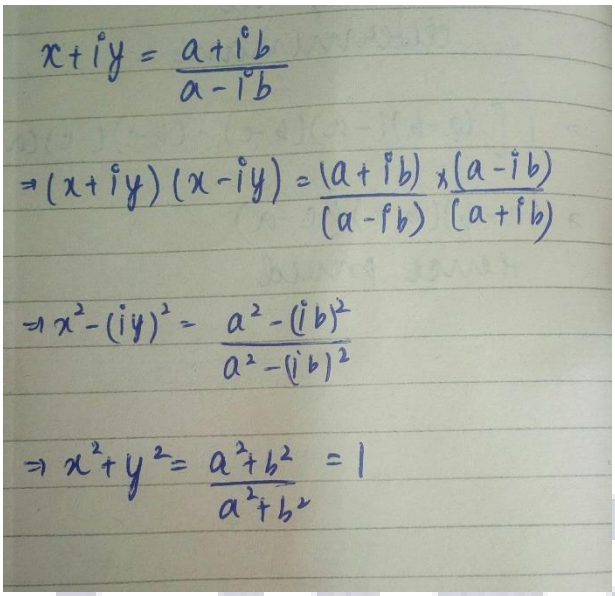
Since points A, B and C are collinear.

$AB : AC = 2\sqrt{3} : 6\sqrt{3} = 1 : 3$

Hence from the lengths of $AB, BC$ and $AC$ we can say that the first point divides the join of the other two in the ratio $1 : 3$ externally.

**Q28. If $x + iy = \frac{a+ib}{a-ib}$ then prove that $x^2 + y^2 = 1$**

**Ans)**




**Q29.Two finite sets have m and n elements respectively .The total number of subsets of first set is 56 more than the total number of subsets of the second set.Find the values of m and n**

*Given:*

$2^m - 2^n = 112$

$\Rightarrow 2^n(2^{m-n} - 1) = 112$

$\Rightarrow 2^n(2^{m-n} - 1) = 2^4 \times 7 = 2^4(2^3 - 1)$

$\Rightarrow n = 4$ *and* $m - n = 3$

**Ans)** $\Rightarrow m = 7$

**OR If X and Y are subsets of universal set U,then show that (i) $y \subset x \cup y$ (ii) $x \cap y \subset x$**

**Ans) (i)X ∪ Y = {x | x ∈ X or x ∈ Y}**

**Thus x ∈ Y ⇒ x ∈ X ∪ Y**

**Hence, Y ⊂ X ∪ Y**

**(ii) X ∩ Y = {x | x ∈ X and x ∈ Y}**

**Thus x ∈ X ∩ Y ⇒ x ∈ X**

**Hence X ∩ Y ⊂ X**

**Q30.Ans) As Centre lies on 2x – y – 3 = 0**

**∴ Let the centre be C ≡ (h, 2h –3) It also passes through A≡ (3, –2) and B≡ (–2, 0**

$\therefore$ AC = BC

$\Rightarrow (h-3)^2 + (2h-1)^2$

$= (h+2)^2 + (2h-3)^2$

$\Rightarrow -6h + 9 - 4h + 1$

$= 4h + 4 - 12h + 9 - 2h = 3$

$\therefore h = -\frac{3}{2} \qquad \therefore C = \left(\frac{-3}{2}, -6\right)$

$\therefore$ Equation of the circle is

$(x-h)^2 + (y-k)^2 = R^2$

$\Rightarrow \left(x+\frac{3}{2}\right)^2 + (y+6)^2$

$= \left(\frac{-3}{2}, -3\right)^2 + (-6+2)^2$

$\Rightarrow x^2 + 3x + \frac{9}{4} + y^2 + 12y + 36$

$= \frac{81}{4} + 16$

$x^2 + y^2 + 3x + 12y + 2 = 0$

**Q31. If $tan\, x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$ ,find the value of sin x and cos x .Also find the values of $\sin\frac{x}{2}, \cos\frac{x}{2}, \tan\frac{x}{2}$.**

**Ans) We Know that**

$$\sec^2 x = 1 + \tan^2 x = 1 + \frac{9}{16} = \frac{25}{16}$$

$$\sec x = \pm\frac{5}{4} \text{ or } \cos x = -\frac{4}{5} \quad \because \pi < x < \frac{3\pi}{2}$$

$$\text{We have } 2\sin^2\frac{x}{2} = 1 - \cos x = 1 - \left(-\frac{4}{5}\right) = \frac{9}{5}$$

$$\Rightarrow \sin^2\frac{x}{2} = \frac{9}{10}$$

$$\Rightarrow \sin\frac{x}{2} = \frac{3}{\sqrt{10}} \quad \because \frac{\pi}{2} < \frac{x}{2} < \frac{3\pi}{4}$$

$$\text{Again } 2\cos^2\frac{x}{2} = 1 + \cos x = 1 + \left(-\frac{4}{5}\right) = \frac{1}{5}$$

$$\cos^2\frac{x}{2}=\frac{1}{10}$$

$$\text{or}\quad \cos\frac{x}{2}=-\frac{1}{\sqrt{10}}\quad \because \frac{\pi}{2}<\frac{x}{2}<\frac{3\pi}{4}$$

$$\tan\frac{x}{2}=\frac{\sin\frac{x}{2}}{\cos\frac{x}{2}}=\frac{\frac{3}{\sqrt{10}}}{-\frac{1}{\sqrt{10}}}=-3$$

**SECTION – D**

**( Question number 32 to 34 carry 4 marks each )**

**Q32.(a)If the coordinate of all three form a triangle find the centroid of it.**

**Ans )**$\left(\frac{29}{3}, 12, 8\right)$

**(b)Find the mid point of Pankaj and his father.**

**Ans)** $\left(\frac{9}{2}, 3, 7\right)$

**(c) Find the distance between Pankaj and kite.**

**Ans)**$\sqrt{994}$ **units**

**Or**

**Find distance between Pankaj father and kite.**

**Ans)**$\sqrt{963}$ **units**

**Q33.(a) Find the total number of students on which the survey is conducted.**

**Ans)240**

**(b) Find the number of students who go for only Engineering Course.**

**Ans) 90**

**(c)Find the number of students who go for Engineering or Arts.**

**Ans)200**

**or**

**Find the number of students that go for medical or engineering.**

**Ans)140**

**Q34.(a) Name the curve along which Rakesh moves.**

**Ans) Curve along which the Rakesh moves - ELLIPSE**

**(b) Find the equation of curve traced by Rakesh.**

**Two fixed points where hand pumps are placed are called FOCI**

**equation of the curve traced by the farmer**

**distance fixed = 26 => 2a = 26 => a = 13**

**Distance between foci = 10**

**$b^2 = 13^2 - (10/2)^2 = 12^2$**

**=> b = 12**

**$x^2/13^2 + y^2/12^2 = 1$**

**$x^2/a^2 + y^2/b^2 = 1$**

**(c) Find the eccentricity of the curve along which Rakesh moves.**

**Ans)eccentricity of curve along which Rakesh moves = 5/12**

**Or**

**Find the co-ordinates of handpumps**

**Ans)** $(\pm 5, 0)$

## SECTION – E

**( Question number 35 to 38 carry 5 marks each )**

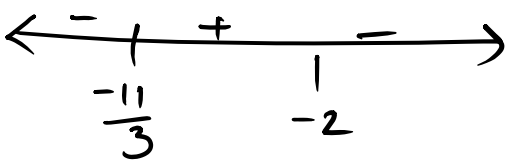
**Q35.Find the solution set for** $\left|\frac{x-3}{x+2}\right| \geq 4$

Case (i) $\frac{x-3}{x+2} \geq 4$

$\frac{x-3}{x+2} - 4 \geq 0$

$\frac{x-3-4x-8}{x+2} \geq 0$

$\frac{-3x-11}{x+2} \geq 0$



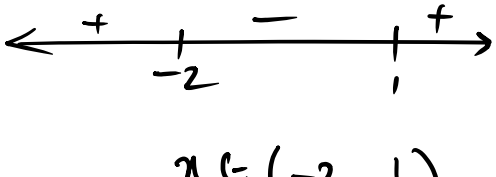

$x \in \left[-\frac{11}{3}, -2\right)$

Case (ii) $\frac{x-3}{x+2} \leq -4$

$\frac{x-3}{x+2} + 4 \leq 0$

$\frac{x-3+4x+8}{x+2} \leq 0$

$\frac{5x-5}{x+2} \leq 0$




$x \in (-2, 1)$

$$\therefore \quad x \in \left[-\frac{11}{3}, -2\right) \cup (-2, 1)$$

**Q36.Prove that** $cos^2 x + cos^2\left(x + \frac{\pi}{3}\right) + cos^2\left(x - \frac{\pi}{3}\right) = \frac{3}{2}$

**Using this, cos^2x = {1 + cos(2x)}/2**
**cos^2(x + π/3) = {1 + cos(2x + 2π/3)}/2 and cos^2(x - π/3) = {1 + cos(2x - 2π/3)}/2**

**ii) Hence, left side of the given one is:**

**= {1 + cos(2x)}/2 + {1 + cos(2x + 2π/3)}/2 + {1 + cos(2x - 2π/3)}/2**

**= (3/2) + (1/2)[cos(2x) + cos(2x + 2π/3) + cos(2x - 2π/3)]**

**= (3/2) + (1/2)[cos(2x) + 2cos(2x)*cos(2π/3)]**
**[Since cos(A+B) + cos(A-B) = 2cosA*cosB]**

**= (3/2) + (1/2)[cos(2x) - cos(2x)] [Since cos(2π/3) = -1/2]**

**= 3/2 = Right side**

**Q37.Evaluate** $\lim_{x\to\frac{\pi}{4}} \frac{tan^3 x - tan x}{cos\left(x+\frac{\pi}{4}\right)}$

$$\lim_{x\to\frac{\pi}{4}} \frac{\tan^3 x - \tan x}{\cos x + \frac{\pi}{4}}$$

$$\lim_{x\to\frac{\pi}{4}} \frac{\tan^3 x - \tan x}{\cos x + \frac{\pi}{4}} = \lim_{x\to\frac{\pi}{4}} \tan x . \lim_{x\to\frac{\pi}{4}} \left[\frac{-(1-\tan^2 x)}{\cos\left(x+\frac{\pi}{4}\right)}\right]$$

$$= -1 \times \lim_{x\to\frac{\pi}{4}} \frac{((1-\tan x)(1+\tan x))}{\cos\left(x+\frac{\pi}{4}\right)}$$

$$= \lim_{x\to\frac{\pi}{4}} -(1+\tan x) . \lim_{x\to\frac{\pi}{4}} \left(\frac{1-\tan x}{\left(\cos x + \frac{\pi}{4}\right)}\right)$$

$$= \lim_{x\to\frac{\pi}{4}} -(1+\tan x) . \lim_{x\to\frac{\pi}{4}} \left(\frac{1-\tan x}{\left(\cos x + \frac{\pi}{4}\right)}\right)$$

$$= -(1+1) . \lim_{x\to\frac{\pi}{4}} \frac{((\cos x - \sin x))}{\cos x . \cos\left(x+\frac{\pi}{4}\right)}$$

$$= -2\sqrt{2}\lim_{x\to\frac{\pi}{4}}\frac{\left[\left(\text{Cos}\frac{\pi}{4}.\text{Cosx} - \text{Sin}\frac{\pi}{4}.\text{Sinx}\right)\right]}{\text{Cosx}.\text{Cos}\left(x+\frac{\pi}{4}\right)}$$

$$= \frac{\lim_{x\to\frac{\pi}{4}}\left(-2\sqrt{2}.\text{Cos}\left(x+\frac{\pi}{4}\right)\right)}{\text{Cosx}.\text{Cos}\left(x+\frac{\pi}{4}\right)} = -\frac{2\sqrt{2}}{\text{Cos}\frac{\pi}{4}} \text{ {Taking limits}}$$

$$= -\frac{2\sqrt{2}}{\frac{1}{\sqrt{2}}}$$

$$= -2 \times 2$$

$$= -4$$

**Or**

**Find** $\lim_{x\to 1} f(x)$ *and* $\lim_{x\to 2} f(x)$ **for** $f(x) = \begin{cases} x^2 - 1, x < 1 \\ 2x + 3, 1 \le x < 2 \\ x^2 + 1, x \ge 2 \end{cases}$

At $x=1$

LHL

$\lim_{x\to 1^-} f(x)$

$\lim_{h\to 0} f(1-h)$

$\lim_{h\to 0} (1-h)^2 - 1$

$=0$

RHL

$\lim_{x\to 1^+} f(x)$

$\lim_{h\to 0} f(1+h)$

$\lim_{h\to 0} 2(1+h)+3$

$= 5$

as LHL $\neq$ RHL $\Rightarrow \lim_{x\to 1} f(x)$ doesnot exist

At $x=2$

LHL: $\lim_{x\to 2^-} f(x)$

$= 7$

RHL: $\lim_{x\to 2^+} f(x)$

$= 5$

as LHL $\neq$ RHL $\Rightarrow \lim_{x\to 2} f(x)$ doesnot exist

**Q38.Calculate the mean ,variance and standard deviation for the following data**

| Classes | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 | 90-100 |
|---|---|---|---|---|---|---|---|
| Frequency | 3 | 7 | 12 | 15 | 8 | 3 | 2 |

**Ans)**

| $C.I$ | $x$ | $\mathbf{No.}(F)$ | $Fx$ | $x_i - \overline{x}$ | $(x_i - \overline{x})^2$ | $F(x_i - \overline{x})^2$ |
|---|---|---|---|---|---|---|
| 30-40 | 35 | 3 | 105 | -27 | 729 | 2187 |
| 40-50 | 45 | 7 | 315 | -17 | 289 | 2023 |
| 50-60 | 55 | 12 | 660 | -7 | 49 | 588 |
| 60-70 | 65 | 15 | 975 | 3 | 9 | 135 |
| 70-80 | 75 | 8 | 600 | 13 | 169 | 1352 |
| 80-90 | 85 | 3 | 255 | 23 | 529 | 1587 |
| 90-100 | 95 | 2 | 190 | 33 | 1089 | 2178 |
| | | $\sum f = 50$ | $\sum fx = 3100$ | | | 10050 |

$$\overline{x} = \frac{\Sigma fx}{\sum f} = \frac{3100}{50} = 62$$

$$\sigma^2 = \frac{\Sigma f(x-\overline{x})^2}{\Sigma f} = \frac{10050}{50} = 201$$

$$\sigma = \sqrt{201}$$

$$= 14 \cdot 17$$

----------**END**----------

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