

**PART-A**

**I. Answer all the multiple choice questions :**

**5 × 1 = 5**

1. If  $A = \begin{bmatrix} 1 & 2 & 4 \\ -1 & 3 & -2 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 & -4 & -1 \\ 1 & 5 & -2 \end{bmatrix}$  the  $(A + B)$  is

- a)  $\begin{bmatrix} 4 & 2 & -3 \\ 0 & 8 & 4 \end{bmatrix}$     b)  $\begin{bmatrix} 4 & -2 & -3 \\ 0 & -8 & -4 \end{bmatrix}$     c)  $\begin{bmatrix} -4 & 2 & 3 \\ 0 & -8 & 4 \end{bmatrix}$     d)  $\begin{bmatrix} 4 & -2 & -3 \\ 0 & -8 & -4 \end{bmatrix}$

**Solution : Option : (b)**

$$A + B = \begin{bmatrix} 1 & 2 & 4 \\ -1 & 3 & -2 \end{bmatrix} + \begin{bmatrix} 3 & -4 & -1 \\ 1 & 5 & -2 \end{bmatrix} = \begin{bmatrix} 4 & -2 & -3 \\ 0 & -8 & -4 \end{bmatrix}$$

2. If  ${}^n C_{10} = {}^n C_{15}$  then n is

- a) 25                      b) 29                      c) 24                      d) 23

**Solution : Option (a)**

$${}^n C_{10} = {}^n C_{15} \Rightarrow n = 10 + 15 = 25$$

3. The probability of getting a black card from a pack of 52 cards is

- a)  $\frac{3}{4}$                       b)  $\frac{1}{52}$                       c)  $\frac{1}{4}$                       d)  $\frac{1}{2}$

**Solution : Option (d)**

$$P(A) = \frac{26}{52} = \frac{1}{2}$$

4. The value of  $4 \cos^3 10^\circ - 3 \cos 10^\circ$  is

- a)  $\frac{\sqrt{3}}{2}$                       b)  $\frac{2}{\sqrt{3}}$                       c)  $\frac{1}{\sqrt{3}}$                       d)  $\frac{1}{2}$

**Solution : Option (a)**

$$4 \cos^3 10^\circ - 3 \cos 10^\circ = \cos (3 \times 10^\circ) = \cos 30^\circ = \frac{\sqrt{3}}{2}.$$

5. The value of  $\int 4 \sec^2 x \, dx$  is

- a)  $4 \sec x + c$                       b)  $4 \sin x + c$                       c)  $4 \tan x + c$                       d)  $4 \cot x + c$

**Solution : Option (c)**

$$\int 4 \sec^2 x \, dx = 4 \tan x + c$$

**II. Match the following**

6. i) The value of  $\begin{vmatrix} 3200 & 3201 \\ 3202 & 3203 \end{vmatrix}$  is a) 27
- ii) If  ${}^5P_r = 60$ , then r is b) 12
- iii) If  $5 : 20 = 3 : x$  then the value of x is c)  $\frac{y}{x}$
- iv) The value of  $\lim_{x \rightarrow 3} \left( \frac{x^3 - 27}{x - 3} \right)$  is d)  $\frac{x}{y}$
- v) If  $x^2 - y^2 = a^2$  then  $\frac{dy}{dx}$  is e) -2
- f) 3

**Solution :**

i)  $\begin{vmatrix} 3200 & 3201 \\ 3202 & 3203 \end{vmatrix} = \begin{vmatrix} 3200 & 1 \\ 3202 & 1 \end{vmatrix} = 3200 - 3202 = -2$

ii)  ${}^5P_r = 60 \Rightarrow$  for  $r = 3, 5 \times 4 \times 3 = 60. \therefore r = 3.$

iii)  $5 : 20 = 3 : x$

$$\frac{5}{20} = \frac{3}{x} \Rightarrow x = 12$$

iv)  $\lim_{x \rightarrow 3} \left( \frac{x^3 - 27}{x - 3} \right) = \lim_{x \rightarrow 3} \left( \frac{x^3 - 3^3}{x - 3} \right) = 3 \times 3^2 = 27$

v)  $x^2 - y^2 = a^2$  then  $\frac{dy}{dx}$  is

$$2x - 2y \cdot \frac{dy}{dx} = 0 \Rightarrow \frac{2x}{2y} = \frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{x}{y}$$

**III. For question numbers 7 to 11 choose the appropriate answer from the brackets given below :**

**(5 × 1 = 5)**

**(56, 9,  $\frac{-3}{4}$ , 1, 2, 4)**

7. If  $[2 \times 2] \begin{bmatrix} 1 \\ 4 \\ 2 \end{bmatrix} = [3]$  then the value of x is .....

8. The number of triangles that can be formed from the 8 non collinear points is .....
9. The third proportional of 4 and 6 is .....
10. The value of  $\lim_{x \rightarrow 0} \left( \frac{\sin 4x}{\sin 2x} \right)$  is .....
11. The value of  $\int_0^{\pi/2} \sin 2x \, dx$  is .....

**Solution :**

$$7. \quad [2 \quad x \quad 2] \begin{bmatrix} 1 \\ 4 \\ 2 \end{bmatrix} = [3]$$

$$2 + 4x + 4 = 3$$

$$4x = -3$$

$$x = \frac{-3}{4}$$

$$8. \quad \text{Number of triangles} = {}^8C_3 = \frac{8 \times 7 \times 6}{3 \times 2 \times 1} = 56$$

$$9. \quad 4 : 6 :: 6 : x$$

$$4x = 36 \Rightarrow x = 9.$$

$$10. \quad \lim_{x \rightarrow 0} \frac{\sin 4x}{\sin 2x} = \lim_{x \rightarrow 0} \frac{4x}{2x} = 2$$

$$11. \quad \int_0^{\pi/2} \sin 2x = -\left. \frac{\cos 2x}{2} \right|_0^{\pi/2} = -\frac{1}{2} [\cos x - \cos 0] = \frac{-1}{2} [-1 - 1] = 1$$

**IV. Answer the following questions :**

**5 × 1 = 5**

$$12. \quad \text{Negate : } \sim p \rightarrow q$$

$$\text{Solution : } \sim (\sim p \rightarrow q) = \sim p \wedge \sim q$$

$$(\because \sim (a \rightarrow b) = a \wedge \sim b)$$

$$13. \quad \text{If } a : b = 2 : 3, b : c = 5 : 7 \text{ and } c : d = 3 : \text{ then find } a : d.$$

$$\text{Solution : } \frac{a}{d} = \frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} \Rightarrow \frac{a}{d} = \frac{2}{3} \times \frac{5}{7} \times \frac{3}{1} = \frac{10}{7}$$

$$a : d = 10 : 7$$

14. If  $\tan A = \frac{1}{\sqrt{3}}$  the find  $\tan 2A$ .

**Solution :**  $\tan A = \frac{1}{\sqrt{3}} \Rightarrow A = 30^\circ$

$$\tan 2A = \tan 60^\circ = \sqrt{3}$$

15. Differentiate  $3x^2 + 4y^2 = 10$  w.r.t.x.

**Solution :**  $3x^2 + 4y^2 = 10$

Diff w.r.t. 'x'

$$6x + 8y \cdot \frac{dy}{dx} = 10 \Rightarrow 8y \frac{dy}{dx} = -6x \Rightarrow \frac{dy}{dx} = \frac{-6x}{8y} = \frac{-3x}{4y}$$

16. Evaluate  $\int \left( x^2 - \frac{6}{x} + 5e^x \right) dx$

**Solution :**  $\int \left( x^2 - \frac{6}{x} + 5e^x \right) dx = \frac{x^3}{3} - 6 \log x + 5e^x + c$

### PART - B

V) Answer any SIX questions

17. In how many ways can the letters of the word "HOPPER" be arranged ?

**Solution :** HOPPER

$$n = 6 \quad p = 2$$

$$\text{No. of ways} = \frac{6!}{2!} = \frac{720}{2} = 360$$

18. Find the number of parallelograms that can be formed from the set of 6 parallel lines intersecting another set of 4 parallel lines.

**Solution :**  $m = 6 \quad n = 4$

$$\text{Name of parallelograms} = {}^m C_2 \times {}^n C_2 = {}^6 C_2 \times {}^4 C_2 = \frac{6 \times 5}{2 \times 1} \times \frac{4 \times 3}{2 \times 1} = 15 \times 6 = 90$$

19. Two coins are tossed simultaneously. What is the probability of getting

a) Atleast one tail

b) Atmost one tail

Solution :  $S = \{HH, HT, TH, TT\}$

$$\text{a) } p(\text{atleast one tail}) = \frac{3}{4}$$

$$b) P(\text{at most one tail}) = \frac{3}{4}$$

20. **Divide Rs. 6,000 in the ratio 3 : 4 : 5.**

**Solution :** given ratio 3 : 4 : 5

Let the parts are  $3x, 4x, 5x$ .

Given,  $3x + 4x + 5x = 6,000$

$$12x = 6000 \Rightarrow x = 500$$

$$1^{\text{st}} \text{ part} = 3 \times 500 = 1500$$

$$2^{\text{nd}} \text{ part} = 4 \times 500 = 2000$$

$$3^{\text{rd}} \text{ part} = 5 \times 500 = 2500$$

21. **500 workers can finish a work in 8 days. How many workers will finish the same work in 5 days ?**

**Solution :**

Workers	↑	Days	↓
500	↑	8	↓
X	↑	5	↓

Workers and days are in inverse proportion

$$\therefore \frac{500}{x} = \frac{5}{8}$$

$$5x = 500 \times 8$$

$$x = 800 \quad \therefore \text{No. of workers} = 800$$

22. **For Rs. 512.50 due 6 months at 15% p.a. Find the true present value and discounted value of the bill.**

**Solution :**

$$F = \text{Rs. } 512.50$$

$$t = 6 \text{ months} = 0.5 \text{ years}$$

$$r = 0.15\%$$

$$\text{Present value } P = \frac{F}{1 + tr} = \frac{512.50}{1 + 0.075} = \text{Rs. } 476.74$$

$$DV = F(1 - tr)$$

$$DV = 512.50 (1 - 0.075) = \text{Rs. } 474.06$$

23. **Find the equation of the parabola given that its focus is  $(-4, 0)$  and directrix is  $x = 4$ .**

**Solution :** Focus =  $(-4, 0) \Rightarrow a = 4$

Equation is  $y^2 = -4ax \Rightarrow y^2 = -16x$

24. **Find the axis and length of the latus rectum of the parabola  $x^2 = 16y$ .**

**Solution :**  $x^2 = 16y$

$4a = 16 ; a = 4$

Axis =  $y$  - axis

LLR =  $4a = 4 \times 4 = 16$  units

25.  $\int \frac{4x+3}{2x^2+3x+5} dx$

**Solution :**  $\int \frac{4x+3}{2x^2+3x+5} dx$

$f(x) = 2x^2 + 3x + 5$

$f'(x) = 4x + 3$

$$\int \frac{f'(x)}{f(x)} dx = \log(f(x)) + c$$

$$= \log(2x^2 + 3x + 5) + c$$

26. **Evaluate**  $\int_0^3 \left( \frac{x+3}{x+2} \right) dx$ .

**Solution :**  $\int_0^3 \frac{x+3}{x+2} dx = \int_0^3 \frac{x+2+1}{x+2} dx \Rightarrow \int_0^3 \left( 1 + \frac{1}{x+2} \right) dx$

$$= [x + \log(x+2)]_0^3 = 3 + \log 5 - (0 + \log 2)$$

$$= 3 + \log 5 - \log 2$$

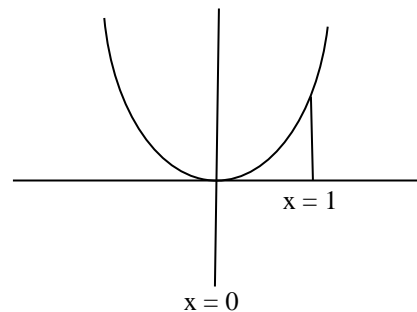
27. **Find the area enclosed by the curve  $y = x^2$ ,  $x$  - axis and the ordinates  $x = 0$  and  $x = 1$ .**

**Solution :**

$y = x^2, x = 0, x = 1$

$$A = \int_0^1 y dx \Rightarrow A = \int_0^1 x^2 dx$$

$$\Rightarrow \left[ \frac{x^3}{3} \right]_0^1 \Rightarrow A = \frac{1}{3}$$



**PART – C**

**VI. Answer any FIVE of the following questions :**

**5 × 3 = 15**

**28. Solve :**

**3x + 2y = 8 and 4x – 3y = 5 by Cramer’s rule.**

**Solution :**

$$3x + 2y = 8$$

$$4x - 3y = 5$$

$$A = \begin{vmatrix} 3 & 2 \\ 4 & -3 \end{vmatrix} = -17$$

$$\Delta x = \begin{vmatrix} 8 & 2 \\ 5 & -3 \end{vmatrix} = -34$$

$$\Delta y = \begin{vmatrix} 3 & 8 \\ 4 & 5 \end{vmatrix} = -17$$

$$x = \frac{\Delta x}{\Delta} = \frac{-34}{-17} = 2$$

$$y = \frac{\Delta y}{\Delta} = \frac{-17}{-17} = 1$$

**29. The difference between BD and TD on a certain sum of money due in 6 months is Rs.**

**27. Find the amount of the bill if the rate of interest is 6% p.a.**

**Solution :**  $BD - TD = 27$

$$BG = 27$$

$$t = 6 \text{ months} = 0.05 \text{ years}$$

$$r = 0.06$$

$$BG = TD \cdot tr$$

$$27 = TD \cdot 0.5 \times 0.06$$

$$TD = 900$$

$$BD - 900 = 27$$

$$BD = 927$$

$$F = \frac{BD \times TD}{BG} = \frac{927 \times 900}{27} \Rightarrow F = \text{Rs.} 30,900$$

30. A person invests Rs. 15,000 partly in 3% stock at 75 and partly in 6% stock at 125. If the income from both is Rs. 675. Find his investment in 2 types of stocks.

**Solution :** Money invested in 3% stock = x

Money invested in 6% stock = 15,000 – x

$$\text{Income } I_1 = \frac{x \times 3}{75} = 0.04x$$

$$\text{Income } I_2 = \frac{(15,000 - x) \times 6}{125}$$

$$I_2 = 720 - 0.048x$$

$$I_1 + I_2 = 675$$

$$0.04x + 720 - 0.048x = 675$$

$$0.008x = 45$$

$$x = \text{Rs. } 5625$$

∴ Money invested in 3% stock = Rs. 5625

Money invested in 6% stock = 1500 – 5625 = Rs. 9375

31. The price of a T.V. set inclusive of sales tax of 9% is Rs. 13,407. Find its marked price. If the sales tax is increased to 13%, how much more does the customer pay for the T.V. ?

**Solution :** SP of T.V. = Rs. 13,407

$$SP = MP + ST\% MP$$

$$13,407 = x + \frac{9}{100} x$$

$$13,407 = 1.09x$$

$$MP = \text{Rs. } 12,300$$

If sales tax is 13%

$$\text{Then } SP = MP + ST\% MP$$

$$SP = 12,300 + \frac{13}{100}(12,300)$$

$$SP = \text{Rs. } 13,899/-$$

32. Find  $\frac{dy}{dx}$ , given that  $x = a \cos^4 \theta$ ,  $y = a \sin^4 \theta$ .

**Solution :**  $x = a \cos^4 \theta$                        $y = a \sin^4 \theta$



$$\frac{dx}{d\theta} = -4a \cos^3 \theta \cdot \sin \theta \quad \frac{dy}{d\theta} = 4a \sin^3 \theta \cos \theta$$

$$\frac{dy}{dx} = \frac{4a \sin^3 \theta \cos \theta}{-4a \cos^3 \theta \sin \theta} = \frac{-\sin^2 \theta}{\cos^2 \theta} = -\tan^2 \theta$$

33. A ladder of 15 feet long leans against a smooth vertical wall. If the top slides downwards at the rate of 2 ft/sec. Find how fast the lower end is moving when the lower end is 12 feet away from the wall.

**Solution :**  $\frac{dy}{dt} = -2 \text{ ft/sec} \quad \frac{dx}{dt} = ? \quad x = 12$

$$x^2 + y^2 = 15^2$$

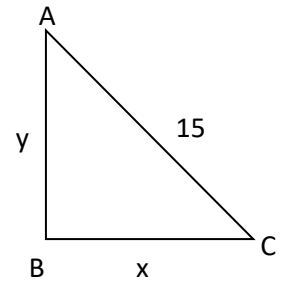
$$y^2 = 15^2 - 12^2$$

$$y = 9$$

$$x^2 + y^2 = 15^2$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0 \Rightarrow 2 \times 12 \times \frac{dx}{dt} + 2 \times 9 \times (-2) = 0$$

$$\frac{dx}{dt} = \frac{+36}{24} = \frac{3}{2} \text{ ft/sec}$$



34. Evaluate  $\int \frac{x+2}{(2x-1)(x-3)} dx$ .

**Solution :**  $\int \frac{x+2}{(2x-1)(x-3)} dx = \int \frac{A}{(2x-1)} + \frac{B}{(x-3)} dx$

$$x + 2 = A(x - 3) + B(2x - 1)$$

$$x = 3, B = 1$$

$$x = \frac{1}{2}, A = -1$$

$$\therefore \int \frac{x+2}{(2x-1)(x-3)} dx = \int \frac{x+2}{(2x-1)(x-3)} dx = \int \frac{-1}{2x-1} + \frac{1}{x-3} dx$$

$$= -\frac{\log(2x-1)}{2} + \log(x-3) + c$$

#### PART - D

VII. Answer any five questions :

5 × 5 = 25

35. Solve the linear equations by matrix method.

$$x + y - z = 1$$

$$3x + y - 2z = 3$$

$$x - y - z = -1$$

**Solution :**

$$x + y - z = 1$$

$$3x + y - 2z = 3$$

$$x - y - z = -1$$

$$Ax = B \Rightarrow X = A^{-1}B$$

$$\text{Where } A = \begin{bmatrix} 1 & 1 & -1 \\ 3 & 1 & -2 \\ 1 & -1 & -1 \end{bmatrix}, x = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}$$

$$|A| = \begin{vmatrix} 1 & 1 & -1 \\ 3 & 1 & -2 \\ 1 & -1 & -1 \end{vmatrix} = 2 \neq 0$$

$$\Rightarrow C_{11} = -3, C_{12} = 1, C_{13} = 4, C_{21} = 2, C_{22} = 0, C_{23} = 2, C_{31} = 1, C_{32} = 1, C_{33} = 2$$

$$C = \begin{bmatrix} -3 & 1 & -4 \\ 2 & 0 & 2 \\ -1 & -1 & -2 \end{bmatrix}$$

$$\text{Adj}(A) = \begin{bmatrix} -3 & 2 & -1 \\ 1 & 0 & -1 \\ -4 & 2 & -2 \end{bmatrix}$$

$$x = \frac{1}{2} \begin{bmatrix} -3 & 2 & -1 \\ 1 & 0 & -1 \\ -4 & 2 & -2 \end{bmatrix} \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}$$

$$x = 2, y = 1, z = 2.$$

36. Find the coefficient  $x^8$  in  $\left(3x^2 - \frac{1}{2x}\right)^{10}$ .

**Solution :** Given  $\left(3x^2 - \frac{1}{2x}\right)^{10}$

$$T_{r+1} = {}^nC_r x^{4-r} a^r$$

$$T_{r+1} = {}^{10}C_r (3x^2)^{10-r} \left(\frac{1}{2x}\right)^r$$

$$T_{r+1} = {}^{10}C_r (3)^{10-r} \left(\frac{1}{2}\right)^r (x)^{2(10-r)-r}$$

Take  $2(10-r) - r = 8$

$$20 - 3r = 8 \Rightarrow 3r = 12 \Rightarrow r = 4$$

$$\text{Co-eff of } x^8 \text{ is } = {}^{10}C_4 (3)^{10-4} \left(\frac{1}{2}\right)^4 = {}^{10}C_4 (3)^6 \left(\frac{1}{2}\right)^4$$

37. Resolve  $\frac{2x^2 + 10x - 3}{(x+1)(x-3)(x+3)}$  into partial fractions.

**Solution :** Given  $\frac{2x^2 + 10x - 3}{(x+1)(x-3)(x+3)}$

$$\frac{2x^2 + 10x - 3}{(x+1)(x-3)(x+3)} = \frac{A}{x+1} + \frac{B}{x-3} + \frac{C}{x+3}$$

$$2x^2 + 10x - 3 = A(x-3)(x+3) + B(x+1)(x+3) + C(x+1)$$

Put  $x = 3$ ,  $2(3)^2 + 10(3) - 3 = B(4)(6)$

$$18 + 30 - 3 = 24B$$

$$\boxed{\frac{45}{24} = B}$$

Put  $x = -3$ ,  $18 - 30 - 3 = C(-2)(-6)$

$$\frac{15}{12} = C \Rightarrow C = \frac{-15}{12}$$

Put  $x = -1$ ,  $2 - 10 - 3 = A(-8)$

$$\frac{-11}{-8} = A \Rightarrow A = \frac{11}{8}$$

$$\frac{2x^2 + 10x - 3}{(x+1)(x-3)(x+3)} = \frac{\frac{11}{8}}{(x+1)} + \frac{\frac{45}{24}}{(x-3)} + \frac{\frac{-15}{12}}{x+3}$$

38. Show that  $\sim(p \vee q) \rightarrow (\sim p \wedge \sim q)$  is a Tautology.

**Solution :**

			(a)			(b)	a→b
p	q	p∨q	~(p∨q)	~p	~q	~p∩~q	T
T	T	T	F	F	F	F	T
T	F	T	F	F	T	F	T
F	T	T	F	T	F	F	T
F	F	F	T	T	T	T	T

∴ Given proposition is a tautology.

39. ABC company required 1000 hours to produce 1<sup>st</sup> 30 engines. If the learning effect is 90%. Find the total labour cost at Rs. 20/ hour to produce a total of 120 engines.

**Solution :** 1 lot = 30 engine

120 engine = 4 lots

Unit produced	Total output time per unit	Cumulative average time per unit	Total labours
1	1	1000	1000
1	2	90% of 1000 = 900	1800
2	4	90% of 900 = 810	3240

Total hours = 3240

Total labour cost = 20 × 3240 = Rs. 64,800/-

40. Solve the following LPP graphically

**Maximize : Z = 5x + 3y**

**Subject to the constraints :**

**3x + 5y ≤ 15,**

$$5x + 2y \leq 10,$$

$$x \geq 0,$$

$$y \geq 0.$$

**Solution :**  $\max Z = 5x + 3y$

$$3x + 5y = 15$$

Put

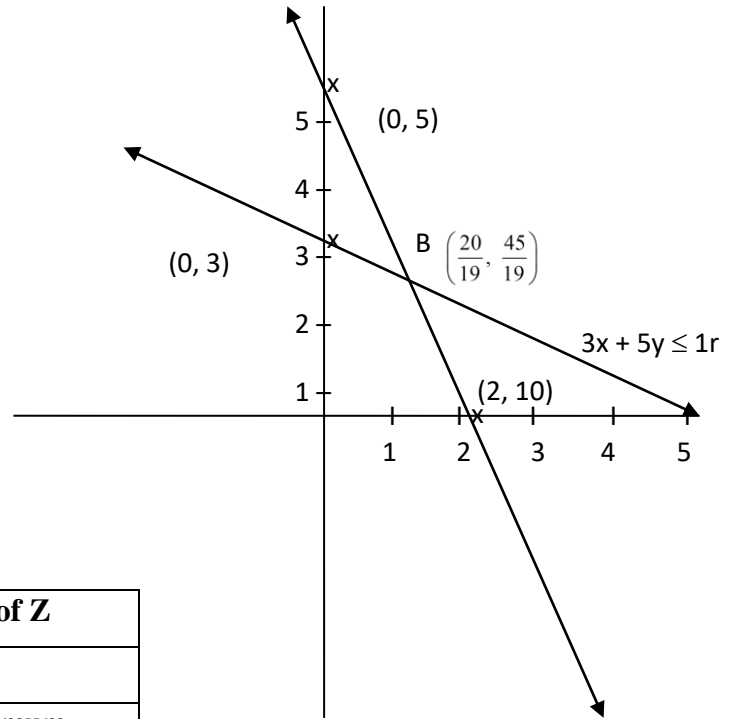
x	0	5
y	3	0

$$5x + 2y = 10$$

x	0	2
y	5	0

We set  $3x + 5y = 15$

$$5x + 2y = 10$$



Corner points	Value of Z
(0, 3)	9
$\left(\frac{20}{19}, \frac{45}{19}\right)$	12.36 – maximum
(2, 0)	10

Hence  $Z = \frac{235}{19}$  is maximum at  $\left(\frac{20}{19}, \frac{45}{19}\right)$

41. **Prove that :**  $\frac{\sin 6A + \sin 2A + 2 \sin 4A}{\sin 7A + \sin 3A + 2 \sin 5A} = \frac{\sin 4A}{\sin 5A}.$

**Solution :** 
$$\frac{\sin 6A + \sin 2A + 2 \sin 4A}{\sin 7A + \sin 3A + 2 \sin 5A} = \frac{2 \sin \left(\frac{8A}{2}\right) \cdot \cos \left(\frac{4A}{2}\right) + 2 \sin 4A}{2 \sin \left(\frac{10A}{2}\right) \cdot \cos \left(\frac{4A}{2}\right) + 2 \sin 5A}$$

$$= \frac{2 \sin 4A \cos 2A + 2 \sin 4A}{2 \sin 5A \cos 2A + 2 \sin 5A} = \frac{2 \sin 4A (\cos 2A + 1)}{2 \sin 5A (\cos 2A + 1)} = \frac{\sin 4A}{\sin 5A}$$

42. Find the equation of the circle passing through the points (1,-4) ,(5,2) and having its centre on the line  $x-2y+9=0$  .

**Solution :** General equation of the circle is  $x^2+y^2+2gx+2fy+c=0$

$$(1,-4) \rightarrow 2g-8f+c=-17 \dots\dots\dots(1)$$

$$(5,2) \rightarrow 10g+4f+c=-29 \dots\dots\dots(2)$$

$$\text{Centre } (-g,-f) \text{ on } x-2y+9=0 \rightarrow -g + 2f = -9 \dots\dots\dots(3)$$

$$\text{Solving (1)and(2), } -2g -3f=3 \dots\dots\dots(4)$$

$$\text{Solving (3) and (4) } f=-3, g=3 \text{ and } c=-47$$

Then the equation of circle is  $x^2+y^2+6x-6y-47=0$

43. Evaluate  $\lim_{x \rightarrow 2} \left( \frac{x^2 - 4}{\sqrt{x+2} - \sqrt{3x-2}} \right)$

$$\text{Solution: } \lim_{x \rightarrow 2} \left( \frac{x^2 - 4}{\sqrt{x+2} - \sqrt{3x-2}} \right) \times \lim_{x \rightarrow 2} \left( \frac{\sqrt{x+2} + \sqrt{3x-2}}{\sqrt{x+2} + \sqrt{3x-2}} \right)$$

$$= \lim_{x \rightarrow 2} \left( \frac{(x+2)(x-2)}{\sqrt{x+2} - \sqrt{3x-2}} \right) \times \lim_{x \rightarrow 2} \left( \frac{\sqrt{x+2} + \sqrt{3x-2}}{\sqrt{x+2} + \sqrt{3x-2}} \right)$$

$$= \lim_{x \rightarrow 2} \left( \frac{(x+2)(x-2)}{(x+2) - (3x-2)} \right) \times \lim_{x \rightarrow 2} (\sqrt{x+2} + \sqrt{3x-2})$$

$$= \lim_{x \rightarrow 2} \left( \frac{(x+2)(x-2)}{-(x-2)} \right) \times \lim_{x \rightarrow 2} (\sqrt{x+2} + \sqrt{3x-2})$$

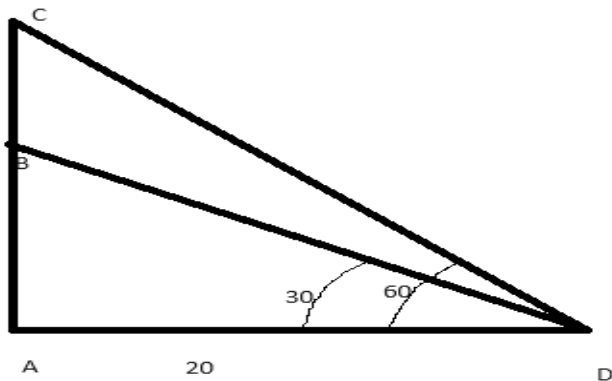
$$= \left( \frac{(2+2)(2+2)}{-2} \right) = -8$$

### PART-E

**VIII. Answer any TWO of the following questions :**

44) A flag staff stands upon the top of a building at a distance of 20mts .The angles of elevation of the top of the flag staff and the building are  $60^\circ$  and  $30^\circ$  respectively .Find the height of the flag staff .

**Solution:**



Let the height of the flag staff  $BC=h$

From triangle  $BAD$ ,  $\tan 30^\circ = \frac{h}{AB}$  then  $AB = \frac{h}{\tan 30^\circ}$

From triangle  $CAD$ ,  $\tan 60^\circ = \frac{h+AB}{20}$  then  $h+AB = 20\sqrt{3}$   $h = \frac{40\sqrt{3}}{\sqrt{3}} = 40$  m

45) If  $y = a \cos(\log x) + b \sin(\log x)$ . Show that  $x^2 y_2 + x y_1 + y = 0$

Solution:  $y = a \cos(\log x) + b \sin(\log x)$

Differentiating w.r.t  $x$ ,

$$y_1 = -\frac{a \sin(\log x)}{x} + \frac{b \cos(\log x)}{x}$$

$$x y_1 = -a \sin(\log x) + b \cos(\log x)$$

Again differentiating w.r.t  $x$ ,

$$x y_2 + y_1 = \frac{a \cos(\log x)}{x} - \frac{b \sin(\log x)}{x}$$

$$x^2 y_2 + x y_1 + y = 0$$

46) The total revenue function is given by  $R = 400x - 2x^2$  and the total cost function is given by  $C = 2x^2 + 40x + 4000$ . Find

a) The marginal revenue and marginal cost function

b) the output at which marginal revenue = marginal cost

Solution: Marginal revenue =  $400 - 4x$

Marginal cost =  $4x + 40$

Output when  $MR = MC$ , i.e,  $400 - 4x = 4x + 40$

$$8x = 360$$

X=45 units

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