

1. New Quantity = $\frac{b}{a} \times \text{Original Quantity}$ (Ratio a:b)
 Factor multiplying Ratio
 b-antecedent, a-consequent
2. Inverse Ratio $\rightarrow a:b \Rightarrow b:a$ $4:3 \Rightarrow 3:4$
3. Compounded Ratio $\rightarrow \underbrace{a:b}_{\text{Antecedent}} \& \underbrace{c:d}_{\text{Consequent}} = ac:bd$ $4:5, 3:7 = 12:35$
4. Duplicate Ratio = $a:b \Rightarrow a^2:b^2$ ($a:b \times a:b$)
5. Triplicate Ratio = $a:b \Rightarrow a^3:b^3$
6. Sub-duplicate = $a:b \Rightarrow \sqrt{a}:\sqrt{b}$
7. Sub-triplicate = $a:b \Rightarrow \sqrt[3]{a}:\sqrt[3]{b}$
8. Continued Ratio = $a, b, c, d \Rightarrow a:b:c:d$ - Partnership Ratio
 $a:b = 2:5$ $b:c = 4:7$ $a:b:c = ?$
 $a:b:c = 8:20:35$ $\frac{a}{b} = \frac{2}{5} \times \frac{4}{4} = \frac{8}{20}$ $\frac{b}{c} = \frac{4}{7} \times \frac{5}{5} = \frac{20}{35}$
9. Continuous Proportion = $\boxed{\frac{a}{b} = \frac{b}{c} \Rightarrow ac = b^2}$; $b = \sqrt{ac}$ = G.M of a & c
10. Cross Prod. Rule
 Prod. of Means $\rightarrow \frac{2}{6} = \frac{3}{x} = 2x = 18 \Rightarrow x = 9$
 Prod. of extremes $\frac{2}{6} = \frac{3}{9}$ ✓

11. Invertendo \rightarrow If $a:b = c:d$ then $b:a = d:c$
 $1:2 = 4:8$ then $2:1 = 8:4$

12. Alternando $\rightarrow a:b = c:d$ then $a:c = b:d$
 $5:7 = 10:14$ then $5:10 = 7:14$ ($1:2 = 1:2$)

13. Componendo \rightarrow If $a:b = c:d$; then $a+b:b = c+d:d$

14. Dividendo \rightarrow If $a:b = c:d$; then $a-b:b = c-d:d$

15. 13 & 14 \rightarrow If $a+b = c:d$ then $a+b:a-b = c+d:c-d$
 $a-b:a+b = c-d:c+d$

16. Addendo \rightarrow If $2:3 = 4:6 = 6:9 = 10:15 = k(0.66666)$
 $= 2+4+6+10 : 3+6+9+15$
 $= 22:33 = 0.6666(k)$

17. Subtrahendo $\rightarrow \frac{2-4-6-10}{3-6-9-15} = \frac{-18}{-27} = 0.6666(k)$

18. $a^0 = 1$

23. $(a \times b)^n = a^n \times b^n$

19. $\sqrt[n]{a} = a^{1/n}$

24. Base $x \begin{matrix} 2 & 3 & 4 & 5 \\ \downarrow & \downarrow & & \\ 2^2 & 2^3 & & \end{matrix}$

20. $a^m \times a^n = a^{m+n}$

$2^2 \times 2^3 = 4 \times 8 = 16$

21. $a^m \div a^n = a^{m-n}$

25: Reciprocal / Negative Power

$60000 = 6 \times 10^7$

$10^7 \div 6 = 60000 = 5581.7986$

22. $(a^m)^n = a^{mn}$

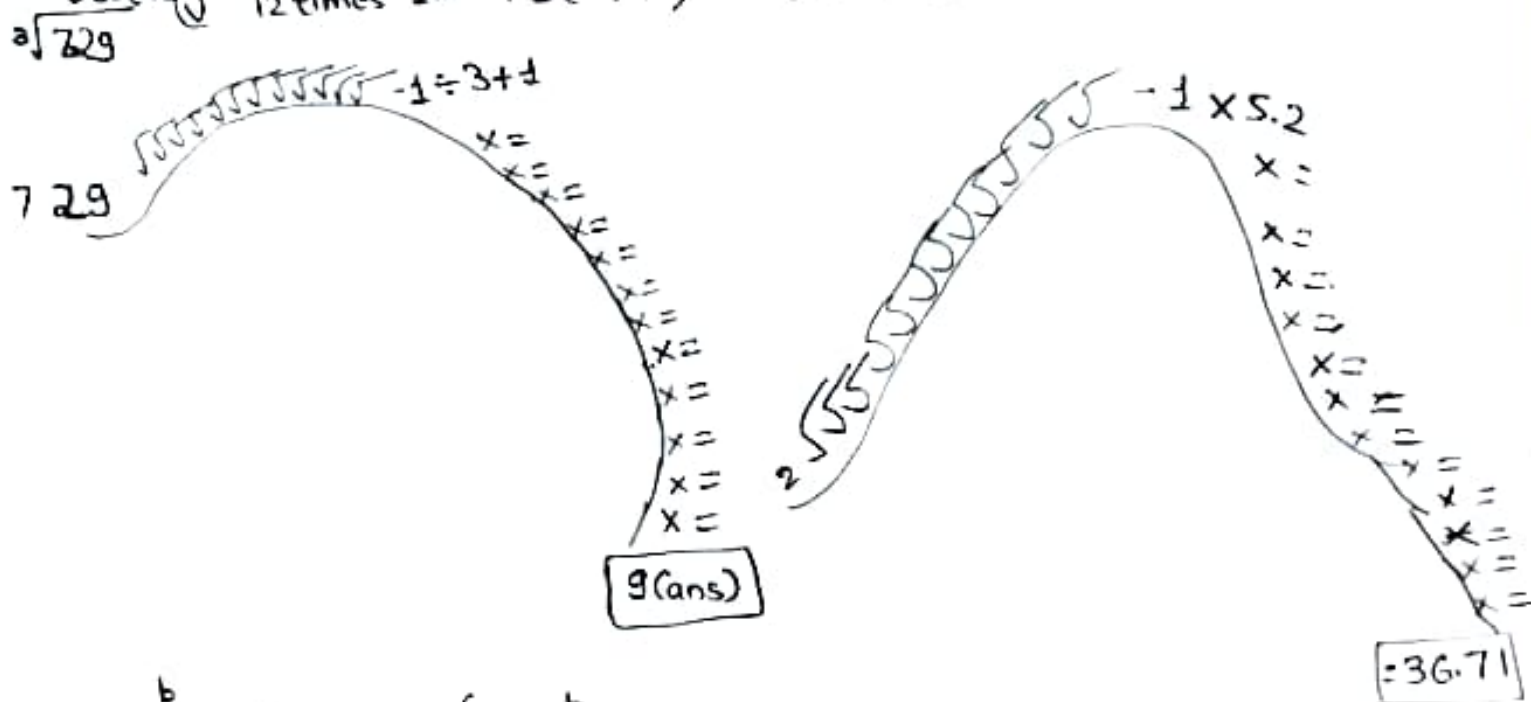
$(2^3)^4 = 2^{3 \times 4} = 2^{12} = 8^4 = 4096$

$\frac{1}{3^4} = \frac{1}{81}$

26. Calculator Trick for any root

Base ($\sqrt{\quad}$) 2 times - 1 \div n + 1 (x \Rightarrow) 12 times

Power ($\sqrt{\quad}$) 12 times - 1 \times n + 1 (\Rightarrow) 12) — Power trick



$$27. \frac{a^b}{a^c} = a^{\frac{b}{c}} \quad \log_a a^{\frac{b}{c}} = \frac{b}{c}$$

$$n > 0, a > 0, a \neq 1$$

$$28. \log_a a = 1$$

$$29. \log_a 1 = 0 \quad \log_2 1 = 0$$

$$2^0 = 1$$

$$30. \log_a mn = \log_a m + \log_a n$$

$$31. \log_a \frac{m}{n} = \log_a m - \log_a n$$

$$32. \log_a m^n = n \log_a m$$

$$33. \log_b m = \frac{\log m}{\log b} = \frac{\log_a m}{\log_a b}$$

$$\log_3 3^8 = 8 \log_3 3 = 8$$

$$34. \log_b a = \log_a b = \frac{\log a}{\log b} \times \frac{\log b}{\log a} = 1$$

35. Common Log Base = 10

- Natural Log Base = e

calculus & stats = 2.71828

$$36. ax^2 + bx + c = 0$$

a = x^2 coefficient

b = x coefficient

c = constant

$$37. \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$38. \text{Sum of roots} = \frac{-b}{a}$$

$$\alpha + \beta = \frac{-b}{a}$$

$$39. \text{Prod. of roots} = \frac{c}{a}$$

$$\alpha\beta = \frac{c}{a}$$

$$40. x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

Construction of Qd. Eq.

$$41. b^2 - 4ac = 0 \text{ Real \& Equal}$$

$$42. b^2 - 4ac < 0 \text{ Imaginary}$$

$$43. b^2 - 4ac > 0 \text{ Real \& Unequal}$$

$$44. b^2 - 4ac > 0 \text{ Real, Unequal}$$

& per. sq. & Rational

$$45. b^2 - 4ac > 0 \text{ Real, Unequal}$$

& not per. sq. & Irrational

$$46. m + \sqrt{n} \text{ other will be } m - \sqrt{n}$$

Conjugate pair

$$47. ax + b = 0 \text{ Simple equation}$$

$$3x - 5 = 13 \rightarrow 3x = 18$$

$$3x = 5 + 13 \rightarrow x = 6$$

$$48. a_1x + b_1y + c_1 = 0 \text{ - Simultaneous}$$

$$a_2x + b_2y + c_2 = 0$$

$$49. ax^3 + bx^2 + cx + d = 0$$

Trial & Error

MATRICES

$$S0. A + B = B + A$$

$$S1. (A + B) + C = A + (B + C)$$

$$S2. k(A + B) = kA + kB$$

$$S3. A_{m \times p} \times B_{p \times n} = AB_{m \times n}$$

$$S4. A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\det A \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$S5. A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$$

$$a_{11} \begin{bmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{bmatrix} - a_{12} \begin{bmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{bmatrix}$$

$$+ a_{13} \begin{bmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{bmatrix}$$

$$S6. C_{ij} = (-1)^{i+j} M_{ij}$$

$$S7. A^{-1} = \frac{1}{\det A} \times \text{adj } A$$

Inverse of A; $\det A \neq 0$

Cramer's Rule

58. $2x + 3y - 4z = 10$

$7x + y + 2z = 19$

$-2x - 5y + 3z = 8$

$\Delta, \Delta_x, \Delta_y, \Delta_z$

$$\Delta = \begin{vmatrix} 2 & 3 & -4 \\ 7 & 1 & 2 \\ -2 & -5 & 3 \end{vmatrix}$$

$$\Delta_x = \begin{vmatrix} 10 & 3 & -4 \\ 19 & 1 & 2 \\ 8 & -5 & 3 \end{vmatrix}$$

$$\Delta_y = \begin{vmatrix} 2 & 10 & -4 \\ 7 & 19 & 2 \\ -2 & 8 & 3 \end{vmatrix}$$

$$\Delta_z = \begin{vmatrix} 2 & 3 & 10 \\ 7 & 1 & 19 \\ -2 & -5 & 8 \end{vmatrix}$$

$x = \Delta_x / \Delta$

$y = \Delta_y / \Delta$

$z = \Delta_z / \Delta$

63. Amt. as per CI = ?

$P = 20000 \quad t = 3 \text{ years}$

$r = 8\% \text{ for first 2 yrs}$

$r = 12\% \text{ for last yr.}$

$20000 + 8\% + 8\% + 12\%$

$= 26127.36$

$CI = 6127.36$

Time Value of Money

59. $SI = \frac{PRT}{100}$

60. $A = P + SI$

$= P + \frac{PRT}{100}$

$= P \left(1 + \frac{RT}{100} \right)$

61. $A = P(1+i)^n$

$i = \frac{8\%}{\text{no compy}}$

$n = t \times \text{no compy}$

62. $P = 1000, i = 10\%, n = 3$

$1000 + 10\% + 10\% + 10\%$

$A = 1331$

$CI = 1331 - 1000 = 331$

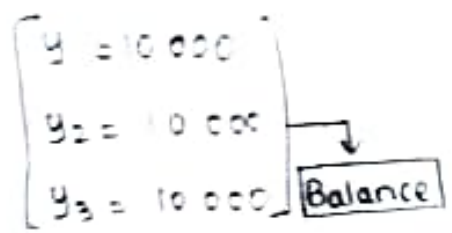
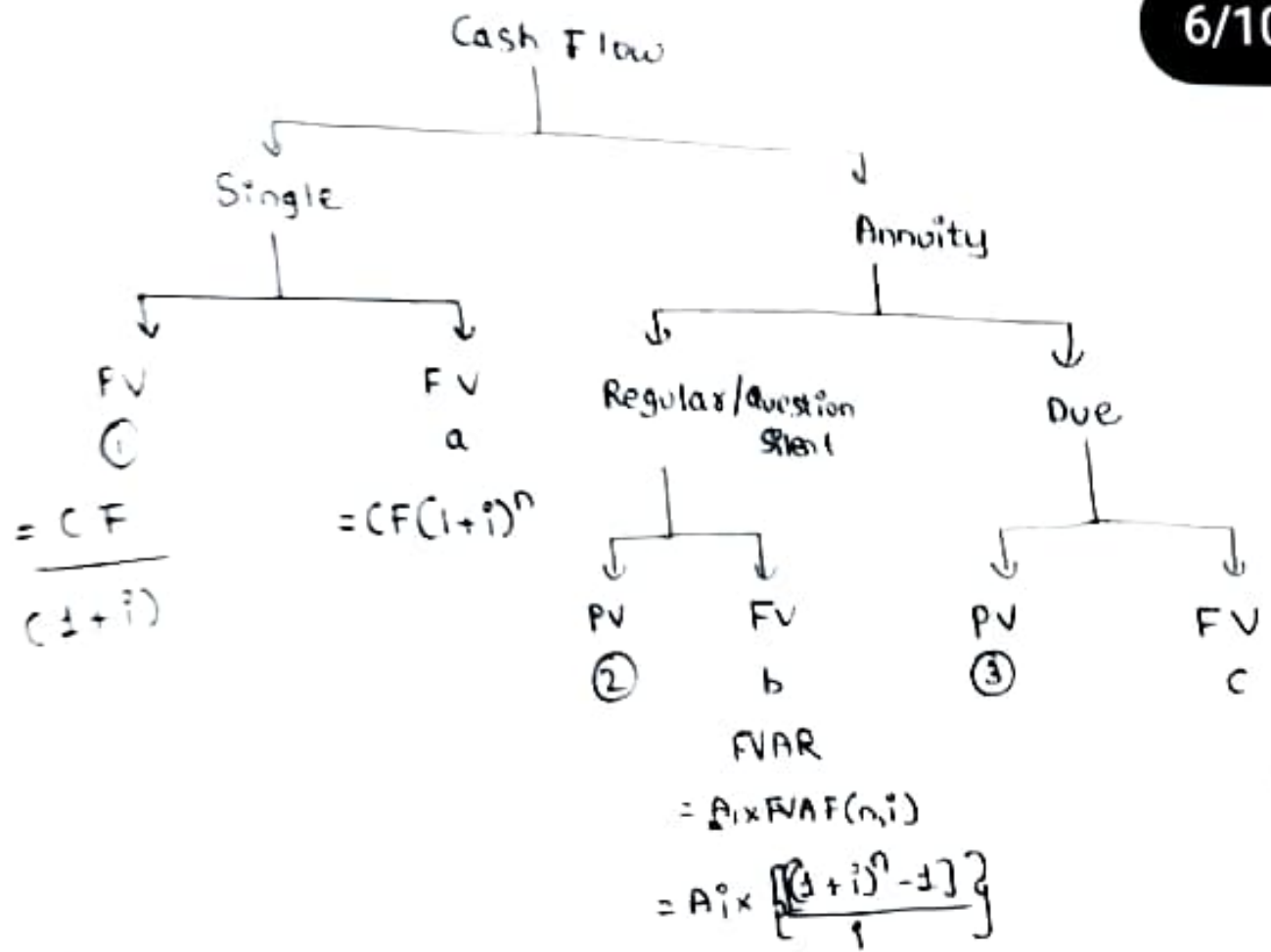
64. $E = [(1+i)^n - 1]$

PNB = 8% pa. Semi Annually

$i = \frac{8}{2} = 4\%$

$= [(1.04)^2 - 1] \times 100$

$= 8.16\%$



$= 10000 \times [3 + \text{Something}]$

Fut. Val. Ann. Fac.

69. $PVP = \frac{A \cdot i}{i}$

70. Growing Perpetuity

$PVGP = \frac{A \cdot i}{i - g}$

66. $FVA \text{ Due} = A \cdot i \cdot FVAF(n, i)$

67. $PVA \text{ Reg} = A \cdot i \cdot \frac{1 - (1+i)^{-n}}{i}$

$1 + i = \dots n \text{ times } \boxed{GT}$

68. $PVA \text{ Due}$

69. 3000, 3000, 3000
10% p.a

$PVP = \frac{3000}{10\%} = 30000$

70. 1000, 1050, 1102.5

$PVGP = \frac{1000}{0.10 - 0.05} = 20000$

71. NPV

= PV Inflows - PV of Outflows

NPV ≥ 0 , accept the proposalNPV < 0 , reject

72. Real Rate of Return

= Nominal Rate of Return

- Rate of Return.

73. Com. Annual Growth Rate

Permutation & Combination

74. $n! = n(n-1)(n-2)\dots 3 \cdot 2 \cdot 1$

$$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040$$

$$1 = 1, 2 = 2, 3 = 6, 4 = 24, 5 = 120$$

$$6 = 720, 7 = 5040, 8! = 40320,$$

$$9! = 362880, 10! = 3628800$$

75. ${}^n P_r = \frac{n!}{(n-r)!}$

$$n \geq r$$

$${}^{10} P_4 = \frac{10!}{(10-4)!} \text{ or } 10 \times 9 \times 8 \times 7$$

no. of factors =

76. ${}^n P_n = n!$

$$(n+1)! - n! = n \cdot n!$$

$$(4+1)! - 4! = 4 \cdot 4!$$

$$\text{LHS } 5! - 4! = 120 - 24 \\ = 96$$

$$\text{RHS} = 4 \cdot 4! = 4 \times 24 = 96 \\ \text{Proved}$$

77. Circular Permutation
 $= (n-1)!$

78. Circular Permutation (TII)

$$\frac{1}{2} (n-1)! \left[\begin{array}{l} \text{No two neighbours} \\ \text{are same} \end{array} \right] \\ \left[\text{necklaces, garland} \right]$$

79. Permutation with Restriction
 $n-1 P_r$ 1 excluded80. Particular obj is always inc.
 $x \cdot {}^{n-1} P_{r-1}$

81. ${}^{n-1} P_r + x \cdot {}^{n-1} P_{r-1} = {}^n P_r$

82. No. of ways when things
are never together

1 = Together

$$83. {}^n C_r = \frac{{}^n P_r}{r!}$$

$${}^n C_r = \frac{n!}{r!(n-r)!}$$

$$\begin{aligned} {}^{10} C_4 &= \frac{{}^{10} P_4}{4!} \\ &= \frac{10 \times 9 \times 8 \times 7}{24} \\ &= 210 \end{aligned}$$

$$84. {}^n C_0 = 1, {}^n C_n = 1$$

$$85. {}^{10} C_8 = {}^{10} C_2$$

Complimentary
Combination

$${}^{14} C_{11} = {}^{14} C_3$$

$${}^n C_r = {}^n C_{n-r}$$

$${}^{14} C_7 = {}^{14} C_{14-7}$$

$${}^{14} C_{11} = {}^{14} C_3$$

6, 11, 16, ...

$$a=6, d=+5$$

$$6+5 = 11$$

86. Special Combination Formula

$${}^n C_r + {}^n C_{r-1} = {}^{n+1} C_r$$

$${}^{600} C_8 + {}^{600} C_9 = {}^{601} C_9$$

87. Combination of one or more

$$2^n - 1$$

5 - One or more

$$\begin{aligned} {}^5 C_0 + {}^5 C_1 + {}^5 C_2 + {}^5 C_3 + {}^5 C_4 + {}^5 C_5 &= 32 - 2^0 \\ &= 2^5 - 1 \end{aligned}$$

88. No. of straight lines = ${}^n C_2$

89. No. of triangles = ${}^n C_3$

90. No. of Collinear = Linear - Collinear

91. No. of Parallelogram = ${}^n C_2 \times {}^m C_2$

92. No. of Diagonals = ${}^n C_2 - n$

AP, GP

$$93. d = t_2 - t_1 = t_3 - t_2 = t_n - t_{n-1}$$

Common diff. of AP

$$94. t_n = a + (n-1)d \text{ (Gen. Term of AP)}$$

$$95. a \pm d = \dots n \text{ times}$$

$$t_2 \quad t_3 \quad t_4 \quad t_n$$

Shortcut Trick

96. $S_n = \frac{n}{2} (a + t_n)$

97. $S_n = \frac{n}{2} \{2a + (n-1)d\}$

98. $a + d = \dots = \text{upto } n \text{ terms } G_1 T + a$
 $t_2 \quad t_3$

99. $S_{10} = \frac{10}{2} \{2 \times 20 + 9 \times (-4)\}$
 $= 5(40 - 36) = 20$
 $20 - 4 = \dots = \dots = t_{10} G_1 T + 20$

99. $\frac{n(n+1)}{2}$

100. $S = n^2$

101. $S = n(n+1)(2n+1)$

102. $S = \{n(n+1)^2\}$

103. $r = \frac{t_2}{t_1} = \frac{t_n}{t_{n-1}} = \frac{t_3}{t_2}$

104. $t_n = ar^{n-1}$
 $r \times a = \dots = \dots =$
 $t_2 \quad t_3 \quad t_4 \dots t_n$

206, 18, 54
 $a = 2, r = 3$
 $t_8 = ar^7 = 2 \times 3^7 = 4374$
 $3 \times 2 = \dots = \text{upto } 8 \text{ times}$
 $= 4374$

105. $S_n = a \frac{(1-r^n)}{1-r}$
 $r < 1$

106. $S_n = a \frac{(r^n - 1)}{r - 1}$
 $r > 1$

107. $r \times a = \dots = \dots = G_1 T + a$
 $t_2 \quad t_3 \quad t_4 \dots t_n$

20, 10, 5, 5/2

$S_5 = \frac{a(r^5 - 1)}{r - 1}$
 $= \frac{20(0.5^5 - 1)}{0.5 - 1}$
 $= 20 \times \frac{1 - 0.96875}{1 - 0.5}$
 $= 38.75$

$0.5 \times 20 = \dots = \dots = G_1 T + 20$
 $t^2 \quad t^3 \quad t^4 \quad t^5$

108. $S_\infty = \frac{a}{1-r}$

$$109. A = \{2, 5, 7\}$$

$$\{2\} \{5\} \{7\}$$

$$\{2, 5\} \{5, 7\} \{2, 7\}$$

$$\{2, 5, 7\} \phi$$

(8)

$$\text{Total}^{\text{A}} \text{ Subsets} = 2^n$$

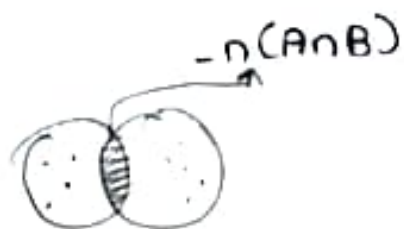
$$110. \text{ Proper Subsets} = 2^n - 1$$

111. De Morgan's Law

$$(A \cup B)' = A' \cap B'$$

$$(A \cap B)' = A' \cup B'$$

$$112. n(A \cup B) = n(A) + n(B)$$

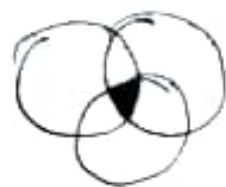


$$113. n(A \cup B \cup C) = n(A) + n(B) + n(C)$$

$$- n(A \cap B) - n(A \cap C) -$$

$$n(B \cap C) + n(A \cap B \cap C)$$

3 set operations



$$121. \frac{d}{dx} (\log x) = \frac{1}{x}$$

$$114. f \circ g = f \circ g(x) = f[g(x)]$$

$$f(x) = x^2, g(x) = (2x-1)$$

$$f \circ g = f(g(x))$$

$$= (2x-1)^2$$

$$g \circ f = g(f(x))$$

$$= 2x^2 - 1$$

$$115. f(x) = 2x + 1$$

$$y = 2x + 1 \Rightarrow 2x = y - 1$$

$$x = \frac{y-1}{2}$$

$$y = \frac{x-1}{2} = f^{-1}(x)$$

Calculus

$$116. \frac{d(x^n)}{dx} = nx^{n-1}$$

$$117. \frac{d e^x}{dx} = e^x$$

$$118. \frac{d a^x}{dx} = a^x \log_e a$$

$$119. \frac{d k}{dx} = 0$$

$$120. \frac{d e^{ax}}{dx} = ae^{ax}$$