Logarithms :

$$\log_K(x) = a$$

(x → number, K → base)

$$\Downarrow$$

$$K^a = x$$

eg.- $\log_2(32) = 5$ (i.e. 5 divisions by 2 are needed).

$32 \to 16 \to 8 \to 4 \to 2 \to 1$

Formulas :

$$\log_K(a \cdot b) = \log_K(a) + \log_K(b)$$

$$\log_K(x^n) = n \cdot \log_K(x)$$

$$\log_K\left(\frac{a}{b}\right) = \log_K(a) - \log_K(b)$$

$$\log_u(x) = \frac{\log_K(x)}{\log_K(u)}$$

$\ln(x) \Longrightarrow$ It has base $e \approx 2.71828$

(x → number)

~~***~~ IMP

$$\log_K(x) = a \rightleftharpoons \text{digits of } a = \lceil \log_b(x) + 1 \rceil$$

eg.-

$\log_2(123) = 1111011$ (7 digits)

$\lceil \log_2(123) + 1 \rceil = 7$

MATHS CHEET SHEET

* SUM

$$\sum_{x=1}^{n} x = 1+2+3+\dots+n = \frac{n(n+1)}{2}$$

$$\sum_{x=1}^{n} x^2 = 1^2+2^2+3^2+\dots+n^2 = \frac{n(n+1)(2n+1)}{6}$$

* AP

$$\underbrace{a+\dots+b}_{n\text{-numbers}} = \frac{n(a+b)}{2}$$

e.g. 3, 7, 11, 15

$$3+7+11+15 = \frac{4\cdot(3+15)}{2} = 36$$

* GP

$$a+ak+ak^2+\dots+b = \frac{bk-a}{k-1}$$

e.g. 3, 6, 12, 24

$$3+6+12+24 = \frac{24\cdot 2-3}{2-1} = 45$$

Sp. case

$$\underbrace{1+2+4+8+\dots+2^{n-1}}_{n} = 2^n-1$$

* Harmonic Sum:

$$\sum_{x=1}^{n} \frac{1}{x} = 1+\frac{1}{2}+\frac{1}{3}+\dots+\frac{1}{n}$$

$$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6} \le 1+\frac{1}{2}+\frac{1}{2}+\frac{1}{4}+\frac{1}{4}+\frac{1}{4}$$

* Factorial:

$$\prod_{x=1}^{n} x = 1\cdot 2\cdot 3\cdot\dots\cdot n \quad \text{or} \quad 0! = 1,\ n! = n\cdot(n-1)!$$

* Fibonacci:

$f(0) = 0$

$f(1) = 1$

$f(n) = f(n-1)+f(n-2)$

$$f(n) = \frac{(1+\sqrt{5})^n - (1-\sqrt{5})^n}{2^n\sqrt{5}}$$