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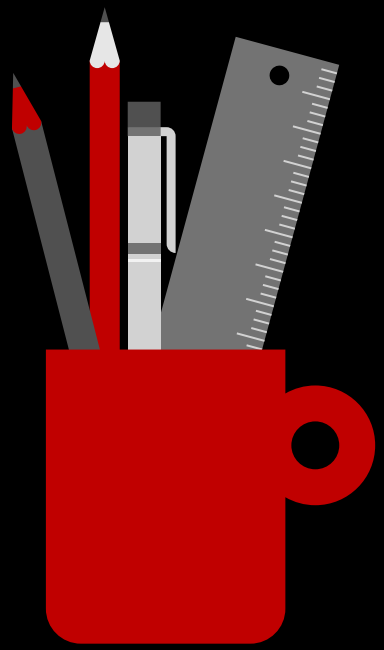

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i) $\log_a mn = \log_a m + \log_a n$

Let $\log_a m = x$, $\log_a n = y$

$a^x = m$, $a^y = n$

$m \cdot n = a^x \cdot a^y$

$mn = a^{x+y}$

$\log_a mn = x + y$

$$\boxed{\log_a mn = \log_a m + \log_a n}$$

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ii) $\log_a \frac{m}{n} = \log_a m - \log_a n$

Let $\log_a m = x$, $\log_a n = y$

$a^x = m$, $a^y = n$

$\frac{m}{n} = \frac{a^x}{a^y}$

$\frac{m}{n} = a^{x-y}$

$\log_a \frac{m}{n} = x - y$

$\boxed{\log_a \frac{m}{n} = \log_a m - \log_a n}$

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3) $\log_a m^n = n \log_a m$

Let $\log_a m = x$

$a^x = m$

$m^n = a^{nx}$

$\log_a m^n = nx$

$\log_a m^n = n \log_a m$

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4) $\log_a n = \log_b n \times \log_a b$ or $\dfrac{\log_b n}{\log_b a}$

Let $\log_b n = x$

$b^x = n$

taking log of both sides

$\log_a b^x = \log_a n$

$x \cdot \log_a b = \log_a n$

$$\boxed{\log_a n = \log_b n \times \log_a b}$$

put $n = a$

$\log_a a = \log_b a \times \log_a b$

$1 = \log_b a \times \log_a b$

$\log_a b = \dfrac{1}{\log_b a}$

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$$\log_a b = \frac{1}{\log_b a}$$

$$\therefore \log_a n = \log_b n \times \log_a b$$

$$\therefore \log_a b = \frac{\log_a n}{\log_b n}$$

$$\frac{\log_a n}{\log_b n} = \frac{1}{\log_b a}$$

$$\boxed{\log_a n = \frac{\log_b n}{\log_b a}}$$