Formulae for Mathematics 1 and 2

Logarithms

$$\ln(ab) = \ln a + \ln b$$

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

$$\ln a^n = n \ln a$$

$$\log_a b = \frac{\ln b}{\ln a}$$

Binomial theorem

$$(a+x)^n = a^n + na^{n-1}x + \frac{n(n-1)}{2!}a^{n-2}x^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}x^3 + \ldots$$

Trigonometric identities

$$\sin^2 x + \cos^2 x = 1$$

$$\tan^2 x + 1 = \sec^2 x$$

$$1 + \cot^2 x = \operatorname{cosec}^2 x$$

$$\sin(x+y) = \sin x \cos y + \cos x \sin y$$

$$\sin(x-y) = \sin x \cos y - \cos x \sin y$$

$$\cos(x+y) = \cos x \cos y - \sin x \sin y$$

$$\cos(x-y) = \cos x \cos y + \sin x \sin y$$

$$\sin 2x = 2 \sin x \cos x$$

$$\cos 2x = \cos^2 x - \sin^2 x$$

Circle sectors and segments

$$s = r\theta$$

$$A_{\text{sa}} = \tfrac{1}{2}rs = \tfrac{1}{2}r^2\theta$$

$$A_{\text{sm}} = \tfrac{1}{2}r^2(\theta - \sin\theta)$$

General sine equations

$$y = A\sin(\omega t - \alpha)$$

$$y = A\sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$$

Matrix inverse

$$A^{-1} = \frac{\text{Adjoint}(A)}{|A|}$$

Differentiation rules

$$\frac{d}{dx}(f(x)g(x)) = f'(x)g(x) + f(x)g'(x)$$

$$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$$

$$\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$$

$$\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$$

Newton-Raphson iteration

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

Parametric differentiation

$$\frac{dy}{dx} = \frac{dy}{dt}\frac{dt}{dx}$$

$$\frac{d^2y}{dx^2} = \left[\frac{d}{dt}\left(\frac{dy}{dx}\right)\right]\frac{dt}{dx}$$

Areas and volumes

$$A = \int y dx \quad \text{and} \quad V = \pi \int y^2 dx$$

Integration by parts

$$\int u dv = uv - \int v du$$

$$\int uv' dx = uv - \int u'v dx$$

Partial fractions

$$\frac{\ldots}{(x+1)(x-3)} = \frac{A}{x+1} + \frac{B}{x-3}$$

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

$$\frac{\ldots}{(x^2+1)(x^2+3)} = \frac{Ax+B}{x^2+1} + \frac{Cx+D}{x^2+3}$$

Hyperbolic functions

$$\sinh x = \frac{1}{2}(e^x - e^{-x})$$

$$\cosh x = \frac{1}{2}(e^x + e^{-x})$$

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E Durkheim

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