

FORMULA SHEET

Some identities

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

$$\sin(2x) = 2 \sin(x) \cos(x)$$

$$\cos^2(x) = \frac{1 + \cos(2x)}{2}$$

$$\sin^2(x) = \frac{1 - \cos(2x)}{2}$$

$$\cosh^2(x) - \sinh^2(x) = 1$$

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

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

Inverse Trigonometric Integral Identities

$$\int \frac{du}{\sqrt{a^2 - u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + C, \quad u^2 < a^2$$

$$\int \frac{du}{a^2 + u^2} = \frac{1}{a} \tan^{-1}\left(\frac{u}{a}\right) + C$$

$$\int \frac{du}{u\sqrt{u^2 - a^2}} = \frac{1}{a} \sec^{-1}\left|\frac{u}{a}\right| + C, \quad u^2 > a^2$$

Inverse Hyperbolic-Trig Integral Identities

$$\int \frac{du}{\sqrt{a^2 + u^2}} = \sinh^{-1}\left(\frac{u}{a}\right) + C, \quad a > 0$$

$$\int \frac{du}{\sqrt{u^2 - a^2}} = \cosh^{-1}\left(\frac{u}{a}\right) + C, \quad u > a > 0$$

$$\int \frac{du}{a^2 - u^2} = \frac{1}{a} \tanh^{-1}\left(\frac{u}{a}\right) + C, \quad \text{if } u^2 < a^2$$

$$\int \frac{du}{a^2 - u^2} = \frac{1}{a} \coth^{-1}\left(\frac{u}{a}\right) + C, \quad \text{if } u^2 > a^2$$

$$\int \frac{du}{u\sqrt{a^2 - u^2}} = -\frac{1}{a} \operatorname{sech}^{-1}\left(\frac{u}{a}\right) + C, \quad 0 < u < a$$

$$\int \frac{du}{u\sqrt{a^2 + u^2}} = -\frac{1}{a} \operatorname{csch}^{-1}\left|\frac{u}{a}\right| + C, \quad u \neq 0$$

Moments, Mass and Center of Mass of a Thin Rod along x-axis

$$\text{Mass: } M = \int_a^b \delta(x) dx$$

$$\text{Moments: } M_O = \int_a^b x \delta(x) dx$$

$$\text{Center of Mass: } \bar{x} = M_O/M$$

Moments, Mass and Center of Mass of a Thin Plate

$$\text{Mass: } M = \int dm,$$

$$\text{Moments: } M_x = \int \tilde{y} dm, \quad M_y = \int \tilde{x} dm$$

$$\text{Center of Mass: } \bar{x} = M_y/M, \quad \bar{y} = M_x/M$$