# MATH 277 OFFICIAL FORMULA SHEET

## A: BASIC INTEGRALS

Let $r, a, b \in \mathbb{R}$ , $r \neq -1$ , and $a \neq 0$.

1. $\int (ax+b)^r \, dx = \dfrac{(ax+b)^{r+1}}{a(r+1)} + C$ 2. $\int \dfrac{1}{ax+b} \, dx = \frac{1}{a} \ln|ax+b| + C$ 3. $\int e^{ax} \, dx = \frac{1}{a} e^{ax} + C$

4. $\int \sin(ax) \, dx = -\frac{1}{a} \cos(ax) + C$ 5. $\int \cos(ax) \, dx = \frac{1}{a} \sin(ax) + C$

## B: BASIC TRIGONOMETRIC IDENTITIES

$(i)$ $\tan(\theta) = \dfrac{\sin(\theta)}{\cos(\theta)}$ $(ii)$ $\cot(\theta) = \dfrac{\cos(\theta)}{\sin(\theta)}$ $(iii)$ $\sec(\theta) = \dfrac{1}{\cos(\theta)}$ $(iv)$ $\csc(\theta) = \dfrac{1}{\sin(\theta)}$

$(v)$ $\cos^2(\theta) + \sin^2(\theta) = 1$ $(vi)$ $1 + \tan^2(\theta) = \sec^2(\theta)$ $(vii)$ $\cot^2(\theta) + 1 = \csc^2(\theta)$

$(viii)$ $\sin(2\theta) = 2\sin(\theta)\cos(\theta)$ $(ix)$ $\cos(2\theta) = 2\cos^2(\theta) - 1$ $(x)$ $\cos(2\theta) = 1 - 2\sin^2(\theta)$

## C: BASIC HYPERBOLIC IDENTITIES

$(i)$ $\tanh(x) = \dfrac{\sinh(x)}{\cosh(x)}$ $(ii)$ $\coth(x) = \dfrac{\cosh(x)}{\sinh(x)}$ $(iii)$ $\operatorname{sech}(x) = \dfrac{1}{\cosh(x)}$ $(iv)$ $\operatorname{csch}(x) = \dfrac{1}{\sinh(x)}$

$(v)$ $\cosh^2(x) - \sinh^2(x) = 1$ $(vi)$ $1 - \tanh^2(\theta) = \operatorname{sech}^2(\theta)$ $(vii)$ $\coth^2(\theta) - 1 = \operatorname{csch}^2(\theta)$

## D: Special Values

$(i)$ $\cos(0) = 1$ $(ii)$ $\cos(\frac{\pi}{4}) = \dfrac{1}{\sqrt{2}}$ $(iii)$ $\cos(\frac{\pi}{2}) = 0$ $(iv)$ $\cos(\pi) = -1$

$(v)$ $\sin(0) = 0$ $(vi)$ $\sin(\frac{\pi}{4}) = \dfrac{1}{\sqrt{2}}$ $(vii)$ $\sin(\frac{\pi}{2}) = 1$ $(viii)$ $\sin(\pi) = 0$

## E : Other Formulae

Let $\vec{\mathbf{v}}(t)$ , $\vec{\mathbf{a}}(t)$ and $\mathbf{v}$ be respectively **velocity** , **acceleration** and **speed** of a moving object in three space.

The unit Tangent $\vec{\mathbf{T}}$ , the Principal unit Normal $\vec{\mathbf{N}}$ , the unit Binormal $\vec{\mathbf{B}}$ , the curvature $\boldsymbol{\kappa}$ , the radius of curvature $\boldsymbol{\rho}$ and the Torsion $\boldsymbol{\tau}$ are given by :

$(i)$ $\vec{\mathbf{T}} = \dfrac{\vec{\mathbf{v}}(t)}{\mathbf{v}}$ $(ii)$ $\vec{\mathbf{N}} = \vec{\mathbf{B}} \times \vec{\mathbf{T}}$ $(iii)$ $\vec{\mathbf{B}} = \dfrac{\vec{\mathbf{v}}(t) \times \vec{\mathbf{a}}(t)}{\| \vec{\mathbf{v}}(t) \times \vec{\mathbf{a}}(t) \|}$ $(iv)$ $\boldsymbol{\kappa} = \dfrac{\| \vec{\mathbf{v}}(t) \times \vec{\mathbf{a}}(t) \|}{\mathbf{v}^3}$

$(v)$ $\boldsymbol{\rho} = \dfrac{1}{\boldsymbol{\kappa}}$ $(vi)$ $\boldsymbol{\tau} = \dfrac{\left[ \vec{\mathbf{v}}(t) \times \vec{\mathbf{a}}(t) \right] \cdot \frac{d\vec{a}(t)}{dt}}{\| \vec{\mathbf{v}}(t) \times \vec{\mathbf{a}}(t) \|^2}$ $(vii)$ $a_{\mathbf{T}} = \dfrac{d\mathbf{v}}{dt}$ **or** $\dfrac{\vec{\mathbf{v}}(t) \cdot \vec{\mathbf{a}}(t)}{\mathbf{v}}$ $(viii)$ $a_{\mathbf{N}} = \boldsymbol{\kappa}\, \mathbf{v}^2$