

# MATHEMATICS 31

## Formula Sheet

### TRIGONOMETRY

#### Function of single angle

$$\sin \theta = \frac{1}{\csc \theta} \quad \csc \theta = \frac{1}{\sin \theta}$$

$$\cos \theta = \frac{1}{\sec \theta} \quad \sec \theta = \frac{1}{\cos \theta}$$

$$\tan \theta = \frac{1}{\cot \theta} \quad \cot \theta = \frac{1}{\tan \theta}$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta} \quad \cot \theta = \frac{\cos \theta}{\sin \theta}$$

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

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

$$1 + \cot^2 \theta = \csc^2 \theta$$

#### Derivatives of the Trigonometric Functions

$$\frac{d}{dx} \sin x = \cos x \quad \frac{d}{dx} \csc x = -\csc x \cot x$$

$$\frac{d}{dx} \cos x = -\sin x \quad \frac{d}{dx} \sec x = \sec x \tan x$$

$$\frac{d}{dx} \tan x = \sec^2 x \quad \frac{d}{dx} \cot x = -\csc^2 x$$

#### Limits

$$\lim_{\theta \rightarrow 0} \sin \theta = 0$$

$$\lim_{\theta \rightarrow 0} \cos \theta = 1$$

$$\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1$$

$$\lim_{\theta \rightarrow 0} \frac{\theta}{\sin \theta} = 1$$

$$\lim_{\theta \rightarrow 0} \frac{\cos \theta - 1}{\theta} = 0$$

$$\lim_{\theta \rightarrow 0} \frac{1 - \cos \theta}{\theta} = 0$$

## APPLICATIONS OF DERIVATIVES

| SOLIDS                             | SURFACE AREA                                                                               | VOLUME                     |
|------------------------------------|--------------------------------------------------------------------------------------------|----------------------------|
| Sphere                             | $SA = 4\pi r^2$                                                                            | $V = \frac{4}{3}\pi r^3$   |
| Cube                               | $SA = 6s^2$                                                                                | $V = s^3$                  |
| Rectangular solid with square base | $SA = 2x^2 + 4xy$                                                                          | $V = x^2y$                 |
| Right-circle cylinder              | $SA = 2\pi r^2 + 2\pi rh$                                                                  | $V = \pi r^2 h$            |
| Right-circle cone                  | lateral area: $A = \pi rs$<br>total area: $SA = \pi r^2 + \pi rs$<br>( $s$ = slant height) | $V = \frac{1}{3}\pi r^2 h$ |

## EXPONENTIAL AND LOGARITHMIC FUNCTIONS

$$\frac{d}{dx} e^x = e^x$$
$$\frac{d}{dx} \ln x = \frac{1}{x}$$
$$\frac{d}{dx} b^x = b^x \ln x$$

## INTEGRATION

$$\int \sin kx \, dx = \frac{-\cos kx}{k} + C$$

$$\int \cos kx \, dx = \frac{\sin kx}{k} + C$$

$$\int \sec^2 kx \, dx = \frac{\tan kx}{k} + C$$

$$\int \csc x \cot x \, dx = -\csc x + C$$

$$\int \sec x \tan x \, dx = \sec x + C$$

$$\int \csc^2 x \, dx = -\cot x + C$$

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