

## SPECIALIST MATHEMATICS FORMULA SHEET

### Circular functions

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

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

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

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

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

$$= 2 \cos^2 A - 1$$

$$= 1 - 2 \sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

$$2 \sin A \cos B = \sin(A + B) + \sin(A - B)$$

$$2 \cos A \cos B = \cos(A + B) + \cos(A - B)$$

$$2 \sin A \sin B = \cos(A - B) - \cos(A + B)$$

$$\sin A \pm \sin B = 2 \sin \frac{1}{2}(A \pm B) \cos \frac{1}{2}(A \mp B)$$

$$\cos A + \cos B = 2 \cos \frac{1}{2}(A + B) \cos \frac{1}{2}(A - B)$$

$$\cos A - \cos B = -2 \sin \frac{1}{2}(A + B) \sin \frac{1}{2}(A - B)$$

### Matrices and determinants

If  $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  then  $\det A = |A| = ad - bc$  and

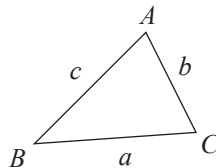
$$A^{-1} = \frac{1}{|A|} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}.$$

### Measurement

Area of sector,  $A = \frac{1}{2} r^2 \theta$ , where  $\theta$  is in radians.

Arc length,  $l = r\theta$ , where  $\theta$  is in radians.

In any triangle  $ABC$ :



$$\text{Area of triangle} = \frac{1}{2} ab \sin C$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

### Quadratic equations

$$\text{If } ax^2 + bx + c = 0 \text{ then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

### Distance from a point to a plane

The distance from  $(x_1, y_1, z_1)$  to

$Ax + By + Cz + D = 0$  is given by

$$\frac{|Ax_1 + By_1 + Cz_1 + D|}{\sqrt{A^2 + B^2 + C^2}}.$$

### Derivatives

$f(x) = y$	$f'(x) = \frac{dy}{dx}$
$\arcsin x$	$\frac{1}{\sqrt{1-x^2}}$
$\arccos x$	$\frac{-1}{\sqrt{1-x^2}}$
$\arctan x$	$\frac{1}{1+x^2}$

### Properties of derivatives

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

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

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

### Arc length along a parametric curve

$$l = \int_a^b \sqrt{\mathbf{v} \cdot \mathbf{v}} dt, \text{ where } a \leq t \leq b.$$

### Integration by parts

$$\int f'(x)g(x) dx = f(x)g(x) - \int f(x)g'(x) dx$$

### Volumes of revolution

About  $x$  axis,  $V = \int_a^b \pi y^2 dx$ , where  $y$  is a function of  $x$ .

About  $y$  axis,  $V = \int_c^d \pi x^2 dy$ , where  $y$  is a one-to-one function of  $x$ .