



Government of **Western Australia**  
School Curriculum and Standards Authority



# **MATHEMATICS: SPECIALIST**

## **UNITS 3A AND 3B**

### **FORMULA SHEET**

### **2013**

Copyright  
© School Curriculum and Standards Authority, 2013

This document—apart from any third party copyright material contained in it—may be freely copied, or communicated on an intranet, for non-commercial purposes by educational institutions, provided that it is not changed in any way and that the School Curriculum and Standards Authority is acknowledged as the copyright owner.

Copying or communication for any other purpose can be done only within the terms of the Copyright Act or by permission of the Authority.

Copying or communication of any third party copyright material contained in this document can be done only within the terms of the Copyright Act or by permission of the copyright owners.

This document is valid for teaching and examining until 31 December 2013.

**Vectors**

---

Magnitude:	$ (a_1, a_2)  = \sqrt{a_1^2 + a_2^2}$
Dot product:	$\mathbf{a} \cdot \mathbf{b} =  \mathbf{a}  \mathbf{b}  \cos \theta = a_1 b_1 + a_2 b_2$
Triangle inequality:	$ \mathbf{a} + \mathbf{b}  \leq  \mathbf{a}  +  \mathbf{b} $
Vector equation of a line in the plane:	
one point and the slope:	$\mathbf{r} = \mathbf{r}_1 + \lambda \mathbf{l}$
two points:	$\mathbf{r} = \mathbf{r}_1 + \lambda(\mathbf{r}_2 - \mathbf{r}_1)$
normal:	$\mathbf{r} \cdot \mathbf{n} = c$
Vector equation of a circle in the plane:	$ \mathbf{r} - \mathbf{d}  = \rho$

**Trigonometry**

---

In any triangle $ABC$ :	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
	$a^2 = b^2 + c^2 - 2bc \cos A$
	$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$
	$\text{Area} = \frac{1}{2} ab \sin C$

In a circle of radius  $r$ , for an arc subtending angle  $\theta$  (radians) at the centre:

$$\begin{aligned} \text{Length of arc} &= r\theta \\ \text{Area of segment} &= \frac{1}{2} r^2 (\theta - \sin \theta) \\ \text{Area of sector} &= \frac{1}{2} r^2 \theta \end{aligned}$$

Identities:	$\cos^2 \theta + \sin^2 \theta = 1$
	$\cos(\theta \pm \varphi) = \cos \theta \cos \varphi \mp \sin \theta \sin \varphi$
	$\sin(\theta \pm \varphi) = \sin \theta \cos \varphi \pm \cos \theta \sin \varphi$
	$\tan(\theta \pm \varphi) = \frac{\tan \theta \pm \tan \varphi}{1 \mp \tan \theta \tan \varphi}$
	$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$
	$\quad = 2\cos^2 \theta - 1$
	$\quad = 1 - 2\sin^2 \theta$
	$\sin 2\theta = 2 \sin \theta \cos \theta$
	$\tan 2\theta = \frac{2 \tan \theta}{1 - \tan^2 \theta}$

**See next page**

**Exponentials and logarithms**

---

For  $a, b > 0$  and  $m, n$  real:

$$\begin{aligned} a^m a^n &= a^{m+n} & \frac{a^m}{a^n} &= a^{m-n} \\ a^0 &= 1 & a^{-n} &= \frac{1}{a^n} \\ (a^m)^n &= a^{mn} & (ab)^m &= a^m b^m \end{aligned}$$

For  $a > 0$  and  $m$  an integer and  $n$  a positive integer:

$$a^{\frac{1}{n}} = \sqrt[n]{a} \qquad a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$$

For  $a, y, m, n$  positive and real and  $k$  real:

$$\begin{aligned} 1 &= a^0 \Leftrightarrow \log_a 1 = 0 & y &= a^x \Leftrightarrow \log_a y = x \\ \log_a (mn) &= \log_a m + \log_a n & a &= a^1 \Leftrightarrow \log_a a = 1 \\ \log_a (m^k) & & \log_a (m^k) &= k \log_a m \end{aligned}$$

**Measurement**

---

Circle:  $C = 2\pi r = \pi D$ , where  $C$  is the circumference,  $r$  is the radius and  $D$  is the diameter  
 $A = \pi r^2$ , where  $A$  is the area

Triangle:  $A = \frac{1}{2}bh$ , where  $b$  is the base and  $h$  is the perpendicular height

Parallelogram:  $A = bh$

Trapezium:  $A = \frac{1}{2}(a+b)h$ , where  $a$  and  $b$  are the lengths of the parallel sides

Prism:  $V = Ah$ , where  $V$  is the volume,  $A$  is the area of the base

Pyramid:  $V = \frac{1}{3}Ah$

Cylinder:  $S = 2\pi rh + 2\pi r^2$ , where  $S$  is the total surface area  
 $V = \pi r^2 h$

Cone:  $S = \pi rs + \pi r^2$ , where  $s$  is the slant height  
 $V = \frac{1}{3}\pi r^2 h$

Sphere:  $S = 4\pi r^2$   
 $V = \frac{4}{3}\pi r^3$

See next page

**Functions**

---

Differentiation: If  $f(x) = y$  then  $f'(x) = \frac{dy}{dx}$

If  $f(x) = x^n$  then  $f'(x) = nx^{n-1}$

If  $f(x) = e^x$  then  $f'(x) = e^x$

If  $f(x) = \ln x$  then  $f'(x) = \frac{1}{x}$

Product rule: If  $y = f(x) g(x)$   
then  $y' = f'(x) g(x) + f(x) g'(x)$

or If  $y = uv$   
then  $\frac{dy}{dx} = \frac{du}{dx} v + u \frac{dv}{dx}$

Quotient rule: If  $y = \frac{f(x)}{g(x)}$   
then  $y' = \frac{f'(x) g(x) - f(x) g'(x)}{(g(x))^2}$

or If  $y = \frac{u}{v}$   
then  $\frac{dy}{dx} = \frac{\frac{du}{dx} v - u \frac{dv}{dx}}{v^2}$

Chain rule: If  $y = f(g(x))$   
then  $y' = f'(g(x)) g'(x)$

or If  $y = f(u)$  and  $u = g(x)$   
then  $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

Quadratic function: If  $y = ax^2 + bx + c$  and  $y = 0$  then  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  for  $x \in \mathbb{C}$

Piecewise-defined functions:

Absolute value function:  $|x| = \begin{cases} x, & \text{for } x \geq 0 \\ -x, & \text{for } x < 0 \end{cases}$

Sign function:  $\text{sgn}(x) = \begin{cases} 1, & \text{for } x > 0 \\ 0, & \text{for } x = 0 \\ -1, & \text{for } x < 0 \end{cases}$

Greatest integer function:  $\text{int}(x) = \text{greatest integer } \leq x$  for all  $x$

*Note: Any additional formulas identified by the examination panel as necessary will be included in the body of the particular question.*