



# **MATHEMATICS METHODS**

## **Unit 1 and Unit 2**

### **Formula Sheet**

*(For use with Year 11 examinations and response tasks)*

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This document is valid for teaching and examining from 1 July 2015.

## 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 and  $A$  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  
 $V = \pi r^2h$

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

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

## Functions and graphs

### Lines and Linear relationships

For points  $P(x_1, y_1)$  and  $Q(x_2, y_2)$

Mid-point of  $P$  and  $Q$  : 
$$M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Gradient of the line through  $P$  and  $Q$  : 
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Equation of the line through  $P$  with slope  $m$ : 
$$y - y_1 = m(x - x_1)$$

Parallel lines: 
$$m_1 = m_2$$

Perpendicular lines: 
$$m_1 m_2 = -1$$

General equation of a line: 
$$ax + by + c = 0 \text{ or } y = mx + c$$

### Quadratic relationships

For the general quadratic equation  $ax^2 + bx + c = 0$ ,  $a \neq 0$

Completing the square: 
$$ax^2 + bx + c = a \left( x + \frac{b}{2a} \right)^2 + \left( c - \frac{b^2}{4a} \right)$$

Discriminant: 
$$\Delta = b^2 - 4ac$$

Quadratic formula: 
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Graphs and Relations

Equation of a circle: 
$$(x - a)^2 + (y - b)^2 = r^2$$
  
where,  $(a, b)$  is the centre and  $r$  is the radius

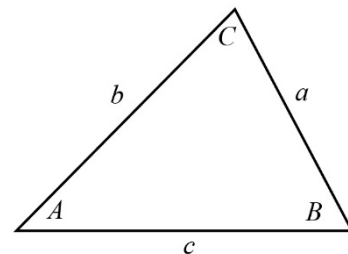
## Trigonometric functions

### Cosine and sine rules

For any triangle  $ABC$  with corresponding length of sides  $a, b, c$

Cosine rule: 
$$c^2 = a^2 + b^2 - 2ab \cos C$$

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



Area of  $\Delta$ : 
$$A = \frac{1}{2} ab \sin C$$

$$A = \sqrt{s(s-a)(s-b)(s-c)} \text{ where } s = \frac{1}{2}(a+b+c)$$

Circular measure and radian measure

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

Length of arc:	$\ell = r\theta$	Length of chord:	$l = 2r \sin \frac{1}{2}\theta$
Area of sector:	$A = \frac{1}{2}r^2\theta$	Area of segments:	$A = \frac{1}{2}r^2(\theta - \sin \theta)$

Trigonometric functions: (fundamentals)

$\sin(-\theta) = -\sin \theta$	$\cos(-\theta) = \cos \theta$	$\tan(-\theta) = -\tan \theta$
$\sin\left(\theta + \frac{\pi}{2}\right) = \cos \theta$	$\cos\left(\theta - \frac{\pi}{2}\right) = \sin \theta$	$\sin^2 \theta + \cos^2 \theta = 1$

Angle sum and difference identities

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

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

**Counting and probability**

Combinations

Number of combinations:  $\binom{n}{r} = \frac{n!}{r!(n-r)!}$   
(of  $r$  objects taken from a set of  $n$  distinct objects)

Binomial expansion:  $(x + y)^n = x^n + \binom{n}{1}x^{n-1}y + \dots + \binom{n}{r}x^{n-r}y^r + \dots + y^n$

Binomial coefficients:  $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n \times (n-1) \times \dots \times (n-r+1)}{r \times (r-1) \times \dots \times 2 \times 1}$

Probability

Fundamentals of probability:

$$P(\text{complement of } A) = P(\bar{A}) = 1 - P(A)$$

$$P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \text{ and } B) = P(A \cap B) = P(A)P(B/A)$$

$$= P(B)P(A/B)$$

Conditional probability:

$$P(B/A) = \frac{P(A \cap B)}{P(A)} \text{ for } P(A) \neq 0$$

## Exponential functions

Index laws:

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

$$a^m b^m = (ab)^m$$

$$a^m a^n = a^{m+n}$$

$$(a^m)^n = a^{mn}$$

$$a^{-m} = \frac{1}{a^m}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$a^0 = 1$$

For  $a > 0$ ,  $m$  an integer and  $n$  a positive integer,  $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$

## Arithmetic and geometric sequences and series

Arithmetic sequences

For initial term  $a$  and common difference  $d$ :  $T_n = a + (n-1)d, n \geq 1$

$$T_{n+1} = T_n + d, \text{ where } T_1 = a$$

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

Geometric sequences

For initial term  $a$  and common ratio  $r$ :

$$T_{n+1} = rT_n, \text{ where } T_1 = a$$

$$T_n = ar^{n-1}, n \geq 1$$

$$S_n = \frac{a(1-r^n)}{1-r}$$

$$S_\infty = \frac{a}{1-r}, |r| < 1$$

## Introduction to differential calculus

Rates of change

Difference quotient: 
$$\frac{\delta y}{\delta x} = \frac{f(x+h) - f(x)}{h}$$

Derivative (concept): 
$$\frac{dy}{dx} = f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

Computation of derivatives: 
$$\frac{d}{dx}(x^n) = nx^{n-1}.$$

Anti-derivatives: 
$$\text{If } f'(x) = ax^n \text{ then } f(x) = \frac{ax^{n+1}}{n+1} + c(\text{constant}), n \neq -1$$

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