Government of Western Australia
School Curriculum and Standards Authority

MATHEMATICS METHODS

Unit 1 and Unit 2

Formula Sheet

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

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Disclaimer

Any resources such as texts, websites and so on that may be referred to in this document are provided as examples of resources that teachers can use to support their learning programs. Their inclusion does not imply that they are mandatory or that they are the only resources relevant to the course. Teachers must exercise their professional judgement as to the appropriateness of any they may wish to use.

This document is valid for teaching and examining from 1 January 2024.

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

$V = \pi r^2 h$

Cone: $S = \pi rs + \pi r^2$, where s is the slant height

$V = \frac{1}{3} \pi r^2 h$

Sphere: $S = 4\pi r^2$

$V = \frac{4}{3} \pi r^3$

Functions and graphs

Lines and Linear relationships

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

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: $ax + by + c = 0$ 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

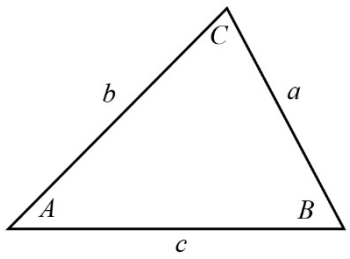
Equation of a circle: $(x - a)^2 + (y - b)^2 = r^2$

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: $c^2 = a^2 + b^2 - 2ab\ cosC$

Sine rule: $\frac{a}{sinA} = \frac{b}{sinB} = \frac{c}{sinC}$

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

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

Circular measure and radian measure

In a circle of radius r, for an arc subtending angle θ (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 identites $\sin(A \pm B) = \sin A\ \cos B \pm \cos A\ \sin B$

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

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

Binomial coefficients: $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n\times(n-1)\times\cdots\times(n-r+1)}{r\times(r-1)\times\cdots\times2\times1}$

Probability

Fundamentals of probability:

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

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

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

$= P(B)P(A|B)$

Conditional probability:

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

Exponential functions

Index laws:

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

$$a^m b^m = (ab)^m \qquad a^m a^n = a^{m+n} \qquad (a^m)^n = a^{mn}$$

$$a^{-m} = \frac{1}{a^m} \qquad \frac{a^m}{a^n} = a^{m-n} \qquad a^0 = 1$$

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

Arithmetic and geometric sequences and series

Arithmetic sequences

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

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

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

Geometric sequences

For initial term a and common ratio r: $T_{n+1} = rT_n, where\ T_1 = a$

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

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

Introduction to differential calculus

Rates of change

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

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

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

Anti-derivatives: If $f'(x) = ax^n$ 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.