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

WACE
Western Australian Certificate of Education

MATHEMATICS

METHODS

SAMPLE FORMULA SHEET
2016

This document is valid for teaching and examining until 31 December 2016.

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

Exponentials

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

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

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

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

Logarithims

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

$1 = a^0 \Leftrightarrow \log_a 1 = 0$ $\qquad$ $y = a^x \Leftrightarrow \log_a y = x$

$\log_a mn = \log_a m + \log_a n$ $\qquad$ $a = a^1 \Leftrightarrow \log_a a = 1$

$\log_e x = \ln x$ $\qquad$ $\log_a(m^k) = k \log_a m$

Calculus

Differentiation:

If $f(x) = y$ then $f'(x) = \dfrac{dy}{dx}$ $\qquad$ If $f(x) = \ln x$ then $f'(x) = \dfrac{1}{x}$

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

If $f(x) = e^x$ then $f'(x) = e^x$ $\qquad$ If $f(x) = \cos x$ then $f'(x) = -\sin x$

Product rule:

If $y = f(x)\, g(x)$ then $y' = f'(x)\, g(x) + f(x)\, g'(x)$

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

Quotient rule:

If $y = \dfrac{f(x)}{g(x)}$ then $y' = \dfrac{f'(x)\, g(x) - f(x)\, g'(x)}{(g(x))^2}$

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

Chain rule:

If $y = f(g(x))$ then $y' = f'(g(x))\, g'(x)$

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

Powers: $\displaystyle\int x^n dx = \frac{x^{n+1}}{n+1} + c,\ n \neq -1$

Exponentials: $\displaystyle\int e^x dx = e^x + c$

Natural logarithm: $\displaystyle\int \frac{1}{x}\, dx = \ln |x| + c$ and $\displaystyle\int \frac{f'(x)}{fx}\, dx = \ln (f(x)) + c$

Trigonometry: $\displaystyle\int \sin x\, dx = -\cos x + c$ and $\displaystyle\int \cos x\, dx = \sin x + c$

Fundamental Theorem of Calculus: $\dfrac{d}{dx}\left(\int_a^x f(t)\, dt\right) = f(x)$ and $\int_a^b f'(x)\, dx = f(b) - f(a)$

Incremental formula: $\delta y \simeq \dfrac{dy}{dx}\, \delta x$

Exponential growth and decay: If $\dfrac{dy}{dt} = ky$, then $y = Ae^{kt}$

See next page

Random variables, distributions, pobability and proportions

Probability: For any event A and its complement A, and event B

$P(A) + P(\bar{A}) = 1$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A \cap B) = P(A)\, P(B|A) = P(B)\, P(A|B)$

In a Bernoulli trial: $\bar{x}$ is the sample proportion $\hat{p}$,

Mean $\mu = p$ and standard deviation $\sigma = \sqrt{p(1-p)}$

In a binomial distribution:

$$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$$

Mean $\mu = np$ and standard deviation $\sigma = \sqrt{np(1-p)}$

Expected value: If X is a discrete random variable,

$E(x) = \sum i p_i x_i$, where x_i are the possible values of X and $p_i = P(X = x_i)$

If X is a continuous random variable,

$E(x) = \int_{-\infty}^{\infty} xp(x)dx$, where $p(x)$ is the probability density function of X.

Variance: If X is a discrete random variable,

$Var(x) = \sum i\, p_i\, (x_i - \mu)^2$, where $\mu = E(X)$ is the expected value

If X is a continuous random variable,

$Var(x) = \int_{-\infty}^{\infty} (x - \mu)^2\, p(x)dx.$

A confidence interval for the proportion, p, of a population is:

$$\left(\hat{p} - z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad , \quad \hat{p} + z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \right)$$

where $\hat{p}$ is the sample mean,

n is the sample size and

z is the cut-off value on the standard normal distribution corresponding to the confidence level.

Margin of error: $E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ is the half-width of the confidence interval

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