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

MATHEMATICS METHODS
ATAR COURSE

FORMULA SHEET

2021

Differentiation and integration

$\frac{d}{dx}x^n = nx^{n-1}$		$\int x^n dx = \frac{x^{n+1}}{n+1} + c, \quad n \neq -1$
$\frac{d}{dx}e^{ax-b} = ae^{ax-b}$		$\int e^{ax} dx = \frac{1}{a}e^{ax} + c$
$\frac{d}{dx}\ln x = \frac{1}{x}$		$\int \frac{1}{x} dx = \ln x + c, \quad x > 0$
$\frac{d}{dx}\ln f(x) = \frac{f'(x)}{f(x)}$		$\int \frac{f'(x)}{f(x)} dx = \ln f(x) + c, \quad f(x) > 0$
$\frac{d}{dx}\sin(ax-b) = a\cos(ax-b)$		$\int \sin(ax-b)\, dx = -\frac{1}{a}\cos(ax-b) + c$
$\frac{d}{dx}\cos(ax-b) = -a\sin(ax-b)$		$\int \cos(ax-b)\, dx = \frac{1}{a}\sin(ax-b) + c$
Product rule	If $y = uv$ then $\frac{d}{dx}(uv) = v\frac{du}{dx} + u\frac{dv}{dx}$ or	If $y = f(x)\,g(x)$ then $y' = f'(x)\,g(x) + f(x)\,g'(x)$
Quotient rule	If $y = \frac{u}{v}$ then $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ or	If $y = \frac{f(x)}{g(x)}$ then $y' = \frac{f'(x)\,g(x) - f(x)\,g'(x)}{(g(x))^2}$
Chain rule	If $y = f(u)$ and $u = g(x)$ then $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ or	If $y = f(g(x))$ then $y' = f'(g(x))\,g'(x)$
Fundamental theorem	$\frac{d}{dx}\left(\int_a^x f(t)\,dt\right) = f(x)$ and	$\int_a^b f'(x)\,dx = f(b) - f(a)$
Increments formula	$\delta y \approx \frac{dy}{dx} \times \delta x$	
Exponential growth and decay	$\frac{dP}{dt} = kP \Leftrightarrow P = P_0 e^{kt}$	

Mensuration

Parallelogram	$A = bh$
Triangle	$A = \frac{1}{2}bh$ or $A = \frac{1}{2}ab\sin C$
Trapezium	$A = \frac{1}{2}(a+b)h$
Circle	$A = \pi r^2$ and $C = 2\pi r = \pi d$

Prism	$V = Ah$, where A is the area of the cross section	
Pyramid	$V = \frac{1}{3}Ah$, where A is the area of the base	
Cylinder	$V = \pi r^2 h$	$TSA = 2\pi rh + 2\pi r^2$
Cone	$V = \frac{1}{3}\pi r^2 h$	$TSA = \pi rs + \pi r^2$, where s is the slant height
Sphere	$V = \frac{4}{3}\pi r^3$	$TSA = 4\pi r^2$

Trigonometry

$\sin^2 x + \cos^2 x = 1$	$\tan x = \frac{\sin x}{\cos x}$

Logarithms

$x = \log_a b \Leftrightarrow a^x = b$	$a^{\log_a b} = b$ and $\log_a(a^b) = b$
$\log_a mn = \log_a m + \log_a n$	$\log_a \frac{m}{n} = \log_a m - \log_a n$
$\log_a(m^k) = k\log_a m$	$\log_e x = \ln x$

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Probability

For any event A and its complement A'	$P(A') = 1 - P(A)$
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	$P(A\|B) = \frac{P(A \cap B)}{P(B)}$

Random variables and probability distributions	Mean	Variance
Bernoulli: mean is the sample proportion $\hat{p}$	$\mu = p$	$\sigma^2 = p\,(1-p)$
Binomial distribution: $P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$	$\mu = np$	$\sigma^2 = np\,(1-p)$
Discrete random variable: $P(X = x) = P(x)$	$\mu = E(X) = \sum x\,p(x)$	$\sigma^2 = \sum (x-\mu)^2 p(x)$
Continuous random variable: $P(a \le X \le b) = \int_a^b p(x)\,dx$		
Expected value: $\mu = E(X) = \int_{-\infty}^{\infty} x\,p(x)\,dx$	Variance: $\sigma^2 = \int_{-\infty}^{\infty} (x-\mu)^2 p(x)\,dx$	

Sample proportions	$\hat{p} = \frac{X}{n}$
Mean: $E(\hat{p}) = p$	Standard deviation: $\sigma = \sqrt{\frac{p(1-p)}{n}}$
Margin of error: $E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$	Confidence interval: $\hat{p} - z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \le p \le \hat{p} + z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

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

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303 Sevenoaks Street
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