**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 January 2024.

**Measurement**

Circle: *C* = 2*πr* = *π D*, where *C* is the circumference,

 *r* is the radius and *D* is the diameter

 *A* = *πr2*, 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 *πrh* + 2 *πr2*, where *S* is the total surface area

 *V* = *πr2h*

Cone: *S* = *πrs* + *πr2*, where *s* is the slant height

 *V* = $\frac{1}{3}$ *πr2h*

Sphere: *S* = 4*πr2*

 *V =* $\frac{4}{3}$ *πr3*

**Functions and graphs**

Lines and Linear relationships

For points $P\left(x\_{1},y\_{1}\right)$ and $Q\left(x\_{2},y\_{2}\right)$

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*: $y-y\_{1}=m\left(x-x\_{1}\right)$

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 $ax^{2}+bx+c=0, a\ne 0$

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

Discriminant:$Δ=b^{2}-4ac$

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

Graphs and Relations

Equation of a circle: $\left(x-a\right)^{2}+\left(y-b\right)^{2}=r^{2}$

 where, $\left(a,b\right)$ is the centre and 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 : $A=\frac{1}{2}ab\sin(C)$

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

Circular measure and radian measure

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

Length of arc: $l=rθ$ Length of chord: $l=2r\sin(\frac{1}{2})θ$ 

Area of sector: $A=\frac{1}{2}r^{2}θ$ Area of segments: $A=\frac{1}{2}r^{2}(θ-\sin(θ))$

Trigonometric functions: (fundamentals)

$\sin(\left(-θ\right))=-\sin(θ)$ $\cos(\left(-θ\right))=\cos(θ)$ $\tan(\left(-θ\right))=-\tan(θ)$

$\sin(\left(θ+\frac{π}{2}\right))=\cos(θ)$ $\cos(\left(θ-\frac{π}{2}\right))=\sin(θ)$ $sin^{2}θ+cos^{2}θ=1$

Angle sum and difference identites $\sin(\left(A\pm B\right))=\sin(A) \cos(B)\pm \cos(A) \sin(B)$

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

**Counting and probability**

Combinations

Number of combinations: $\left(\begin{matrix}n\\r\end{matrix}\right)$ $=\frac{n!}{r!\left(n-r\right)!}$

(of $r$ objects taken from a set of$ n$ distinct objects)

Binomial expansion: $\left(x+y\right)^{n}=x^{n}+\left(\begin{matrix}n\\1\end{matrix}\right)x^{n-1}y+\cdots +\left(\begin{matrix}n\\r\end{matrix}\right)x^{n-r}y^{r}+\cdots +y^{n}$

Binomial coefficients: $\left(\begin{matrix}n\\r\end{matrix}\right)=\frac{n!}{r!\left(n-r\right)!}=\frac{n×\left(n-1\right)×\cdots ×\left(n-r+1\right)}{r×\left(r-1\right)×\cdots ×2×1}$

Probability

Fundamentals of probability:

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

$P\left(A or B\right)$ $=P\left(A∪B\right)=P\left(A\right)+P\left(B\right)-P\left(A∩B\right)$

$P\left(A and B\right)$ $=P\left(A∩B\right)=P\left(A\right)P\left(B|A\right)$

 $ =P\left(B\right)P\left(A|B\right)$

Conditional probability:

$P\left(B|A\right)$ $=\frac{P\left(A∩B\right)}{P\left(A\right)} for P\left(A\right)\ne 0$

**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, $a^{\frac{m}{n}}=\sqrt[n]{a^{m}}=\left(\sqrt[n]{a}\right)^{m}$

**Arithmetic and geometric sequences and series**

Arithmetic sequences

For initial term *a* and common difference *d*: $T\_{n}$ $=a+\left(n-1\right)d,n\geq 1$

 $T\_{n+1}$ $=T\_{n}+d,where T\_{1}=a$

 $S\_{n}$ $=\frac{n}{2}\left(2a+\left(n-1\right)d\right)$

Geometric sequences

For initial term *a* and common ratio *r*: $T\_{n+1}$ $=rT\_{n},where T\_{1}=a$

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

 $S\_{n}$ $=\frac{a\left(1-r^{n}\right)}{1-r}$

**Introduction to differential calculus**

Rates of change

Difference quotient: $\frac{δy}{δx}=\frac{f\left(x+h\right)-f\left(x\right)}{h}$

Derivative (concept): $\frac{dy}{dx}=f^{'}\left(x\right)=\lim\_{h\to 0}\frac{f\left(x+h\right)-f\left(x\right)}{h}$

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

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

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