# Mathematics: applications and interpretation SL formula booklet

For use during the course and in the examinations
First examinations 2021

Version 1.0

# STANDARD LEVEL

# Contents

# Topic 1: Number and algebra – SL

| 1.2 | The $n$th term of an arithmetic sequence | $u_n = u_1 + (n-1)d$ |
|---|---|---|
| | The sum of $n$ terms of an arithmetic sequence | $S_n = \dfrac{n}{2}\left(2u_1 + (n-1)d\right)$ ; $S_n = \dfrac{n}{2}(u_1 + u_n)$ |
| 1.3 | The $n$th term of a geometric sequence | $u_n = u_1 r^{n-1}$ |
| | The sum of $n$ terms of a finite geometric sequence | $S_n = \dfrac{u_1(r^n - 1)}{r - 1} = \dfrac{u_1(1 - r^n)}{1 - r}$ , $r \neq 1$ |
| 1.4 | Compound interest | $FV = PV \times \left(1 + \dfrac{r}{100k}\right)^{kn}$ , where $FV$ is the future value, $PV$ is the present value, $n$ is the number of years, $k$ is the number of compounding periods per year, $r\%$ is the nominal annual rate of interest |
| 1.5 | Exponents and logarithms | $a^x = b \iff x = \log_a b$ , where $a > 0, b > 0, a \neq 1$ |
| 1.6 | Percentage error | $\varepsilon = \left\lvert \dfrac{v_A - v_E}{v_E} \right\rvert \times 100\%$ , where $v_E$ is the exact value and $v_A$ is the approximate value of $v$ |

# Topic 2: Functions – SL

| 2.1 | Equations of a straight line | $y = mx + c$ ; $ax + by + d = 0$ ; $y - y_1 = m(x - x_1)$ |
|---|---|---|
| | Gradient formula | $m = \dfrac{y_2 - y_1}{x_2 - x_1}$ |
| 2.5 | Axis of symmetry of the graph of a quadratic function | $f(x) = ax^2 + bx + c \implies$ axis of symmetry is $x = -\dfrac{b}{2a}$ |

# Topic 3: Geometry and trigonometry – SL

| **Prior learning – SL** | |
|---|---|
| Area of a parallelogram | $A = bh$, where $b$ is the base, $h$ is the height |
| Area of a triangle | $A = \dfrac{1}{2}(bh)$, where $b$ is the base, $h$ is the height |
| Area of a trapezoid | $A = \dfrac{1}{2}(a+b)h$, where $a$ and $b$ are the parallel sides, $h$ is the height |
| Area of a circle | $A = \pi r^2$, where $r$ is the radius |
| Circumference of a circle | $C = 2\pi r$, where $r$ is the radius |
| Volume of a cuboid | $V = lwh$, where $l$ is the length, $w$ is the width, $h$ is the height |
| Volume of a cylinder | $V = \pi r^2 h$, where $r$ is the radius, $h$ is the height |
| Volume of prism | $V = Ah$, where $A$ is the area of cross-section, $h$ is the height |
| Area of the curved surface of a cylinder | $A = 2\pi rh$, where $r$ is the radius, $h$ is the height |
| Distance between two points $(x_1, y_1)$ and $(x_2, y_2)$ | $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ |
| Coordinates of the midpoint of a line segment with endpoints $(x_1, y_1)$ and $(x_2, y_2)$ | $\left( \dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2} \right)$ |

| 3.1 | Distance between two points $(x_1, y_1, z_1)$ and $(x_2, y_2, z_2)$ | $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$ |
|---|---|---|
| | Coordinates of the midpoint of a line segment with endpoints $(x_1, y_1, z_1)$ and $(x_2, y_2, z_2)$ | $\left( \dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}, \dfrac{z_1 + z_2}{2} \right)$ |

| | | |
|---|---|---|
| | Volume of a right-pyramid | $V = \dfrac{1}{3}Ah$, where $A$ is the area of the base, $h$ is the height |
| | Volume of a right cone | $V = \dfrac{1}{3}\pi r^2 h$, where $r$ is the radius, $h$ is the height |
| | Area of the curved surface of a cone | $A = \pi r l$, where $r$ is the radius, $l$ is the slant height |
| | Volume of a sphere | $V = \dfrac{4}{3}\pi r^3$, where $r$ is the radius |
| | Surface area of a sphere | $A = 4\pi r^2$, where $r$ is the radius |
| **3.2** | Sine rule | $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$ |
| | Cosine rule | $c^2 = a^2 + b^2 - 2ab\cos C$ ; $\cos C = \dfrac{a^2 + b^2 - c^2}{2ab}$ |
| | Area of a triangle | $A = \dfrac{1}{2}ab\sin C$ |
| **3.4** | Length of an arc | $l = \dfrac{\theta}{360} \times 2\pi r$, where $\theta$ is the angle measured in degrees, $r$ is the radius |
| | Area of a sector | $A = \dfrac{\theta}{360} \times \pi r^2$, where $\theta$ is the angle measured in degrees, $r$ is the radius |

# Topic 4: Statistics and probability – SL

| 4.2 | Interquartile range | $\text{IQR} = Q_3 - Q_1$ |
|---|---|---|
| 4.3 | Mean, $\overline{x}$, of a set of data | $\overline{x} = \dfrac{\sum_{i=1}^{k} f_i x_i}{n}$, where $n = \sum_{i=1}^{k} f_i$ |
| 4.5 | Probability of an event $A$ | $\text{P}(A) = \dfrac{n(A)}{n(U)}$ |
|  | Complementary events | $\text{P}(A) + \text{P}(A') = 1$ |
| 4.6 | Combined events | $\text{P}(A \cup B) = \text{P}(A) + \text{P}(B) - \text{P}(A \cap B)$ |
|  | Mutually exclusive events | $\text{P}(A \cup B) = \text{P}(A) + \text{P}(B)$ |
|  | Conditional probability | $\text{P}(A \mid B) = \dfrac{\text{P}(A \cap B)}{\text{P}(B)}$ |
|  | Independent events | $\text{P}(A \cap B) = \text{P}(A)\,\text{P}(B)$ |
| 4.7 | Expected value of a discrete random variable $X$ | $\text{E}(X) = \sum_{i=1}^{k} x_i\,\text{P}(X = x_i)$ |
| 4.8 | Binomial distribution $X \sim \text{B}(n, p)$ |  |
|  | Mean | $\text{E}(X) = np$ |
|  | Variance | $\text{Var}(X) = np(1 - p)$ |

## Topic 5: Calculus – SL

| 5.3 | Derivative of $x^n$ | $f(x) = x^n \;\Rightarrow\; f'(x) = nx^{n-1}$ |
|---|---|---|
| 5.5 | Integral of $x^n$ | $\displaystyle\int x^n \, \mathrm{d}x = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$ |
| | Area of region enclosed by a curve $y = f(x)$ and the $x$-axis, where $f(x) > 0$ | $\displaystyle A = \int_a^b y \, \mathrm{d}x$ |
| 5.8 | The trapezoidal rule | $\displaystyle\int_a^b y \, \mathrm{d}x \approx \frac{1}{2} h\big((y_0 + y_n) + 2(y_1 + y_2 + \ldots + y_{n-1})\big)$, <br><br> where $h = \dfrac{b-a}{n}$ |