**Mathematics Formula Sheets**

**3 Points**

**New Program**

## Statistics and Probability

$f_1, f_2, \ldots, f_n$ are the frequencies of $x_1, x_2, \ldots, x_n$ respectively, and $N = f_1 + f_2 + \ldots + f_n$ .

**Average:** $\bar{x} = \dfrac{x_1 f_1 + x_2 f_2 + \ldots + x_n f_n}{N}$

**Standard deviation:** $S = \sqrt{\dfrac{(x_1 - \bar{x})^2 \cdot f_1 + (x_2 - \bar{x})^2 \cdot f_2 + \ldots + (x_n - \bar{x})^2 \cdot f_n}{N}}$

**Probability:**

Probability of A and B , where A and B are independent events: $P(A \cap B) = P(A) \cdot P(B)$

Probability of the complementary event to Event A : $P(\overline{A}) = 1 - P(A)$

## Geometry and Trigonometry

**Plane shapes:**

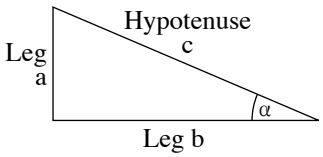
| | | |
|---|---|---|
| Area of a triangle: | $S = \dfrac{\text{side} \cdot \text{height to that side}}{2}$ | |
| Area of a triangle: | $S = \dfrac{1}{2} \cdot b \cdot c \cdot \sin\alpha$ | ($\alpha$ – angle between the sides b and c) |
| Area of a parallelogram: | $S = a \cdot h$ | (a – side, h – height to the side a) |
| Area of a trapezoid: | $S = \dfrac{(a+b) \cdot h}{2}$ | (a , b – bases of the trapezoid, h – height) |
| Area of a quadrilateral with perpendicular diagonals: | $S = \dfrac{d_1 \cdot d_2}{2}$ | ($d_1$ , $d_2$ – diagonals of the quadrilateral) |
| Area of a circle: | $S = \pi \cdot R^2$ | (R – radius of the circle) |
| Circumference of a circle: | $P = 2 \cdot \pi \cdot R$ | (R – radius of the circle) |

**Properties of polygons:**

| | |
|---|---|
| **Parallelogram:** | The diagonals bisect. |
| **Rectangle:** | The diagonals bisect and are equal to each other. |
| **Rhombus:** | The diagonals bisect and are perpendicular to each other. The diagonals are angle bisectors. |
| **Square:** | The diagonals bisect, are equal, and are perpendicular to each other. The diagonals are angle bisectors. |
| **Isosceles trapezoid:** | Angles adjacent to the same base are equal to each other, and the diagonals are equal to each other. |

**Track distance, assuming constant speed**: time • speed = distance

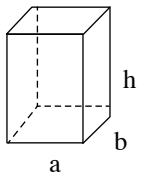
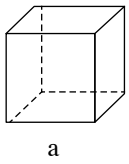
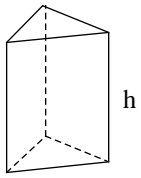
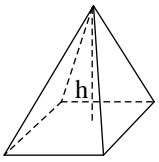
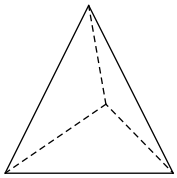
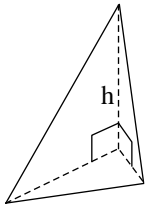
**Trigonometric functions in a right triangle:**

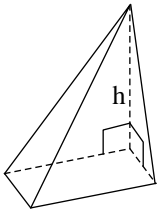
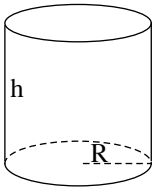
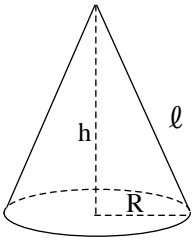
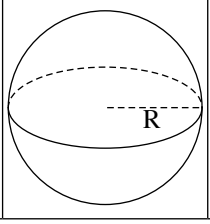



$\sin\alpha = \frac{a}{c}$ , $\cos\alpha = \frac{b}{c}$ , $\tan\alpha = \frac{a}{b}$

Pythagoras' theorem: $a^2 + b^2 = c^2$

**Spatial geometry:**

| Object | Figure | Lateral Surface Area (M) | Surface Area (F) | Volume (V) |
|---|---|---|---|---|
| Rectangular cuboid<br>a and b – edges of the base<br>h – height of the cuboid |  | M – sum of the areas of the lateral faces<br>$M = 2(a \cdot h + b \cdot h)$ | $F = M + 2 \cdot a \cdot b$<br>$F = 2(a \cdot b + b \cdot h + a \cdot h)$ | $V = a \cdot b \cdot h$ |
| Cube<br>a – length of the cube's edge |  | M – sum of the areas of the lateral faces<br>$M = 4 \cdot a^2$ | $F = 6 \cdot a^2$ | $V = a^3$ |
| Right prism with a triangular base<br>P – perimeter of the base<br>S – area of the base<br>h – height of the prism |  | M – sum of the areas of the lateral faces<br>$M = h \cdot P$ | $F = M + 2 \cdot S$ | $V = S \cdot h$ |
| Right pyramid with a rectangular base<br>S – area of the base<br>h – height of the pyramid |  | M – sum of the areas of the lateral faces | $F = M + S$ | $V = \frac{S \cdot h}{3}$ |
| Right pyramid with a triangular base<br>S – area of the base<br>h – height of the pyramid |  | M – sum of the areas of the lateral faces | $F = M + S$ | $V = \frac{S \cdot h}{3}$ |
| Non-right pyramid with a triangular base and one lateral edge perpendicular to the base<br>S – area of the base<br>h – height of the pyramid |  | M – sum of the areas of the lateral faces | $F = M + S$ | $V = \frac{S \cdot h}{3}$ |

| Object | Figure | Lateral Surface Area (M) | Surface Area (F) | Volume (V) |
|---|---|---|---|---|
| Non-right pyramid with a rectangular base and one lateral edge perpendicular to the base<br>S – area of the base<br>h – height of the pyramid |  | M – sum of the areas of the lateral faces | $F = M + S$ | $V = \frac{S \cdot h}{3}$ |
| Right cylinder<br>R – radius of the base<br>h – height of the cylinder |  | $M = 2 \cdot \pi \cdot R \cdot h$ | $F = M + 2 \cdot \pi \cdot R^2$ | $V = \pi \cdot R^2 \cdot h$ |
| Right cone<br>R – radius of the base<br>$\ell$ – generatrix (slant height)<br>h – height of the cone |  | $M = \pi \cdot R \cdot \ell$ | $F = M + \pi \cdot R^2$ | $V = \frac{\pi \cdot R^2 \cdot h}{3}$ |
| Sphere<br>R – radius of the sphere |  | | $F = 4 \cdot \pi \cdot R^2$ | $V = \frac{4}{3} \cdot \pi \cdot R^3$ |

## Algebra

**Quadratic equation:** $ax^2 + bx + c = 0 \quad (a \neq 0)$ Roots: $x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

**Quadratic function:** $y = ax^2 + bx + c \quad (a \neq 0)$ Value of x-coordinate of the parabola vertex: $x = \frac{-b}{2a}$

**Growth and decay:**

$A_t = A_0 \cdot q^t$ (q – growth/decay coefficient per unit of time, t – duration)

$q = \frac{100 \pm p}{100}$ (p – percentage growth/decay per unit of time)

**Exponents:** $a^{-n} = \frac{1}{a^n}$ ($a \neq 0$ , n is a natural number)

## Analytical Geometry

The slope m of a line that passes through the points $(x_1, y_1)$ and $(x_2, y_2)$ and is not perpendicular to the x-axis: $m = \frac{y_2 - y_1}{x_2 - x_1}$

The equation of a line of slope m that passes through the point $(x_1, y_1)$: $y - y_1 = m(x - x_1)$

The coordinates of the midpoint of a segment whose endpoints are $A(x_1, y_1)$ and $B(x_2, y_2)$: $x = \frac{x_1 + x_2}{2}$ , $y = \frac{y_1 + y_2}{2}$

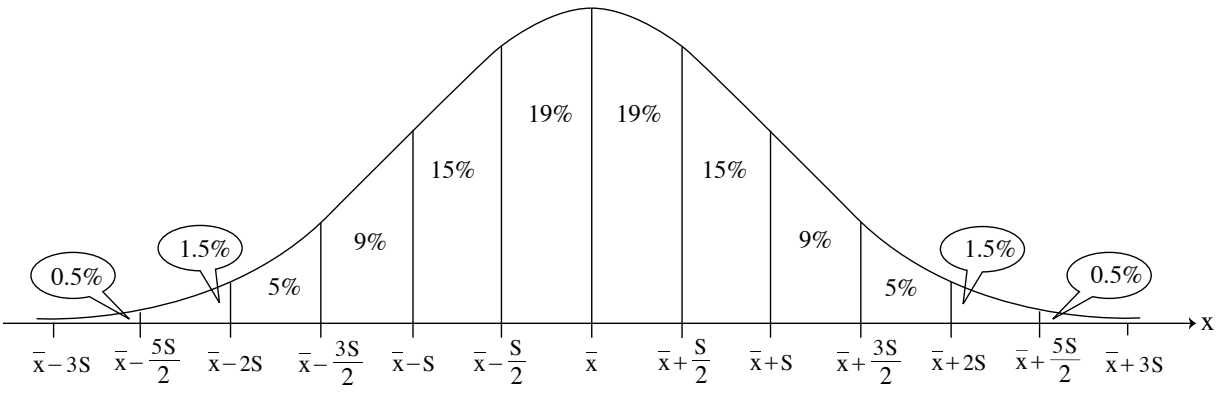
The distance d between the points $A(x_1, y_1)$ and $B(x_2, y_2)$: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

The lines $y = m_1 x + b_1$ and $y = m_2 x + b_2$ are perpendicular to each other if and only if: $m_1 \cdot m_2 = -1$

The lines $y = m_1 x + b_1$ and $y = m_2 x + b_2$ are parallel to each other if and only if: $m_1 = m_2 \quad (b_1 \neq b_2)$

## Normal Distribution

**Normal distribution curve:**




Standard score z of value x: $z = \frac{x - \bar{x}}{S}$ ($\bar{x}$ – average , S – standard deviation)