Here is a summary of important notions you should know from precalculus:

**ALGEBRA**

1. Factoring, algebraic formulas, completing the square
   \[ x^2 - y^2 = (x - y)(x + y), \quad (a \pm b)^2 = a^2 \pm 2ab + b^2, \]
   \[ x^3 + y^3 = (x + y)(x^2 - xy + y^2), \quad x^3 - y^3 = (x - y)(x^2 + xy + y^2), \quad \text{etc.} \]

2. Exponents:
   \[ x^n x^m = x^{n+m}, \quad \frac{x^n}{x^m} = x^{n-m}, \quad x^{-n} = \frac{1}{x^n}, \]
   \[ x^n y^m = (xy)^{n+m}, \quad x^{\frac{1}{n}} = \sqrt[n]{x}, \quad \text{etc.} \]

3. Fractions:
   \[ \frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}, \quad \text{etc.} \]

4. Equation solving: finding solution for \(x\) if
   \[ ax + b = 0, \quad ax^2 + bx + c = 0 \text{ by factoring or with quadratic formula}, \quad \text{etc.} \]

5. Inequalities and absolute values:
   \[ |x| < a \iff -a < x < a; \quad |x| \geq a \iff (x \geq a \text{ or } x \leq -a) \]

6. Basic functions – their domains and graphs:
   \[ f(x) = x, \quad f(x) = x^2, \quad f(x) = x^3, \quad f(x) = |x|, \quad f(x) = \sqrt{x}, \quad f(x) = 1/x, \]
   \[ f(x) = b^x, \quad f(x) = \log_b x \text{ (where } b > 0, b \neq 1)\; \text{; in particular } f(x) = e^x, \quad f(x) = \ln x, \]
   \[ f(x) = \sin x, \quad f(x) = \cos x, \quad f(x) = \tan x. \]

7. Find the domain, axis intercepts for simple functions: e.g.
   \[ f(x) = \sqrt{2x + 3}, \quad f(x) = \sqrt{4 - x^2}, \quad f(x) = \frac{x + 3}{x^2 - 1} \]

8. Logarithms – definition and properties
   \[ \log_b y = x \text{ if and only if } b^x = y \]
   \[ \log(xy) = \log x + \log y, \quad \log\left(\frac{x}{y}\right) = \log x - \log y, \quad \log(x^p) = p \log x \]
GEOMETRY and TRIGONOMETRY

1. Pythagorean theorem: \( b^2 + c^2 = a^2 \), where \( b, c \) are the sides of a right triangle and \( a \) its hypotenuse.

2. Basic geometric formulas: e.g. area of a triangle, area of a rectangle, circumference of a circle, area of a circle, volume of a cylinder, volume of a sphere, etc.

3. Facts about congruent and similar triangles

4. Facts about lines – equations, slope given two points, point-slope formula, write the equation of a line given two points, slopes of parallel/perpendicular lines

\[ \begin{align*}
ax + by + c &= 0, \quad y = mx + b, \\
\Delta y &= \Delta x \\
y - y_0 &= m(x - x_0),
\end{align*} \]
parallel lines have equal slopes; perpendicular lines have slopes which are negative reciprocal, i.e. \( m_2 = -1/m_1 \).

5. Distance formula; equation of a circle

\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}, \quad (x - a)^2 + (y - b)^2 = r^2 \quad \text{circle with center} \ (a, b) \ \text{and radius} \ r \]

6. Basic trigonometric identities

\[ \begin{align*}
sin^2 \theta + \cos^2 \theta &= 1, \\
sec^2 \theta &= 1 + \tan^2 \theta, \\
csc^2 \theta &= 1 + \cot^2 \theta, \\
\sin(-\theta) &= -\sin \theta, \\
\cos(-\theta) &= \cos \theta, \\
\tan(-\theta) &= -\tan \theta, \\
\sin(\pi/2 - \theta) &= \cos \theta, \\
\cos(\pi/2 - \theta) &= \sin \theta, \\
\tan(\pi/2 - \theta) &= \cot \theta.
\end{align*} \]

7. Trigonometric Values (no calculators allowed on exams): e.g. you should be able to determine, using the unit circle and your knowledge of "nice" angles, the exact values of \( \sin(\pi/6) \) or \( \cot(3\pi/4) \).

8. Sum and difference formulas

\[ \sin(A \pm B) = \sin A \cos B \pm \cos A \sin B, \quad \cos(A \pm B) = \cos A \cos B \mp \sin A \sin B \]

9. Double-angle formulas

\[ \sin 2\theta = 2 \sin \theta \cos \theta, \quad \cos 2\theta = \cos^2 \theta - \sin^2 \theta = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta \]

10. Half-angle formulas

\[ \begin{align*}
\sin^2 \frac{\theta}{2} &= \frac{1 - \cos \theta}{2}, \\
\cos^2 \frac{\theta}{2} &= \frac{1 + \cos \theta}{2}
\end{align*} \]

11. Solving simple trig. equations – e.g. \( \tan \theta = -\sqrt{3}, \cos(2\theta) = \sin \theta \).

12. Law of Sines; Law of Cosines in a triangle

\[ \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}, \quad a^2 = b^2 + c^2 - 2bc \cos A, \quad \text{triangle with sides} \ a, b, c \ \text{and angles} \ A, B, C, \ \text{respectively} \]