1. Calculate the sum of the roots for $|2x - 4| = 5$. 
2. Show that there exist two numbers, among any $k + 1$ numbers, such that their difference is divisible by $k$. 
3. For any $p > 1$ and $a, b > 0$, we have the property that the graph of the function $f(x) = x^p$ for $a \leq x \leq b$ lies below the line segment joining $(a, f(a))$ and $(b, f(b))$. That is, let $(x, l(x))$ denote the points on the line segment joining $(a, f(a))$ and $(b, f(b))$. Then we have $f(x) < l(x)$ for $a < x < b$, as illustrated in the figure below for $a = 0.1, b = 1$ and $p = 2$.

![Graph of function and line segment](image)

Use this fact to show that

4. Let us consider a curve $C$ and a line $l$ in $\mathbb{R}^2$. The equation of the curve $C$ is $y = \sqrt{-x^2 - 2x}$ and the equation of the line $l$ is $x + y - m = 0$. For a particular value of $m$, $l$ and $C$ may either not intersect, or interact at one point, or intersect at two different points. Determine all the possible $m$ such that $C$ and $l$ have two different intersection points.
5. Let \( x, a_1, a_2, a_3, y \) and \( b_1, x, b_2, 2y, b_3 \) be the terms from two geometric sequences, where \( x \neq 0 \) and \( y \neq 0 \). Calculate \( \frac{b_3a_1^8}{a_2^8b_1} \).
6. Let $x = 0.82^{0.5}, y = \sin(1), z = \log_3(\sqrt{7})$. Determine the largest and smallest numbers among $x, y, z$. 

7. Let \( \triangle ABC \) be an acute triangle. \( \angle C = 2 \angle A \) and \( 2|AC| = |AB| + |BC| \). Calculate \( \sin \angle A \).
8. Let $x_1, x_2, x_3$ be the three roots of $x^3 - x + 1 = 0$. Calculate $x_1^5 + x_2^5 + x_3^5$. 
9. What is the remainder when the number
$$12 + 11(13^1) + 10(13^2) + 9(13^3) + 8(13^4) + 7(13^5) + 6(13^6) + 5(13^7) + 4(13^8) + 3(13^9) + 2(13^{10}) + 13^{11}$$
is divided by 6?
10. A five-digit number is formed by randomly choosing (with no repetitions) a number from 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 for each digit. For example, 10234 is a valid number, while 12325 is not (since 2 is repeated in the latter number).

(a) Show that the number thus formed is divisible by 9 if and only if the sum of its digits is divisible by 9 (e.g. \(92034 \mod 9 = 0\) and \((9 + 2 + 0 + 3 + 4) \mod 9 = 18 \mod 9 = 0\)).

(b) What is the probability that the five-digit number thus formed is divisible by 90?