

General information

The purpose of this self-assessment test is to help you understand in which basic math topics you already have adequate skills and in which, on the other hand, you need to improve your knowledge and abilities. One of the ingredients of success in university level study is self-assessment. Understanding in advance your strengths and weaknesses will help you tackle your studies with greater awareness.

These topics are not a comprehensive list of all prerequisites for the courses of the first semester (in particular, Mathematical Analysis I) but instead constitute a representative set of the topics in which, over the years, we have noticed are often more problematic for many first year students.

Suggestions

- There is no hurry, read well these suggestions.
- There is no hurry. Take a stroll, choose a comfortable table, take paper (lots) and a pen. Arrange to have the required time. Turn off the mobile phone. In our judgement, a half hour is required for each topic. You can also do some topics one day and other topics another day.
- For each topic, the exercises are in order of difficulty (from easiest to hardest).
- It's normal to make mistakes but it's crucial find ways to notice your own mistakes. For each exercise it is possible to verify the answers yourself.
- Use only paper and pen (no calculators, no tables).
- After doing the exercises, before starting to look at the solutions, compare yourself with some other student to understand if the results are consistent and what verification strategies can be used to understand if the results are correct. Working in a group helps both those who have shortcomings (which he can learn from more knowledgeable colleagues on that particular topic) and those who are stronger (explaining them to other people often helps to better understand some aspects of the subject).

Trigonometry (30 minutes)

A) Calculate the value of

$$\sin \frac{3\pi}{4}$$

B) Solve the following inequality

$$\cos(x) \leq \frac{1}{2}$$

C) Solve the following equation

$$\cos^2(3x) - \sin(3x) + 1 = 0$$

D) Sketch the graph of the following function

$$y = |\sin(2x)| - 1$$

Vectors (30 minutes)

- A) Sketch, in the cartesian coordinate plane, the vectors $\mathbf{a} = (2, 2)$ e $\mathbf{b} = (0, -1)$, calculate the sum and the difference; then add these to the sketch.
- B) Calculate the value of the angle between the vectors \mathbf{b} and \mathbf{a} of A).
- C) Given the vector $\mathbf{a} = (1, 3)$ determine the vector (or the vectors) perpendicular to it of modulus equal to 4.
- D) Given a circle with radius 2, centred at the origin of the axes, find the vector which, applied to the center of the circle, indicates a point which makes an angle $\theta = 5\pi/6$ measured counterclockwise from the x axis.

Inequalities of polynomials and fractions (30 minutes)

A) Solve the following inequality

$$x^2 - 2x + 3 > 0$$

and sketch the graph $y = x^2 - 2x + 3$.

B) Solve the following inequality

$$\frac{x - 1}{x^2 - 4} > 0$$

C) Solve the following inequality

$$x^3 + 2x^2 - 7x + 4 < 0$$

D) Solve the following system of inequalities

$$\begin{cases} \frac{x^2 - 2x}{(x + 1)(5 - x)} \geq 0 \\ \frac{x + 1}{x^2 - 9} < \frac{1}{x + 3} \end{cases}$$

Logarithms (30 minutes)

A) Calculate the value of

$$\log_3 \frac{1}{9} + \log_2 4$$

B) Sketch a graph of the following function

$$y = \ln(x + 1)$$

C) Solve the following inequality

$$\ln(x^2 - 3) < 0$$

D) Solve the following inequality

$$\frac{x \ln(x + 2)}{x - 3} < 0$$

Exponentials (30 minutes)

A) Calculate the value of x

$$\frac{a^2}{a^5} = a^x$$

B) Sketch the graph of the following

$$y = e^{(x+1)}$$

C) Solve the following inequality

$$\left(\frac{2}{3}\right)^{x^2+2} - \left(\frac{27}{8}\right)^x < 0$$

D) Solve the following inequality

$$e^{(2x-2)} - e^{(x-1)} - 2 > 0$$

Modulus (30 minutes)

A) Sketch the graph of the following

$$y = |x| - 2$$

B) Solve the following equation

$$|x^2 - 4| = 3$$

C) Solve the following inequality

$$|x - 1| + |x - 2| \geq 3$$

D) Solve the following inequality

$$\sin\left(\left|x - \frac{\pi}{3}\right|\right) < \frac{1}{2}$$

Radicals (30 minutes)

A) Solve the following equation

$$\sqrt[4]{x-1} = 2$$

B) Sketch the graph of the following

$$y = \sqrt{x-4} + 1$$

C) Solve the following inequality

$$\sqrt[3]{x^2-1} < 2$$

D) Solve the following inequality

$$\sqrt{x+2} - \sqrt{x-3} > 1$$

Geometry (30 minutes)

A) Sketch, on the cartesian coordinate plane, the following line

$$y = 2x - 5$$

B) Write the equation of the parabola with axis given by the equation $x = -1$ and that passes through the points $A = (0, 2)$ and $B = (-3, 5)$. Sketch, on the cartesian coordinate plane, this parabola.

C) Calculate the intersections between the parabola $y = 2x^2 + 3x + 5$ and the line $y = -4x + 2$. Sketch, on the cartesian coordinate plane, these two curves.

D) A circle has centre at the point $A = (1, 1)$ and has radius $r = 2$. At how many points does it intersect the function $y = \sin(x)$?