Please read these instructions carefully!

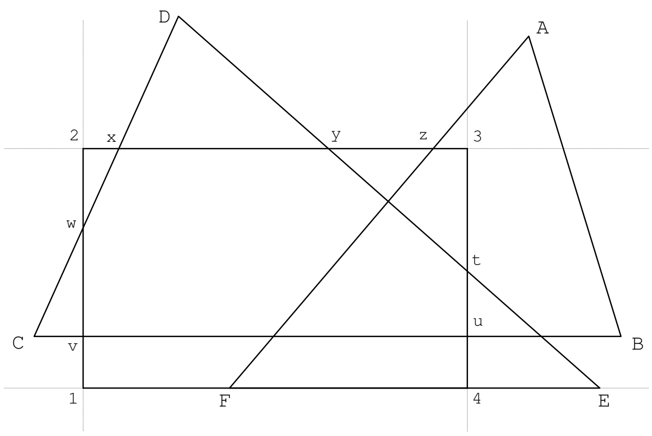
- Answer the test questions in the separate answer sheet.
- You may use the back of all the paper sheets as drafting area (*rascunho*).
- How to:

	A	B	C	D	E
Select the answer (A):	(●	○	○	○	○)
Replace the answer (A) by (C):	(●	○	●	○	○)
Cancel (C) and reactivate (A):	(●	○	●	○	○)

- This test has 26 QUESTIONS (ignoring question zero), each question has a score of 200/26 points.
- **POINTS LOST** for each wrong answer (in percentage of the question's points):
  $\sum wrong$ $1 = 0\%$ $2 = 11.11\%$ $3 = 22.22\%$ $\geq 4 = 33.33\%$.

Name: ______________________________ Number: ______________

Consider polygon $P = [A, B, C, D, E, F]$, which is going to be clipped by the window $Q = [1, 2, 3, 4]$ using the Sutherland-Hodgeman algorithm. Consider that the clipping order is RIGHT, TOP, BOTTOM, LEFT.



1. How many vertices will the output from stage 1 (clip RIGHT) contain?
   A. 6 B. 8 C. 7 D. 9
2. Which is the 3rd vertex of the output from stage 3 of the algorithm (clip BOTTOM)?
   A. y B. 4 C. x D. t
3. How many edges will the final clipped polygon P' contain?
   A. 9 B. 12 C. 11 D. 10
4. Choose the correct sequence of vertices in the polygon that comes out of the final stage (Clip LEFT).
   A. ... 3 t y z ... B. ... F z 3 u v ... C. ... t u v w ... D. ... F z 3 t ...

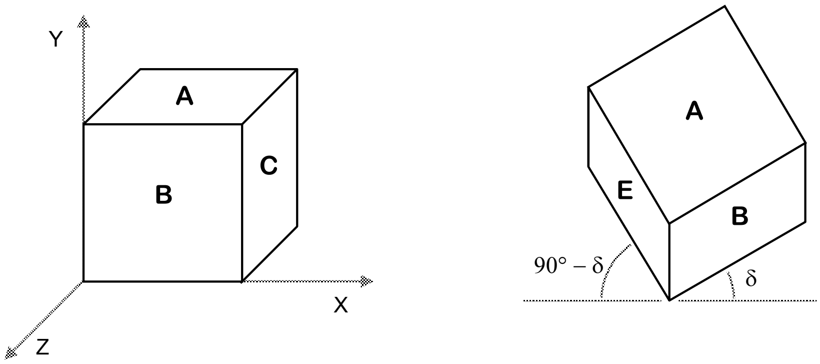
Consider that each of the individual line segments of the original polygon P is going to be clipped against the same window Q using the Cohen-Sutherland line clipping algorithm. Imagine also that the order for the bits (from left to right) **is now the following**: TOP, RIGHT, BOTTOM, LEFT.

5. How many line segments would be trivially accepted?
   A. 3 B. 1 C. none D. 2
6. How many line segments would be trivially rejected?
   A. 1 B. none C. 2 D. 3
7. How many line segments would be effectively clipped 2 times?
   A. none B. 2 C. 3 D. 4

The FILLAREA (Scanline) algorithm is going to be used to paint the interior of the original polygon P, but now in a window that is large enough so that no clipping wlll occur.

8. How many non empty entries would the Edge Table (Tabela de Arestas) contain?
   A. 4 B. 3 C. 1 D. 2
9. what is the total number of edges stored in the Edge Table (Tabela de Areastas)?
   A. 5 B. 3 C. 6 D. 4
10. Considering that the vertices of polygon P have integral coordinates (located exactly at pixel centers), which of the following options represent the set of vertices that **would not be painted** by the algorithm.
    A. A and B B. A, B, E and D C. C, B, E and F D. C and F

In the following figure, faces have been labeled after the projection of a cube for their identification.



11. What is the name of the projection on the left side of the figure, knowing that the object is a cube?
    A. Perspective, center at (0,0,d) B. Perspective, plane at z=-d C. Axonometric D. Oblique
12. Which set of values could have been used in the respective projection matrix $\mathbf{M}_?$?
    A. $A = 45°, B = 0°$ B. $l = 0.5, \alpha = 45°$ C. $d = 0.5$ D. none of others is correct.
13. The projection of a cube shown on the right side is called bird's eye view or military projection. In this parallel projection the projection plane is parallel to the face labeled as **A**. The angle δ is a parameter of the projection. Using the projection matrix for the type of projection of figure on the left ($\mathbf{M}_?$), what is the expression that computes the projection matrix for the figure on the right?
    A. $\mathbf{M}_? \cdot R_y(\delta)$ B. $\mathbf{M}_? \cdot \mathbf{R_z}(\delta) \cdot \mathbf{R_x}(90°)$ C. $\mathbf{M}_? \cdot \mathbf{R_x}(-90°) \cdot \mathbf{R_y}(\delta)$ D. $R_y(\delta) \cdot \mathbf{M}_?$
14. The projection on the right is sometimes wrongly interpreted as a type of axonometric projection. Which one?
    A. parametric B. dimetric C. trimetric D. isometric
15. Consider the `ortho()`, `frustum()` and `perspective()` functions for the definition of a view volume. Choose the sentence that is **false**.
    A. All functions assume that the camera is located at the origin.
    B. One function is used to desribe a parallelepiped, while the other two define a truncated pyramid.
    C. `frustum()` is more general than `perspective()`.
    D. All functions assume that the camera is pointing towards the positive Z-axis.

Consider the Phong illumination model computed by the expression below, for direct illumination (surfaces directly lit by light sources):

$$\mathbf{I} = \mathbf{I}_a\mathbf{K}_a + \mathbf{I}_p[\mathbf{K}_d \cos(\alpha) + \mathbf{K}_s \cos(\phi)^n].$$

16. If we ignore specular reflections, What is responsible for assigning a color to the surface?
    A. $\mathbf{I}_a$ B. $\mathbf{K}_a$ C. $\mathbf{I}_p$ D. $\mathbf{K}_a$ and $\mathbf{K}_d$
17. The angle α is the angle formed between:
    A. **N** and **L**. B. **N** and **H**. C. **L** and **V**. D. **R** and **V**.
18. The amount of reflected light given by the specular term is porportional to the n^{th} power of the cosine of the angle formed between:
    A. **R** and **L** B. **N** and **L** C. **V** and **L** D. **R** and **V**
19. A green object, when lit by a white light, exibits a specular reflection that is yellow. Choose the set of parameters that fit the situation described.
    A. $\mathbf{K}_a = (0.3, 0.3, 0)$, $\mathbf{K}_d = \mathbf{K}_s = (0, 1, 0)$.
    B. $\mathbf{K}_a = \mathbf{K}_d = (0.3, 0.3, 0)$, $\mathbf{K}_s = (0, 1, 0)$.
    C. $\mathbf{K}_a = \mathbf{K}_d = (0.0, 0.3, 0)$, $\mathbf{K}_s = (1, 1, 0)$.
    D. $\mathbf{K}_a = (0.0, 0.3, 0)$, $\mathbf{K}_d = \mathbf{K}_s = (1, 1, 0)$.

Suppose that a vertex shader implementing the Phong illumination model (in camera coordinates) receives both the View matrix (`mV`) and the current Model matrix (`mM`). It also receives the attributes representing the vertex position (`vPosition`) and its respective normal (`vNormal`).

20. Which of the following would you use to compute vector **L**, for a directional light source, specified in Camera Coordinates through a `uniform vec4` varible named `lightDir`?

    A. `normalize(lightDir.xyz)`

    B. `normalize((mV * mM * lightDir).xyz)`

    C. `normalize((mV * lightDir).xyz)`

    D. `normalize((mM * mV * lightDir).xyz)`

21. Which of the following would you use to compute vector **L** for a positional light source, specified in World Coordinates through a `uniform vec4` varible named `lightPos`? Assume that `posC` is the vertex position in Camera Coordinates.

    A. `normalize((mV * lightPos).xyz - posC)`

    B. `normalize((mM * mV * lightPos).xyz - posC)`

    C. `normalize((mV * mM * lightPos).xyz - posC)`

    D. `normalize(lightPos.xyz - posC)`

22. Which of the following would you use to compute the vertex position in camera coordinates (`posC`) ?

    A. `(mV * vPosition).xyz`

    B. `(mV * mM * vPosition).xyz`

    C. `(mM * mV * vPosition).xyz`

    D. `vPosition.xyz`

23. Complete the sentence: Constant shading is only valid under the assumption that ...

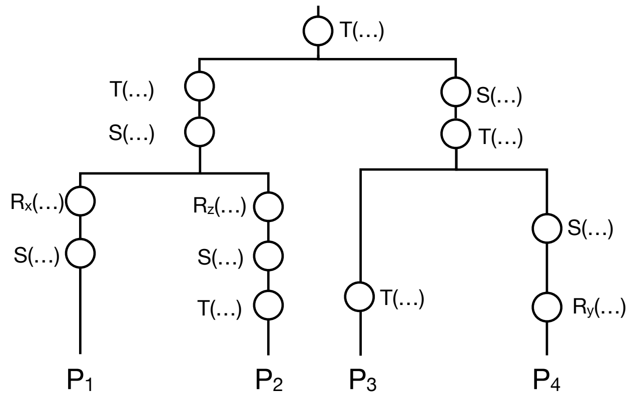
    A. light and viewer are both at infinite distance and that surfces are flat.

    B. light is a point light, the projection is parallel and the faces are flat.

    C. surfaces are flat and both light and viewer have no restrictions on their locations.

    D. light is directional, the projection is conic (perspective) and surfaces are flat.

Consider the scene graph on the right, where the parameters for each transformation have been ommited. Each primitive $\mathbf{P}_i$ doesn't change the current transformation matrix.



24. What is the minimum number of `Push()` and `Pop()` **pairs** required to transform the graph into operational drawing code?

    A. 3 B. 4 C. 5 D. 6

25. In certain APIs, each transformation node in a scene graph can store multiple transformations. Imagine a system where a transformation node could store any sequence of the form $\mathbf{T} \cdot \mathbf{R} \cdot \mathbf{S}$. How many transformation nodes would you need to represent the same scene?

    A. 11 B. 10 C. 12 D. 13

26. Imagine that the scene totally fits inside a unit cube centred at the origin. We would like to draw the objects with an image projected on them from above (y-axis points upwards). The projected image would perfectly fit the size of the top and bottom faces of the cube. The primitives already have a set of their own texture coordinates (`attribute vec2 vTexCoords`) assigned to respective positions (`attribute vec4 vPosition`), and the ModelView matrix is accessible through `uniform mat4 mMV`. How would you generate such effect? The vertex shader will assign a `varying vec2 fTexCoords` with the required texture coordinates...

    A. `fTexCoords = vTexCoords`

    B. `fTexCoords = (mMV * vPosition).xz + vec2(0.5, 0.5)`

    C. `fTexCoords = (mMV * vPosition).xz`

    D. `fTexCoords = vTexCoords + vec2(0.5, 0.5)`

Boa Sorte!