SURNAME, NAME:	GROUP:

Problem 1.1 (4 points; 30 minutes)

A control circuit has an enable input (E), 3 sensors (S) and three lights (G, Y, R). The circuit specifications are as follows:

- If the enable signal E is not active, all lights shall be off.
- If the enable signal E is active, then
    - If all sensors are inactive, the green light (G) shall be on
    - If at least one sensor is active, but not all of them, the yellow light (Y) shall be on.
    - If all sensors are active, the red light (R) shall be on.

All signals are active high.

a) Write the truth table of the circuit. Write the first canonical form (brief) of functions G, Y and R (1 p.).

b) Implement the functions G, Y and R using a 3-input decoder with enable and the additional gates that may be needed (1.5 p.).

c) Write a single VHDL process that implements the circuit as a pure combinational design, assuming the following declarations (1.5 p.):

SIGNAL S: STD_LOGIC_VECTOR(0 TO 2);

SIGNAL E: STD_LOGIC;

SIGNAL G, Y, R: STD_LOGIC;

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Problem 1.2 (3 points; 30 minutes)

Given the following VHDL code:

```vhdl
ARCHITECTURE final OF exam IS
-- Signal declaration




BEGIN

s<=a&b;

PROCESS(                  )
BEGIN
CASE s IS
        WHEN "00" =>    e <= '0';
        WHEN "01" =>    e <= d nand a;
        WHEN "10" =>    e <= c xnor d;
        WHEN OTHERS =>  e <= '1';
        END CASE;
END PROCESS;

PROCESS(                  )
BEGIN
    f(0)<=a OR b;
    f(1)<=e;
END PROCESS;

WITH f SELECT
        z <= "0001" WHEN "00",
             "0010" WHEN "01",
             "0100" WHEN "10",
             "1000" WHEN OTHERS;


        x <= z(1 downto 0) AND z(3 downto 2);



END final;
```

a) Describe the entity of this circuit

b) Declare the necessary signals (in the code)
c) Fill the sensitivity lists (in the code)
d) Draw the schematic. Do not forget to specify the components (e.g. mux, dec, enc, add, etc)
and the lines that correspond to each component (in the code).

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Problem 1.3 (3 points; 20 minutes)

a) Complete the following table with the representation of numbers considering the different systems, using 8 bits. (0.2 p. each value, up to max. 1.5 points):

	A	B
Decimal		
Binario Natural		
Hexadecimal		4E
BCD		
OCTAL	44	

a) Using **A** and **B** from part a), carry out the following operations in 2's complement (8 bits). Indicate if there is overflow, justifying it. If there is overflow, also indicate the correct solution.

A-B (0.75 points)

-A-B (0.75 points)