

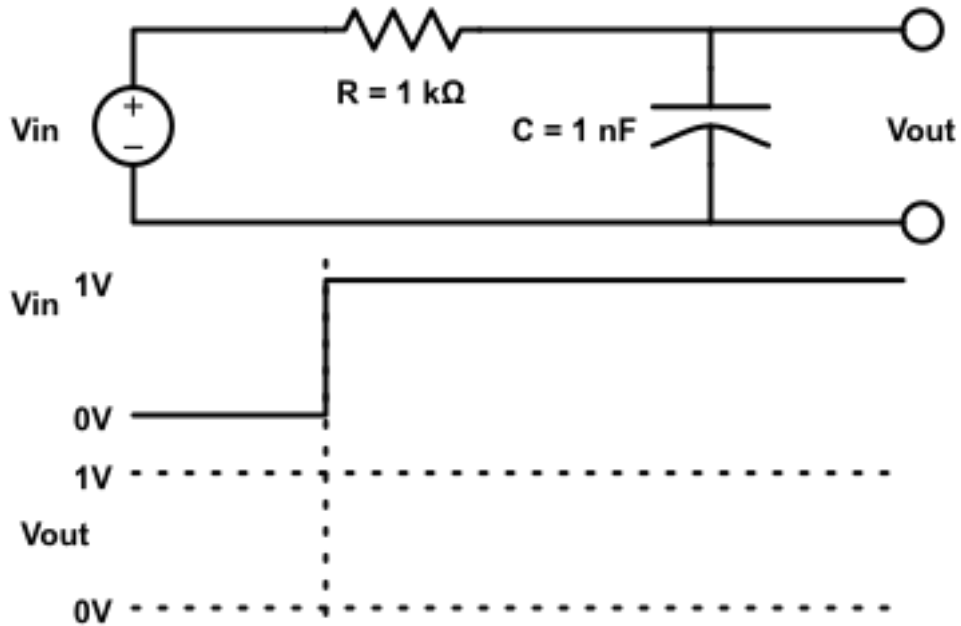
**Introduction to CMOS VLSI Design**  
**Initial Knowledge Quiz**  
**24 August 2010**

Name: \_\_\_\_\_

Year:            Jr.                    Sr.                    Gr.

Major:           EE                    Comp E                CS

1. Simple Electrical Circuits



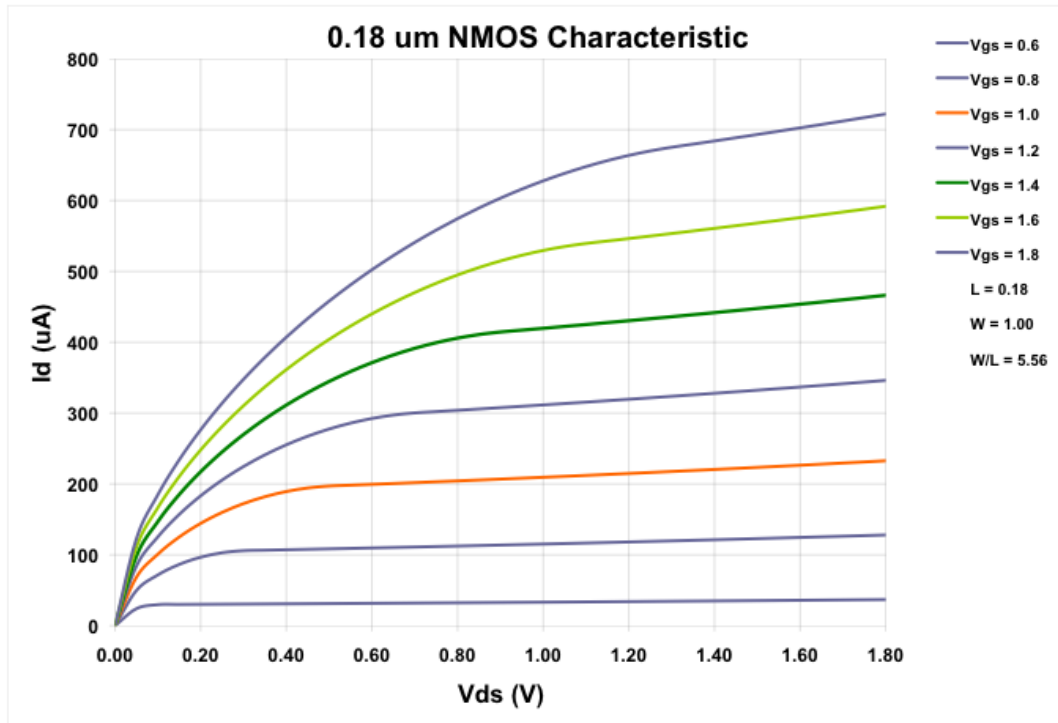
a. For the shown input voltage,  $V_{in}$ , sketch the output voltage,  $V_{out}$ , in the area shown.

b. What is the value of the time constant for the signal in  $V_{out}$ ? \_\_\_\_\_

c. How well do you understand electrical circuits? Circle one response.

- 0.    Have never seen them before.
- 1.    Not very well; could use some tutoring.
- 2.    Working knowledge.
- 3.    Fairly well; the above question was trivial.
- 4.    Very well; could tutor someone else.

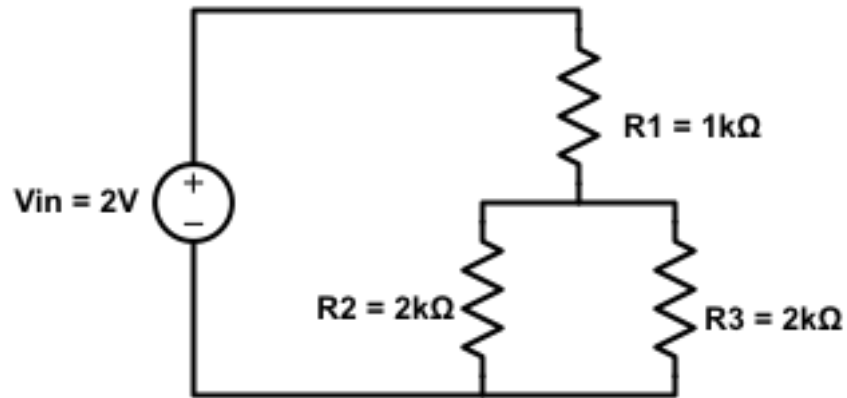
## 2. MOS Transistor Characteristics



For the above transistor characteristic:

- Circle and mark the saturation region of transistor operation.
  - Circle and mark the linear region of transistor operation.
  - What is the output resistance in the saturation region at  $V_{ds} = 1.4$  V and  $V_{gs} = 1.6$  V.
- d. How well do you understand transistors? Circle one response.
- 
0. Have never seen them before.
  1. Not very well; could use some tutoring.
  2. Working knowledge.
  3. Fairly well; the above question was trivial.
  4. Very well; could tutor someone else.

3. Electrical Power



For the above circuit

a. What is the total power dissipated in the three resistors? \_\_\_\_\_

b. If the values of the resistors are doubled, what is the new value of the power dissipation in the resistors? \_\_\_\_\_

c. How well do you understand electrical power? Circle one response. \_\_\_\_\_

- 0. Have never seen it before.
- 1. Not very well; could use some tutoring.
- 2. Working knowledge.
- 3. Fairly well; the above question was trivial.
- 4. Very well; could tutor someone else.

4. Verilog: For the following piece of Verilog, what is the “clutz” function, and draw what the circuit implements.

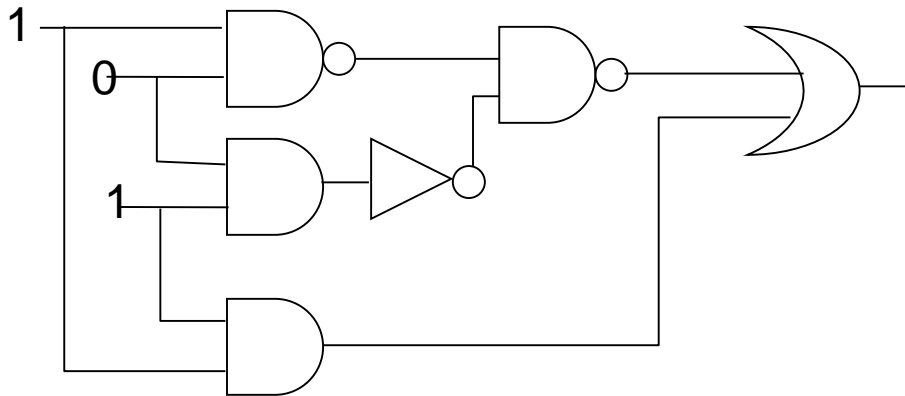
```
module clutz(output c, input a, b)
assign c = a&~b | ~a&b
endmodule;
```

```
module foo(output foobar, input [3:0] data)
wire [2:0] p1;
clutz x6(p1[1], data[3], data[2]);
clutz x5(p1[0], data[1], data[0]);
clutz x7(foobar, p1[1], p1[0]);
endmodule;
```

How well do you understand Verilog? Circle one response.

0. Have never seen it before.
1. Not very well; could use some tutoring.
2. Working knowledge.
3. Fairly well; the above question was trivial.
4. Very well; could tutor someone else.

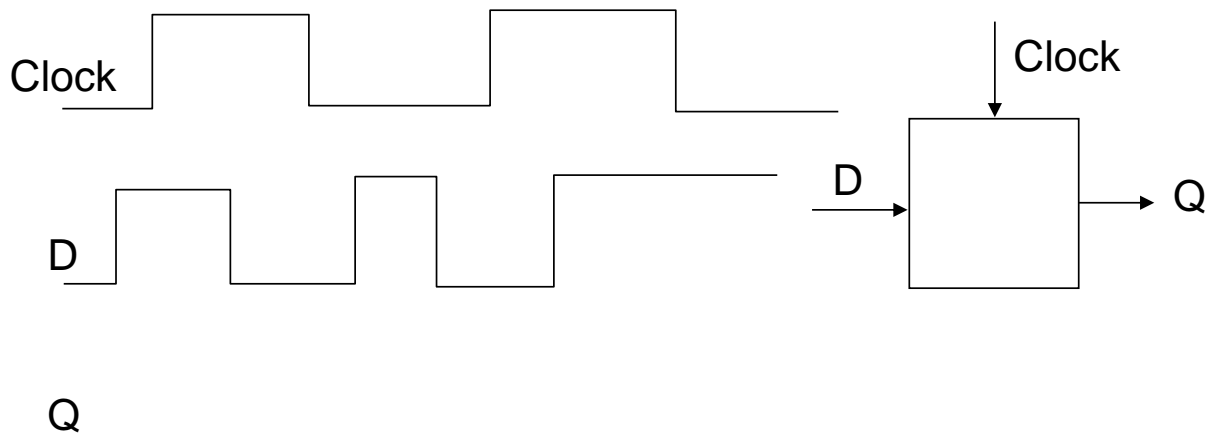
5. Logic: Label the outputs of each gate given the specified inputs.



How well do you understand Digital Logic? Circle one response.

0. Have never seen it before.
1. Not very well; could use some tutoring.
2. Working knowledge.
3. Fairly well; the above question was trivial.
4. Very well; could tutor someone else.

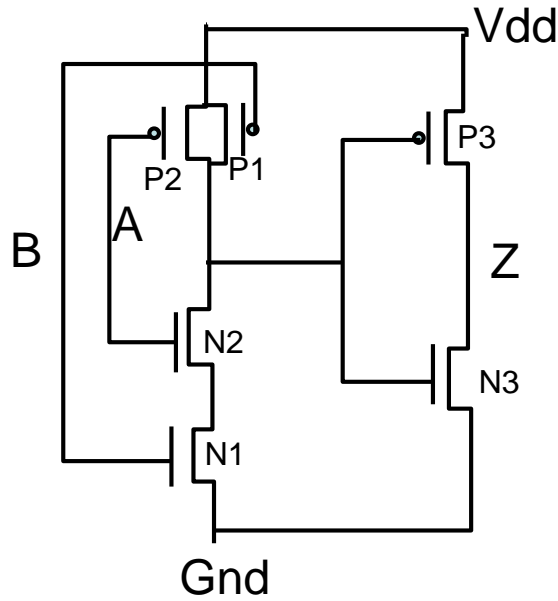
6. Latches and clocking: Draw the output Q of a D type flip flop, given the indicated input. Assume Q initially 0.



How well do you understand clocked logic? Circle one response.

0. Have never seen it before.
1. Not very well; could use some tutoring.
2. Working knowledge.
3. Fairly well; the above question was trivial.
4. Very well; could tutor someone else.

7. Simple CMOS Circuits. Fill in the table, indicating for each input combination which transistors are “ON” or “OFF.” If “Hi” is a logic 1 and “Low” is a logic 0, show the logic output. What is the logic function?



A	B	N1	N2	N3	P1	P2	P3	Z
Hi	Hi							
Hi	Low							
Low	Hi							
Low	Low							

How well do you understand simple CMOS circuits? Circle one response.

0. Have never seen it before.
1. Not very well; could use some tutoring.
2. Working knowledge.
3. Fairly well; the above question was trivial.
4. Very well; could tutor someone else.

8. Moore's Law: What was Moore's Law?

Assume Dennard Scaling: If you halved the "feature size" of a transistor:

1. What happens to the # of transistors per unit area? \_\_\_\_\_
2. What can you lower the operating voltage by? \_\_\_\_\_
3. How much faster can you run the same circuit? \_\_\_\_\_
4. If you did both the above, what happens to the power of a circuit? \_\_\_\_\_

How well do you understand Moore's Law and Dennard Scaling? Circle one response.

0. Have never seen it before.
1. Not very well; could use some tutoring.
2. Working knowledge.
3. Fairly well; the above question was trivial.
4. Very well; could tutor someone else.