Name: _____

Read each question carefully before answering. Answer all parts. Show all work, calculations, and/or reasoning, otherwise no points will be awarded. Properly labeled loops must be shown on K-maps. Point values are as indicated.

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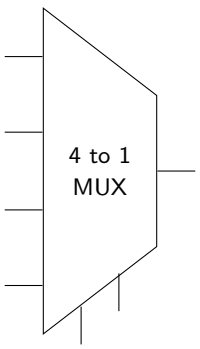
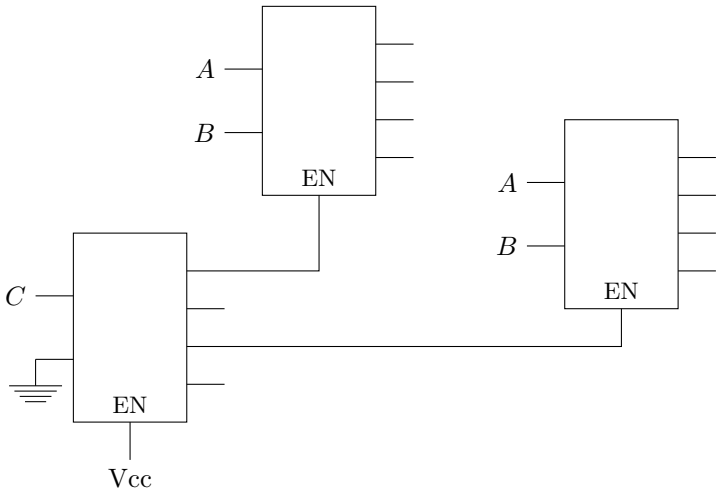
1. (20 points) You receive two 2-bit numbers designated as AB and CD. If $AB \geq CD$, an LED should turn on. The output of this function, F, will therefore be 1 if the LED should be on. Otherwise F will be 0. Implement this using a 4 to 1 MUX and a minimum number of external gates. Fill in the corresponding circuit diagram. Clearly indicate your control bits, and include your multiplexer equation at the bottom of the page.

		AB		
CD	**00**	**01**	**11**	**10**
00				
01				
11				
10				

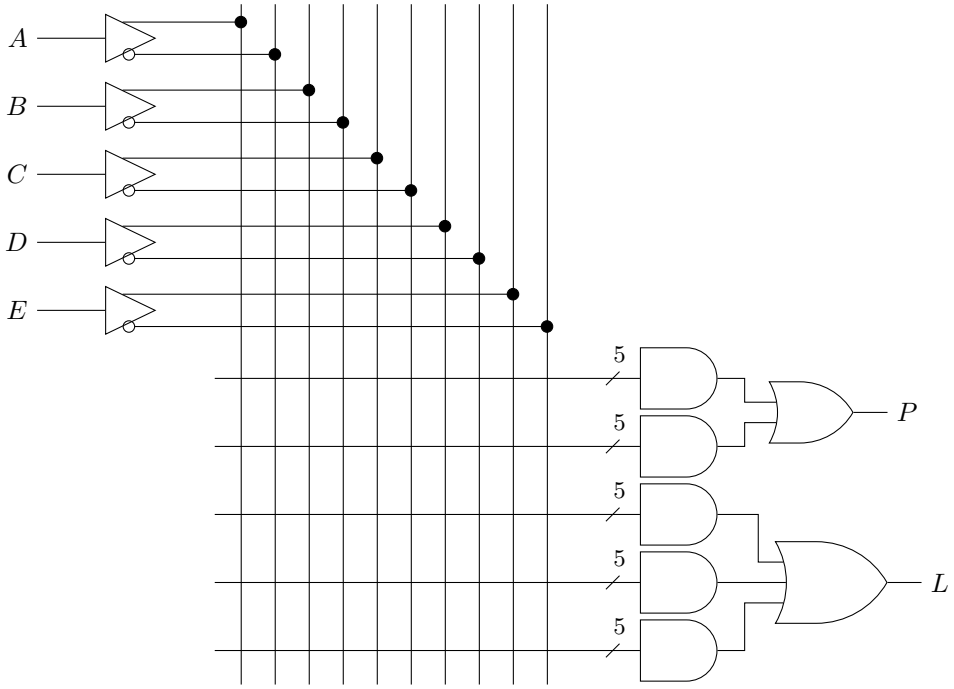


$F =$ _____

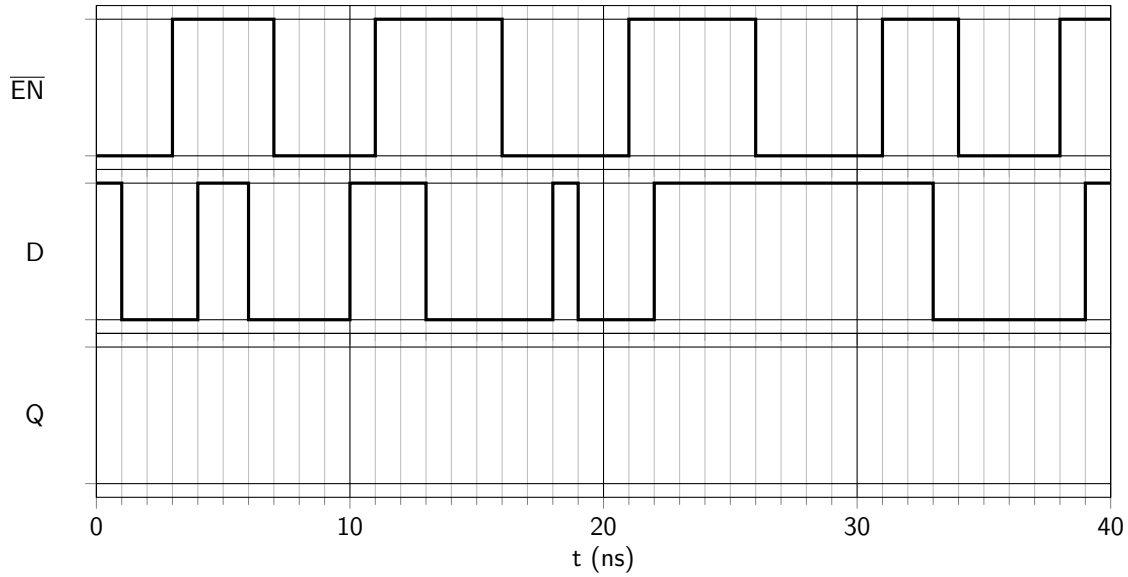
2. (20 points) Your buddy wired up a 3 to 8 decoder using only 2 to 4 decoders as follows. The MSB of the control bits is A, and the LSB of the control bits is C. Label the circuit diagram with the correct outputs from F_0 – F_7.



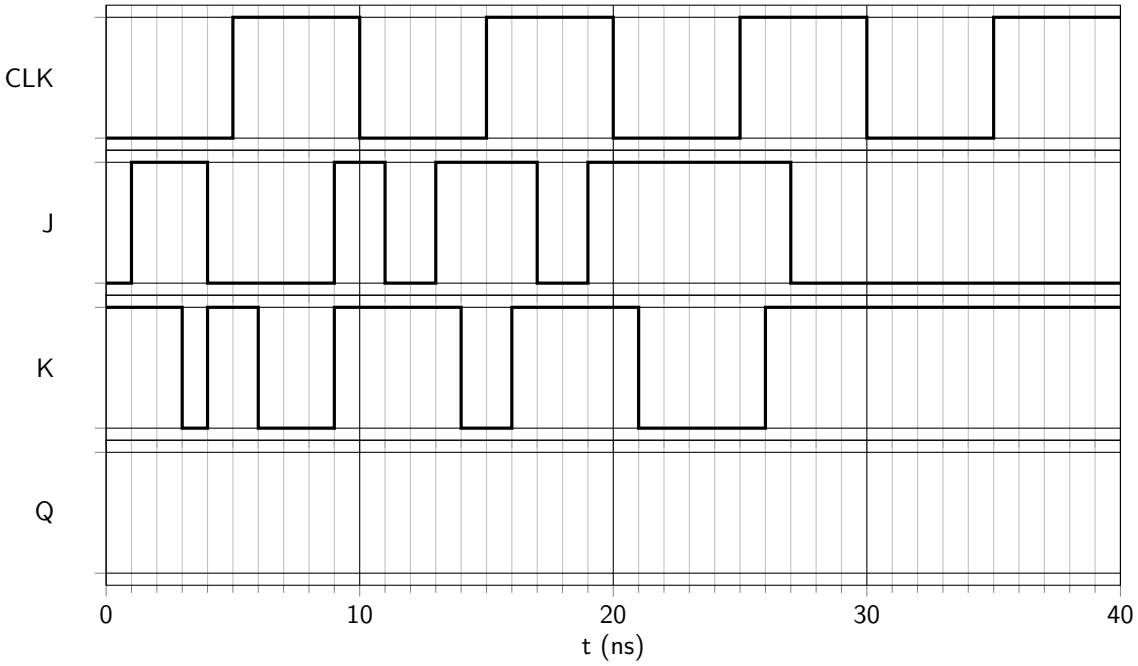
3. (25 points) A sensor on a car tire sends a 5-bit binary signal ($ABCDE$) that represents the tire pressure in PSI. The output L (low pressure) should be 1 if the pressure is less than 19. The output P (puncture) should be 1 if the pressure is less than 3. Use the following PAL diagram to implement outputs L and P. You will **not** need to add any gates to the PAL diagram!



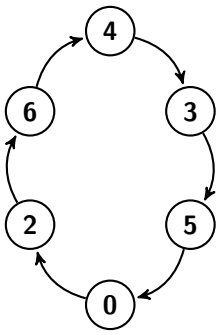
4. (10 points) Fill out the following timing diagram for a D latch with an active-low enable bit. Ignore all gate delays. Q(0) = 0.



5. (10 points) Fill out the following timing diagram for a rising-edge triggered JK flip-flop. Ignore all gate delays. Q(0) = 1.



6. (25 points) Design a 3-bit counter that counts in the sequence given in the state diagram below. Use D flip-flops and a minimum number of external gates. Write each flip-flop equation, then draw the circuit diagram using the template below. K-maps are provided on the next page.

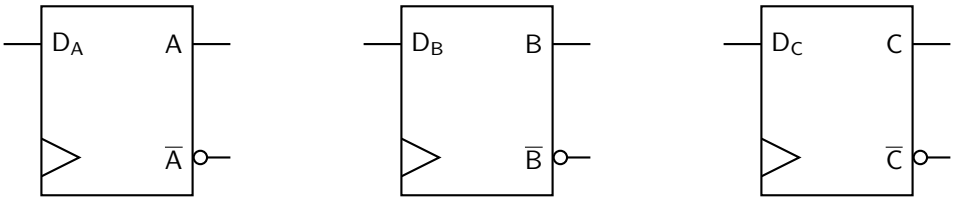


$T_A =$ _____

$T_B =$ _____

$T_C =$ _____

A	B	C	A^+	B^+	C^+
0	0	0			
0	0	1			
0	1	1			
0	1	0			
1	0	0			
1	0	1			
1	1	1			
1	1	0			



	A	
BC	**0**	**1**
00		
01		
11		
10		

	A	
BC	**0**	**1**
00		
01		
11		
10		

	A	
BC	**0**	**1**
00		
01		
11		
10		