1. (10 Points) Convert $(3673)_{10}$ to bases, $r = 2$, $r = 5$, and $r = 16$.

   Solution:
$$(3673)_{10} = (111001011001)_2 = (104143)_5 = (E59)_{16}$$

2. (10 Points) Convert $(36.7)_{10}$ to bases, $r = 2$, $r = 3$, and $r = 16$.

   Solution:
$$(36.7)_{10} = (100100.1\overline{0110})_2 = (1100.\overline{2002})_3 = (24.B\overline{3})_{16}$$

3. (5 Points) Convert the binary number 11100110.01001 to octal and hexadecimal.

   Solution:
$$(11100110.01001)_2 = (346.22)_8 = (E6.48)_{16}$$

4. (5 Points) Convert the hexadecimal number C23A.4E to binary and octal.

   Solution:
$$(C23A.4E)_{16} = (1100001000111010.0100111)_2 = (141072.234)_8$$

5. (10 Points) Take the two binary numbers $a = 110010011$ and $b = 1001000111$ and calculate $a + b$, $b - a$, and $a \cdot b$, using binary arithmetic.

   Solution:
$$\begin{aligned} a + b &= 1111011010 \\ b - a &= 10110100 \\ a \cdot b &= 111001010111000101 \end{aligned}$$

6. (10 Points) Take the two hexadecimal numbers $a = 7A34$ and $b = BAD$ and calculate $a + b$, and $a - b$, using hexadecimal arithmetic.

   Solution:
$$\begin{aligned} a + b &= 85E1 \\ a - b &= 6E87 \end{aligned}$$

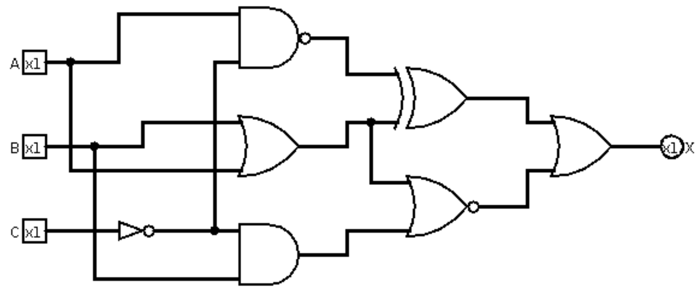
7. (5 Points) Find the 1's and 2's complement of $(114)_{10}$, using byte storage with one sign bit.

   Solution: $(114)_{10} = (1110010)_2$, so the 1's complement, using byte storage and a single sign bit, is
$$(-114)_{10} = 10001101$$
   and the 2's complement is
$$(-114)_{10} = 10001110$$

8. (5 Points) Convert $(61)_{10}$ to binary and then using the 2's complement of $(114)_{10}$ and addition, calculate $61 - 114$ in binary form.

   Solution:
$$\begin{aligned} (61)_{10} &= 00111101 \\ (61 - 114)_{10} &= 11001011 = (-53)_{10} \end{aligned}$$

9. (50 Points) Do the following for the circuit below.



(a) Construct the truth table for the circuit.
Solution:

A	**B**	**C**	**X**
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

(b) Write the circuit's logical function in canonical SOP form.
Solution: $X = A'B'C' + A'B'C + AB'C' + ABC'$

(c) Write the circuit's logical function in canonical POS form.
Solution: $X = (A + B' + C)(A + B' + C')(A' + B + C')(A' + B' + C')$

(d) Write the circuit in minterm form.
Solution: $X = \Sigma m(0, 1, 4, 6)$

(e) Write the circuit in maxterm form.
Solution: $X = \Pi M(2, 3, 5, 7)$

(f) Write the K-Map for the circuit, show the groupings you would use, and then construct the minimized logical circuit function in both SOP form and POS form.
Solution:

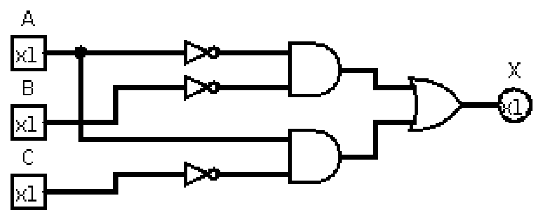
	A B			
C	00	01	11	10
0	1		1	1
1	1			

Use two groups, column 00, and the 110/100 cells. Equation (1) is SOP and equation (2) is POS.

$$X = A'B' + AC' \tag{1}$$
$$X = (A + B')(A' + C') \tag{2}$$

(g) Using the K-Map work, write the circuit diagram of the minimized circuit.

Solution:



(h) Do the Quine-McCluskey procedure on the original circuit, show all steps in the derivation. Construct the minimized logical circuit function in SOP form.

Solution:

000	00–	(0,1)	PI_1
001	–00	(0,4)	PI_2
100	1–0	(4,6)	PI_3
110			

	0	1	4	6
PI_1	$\times$	$\otimes$		
PI_2	$\times$		$\times$	
PI_3			$\times$	$\otimes$

So PI_1 and PI_3 are essential and we get all of the minterms with those two, giving $X = A'B' + AC'$.