1. Implement the given Boolean function using a 4-input multiplexer and minimum number of logic gates. You may use any desired gate. Use AB for the select lines.

\[ F(A, B, C, D) = \sum(1, 2, 5, 7, 8, 10, 11, 13, 14) \]
2. Build an 8-bit comparator that compares unsigned numbers $A = a_7 \cdots a_0$ and $B = b_7 \cdots b_0$ and outputs 1 if $A > B$. First build a smaller unit (using K-map) with logic gates that compares two bit numbers $X = x_1x_0$ and $Y = y_1y_0$. Then, use sufficient number of these elements with required additional gates to build the final circuit.
3. Implement a circuit with minimum number of half adders and full adders that outputs $10 \times A$ where $A = a_3a_2a_1a_0$ is a 4-bit binary number (give priority to using half adder whenever possible).
4. For a 4-to-2 encoder, first show that if more than one input is active (one), it produces incorrect output. Then, design a 4-input priority encoder using:

(a) A typical 4-to-2 encoder and additional logic gates.
(b) Minimum number of 2-to-1 multiplexers.

Note that a priority encoder produces correct output according to the most significant input bit, ignoring the rest. For instance, when both $I_2$ and $I_0$ are 1 (active), the output becomes $Y = 00$, denoting input $I_0$ (which has higher priority than $I_2$).