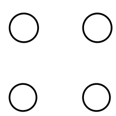
1-1. Answer:

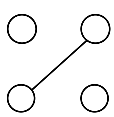
Yes, the graph (a) and (b) are isomorphic. Because in the graph (a), there are two nodes connect with all other nodes (have a degree of 3) and two nodes connect with another two nodes and don't connect with each other (have a degree of 2). And the four nodes in the graph (b) have the same characters.

1-2. Answer:

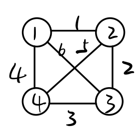
The corresponding complementary graph of the graph (a):

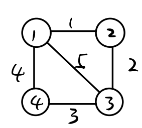


The corresponding complementary graph of the graph (b):



1-3. Answer:

(a) 

(b) 

① Adjacent matrix of

graph (a): $A_{(a)} = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$ graph (b): $A_{(b)} = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$

② Incidence matrix of

graph (a): $M_{(a)} = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$ graph (b): $M_{(b)} = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \end{bmatrix}$

③ Laplacian matrix of

graph (a): $L_{(a)} = \begin{bmatrix} 3 & -1 & -1 & -1 \\ -1 & 3 & -1 & -1 \\ -1 & -1 & 3 & -1 \\ -1 & -1 & -1 & 3 \end{bmatrix}$ graph (b): $L_{(b)} = \begin{bmatrix} 3 & -1 & -1 & -1 \\ -1 & 2 & -1 & 0 \\ -1 & -1 & 3 & -1 \\ -1 & 0 & -1 & 2 \end{bmatrix}$

1-4. Answer:

Disconnecting sets: $E_0^1(G) = \{e_1, e_2\}$, $E_0^2(G) = \{e_3, e_4\}$,
$E_0^3(G) = \{e_1, e_4, e_5\}$, $E_0^4(G) = \{e_2, e_3, e_5\}$,
and all the sets which have a subset of the 4 sets above ($E_0^1(G)$ or $E_0^2(G)$ or $E_0^3(G)$ or $E_0^4(G)$)

Cut sets: $E_0^1(G) = \{e_1, e_2\}$, $E_0^2(G) = \{e_3, e_4\}$,
$E_0^3(G) = \{e_1, e_2, e_5\}$, $E_0^4(G) = \{e_3, e_4, e_5\}$.